Per- and Polyfluoroalkyl Substances (PFAS): Forever Chemicals Presence in Texas and Updates from TCEQ's Toxicology Division

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Overview

- Introduction to PFAS
- TCEQ Human Health and Toxicity Factors
- EPA Drinking Water and Surface Water Regulations
- Drinking Water in Texas: UCMR5
- PFAS Remediation Sites
- Summary

Introduction to PFAS

Source: Harvard Health

What are PFAS?

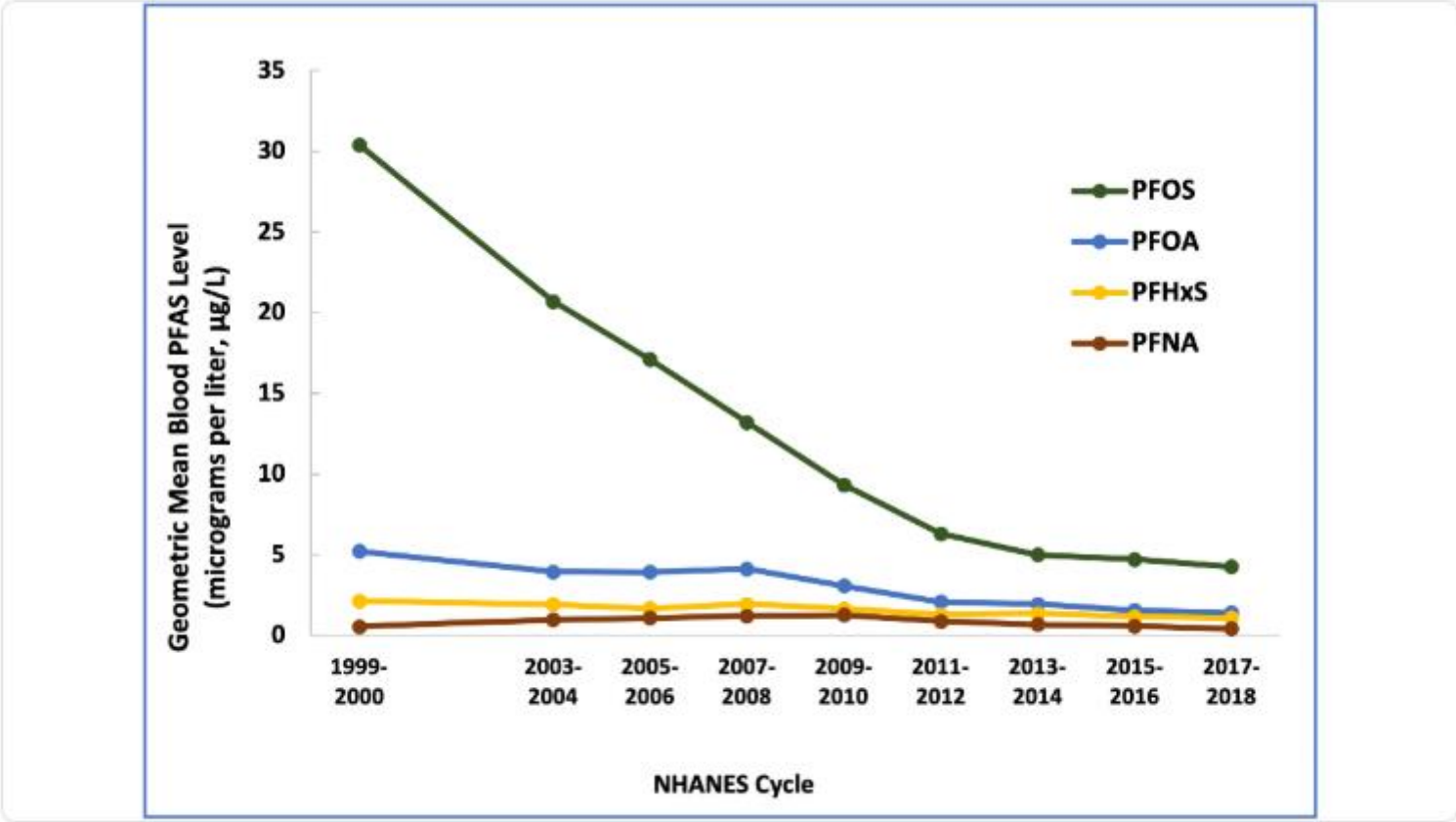
- Per- and poly-fluoroalkyl substances (PFAS)
- Synthetic chemicals that do not occur naturally in the environment
- Over 14,000 PFAS on EPA's CompTox PFAS list
- PFAS: polymers and nonpolymers
  - Non-polymers are of concern due to bioavailability and exposure from environmental media
- "Forever chemicals" – chemically stable, persistent

PFAS exposure

- Occupational: Firefighters, chemical manufacturing workers, ski wax technicians
- Environmental: industrial sites, landfills, solid waste, fugitive emissions and releases, wastewater treatment plant (WWTP) effluent and sludge, firefighting foams (AFFF), agricultural application
- Community: consumer products, contact with environmental media contaminated with PFAS (water, crops), food contact materials, medical products

Source: National Institute for Occupational Safety and Health (NIOSH)

Blood Levels of the Most Common PFAS



PFAS blood levels are declining with reduced production and use.

NHANES = National Health and Nutrition Examination Survey
Source: Centers for Disease Control and Prevention

TCEQ Human Health Toxicity Factors

Source: Centers for Disease Control and Prevention

TCEQ Toxicology and PFAS

- In response to PFAS measured at a site in the TCEQ remediation program, in 2011, TCEQ developed reference doses for 16 PFAS that were used to derive protective concentration levels (PCLs).
- In February 2023, TCEQ updated reference doses for 3 of these PFAS:
  - Perfluorobutanoic acid (PFBA) – update based on recent derivation conducted by the EPA
  - Perfluorohexanoic acid (PFHxA) – update based on recent derivation conducted by the EPA
  - Perfluoropentanoic acid (PFPeA) – updated using the new PFHxA value
- Currently TCEQ is in the process of systematically updating the toxicity factors for the other 13 PFAS.
  - The toxicity factors for PFOA and PFOS were released for public comment at the end of October 2025.

Steps of Toxicity Factor Derivation: Human Health

Review the Literature
Identify studies that investigate health effects after exposure to chemical

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Identify No and Lowest Adverse Effect Levels
Doses in studies that are associated with no adverse effects (NOAEL) and the lowest dose that causes adverse effects (LOAEL)

↓

Identify Most Sensitive Health Effect
Occurs at the lowest dose – preferably a mild, reversible effect → Point of Departure (POD)

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Apply Uncertainty Factors
Divide chemical dose by modeling or uncertainty factors

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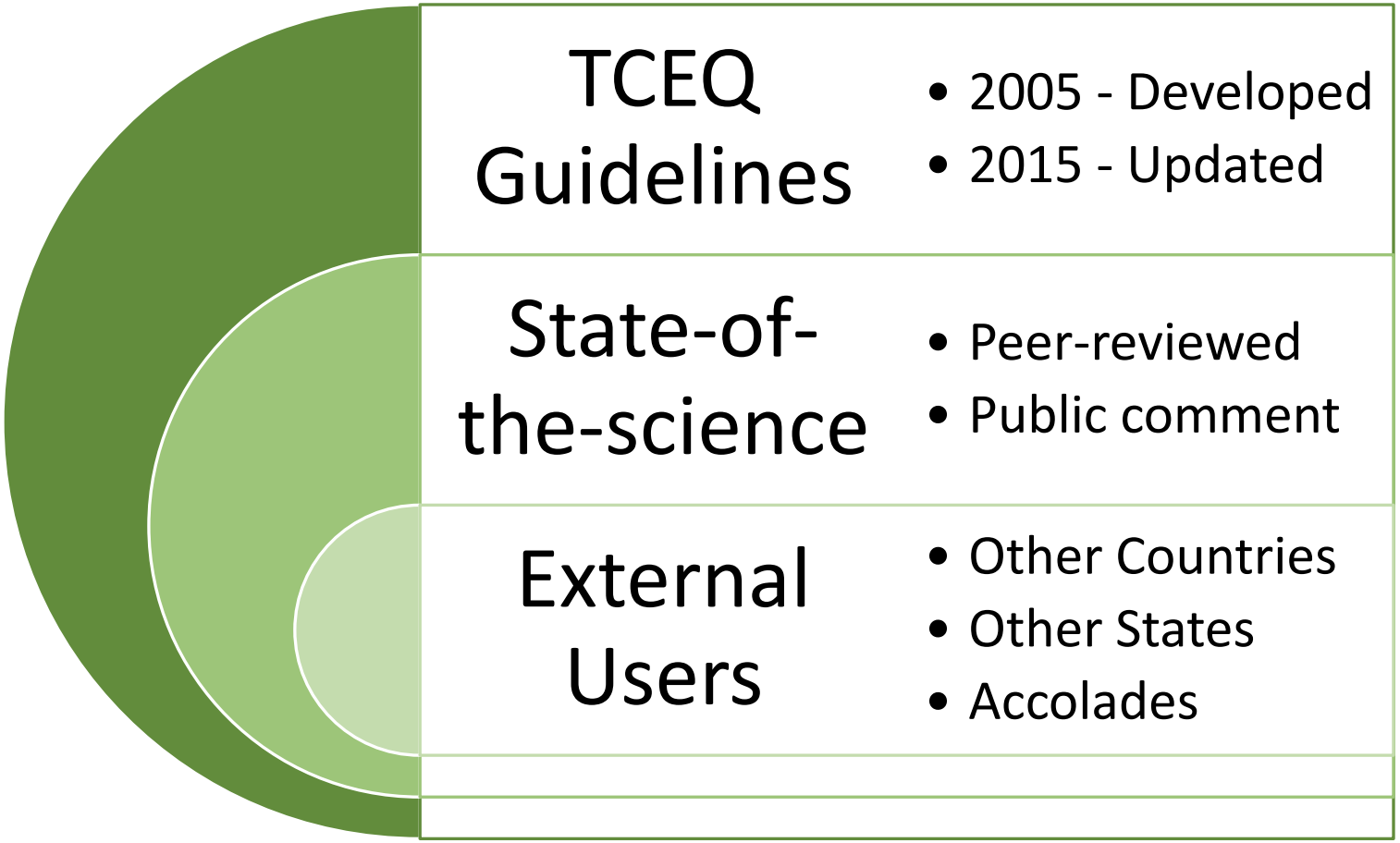
Toxicity Factor
Protective of public health with an ample margin of safety

Derivation of Toxicity Factors



Texas Toxicity Factors for PFAS

Source: PFAS (texas.gov)

Per- and Poly-fluoroalkyl Substances (PFAS)
February 14, 2023

CASRN	PFAS [1]	Acronym	Formula	RfD (mg/kg-day)	RfC (mg/m^3)
375-22-4	**Perfluorobutyric acid**	PFBA	$C_4HF_7O_2$	1.0E-03	3.5E-03
375-73-5	**Perfluorobutane sulfonate** (Perfluorobutane sulfonic acid)	PFBS	$C_4HF_9O_3S$	1.4E-03	4.9E-03
2706-90-3	Perfluoropentanoic acid	PFPeA	$C_5HF_9O_2$	5.0E-04	NA
355-46-4	**Perfluorohexane sulfonate** (Perfluorohexane sulfonic acid)	PFHxS	$C_6HF_{13}O_3S$	3.8E-06	1.3E-05
307-24-4	**Perfluorohexanoic acid**	PFHxA	$C_6HF_{11}O_2$	5.0E-04	NA
375-85-9	Perfluoroheptanoic acid	PFHpA	$C_7HF_{13}O_2$	2.3E-05	NA
1763-23-1	**Perfluorooctanoic sulfonate** (Perfluorooctane sulfonic acid)	PFOS	$C_8HF_{17}O_3S$	2.3E-05	8.1E-05
335-67-1	**Perfluorooctanoic acid** (Perfluorooctanoate)	PFOA	$C_8HF_{15}O_2$	1.2E-05	4.1E-06
754-91-6	**Perfluorooctane sulfonamide**	PFOSA	$C_8H_2F_{17}NO_2S$	1.2E-05	4.1E-06
375-95-1	**Perfluorononanoic acid**	PFNA	$C_9HF_{17}O_2$	1.2E-05	2.8E-05
335-76-2	**Perfluorodecanoic acid**	PFDA	$C_{10}HF_{19}O_2$	1.5E-05	5.3E-05
335-77-3	Perfluorodecane sulfonate	PFDS	$C_{10}HF_{21}SO_3$	1.2E-05	NA
2058-94-8	Perfluoroundecanoic acid	PFUA	$C_{11}HF_{21}O_2$	1.2E-05	NA
307-55-1	**Perfluorododecanoic acid**	PFDoA	$C_{12}HF_{23}O_2$	1.2E-05	4.2E-05
72629-94-8	Perfluorotridecanoic acid	PFTrDA	$C_{13}HF_{25}O_2$	1.2E-05	NA
376-06-7	Perfluorotetradecanoic acid	PFTeDA	$C_{14}HF_{27}O_2$	1.2E-05	NA

CASRN, Chemical Abstracts Services Registry Number; NA, not applicable; RfC, reference concentration; RfD, reference dose

[1] Bolded PFAS had at least some chemical-specific toxicology data (e.g., PFOSA had an LD_{50}).

PFAS PCLs

- TCEQ Remediation Division uses the MCLs as groundwater PCLs for PFOA and PFOS
  - TRRP rule requires use of the MCL as the PCL as it is defined in the $^{GW}RBEL_{Ing}$ equation
- The groundwater ingestion RBEL is the protective concentration of the chemical at the portal of entry in groundwater based on human ingestion of groundwater

PFAS Chemical Name	PFAS Acronym	RfD (mg/kg-day)	GW-ing PCL (mg/L)
Perfluorobutyric acid	PFBA	1.0E-03	2.4E-02
Perfluorobutane sulfonate	PFBS	1.4E-03	3.4E-02
Perfluoropentanoic acid	PFPeA	5.0E-04	1.2E-02
Perfluorohexane sulfonate	PFHxS	3.8E-06	9.3E-05
Perfluorohexanoic acid	PFHxA	5.0E-4	1.2E-02
Perfluoroheptanoic acid	PFHpA	2.3E-05	5.6E-04
Perfluorooctanoic sulfonate	PFOS	2.3E-05	5.6E-04
Perfluorooctanoic acid	PFOA	1.2E-05	2.9E-04
Perfluorooctane sulfonamide	PFOSA	1.2E-05	2.9E-04
Perfluorononanoic acid	PFNA	1.2E-05	2.9E-04
Perfluorodecanoic acid	PFDA	1.5E-05	3.7E-04
Perfluorodecane sulfonate	PFDS	1.2E-05	2.9E-04
Perfluoroundecanoic acid	PFUA	1.2E-05	2.9E-04
Perfluorododecanoic acid	PFDoA	1.2E-05	2.9E-04
Perfluorotridecanoic acid	PFTrDA	1.2E-05	2.9E-04
Perfluorotetradecanoic acid	PFTeDA	1.2E-05	2.9E-04

Source: PFAS (texas.gov)

EPA Drinking Water and Surface Water Regulation

Source: US EPA

PFAS in drinking water: EPA's regulations

- **April 2024** – EPA announced the final National Primary Drinking Water Regulation (NPDWR) for six PFAS.
- The final rule set legally enforceable levels (Maximum Contaminant Levels or MCLs).

Compound	Final MCL (enforceable levels)
PFOA	4.0 parts per trillion (ppt)
PFOS	4.0 ppt
PFHxS	10 ppt
PFNA	10 ppt
HFPO-DA (commonly known as GenX)	10 ppt
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS	1 (unitless) Hazard Index

PFAS in drinking water: EPA May 2025 update

Update as of a May 14, 2025 press release, EPA:

- Does not anticipate revision of MCLs for PFOA and PFOS
  - 4.0 ppt for PFOA and PFOS
- EPA intends to rescind and reconsider MCLs for the other 4 PFAS
  - Individual MCLs for PFHxS, PFNA, HFPO-DA (Gen X)
  - Hazard index for PFHxS, PFNA, PFBS, and Gen X
- Plans to extend the deadline for compliance with the PFOA and PFOS MCLs to 2031
- Intends to take action to reduce the prevalence of PFAS in the environment, including in sources of drinking water.
- Plans to issue a proposed rule in fall 2025 and a finalized rule in spring 2026
- MCLs will become the protective concentration levels (PCLs) for groundwater in the TCEQ remediation program.

Aquatic life criteria: EPA's regulations

- **September 2024** – EPA published final national recommended water quality criteria and benchmarks to help states protect aquatic ecosystems from PFOA and PFOS
  - These benchmarks represent the highest concentrations of pollutants in surface water that would allow fish and other aquatic species to live, grow, and reproduce.
- Recommended criteria and benchmarks are for individual PFAS and do not account for potential mixture effects
- These benchmarks are not regulatory, nor do they automatically become part of a state's water quality standards.

Source: Otter Springs

EPA Aquatic Life Criteria

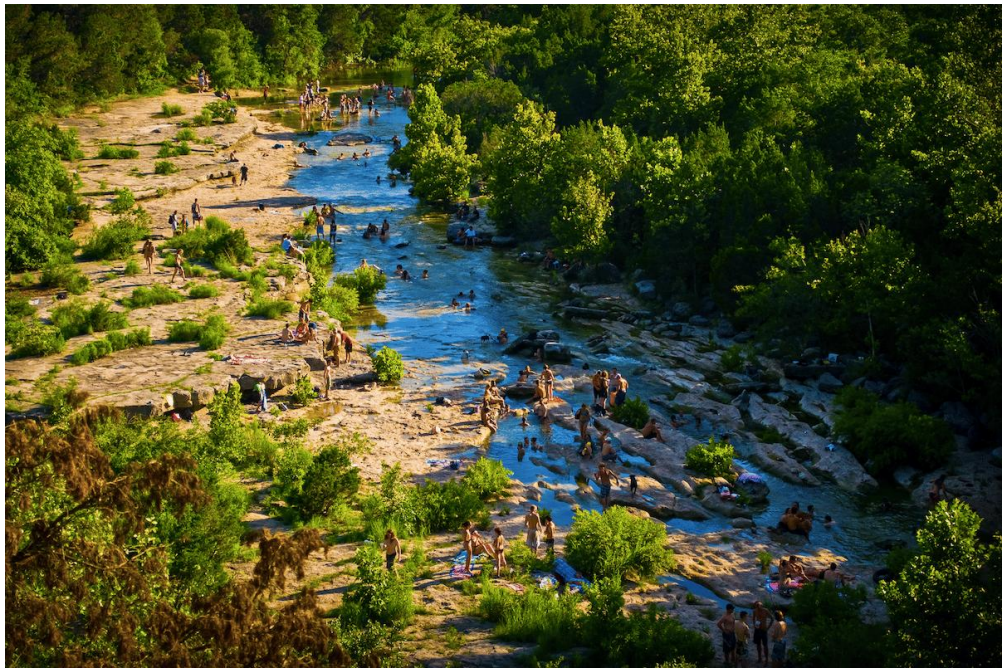
Criteria Component	Acute Water Column (CMC)[1] (mg/L)	Chronic Water Column (CCC)[2] (mg/L)	Invertebrate Whole-Body (mg/kg ww[3])	Fish Whole-Body (mg/kg ww[3])	Fish Muscle (mg/kg ww[3])
PFOA magnitude	3.1	0.10	1.18	6.49	0.133
PFOS Magnitude	0.071	0.00025	0.028	0.201	0.087
Duration	1-hr average	4-day average	Instantaneous	Instantaneous	Instantaneous
Frequency	Not to be exceeded more than once in 3 years, on average	Not to be exceeded more than once in 3 years, on average	Not to be exceeded	Not to be exceeded	Not to be exceeded

1 Criterion Maximum Concentration
2 Criterion Continuous Concentration
3 Wet Weight

Fact Sheet: Final Recommended Aquatic Life Criteria and Benchmarks for Select PFAS

EPA Draft Human Health Water Quality Criteria

- **December 2024** – EPA published draft human health water quality criteria for PFOA, PFOS, and PFBS
  - These draft criteria reflect information including final human health toxicity values, draft bioaccumulation factors, draft relative source contributions, and updated drinking water ingestion rates.
- Public comment period closed **April 2025**



Source: Secret Dallas

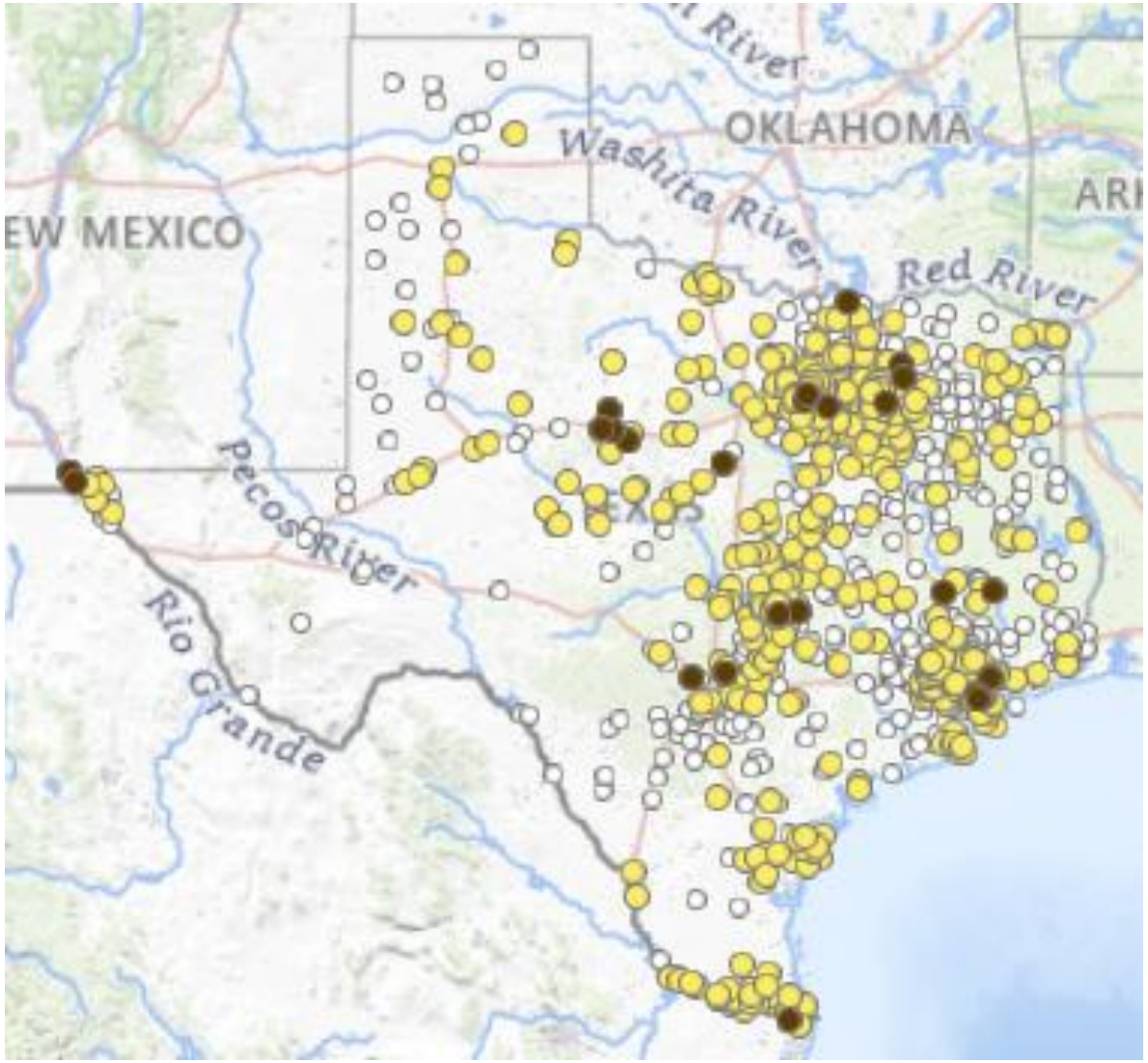
EPA Human Health Water Quality Criteria

Draft Human Health Criteria (HHC) for PFOA, PFOS and PFBS

PFAS	Water + organism HHC (ng/L)	Organism only HHC (ng/L)
PFOA	0.0009	0.0036
PFOS	0.06	0.07
PFBS	400	500

Human Health Water Quality Criteria – Public Comments

- Major comments or concerns in response to EPA's Human Health Water Quality Criteria:
  - EPA's recommended criteria for PFOA and PFOS fall below detectable thresholds of current available technology and laboratory methods
  - Need to invest time and money into developing analytical techniques in order to comply with the draft criteria
  - Criticisms of the key studies EPA used to derive regulatory values
  - Methodology used is overly conservative and does not accurately predict real risk



Source: US EPA

Drinking Water in Texas: Fifth Unregulated Contaminant Rule (UCMR5) Updates

Drinking water sampling in Texas: UCMR5

- Directly implemented by EPA and is not delegated to TCEQ
- 29 PFAS being sampled in addition to lithium to provide national occurrence data
- Minimum reporting levels (MRLs) for PFAS are 2-20 ppt
- Samples collected 2023-2025
- Requires monitoring from all systems serving 3,300 or more people and a national sampling of 800 systems serving less than 3,300. In Texas, this represents approximately 1,157 total systems.
- As of December 2025, data are available from 1,148 public water systems (PWS) in Texas.

UCMR5 results: Texas

- Of the 1,148 Texas PWS in the dataset, 96.8% of the samples were below the associated minimum reporting levels
- 604 out of 1,148 PWS had PFAS ≥ MRL
- 16 different PFAS detected across various PWS
- 0.04% of the samples exceed individual MCL for PFOA
- 0.12% of samples exceeded individual MCL for PFOS
- *0.03% of the samples exceed individual MCL for PFHxS*
- *0.002% of samples exceeded individual MCL for PFNA*
- No values above the 2022 EPA final lifetime health advisory level for PFBS (2,000 ppt)
- No values above the 2024 US Geological Survey health-based screening levels for PFBA or PFHxA (6,000 and 3,000 ppt, respectively)

UCMR5 results in Texas: values above MCLs

Concentrations of PFAS Measured in Public Water Systems in Texas: UCMR5

	PFOA	PFOS	*PFHxS*	*PFNA*
MRL (ppt)	4	4	*3*	*4*
No. ≥ MRL	92	246	*442*	*5*
MCL (ppt)	4	4	*10*	*10*
No. > MCL	83	234	*58*	*3*
Minimum (ppt)	4	4	*3*	*8*
Maximum (ppt)	29.1	82	*36.4*	*25.2*

The values in the table represent individual measurements only, and not the annual average.
Currently, there are 24 PWS in Texas with average results above MCL for one or more PFAS.
23 of 24 PWS have averages that exceed the MCL for PFOS.
14 PWS have averages that exceed the MCL for PFOA.

Drinking water sampling in Texas

- In 2022, TCEQ began a voluntary project monitoring public water systems not included in EPA's UCMR5 state sampling plan.

Fiscal Year	# Samples	# Samples w/Detection of one or more of the 29 PFAS analyzed	# Samples w/Detection of at least one of the 6 PFAS in the 2024 National Primary Drinking Water Regulation	# Samples exceeding the PFOA Maximum Contaminant Level (MCL)	# Samples exceeding the PFOS MCL	# Samples exceeding the Hazard Index (HI)
2022	612	228	124	14	26	11
2023	878	62	45	14	19	4
2024	879	18	9	0	1	0
2025	992 (1088 scheduled)	69	53	24	14	N/A

Source: TCEQ Office of Water

Challenges of regulating PFAS

- Thousands of potential PFAS chemicals
  - How do we regulate thousands of chemicals?
- PFAS are “forever chemicals” with many potential sources
  - Persistent in the environment
  - Detections in environmental media not associated with an obvious source could be caused by an accumulation from many potential sources
  - Polyfluorinated substances, (i.e., not fully fluorinated) may be precursors that degrade to form terminal fully fluorinated molecules such as perfluoroalkyl acids (e.g., PFOA, PFOS)
- Health effects literature is lacking
  - Substantial literature for only a few PFAS chemicals
- Current contamination of soil and groundwater
  - Regulations and actions are needed now
- Cleanup can take a long time and can be associated with substantial cost
- Different agencies are providing different risk estimates from exposure to PFAS
  - Difficulty communicating risk to the public

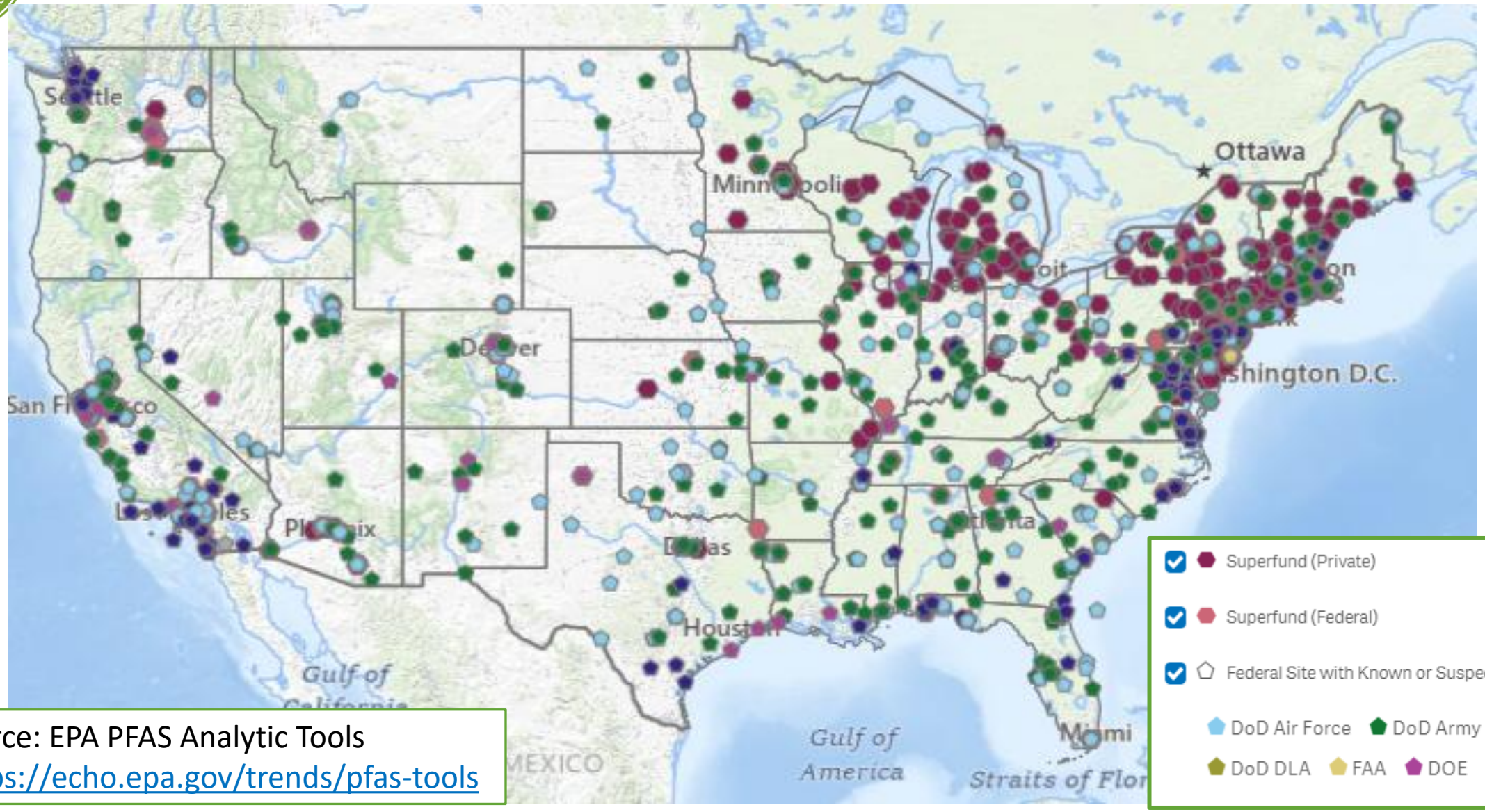
Challenges of communication

- It is very important to be able to communicate with the general public about the risk from PFAS in drinking and recreational water; as well as with public drinking water systems about the nature and the purpose of the standards and how to stay in compliance with them.
- Challenges with risk communication:
  - EPA's standards for drinking water (called Maximum Contaminant Levels or MCLs) for PFOA and PFOS are based on detection limit (4 ppt) and not strictly health-based
- Challenges with communication to drinking water system operators:
  - Potential sources of PFAS contamination in their drinking water at low levels
  - Health effects information is difficult to convey

PFAS Remediation Sites

Source: UW Madison

Sites Contaminated with PFAS



Source: EPA PFAS Analytic Tools
https://echo.epa.gov/trends/pfas-tools

Remediation screening and cleanup levels

- Multiple agencies set values for use in screening or cleanup of contaminated sites
- Values are derived for air, water, and soil exposure pathways
- Particular exposure factors depend on the route by which exposure occurs:
  - Soil – soil ingestion rate, exposure frequency, relative bioavailability factor
  - Water – water ingestion rate
- TCEQ: protective concentration levels (PCLs) – site cleanup levels
- TCEQ's Remediation Division develops ecological screening and cleanup levels and assist with reviewing aquatic life criteria

PFAS-contaminated sites in Texas

- Texas has approximately 55 remediation sites with PFAS contamination being addressed in our Remediation programs.
  - Former manufacturers
  - Fire training facilities
  - Most are Department of Defense (DOD) sites

Source: US EPA

Summary

- PFAS are a diverse group of poly-fluorinated synthetic chemicals with useful applications in industry, firefighting, and food and consumer products
- PFAS environmental contamination occurs globally
- PFAS have the potential to cause adverse health effects
- Texas has remediation sites with PFAS contamination, most of which are DOD sites; widespread groundwater contamination has not been observed
- Toxicity factors are being developed/revised by the TCEQ as new information becomes available.
- EPA has new Maximum Contaminant Levels for at least two PFAS. Challenges remain in how these values are applied because they are based on detection limits.
- EPA Human Health Water Quality Criteria have received comments regarding overly conservative derivations and unrealistic thresholds for detection.
- Difficulty with communicating risk to the public.

Questions?

- TCEQ Toxicology - Texas Commission on Environmental Quality - www.tceq.texas.gov
- Caroline Emery

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