

Emerging Contaminants PFAS Field and Laboratory Observations

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Per- and Poly-fluoroalkyl Substances (PFAS)

- 16 million
- 6 million
- 268 million



From Harvard Study- Environmental Science & Technology Letters
 "Detection of Poly- and Perfluoroalkyl Substances (PFASs) in U.S.
 Drinking Water Linked to Industrial Sites, Military Fire Training Areas,
 and Wastewater Treatment Plants"

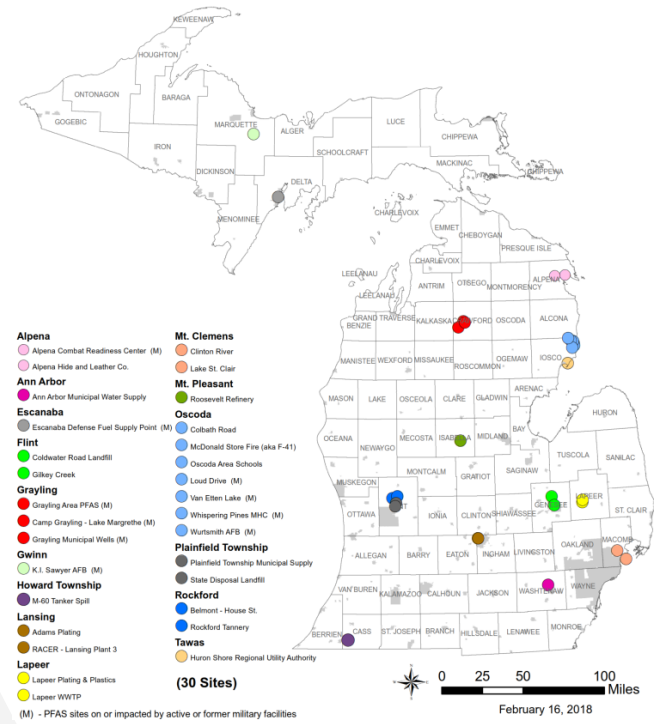
Per- and Polyfluoroalkyl Substances (PFAS)

- ▶ **Emerging contaminants**
- ▶ **Well water sampling**
- ▶ **Analytical challenges**
- ▶ **What's next?**

PFAS in Michigan

Michigan Department of
Environmental Quality

Confirmed PFAS Sites



The making of an emerging contaminant

- **1930s** - Discovery
- **1940/1950s** - Manufacturing and consumer/industrial products
- **1960/1970s** - Significant increase in use
- **2000s** - Human and environmental health concerns
- **Current** - Regulatory action



What it means to be an emerging contaminant

- **Environmental or human health risks**

What it means to be an emerging contaminant

- Environmental or human health risk
- **Evolving methods to sample, analyze and establish toxicology assessments**

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- Evolving methods to sample, analyze and establish toxicology assessments
- **Developing commercial laboratory capacity**

What it means to be an emerging contaminant

- Environmental or human health risk
- Evolving methods to sample, analyze and establish toxicology assessments
- Developing commercial laboratory capacity
- **Regulatory criteria uncertain**

PFAS occurrences

Manufacturing	AFFF Firefighting Foam	Non-Industrial
Aerospace	Airports/Aviation Yards	Waste Disposal (Landfills)
Automotive	Military/Naval Bases	Wastewater Treatment Plants
Chemical	Petroleum Refineries	Agriculture - Biosolid application
Electronics	Chemical Production Facilities	
Textile		
Metal Plating/Finishing		


NORTH CAROLINA
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GenX found in rainwater samples collected near Chemours facility

Raleigh, NC

Feb 23, 2018

The state Division of Air Quality today announced that analysis of rainwater samples recently collected near the Chemours facility show varying levels of GenX. Details may be viewed on DEQ's [GenX website](#) , with concentrations ranging from non-detects and 5.2 parts per trillion to 630 parts per trillion on Jan. 28-29 and 9.98 parts per trillion to 286 parts per trillion on Feb. 4-5.

The state health goal of 140 parts per trillion for drinking water should not be compared to

Contact Information

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Well water sampling



Well water sampling

- Who collects the sample?



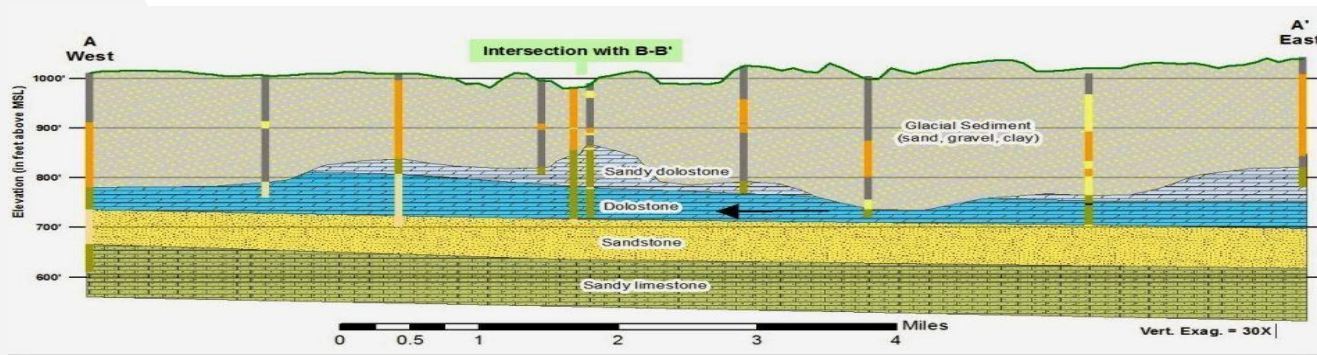
Well water sampling

- Who collects the sample?
- **Sample location?**



Well water sampling

- Who collects the sample?
- Sample location?
- Hydrogeological information?**



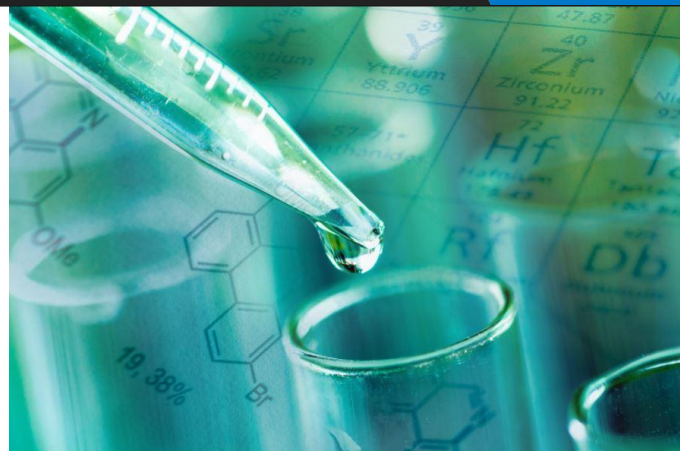
Well water sampling

- Who collects the sample?
- Sample location?
- Hydrogeological information?
- **Sampling method?**



Well water sampling

- Who collects the sample?
- Sample location?
- Hydrogeological information?
- Sampling method?
- **Analytical laboratory?**



Water well sampling

- Who collects the sample?
- Sample location?
- Consider hydrogeological information?
- Sampling method?
- Analytical laboratory?
- Analytical method?

Michigan Department of Environmental Quality, Water Resources Division

DEQ INDUSTRIAL PRETREATMENT PROGRAM PFAS INITIATIVE
PERFLUOROALKYL AND POLYFLUOROALKYL SUBSTANCES (PFAS)
MINIMUM LABORATORY ANALYTE LIST

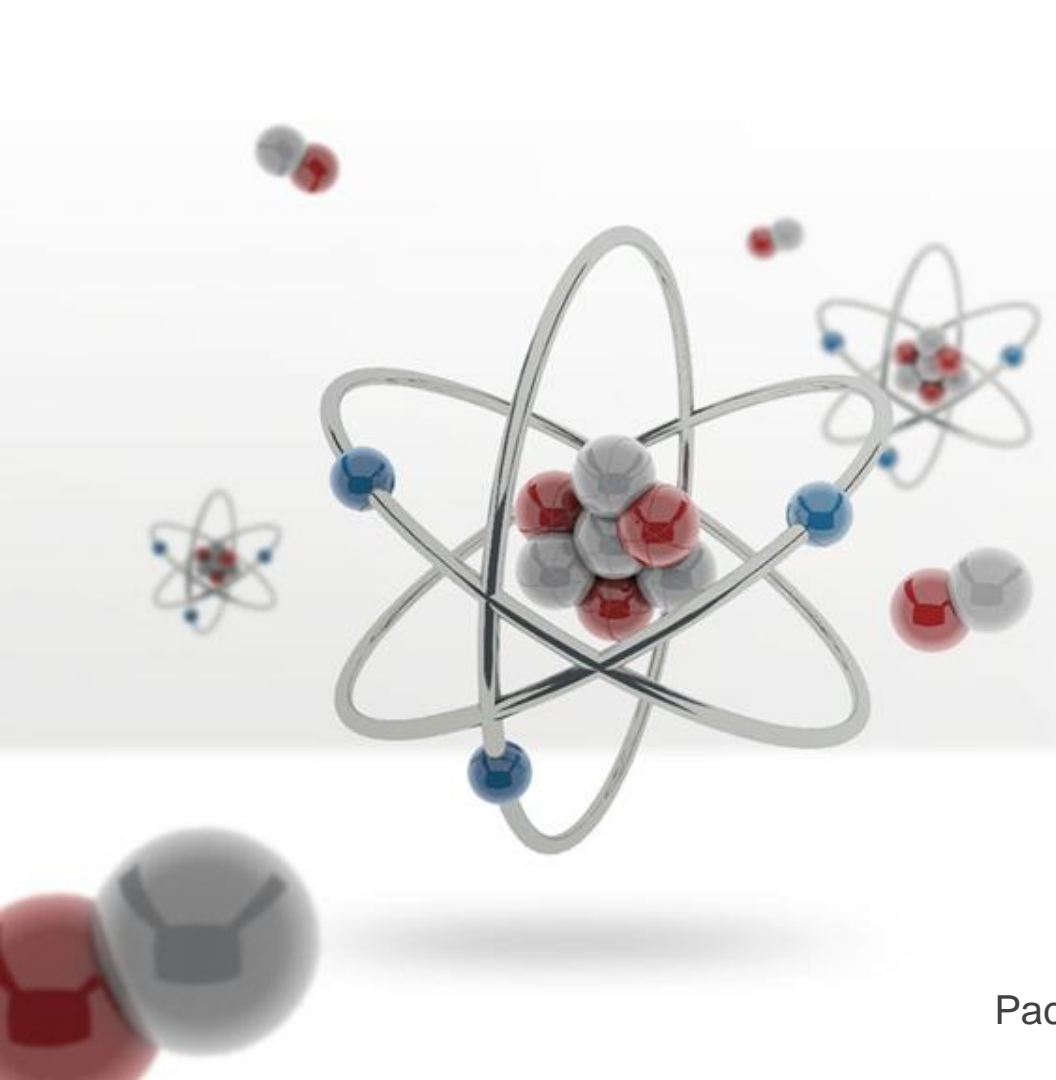
Below is the minimum laboratory PFAS analyte list for analysis of deer, drinking water, groundwater, surface water, soil, wastewater effluent, and landfill leachate collected by Michigan's Departments of Environmental Quality (MDEQ), Health and Human Services (MDHHS), Agriculture and Rural Development, and Natural Resources.

This minimum analyte list was developed based on the potential for these chemicals to be found in Michigan, the availability of the chemical standards used for testing, and the ability of available laboratories to test for these PFAS. This list includes PFAS that can be tested for in drinking water using United States Environmental Protection Agency (USEPA) Method 537 Rev.1.1, which is the only method that should be used when analyzing drinking water samples. Other testing methodology may be used to test for PFAS in other media (not drinking water). This list is not exhaustive of PFAS in Michigan's environment.

A fish icon (🐟) precedes those compounds that are also currently being tested for in fish tissue.

Analyte Name	Acronym	Fluorinated Carbon Chain Length	Molecular Formula	CAS Number	USEPA Method 537 Rev. 1.1
🐟 Perfluorotetradecanoic acid	PFTeA	C ₁₄	C ₁₄ F ₂₉ COOH	376-06-7	X
🐟 Perfluorotridecanoic acid	PFTriA	C ₁₃	C ₁₃ F ₂₈ COOH	72629-94-8	X
🐟 Perfluorododecanoic acid	PFDaA	C ₁₂	C ₁₂ F ₂₇ COOH	307-55-1	X
🐟 Perfluoroundecanoic acid	PFUnA	C ₁₁	C ₁₁ F ₂₆ COOH	2058-94-8	X
🐟 Perfluorodecanoic acid	PFDa	C ₁₀	C ₁₀ F ₂₅ COOH	335-76-2	X
🐟 Perfluorononanoic acid	PFNA	C ₉	C ₉ F ₂₄ COOH	375-95-1	X
🐟 Perfluorooctanoic acid	PFOA	C ₈	C ₈ F ₂₃ COOH	335-67-1	X
🐟 Perfluoroheptanoic acid	PFHpA	C ₇	C ₇ F ₂₂ COOH	375-85-9	X
🐟 Perfluorohexanoic acid	PFHxA	C ₆	C ₆ F ₂₁ COOH	307-24-4	X
🐟 Perfluoropentanoic acid	PFPeA	C ₅	C ₅ F ₂₀ COOH	2706-90-3	
🐟 Perfluorobutanoic acid	PFBA	C ₄	C ₄ F ₁₉ COOH	375-22-4	
🐟 Perfluorodecanesulfonic acid	PFDS	C ₁₀	C ₁₀ F ₂₁ SO ₃ H	335-77-3	
🐟 Perfluoronanesulfonic acid	PFNS	C ₉	C ₉ F ₂₀ SO ₃ H	68259-12-1	
🐟 Perfluorooctanesulfonic acid	PFOS	C ₈	C ₈ F ₁₇ SO ₃ H	1763-23-1	X
🐟 Perfluoroheptanesulfonic acid	PFHpS	C ₇	C ₇ F ₁₆ SO ₃ H	375-92-8	
🐟 Perfluorohexanesulfonic acid	PFHxS	C ₆	C ₆ F ₁₅ SO ₃ H	355-46-4	X

Analyte Acronym	Pace Analytical	ALS Group	Test America	Vista
PFOA	<2.0	<5.0	<2.0	<2.0
PFOS	<2.0	<5.0	<2.0	<2.0
PFHpA	<2.0	<5.0	<2.0	<2.0
PFNA	<2.0	<5.0	<2.0	<2.0
PFBS	<2.0	<5.0	<2.0	<2.0
PFHxS	<2.0	<5.0	<2.0	<2.0
PFBA	<2.0	<10.0	<2.0	<2.0
PFPeA	<2.0	<5.0	<2.0	<2.0
PFHxA	<2.0	<5.0	<2.0	<2.0
PFDA	<2.0	<5.0	<2.0	<2.0
PFUdA or PFUnA	<2.0	<5.0	<2.0	<2.0
PFDS	<2.0	<5.0	<2.0	<2.0
PFDoA	<2.0	<5.0	<2.0	<2.0
PFTrDA	<2.0	<5.0	<2.0	<2.0
PFTeDA	<2.0	<5.0	<2.0	<2.0
PFHxDA	<2.0			<2.0
PFODA	<2.0			
N-MeFOSAA	<4.0		<20.0	<2.0
N-EtFOSAA	<4.0		<20.0	<2.0
PFPrOPrA	<4.0			
NaDONA	<4.0			
PFOSA	<4.0	<5.0		<2.0
8:2 FTS	<4.0	<5.0	<20.0	<2.0
6:2 FTS	<4.0	<5.0	<20.0	<2.0
N-MeFOSA		<5.0	<2.0	<10.0
N-Methyl perfluorooctane sulfonamidoethanol		<5.0		<10.0
N-Ethyl perfluorooctane sulfonamidoethanol		<5.0		<10.0
N-EtFOSA		<5.0		<10.0
PFHpS		<5.0	<2.0	<2.0

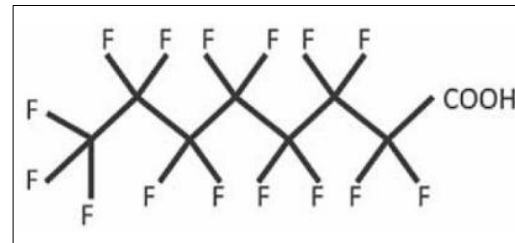
A 3D illustration of an atom with a central nucleus of red and grey spheres, surrounded by three intersecting grey elliptical orbits with blue spheres. Several smaller, similar atomic models are scattered in the background.

Analytical Challenges Associated with PFAS Analysis

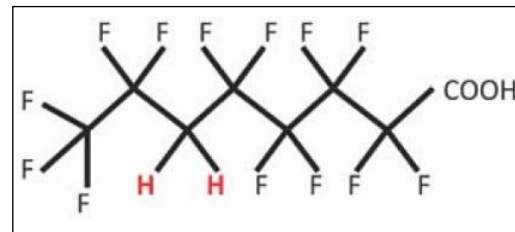
Nathan Eklund, PMP
Pace Persistent Organic Pollutants (POPs) Lab

Per- and Polyfluoroalkyl Substances (PFAS)

Perfluorinated substances are those in which all the hydrogens on the carbons are replaced by fluorine.



Polyfluorinated substances apply to chemicals in which not all the hydrogens on the carbons of the molecule are replaced by fluorine.



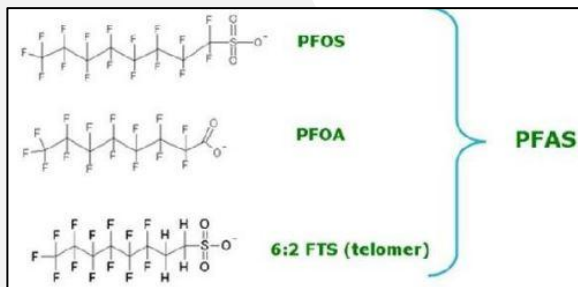
When referring to mixtures of perfluorinated and polyfluorinated substances, it is more correct to use the term per- and polyfluoroalkyl substances or **PFAS**.

Chemical properties – PFAS

Class of synthetic (organofluorine) compounds containing primarily Carbon-Fluorine bonds

Carbon-Fluorine bond is the strongest bond found in nature

- Very strong bonding, extremely stable, variable structure & size depending on chemical group
- Persistent in environment, resistant to thermal/chemical/biological degradation
- Very soluble, potential for bioaccumulation exists
- Hydrophobic and Hydrophilic (head vs. tail)



Hydrophobic

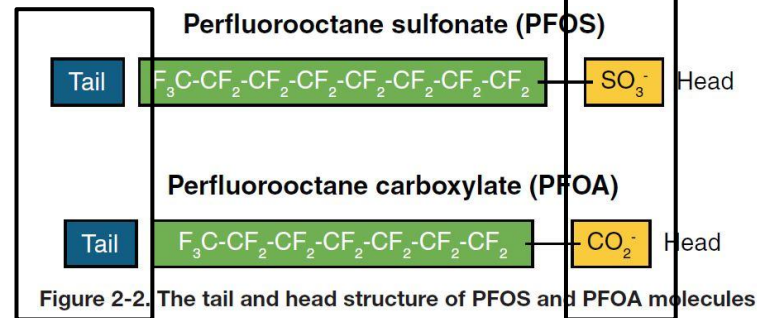


Figure 2-2. The tail and head structure of PFOS and PFOA molecules

PFAS analytical challenges

PFAS is an emerging compound

- EPA has a health risk limit, but not an action limit
- Production analytical chemistry has been available for a short time (instrumentation, standards, etc)

PFAS analytical challenges

Unregulated compound group

- Various compound lists (6, 14, 21, 24)
- Various state and federal certifications
- Various state and federal standards (MN, NH, NJ, etc)

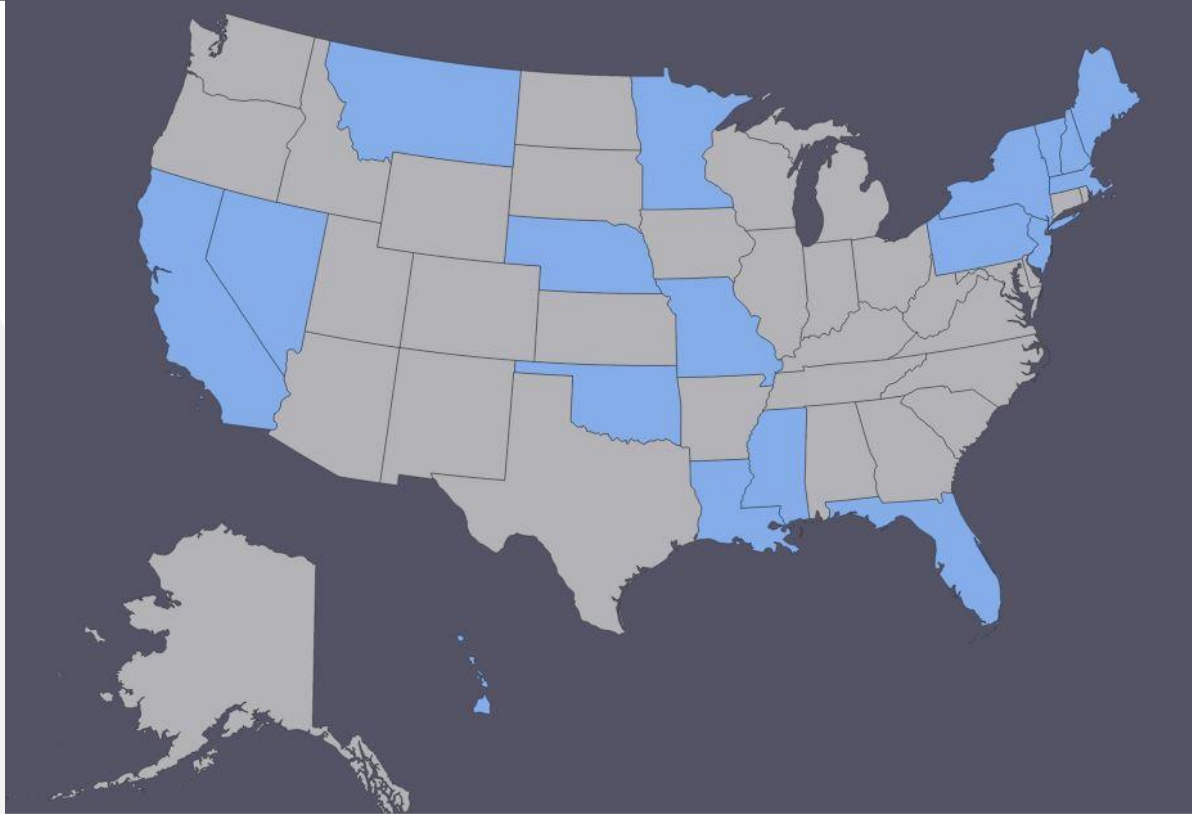
PFAS analytical challenges

Field sampling challenges

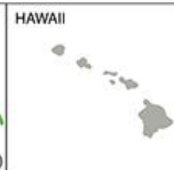
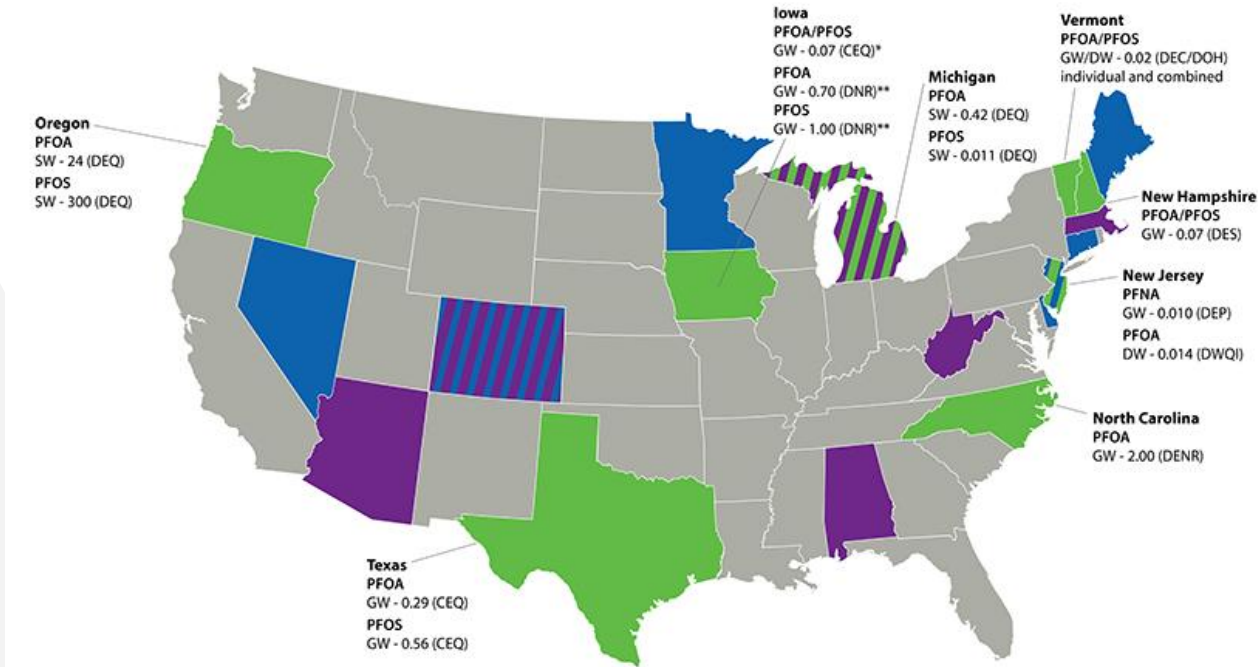
Analytical Methods

- EPA Method 537 (UCMR3)
- EPA Method 537 v1.1 (DW only)
- DOD QSM 5.1 (isotope dilution)
- GenX Compounds
- Future EPA Method (Fall 2018)

PFAS analytical challenges



PFAS analytical challenges



KEY		
■	Promulgated Rule(s) (values in µg/L)	
■	Guidance/Pending Rule(s)	
■	Adopted USEPA LHA Drinking Water Standard of 0.07µg/L for PFOA/PFOS individual and combined	
GW	Groundwater	* Protected GW
DW	Drinking Water	** Non-Protected GW
SW	Surface Water	



SO

WHAT'S

NEXT

?

Where do we go from here?

- Science evolving rapidly
- Working with an emerging contaminant
- Challenges of sampling and testing
- Regulatory direction is evolving

Ongoing initiatives

In Kent County....

- New well construction requires PFAS testing

Ongoing initiatives

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- New well construction requires PFAS testing

In Michigan....

- **Fire fighting foam**

Ongoing initiatives

In Kent County....

- New well construction requires PFAS testing

In Michigan....

- Fire fighting foam
- **Type I well sampling**

Ongoing initiatives

In Kent County....

- New well construction requires PFAS testing

In Michigan....

- Fire fighting foam
- Type I well sampling
- **IPP Reviews**

Ongoing initiatives

In Kent County....

- New well construction requires PFAS testing

In Michigan....

- Fire fighting foam
- Type I well sampling
- IPP Reviews
- **State laboratory capacity for PFAS analysis**

Ongoing initiatives

In Kent County....

- New well construction requires PFAS testing

In Michigan....

- Fire fighting foam
- Type I well sampling
- IPP Reviews
- State laboratory capacity for PFAS analysis

Nationwide....

- **PFOS & PFOA are on the EPA Chemical Contaminant List -4**
(along with 107 other chemicals, chemical groups and microbial contaminants)

- Kent County
- State of Michigan
- EPA
- EPA (CLU-IN)
- Interstate Technology and Regulatory Council (ITRC)
- National Groundwater Association (NGWA)
- Agency for Toxic Substances and Disease Registry (ATSDR)
- National Institute of Environmental Health Sciences (NIEHS)

Questions?

Emerging Contaminants PFAS

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