

The Story of an Emerging Contaminant: The Past, Present, & Future of PFAS in Food

June 7, 2026

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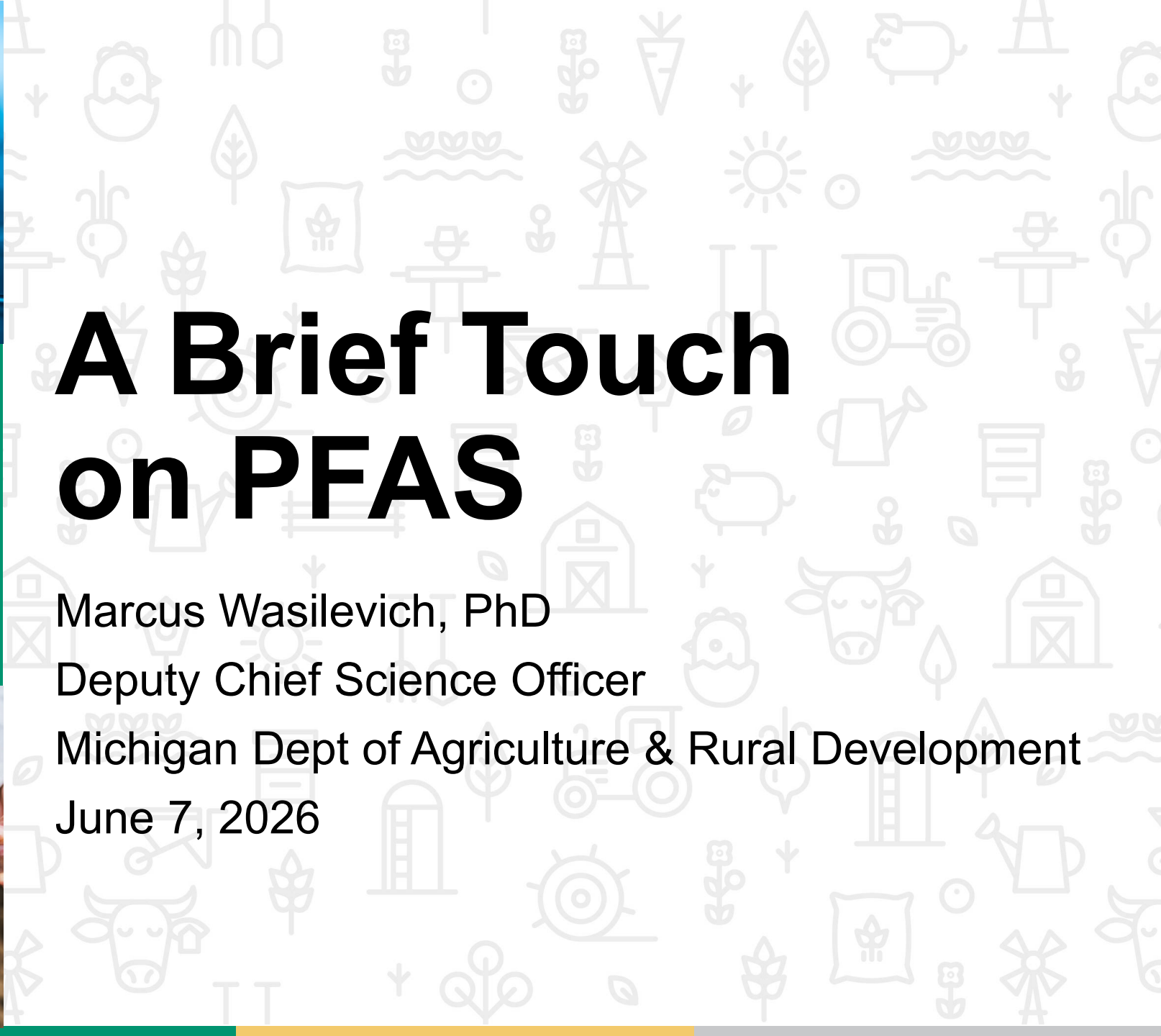
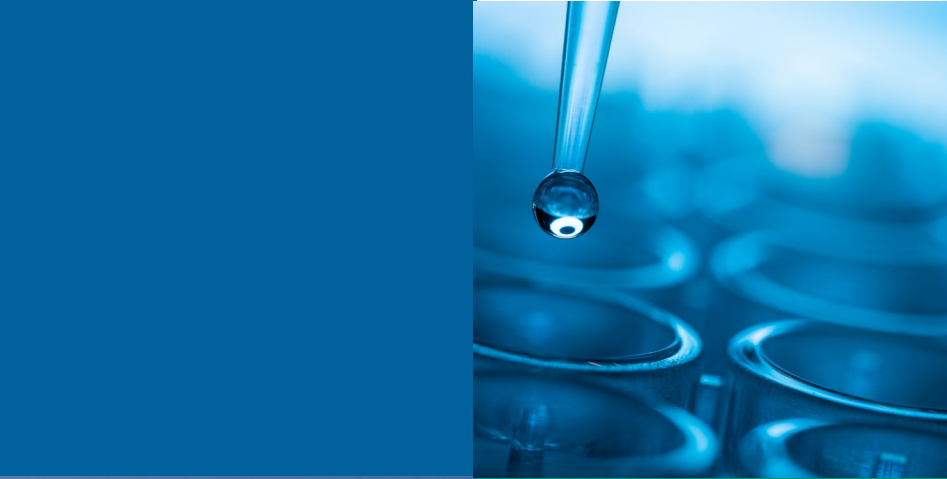
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A Brief Touch on PFAS

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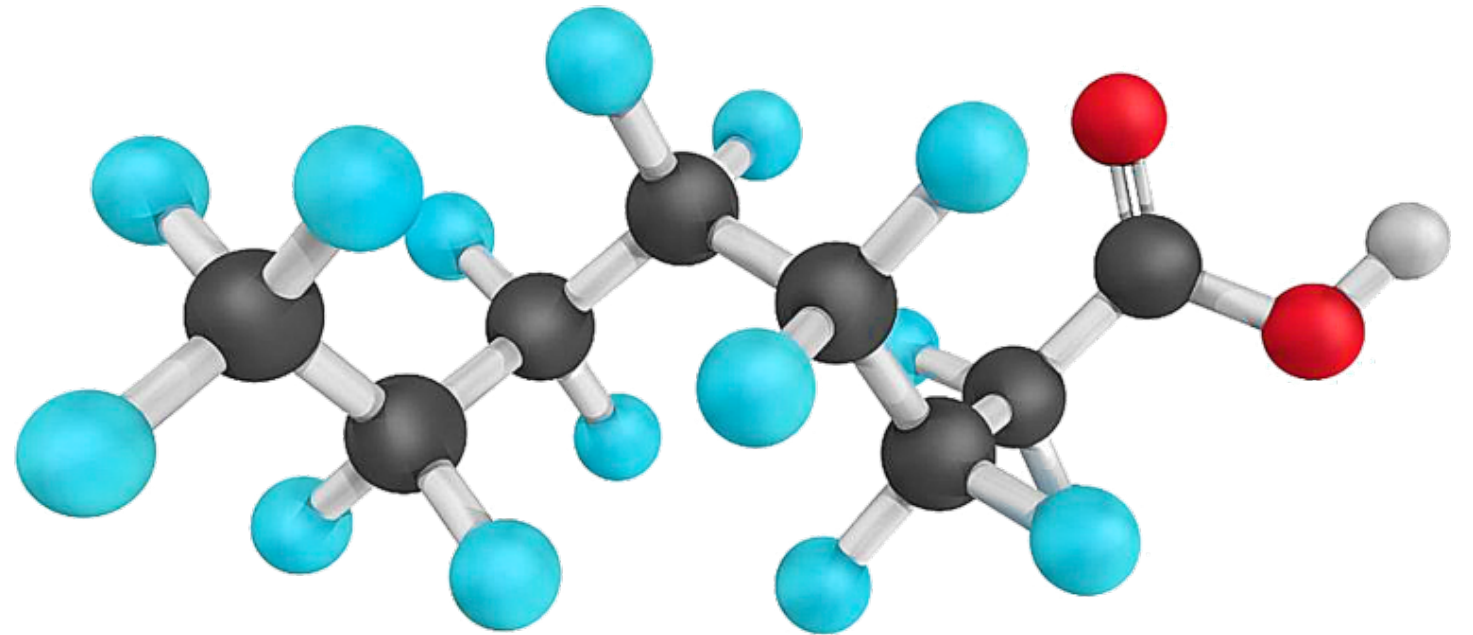
Michigan Dept of Agriculture & Rural Development

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PFAS

- Per- and Polyfluoroalkyl Substances

PFAS

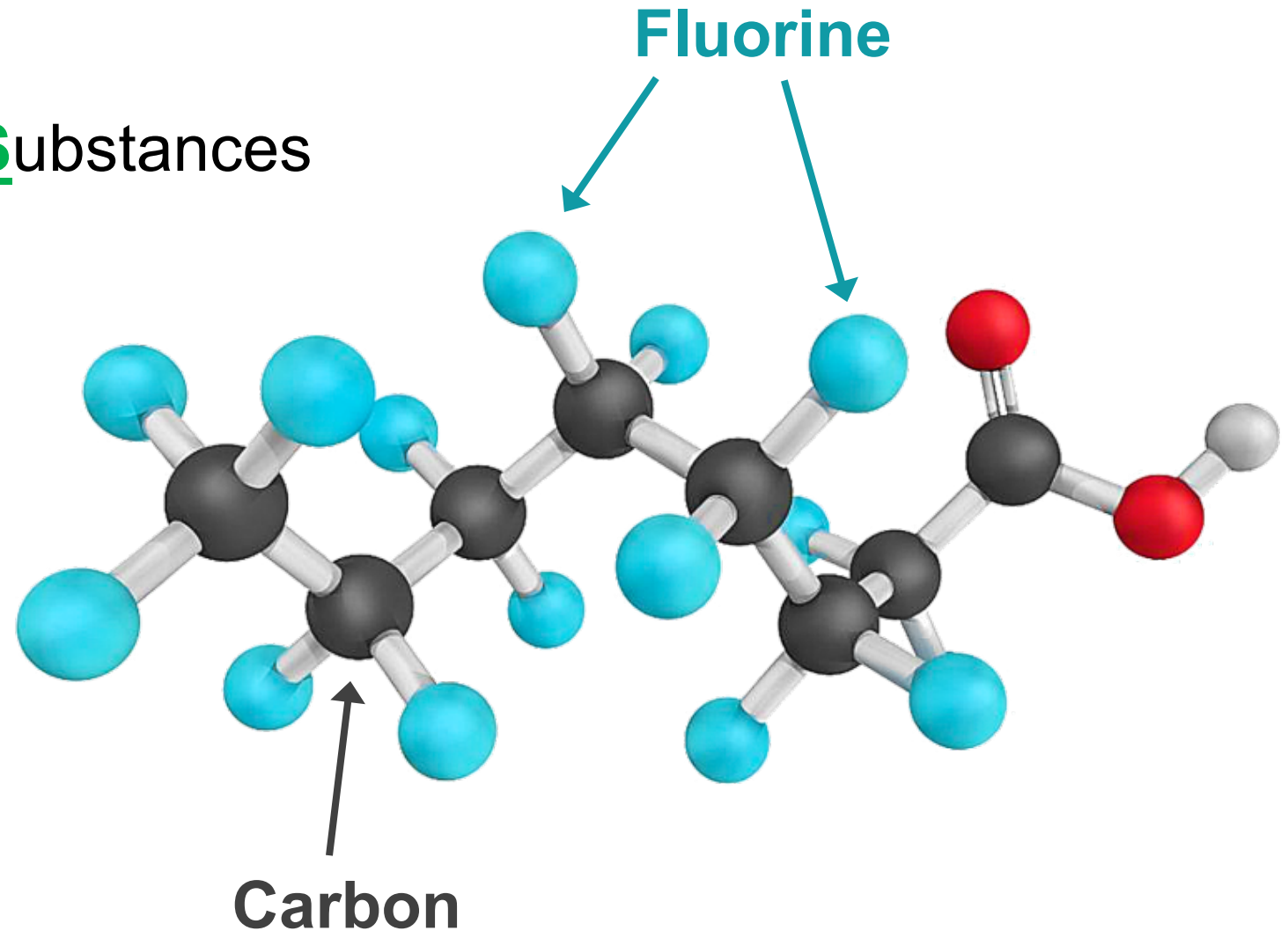


PFAS

- Per- and Polyfluoroalkyl Substances

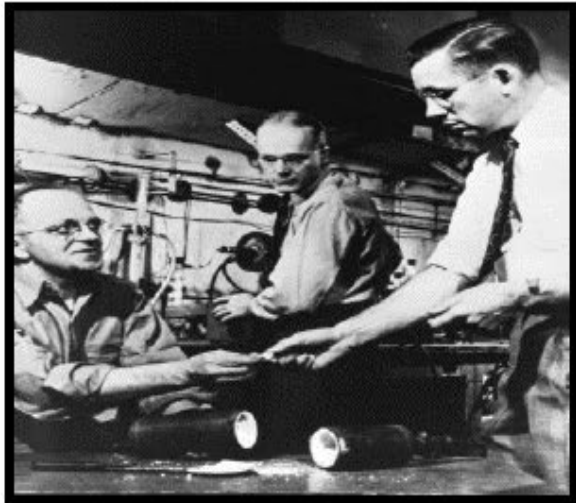
PFAS

- Depending on definition, over 10,000 different types
- Strong Carbon-Fluorine Bonds



PFAS Development

1930s



Teflon accidentally discovered in 1938

1940s



DOD Research (Uranium Enrichment)

1950s



Consumer products

1960s



Aqueous Film Forming Foam (AFFF) is developed

Electrochemical Fluorination

11-29-1948 3M Application for Patent

“electrolyzing a liquid hydrogen fluoride(HF) solution containing a fluorinatable organic starting compound, at an electrolyzing potential which is insufficient to generate free fluorine under the existing conditions, but which is sufficient to cause the production of fluorine-containing carbon compound products **at a useful rate**”

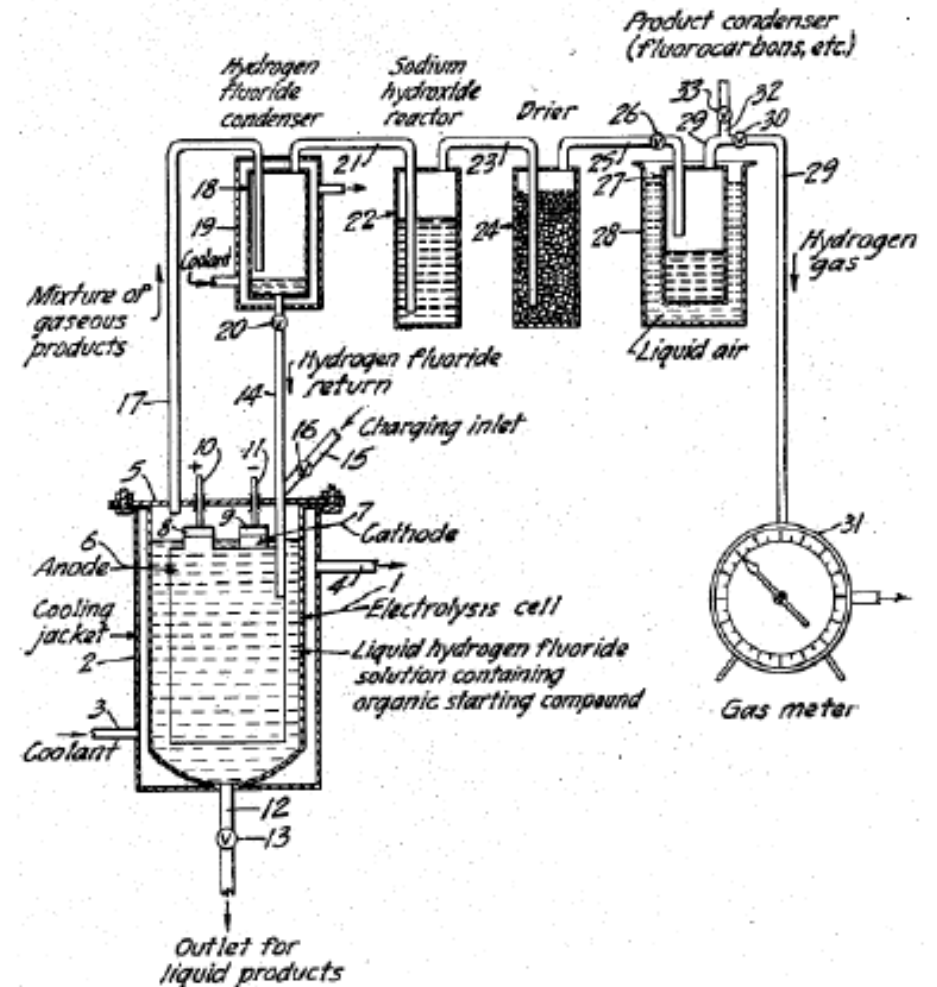
<https://patents.google.com/patent/US2519983A/en>

Patent US2519983

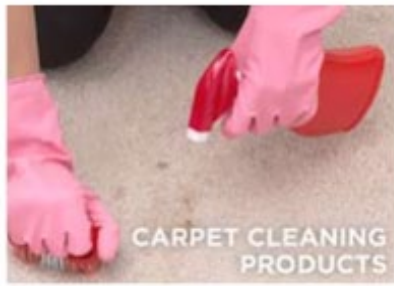
Aug. 22, 1950

J. H. SIMONS
ELECTROCHEMICAL PROCESS OF MAKING FLUORINE-CONTAINING
CARBON-COMPOUNDS
Filed Nov. 29, 1948

2,519,983



PFAS Uses



So Why The Concern?

- Slow to break down, if ever

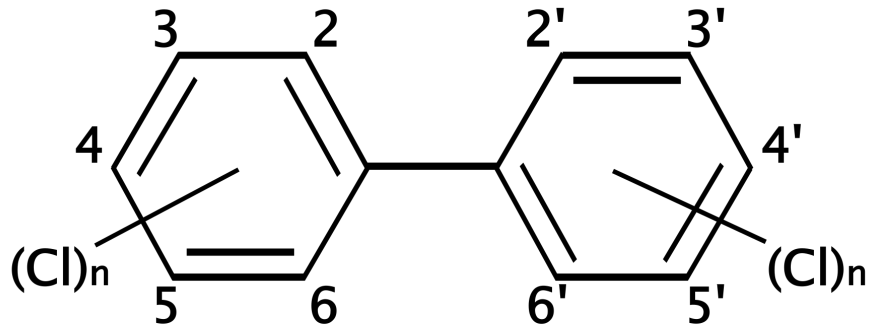
Article | [Open access](#) | Published: 06 July 2024

Reasons why life on Earth rarely makes fluorine-containing compounds and their implications for the search for life beyond Earth

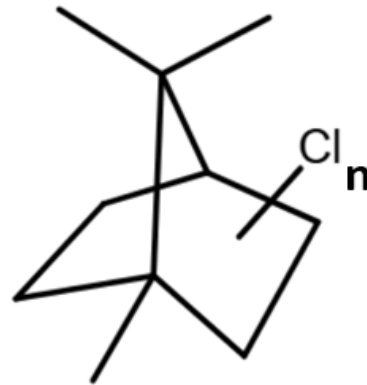
[Janusz J. Petkowski](#) , [Sara Seager](#) & [William Bains](#)

[Scientific Reports](#) **14**, Article number: 15575 (2024) | [Cite this article](#)

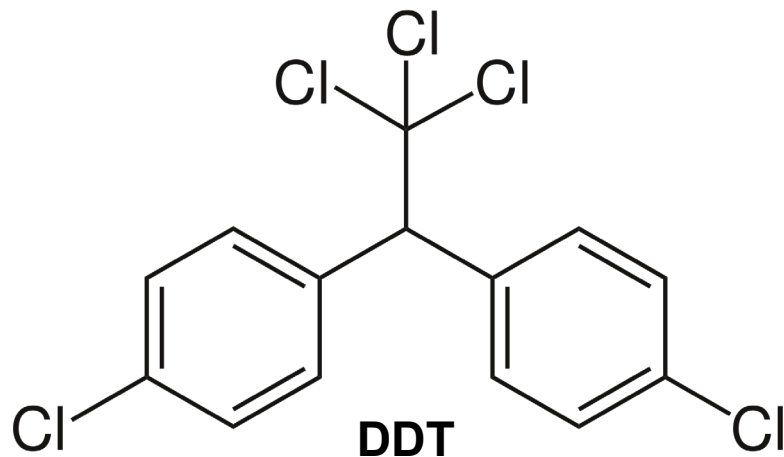
Persistent Organic Pollutants



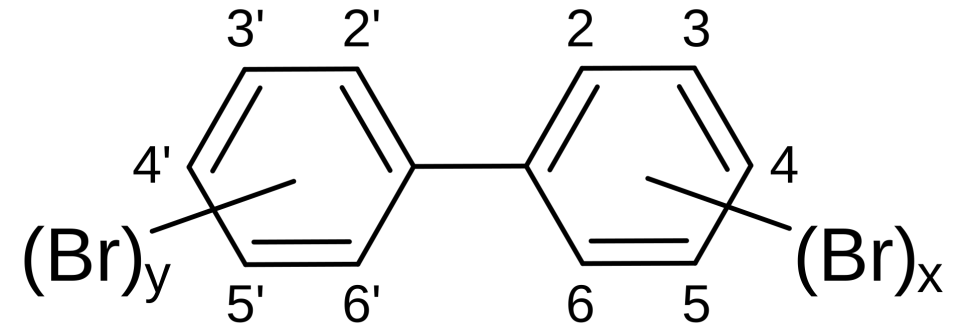
Polychlorinated Biphenyls (PCBs)



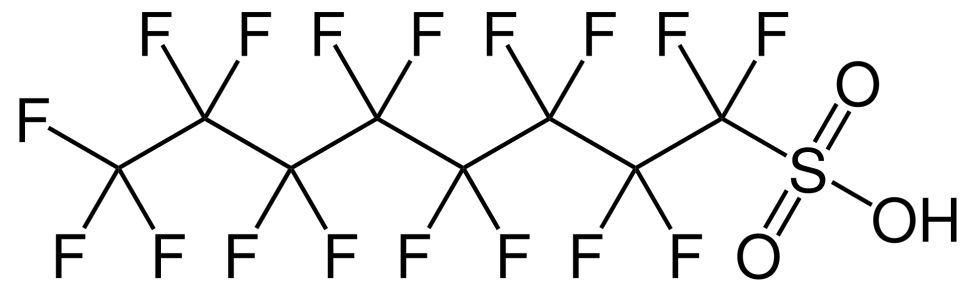
Toxaphene



DDT



Polybrominated Biphenyls (PBBs)



PFOS

So Why The Concern?

- Widespread globally
- Bioaccumulative



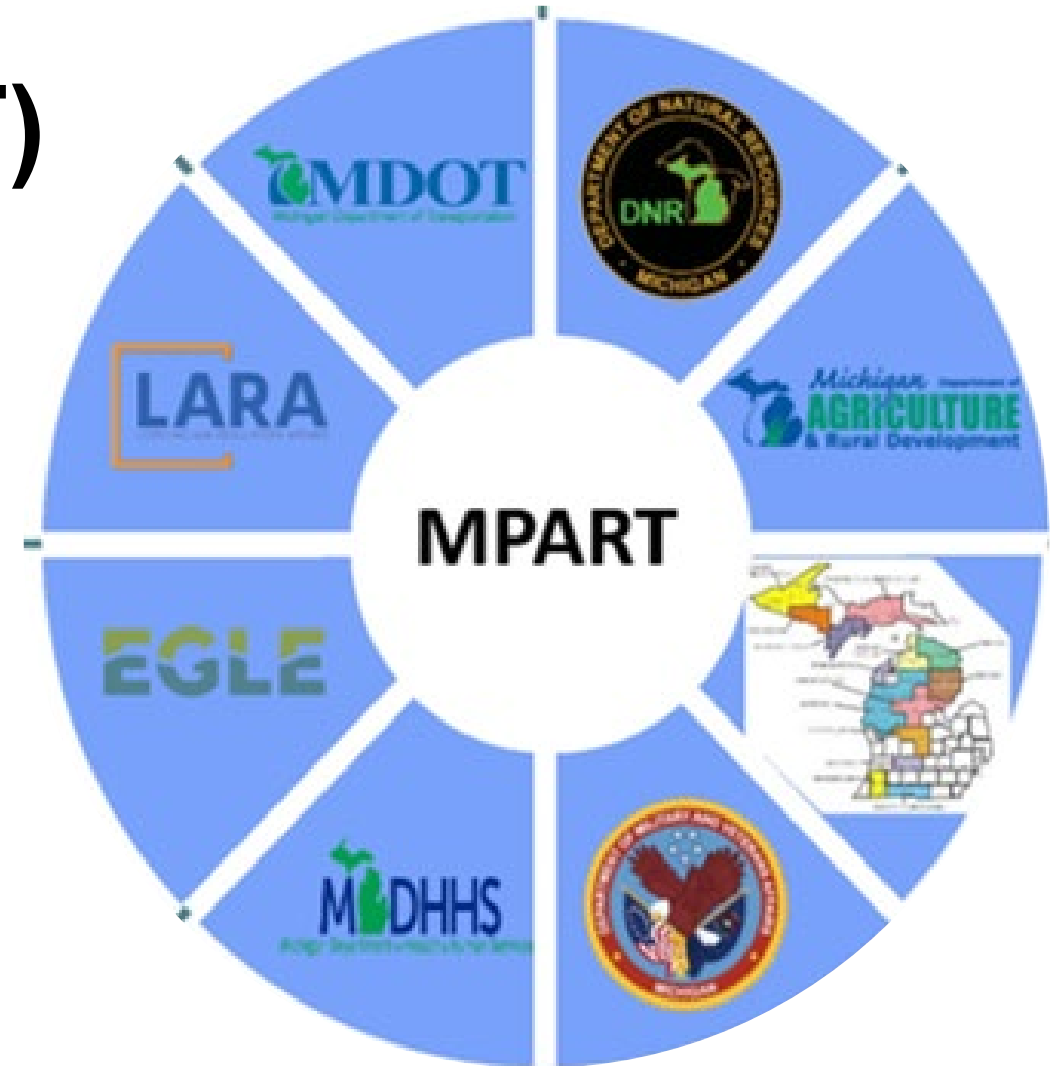
So Why The Concern?

- Long half-life in humans (PFOA & PFOS)
- Some well-studied analytes, such as PFOA and PFOS, have been linked to negative human health outcomes:
 - Liver and Thyroid Malfunction
 - Immunological Disruption
 - Cardiovascular & Developmental Effects
 - Reduced Fertility
 - Higher Cholesterol
 - Developing Certain Types of Cancer

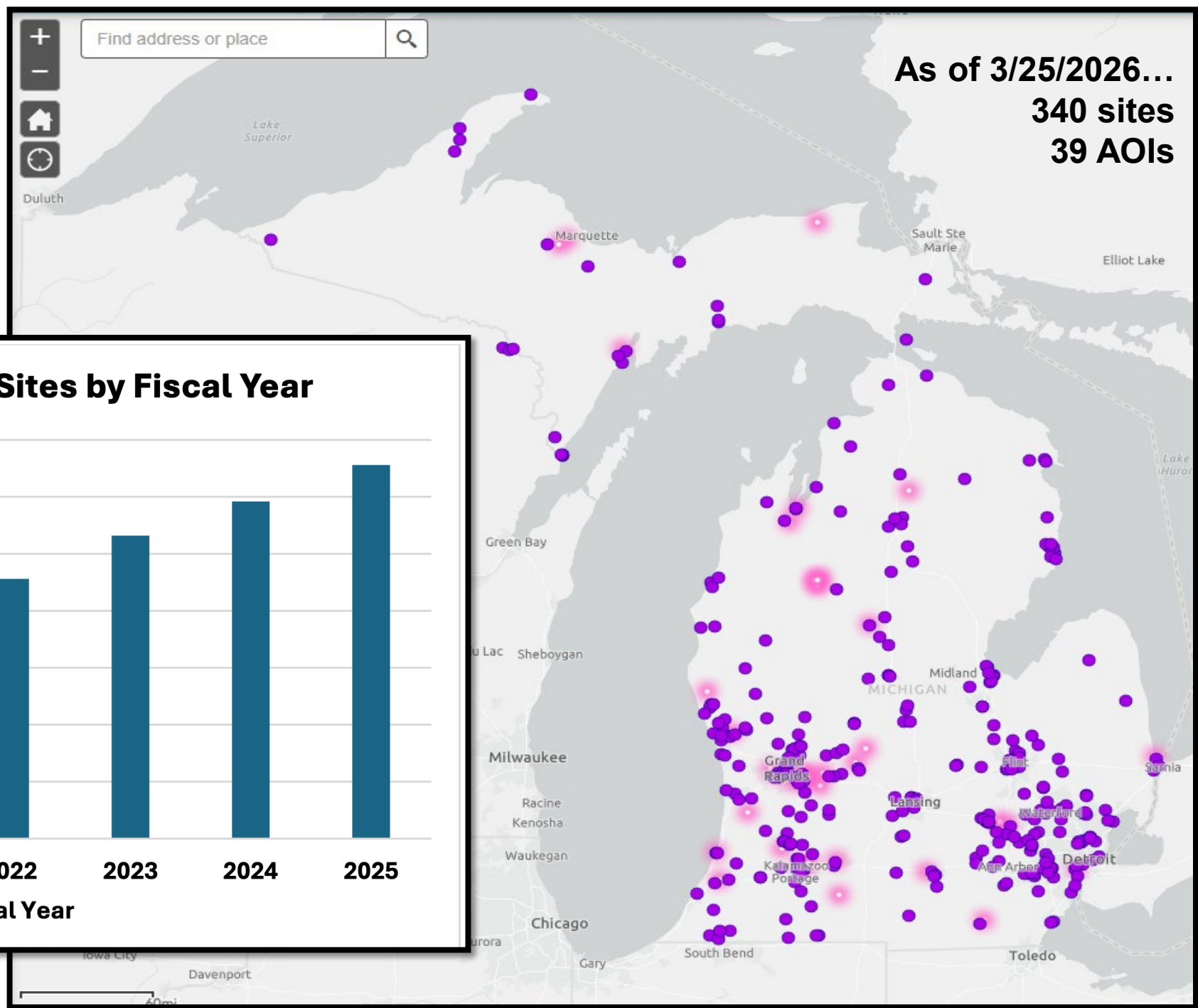


Michigan PFAS Action Response Team (MPART)

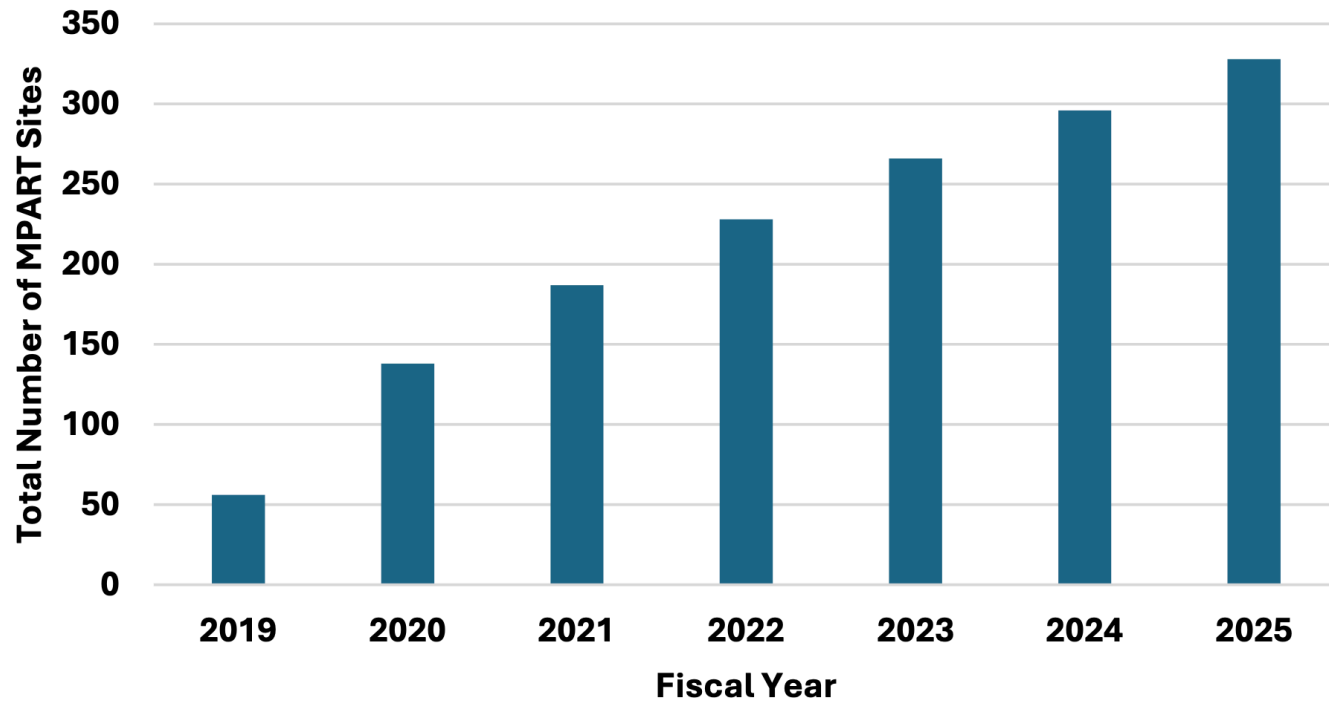
- Executive Order 2019-03
- Unique Multi-Agency Approach
- Leads Coordination and Cooperation Among Levels of Government
- Directs Implementation of State's Action Strategy



Michigan PFAS Sites

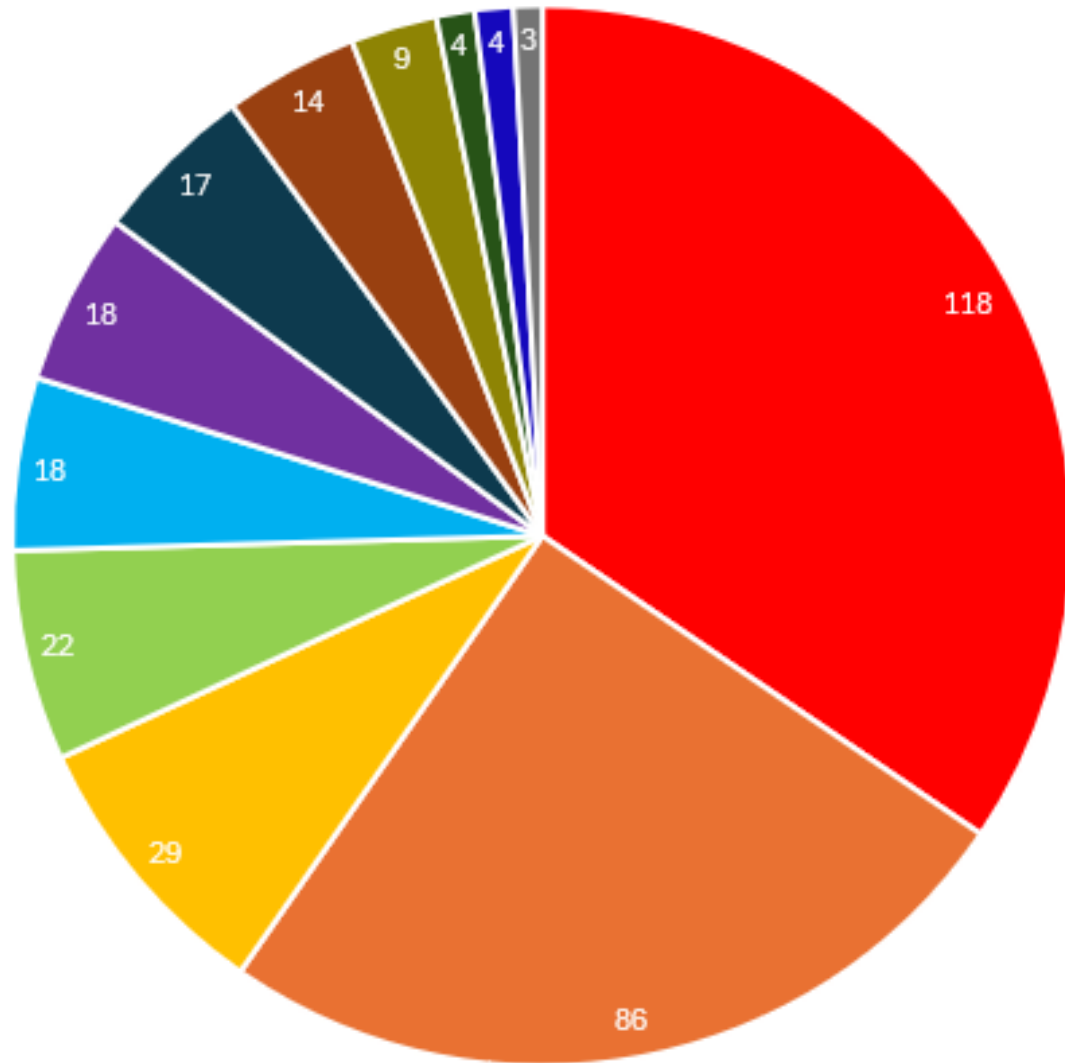


Total Number of MPART Sites by Fiscal Year

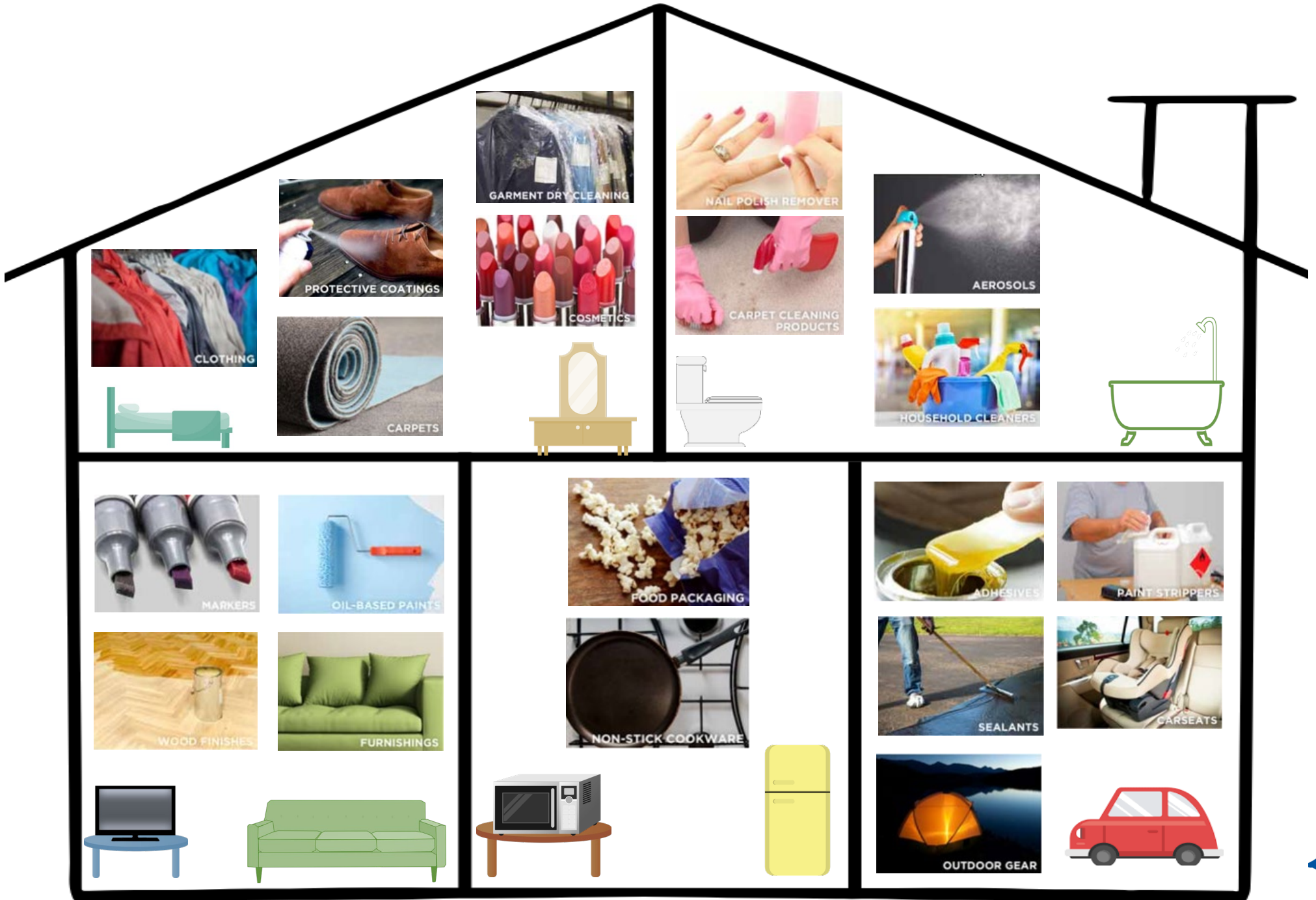


(MPART, 2025)

343 PFAS Sites by Type



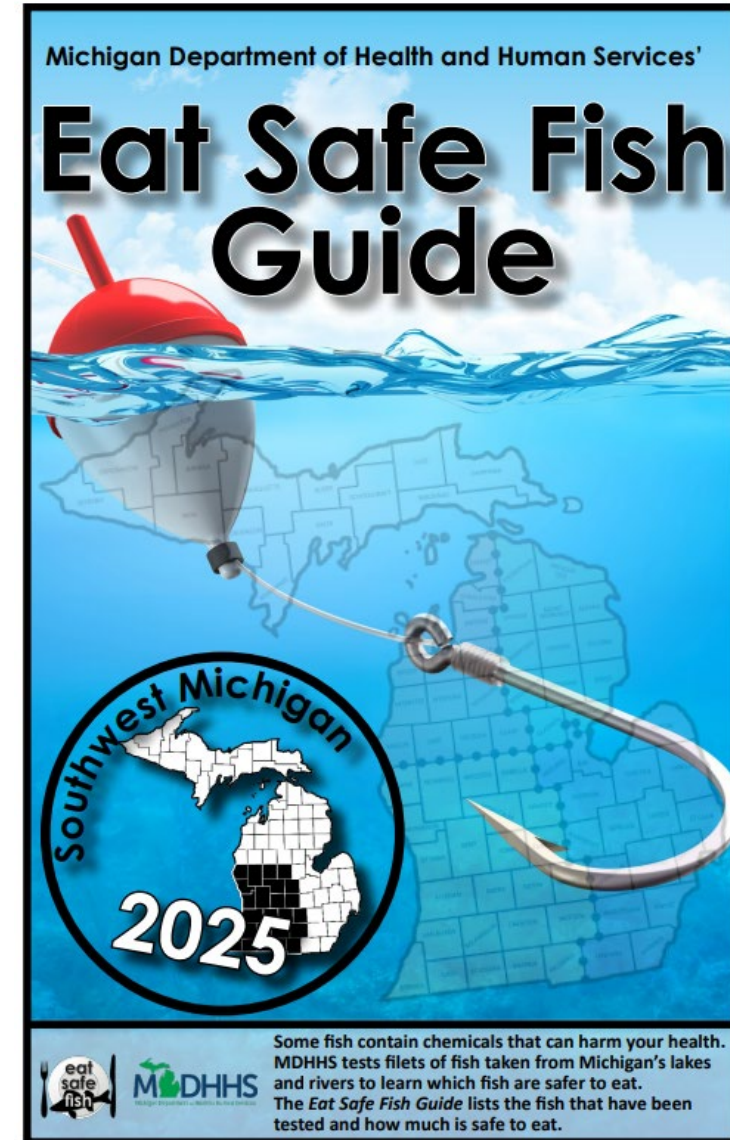
- Landfill
- Industrial (transportation-related, chemical, and other manufacturing)
- Plating
- Wastewater (wastewater treatment plants and a car wash)
- Airport
- Military
- Fire Related
- Paper Manufacturing
- Laundromat/Dry Cleaner
- Tannery
- Refinery
- Unknown



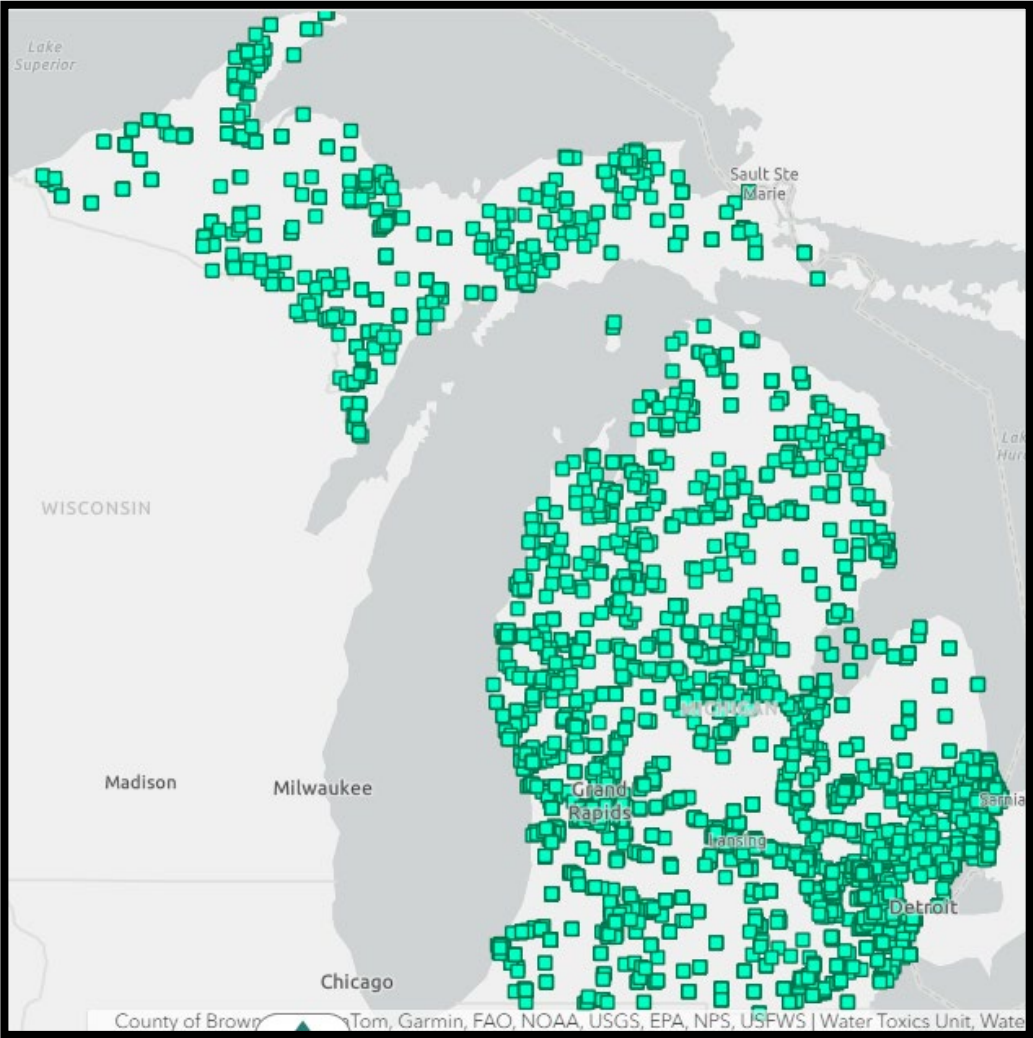
Exposure to PFAS Chemicals



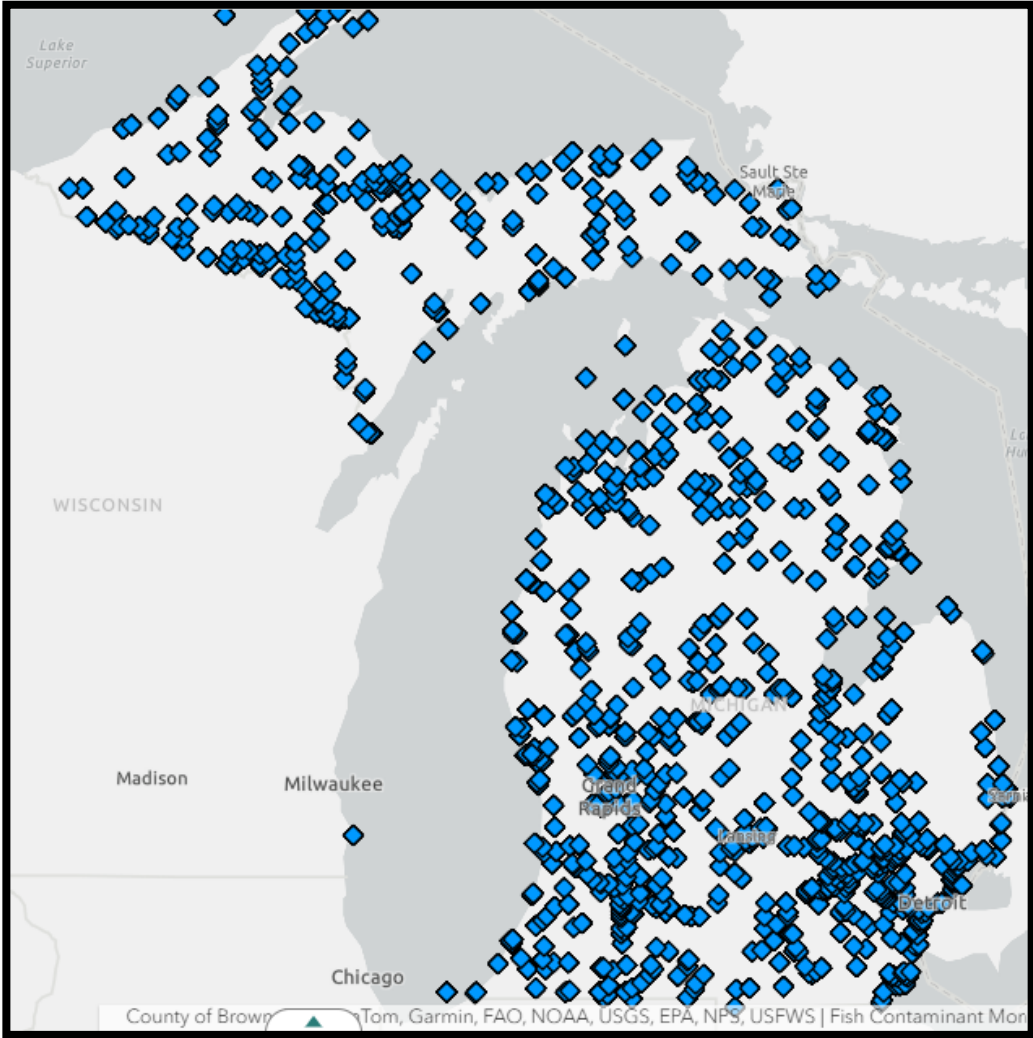
- Drinking contaminated water
- Eating fish caught from water contaminated by PFAS



4053 Surface Water Locations Sampled



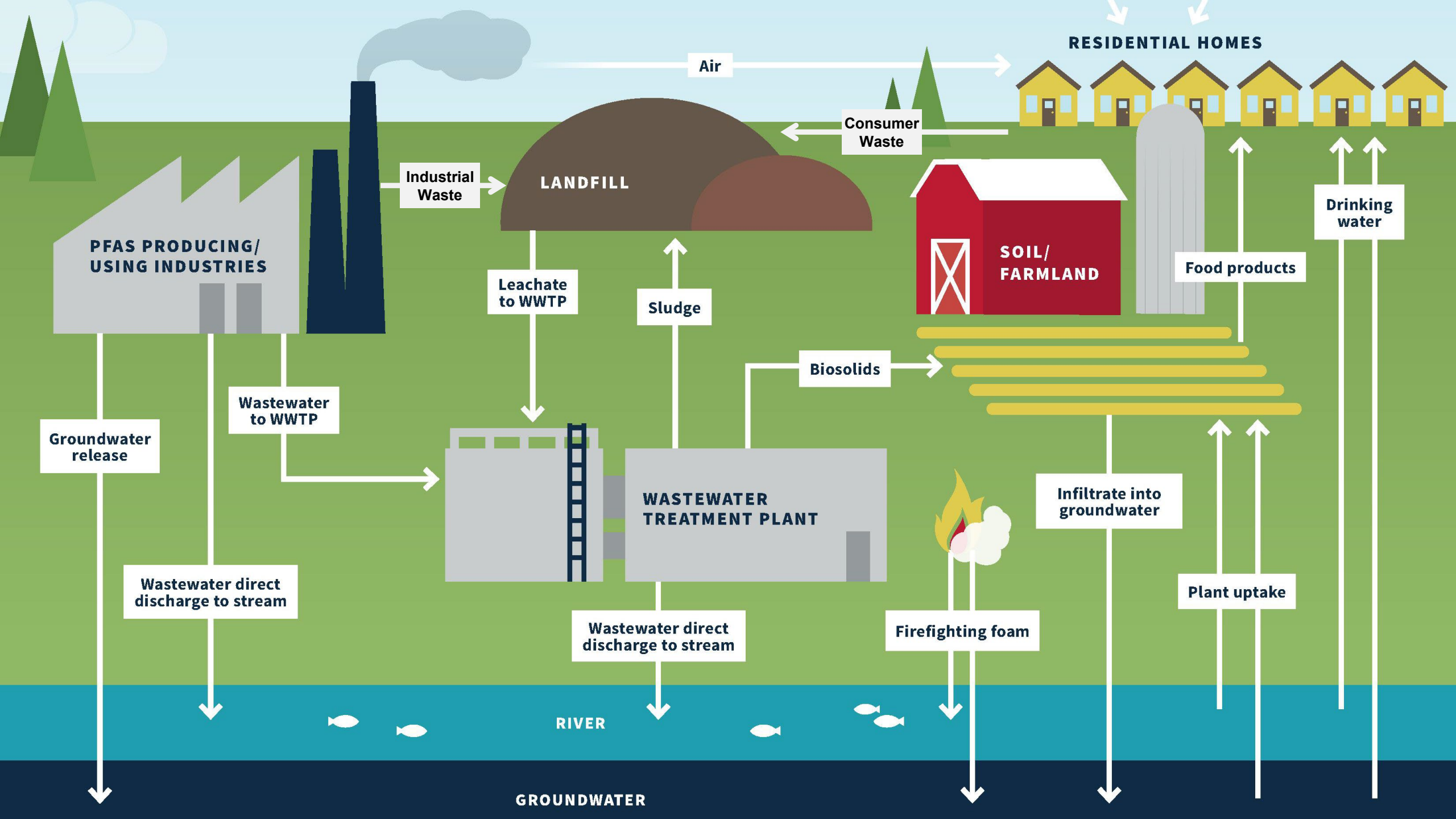
1046 Fish Sampling Locations



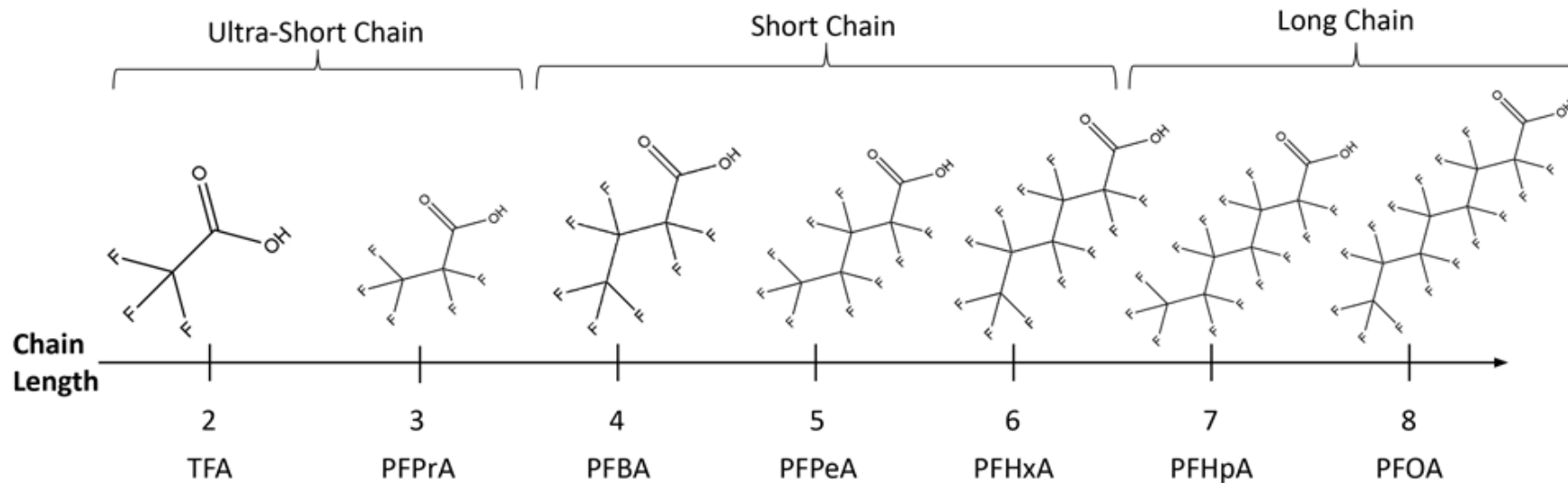
Exposure to PFAS Chemicals



- Incidental swallowing of contaminated soil or dust
- Eating food which has been in contact with packaging materials containing PFAS
- Using some consumer products
- PFAS absorption through skin is typically not a concern



“Chain Length”



- Number of carbons matter
- Environmental mobility and bioaccumulation differs with chain length
- Long chains have a larger potential for causing health impacts

Increasing Bioaccumulation and Toxicity

Increasing Environmental Mobility

(Adapted from Aquagga Inc., 2024)



PFAS in Agriculture: Michigan Actions and Beyond

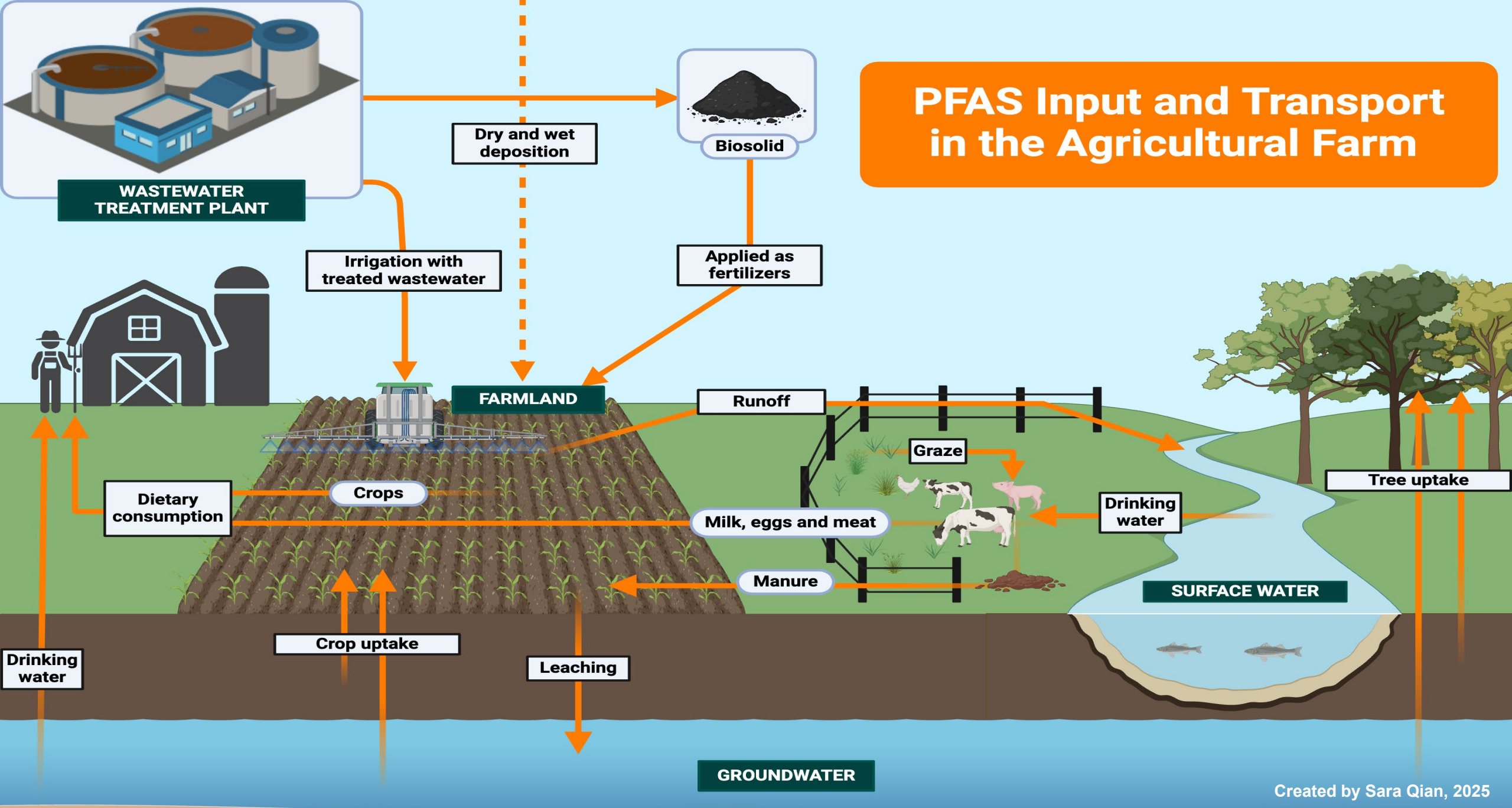
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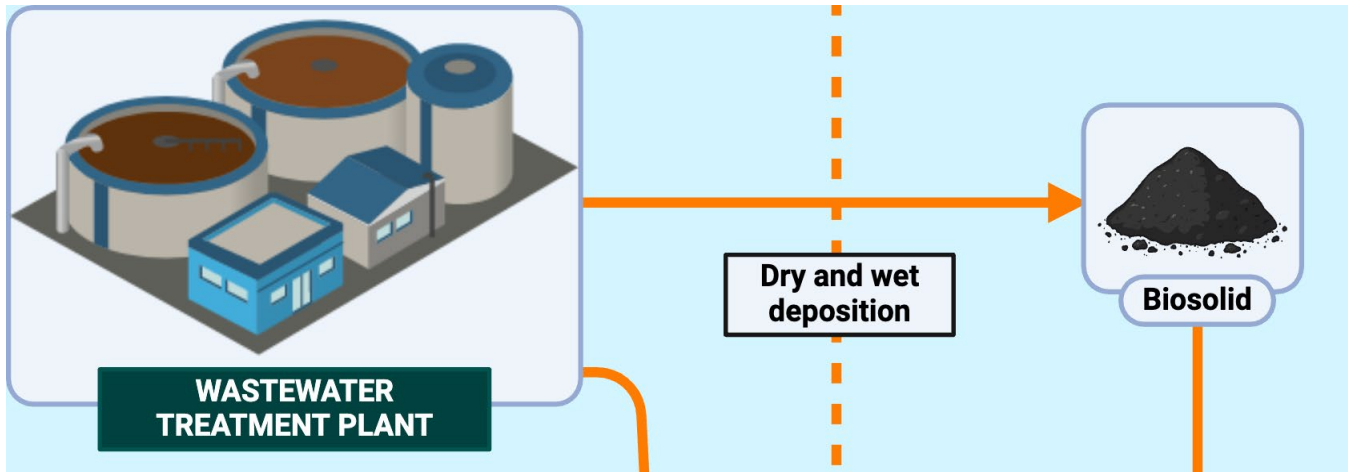
June 7, 2026

PFAS Input and Transport in the Agricultural Farm



Biosolids Regulation in Michigan

Industrial Pretreatment Program

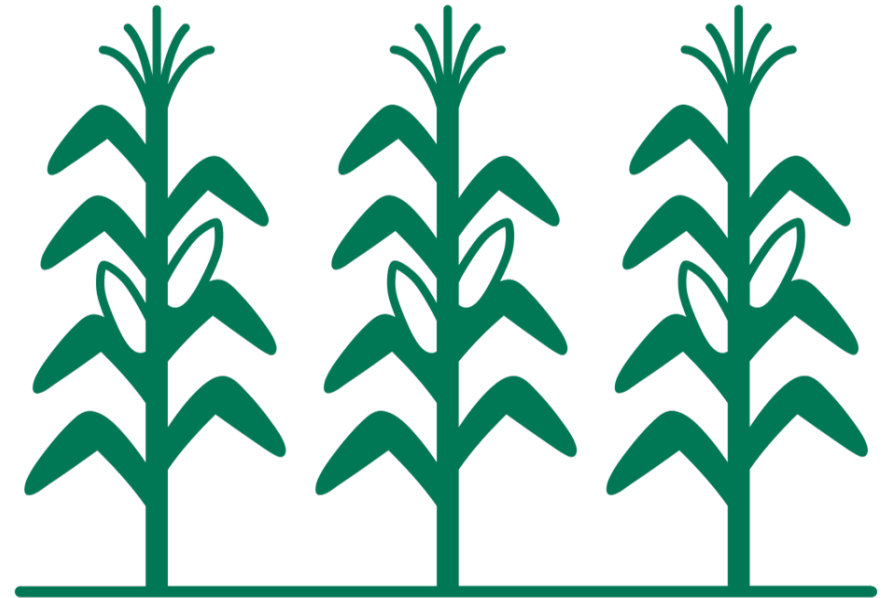


- PFAS added in 2018
- Goal is to identify sources of PFAS within wastewater treatment plants (WWTP) and control or eliminate them at the source
- Monitoring WWTP effluent for PFAS

Biosolids Regulation in Michigan

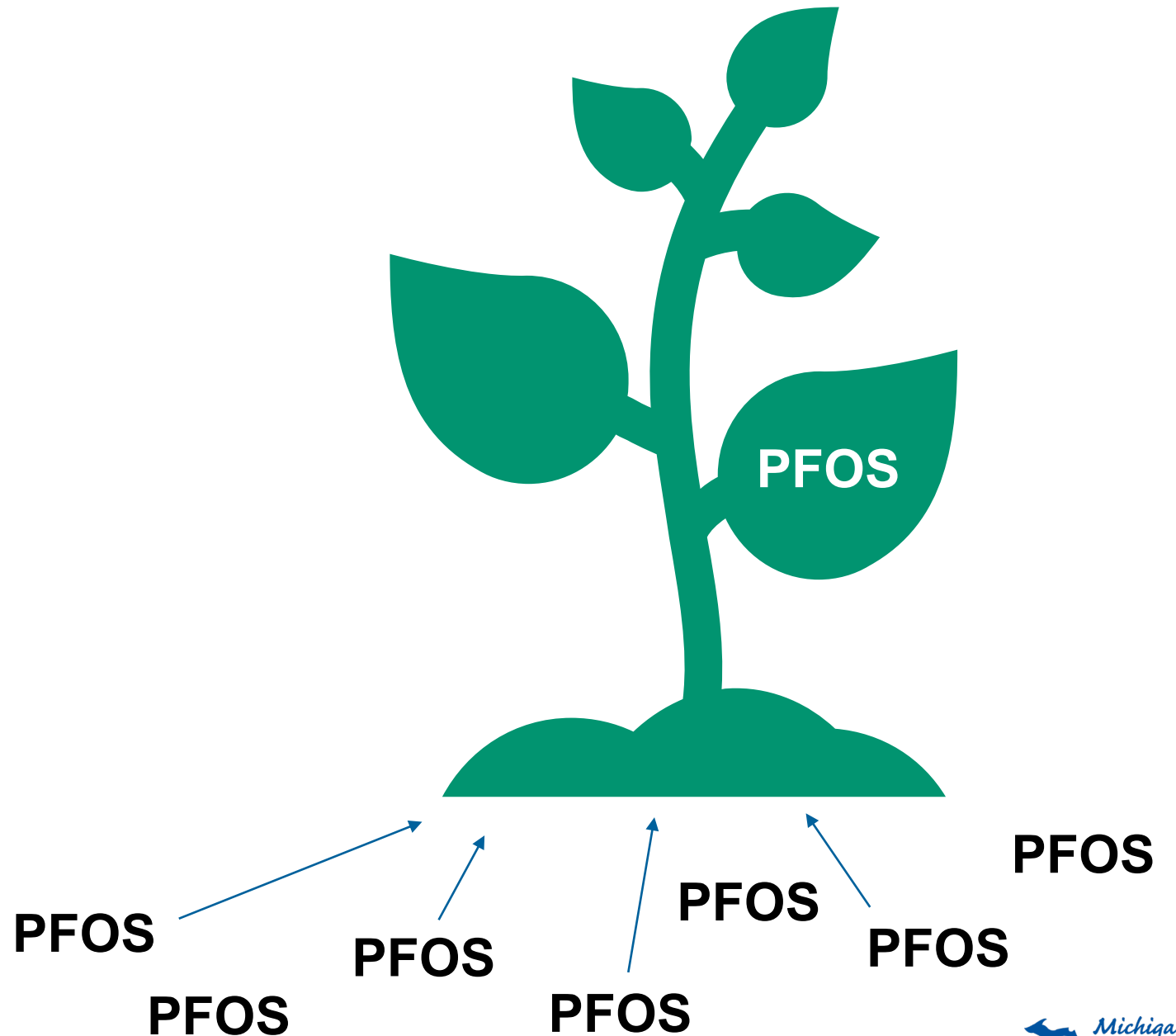
Land Application of Biosolids

- Biosolids from WWTPs regulated for PFOA and PFOS
- $< 20 \mu\text{g}/\text{kg}$ (ppb)
 - Can be applied to land
- Between $20\text{-}100 \mu\text{g}/\text{kg}$ (ppb)
 - Reduced land application rate
- $> 100 \mu\text{g}/\text{kg}$ (ppb)
 - Cannot be applied to land
 - Implement source reduction plan



Crop Uptake

To better understand risk associated with PFAS entering the food chain we need to know more about PFAS movement into plants.



Crop Uptake

- Movement of PFAS into plants is emerging science and is influenced by many factors
 - **Species** (some indication of differential uptake by species)
 - **Location in plant** (edible portions versus plant waste tissue)
 - **Rate of PFAS incorporation** (chain length, annual/perennial crops)
 - **Soil type influence** (organic matter, pH, salinity, temperature)



Differing PFOS Uptake By Vegetables

Little	Some	More
Asparagus Bok Choy Corn (kernels) Green Beans Peppers Potatoes Rhubarb Broccoli	Arugula Carrots Kale Swiss Chard	Lettuce Spinach



From Soil to Plant...



- PFAS getting into plants is usually not a large concern for humans...
 - Fruits and grains appear to accumulate less PFOS
 - We tend to not eat several pounds of the same vegetable in one day, every day

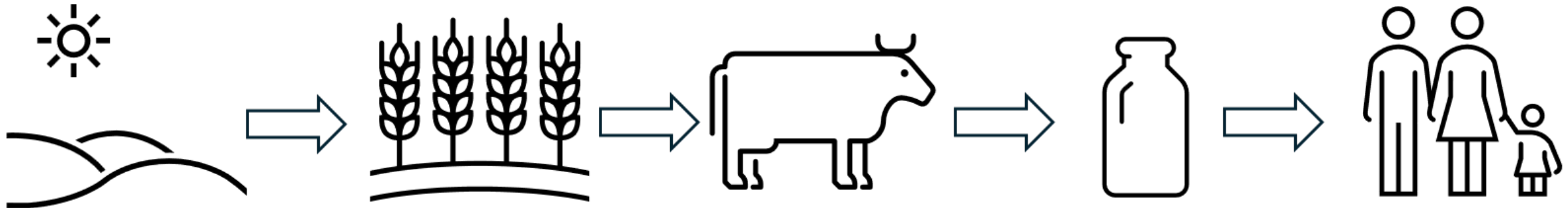
From Soil to Plant... and then to Animal



A 100% grass fed beef cow eats 16 kg of dry mass fodder per day.

That's over 90 pounds of fresh grass or alfalfa each day!

Evaluating The Risks



Which specific PFAS chemicals are being consumed?

Not all analytes are equal.

How much of the food is consumed?

90th Percentile?

Who is consuming the PFAS?

Child or an adult?
Underlying health conditions?

What is the total dose of PFAS?

Background exposures?

PFOS Toxicity Values

Agency	PFOS Toxicity Value (ng/kg-bw/day)	Year Derived
US EPA	20	2016
US EPA	0.1	2024
ATSDR	2.0	2021
MI SAWG	2.89	2019
CA OEHH	0.64	2024
European Union	0.63*	2022

*Sum of four PFAS (PFOS, PFOA, PFNA and PFHxS) with a tolerable weekly intake of 4.4 ng/kw-bw/week, effects on the immune system considered the critical effect.

Michigan Strategy

- It all starts with the soils
 - Identify fields that are impacted by PFAS
 - Suggest mitigation based on what we know about PFAS transfer into plants, and ultimately into animals and their products
 - By addressing soils, we are addressing the end products being produced

So how do we start?



Focus Groups - Michigan Farmer's Understandings and Concerns Around PFAS (2025)

- Trust for Michigan State University, commodity organizations
- Distrust for government
- Desire for more education
- Desire for more research
- Finding PFAS and not being able to mitigate
- Food production being outsourced to other countries if overregulated in the U.S.
- Producers are interested in testing soil, water, crops and/or products for PFAS if it is **voluntary** and **confidential**





Mitigation:

**There is no
one-size-fits-all
solution.**

Mitigation - Crops



- Grow crops that are known to have low PFAS uptake
 - Avoid leafy greens on fields with High PFAS levels
 - Choose grains
- Grow crops for non-consumption purposes
 - Ornamentals
 - Fibers
 - Fuels

Mitigation - Livestock



- Switching from grass/ forage-based diet to corn grain & snaplage
- Purchasing animal feed from non-contaminated sources
- Research being done on PFAS-binders added to cattle fodder to increase PFAS excretion through manure
- Beef and dairy cattle can depurate PFAS from milk and muscle

Mitigation - Depuration

- Length of time that PFAS clears naturally from the body is dependent on:
 - Animal species
 - Type of PFAS
 - Level of contaminant
- Requires the provision of clean water and feed

	PFOS Half-Lives	
	Female	Male
Rabbit	88 days	
Rat	14-83 days	7.5-82 days
Mallard Duck		13.6 days
Quail		20.7 days
Chicken	3.5-160 days	
Mouse	31-38 days	36-43 days
Cattle	39-106 days	120 days
Sheep	No Data	No Data
Monkey	110-200 days	132-200 days
Pig	1.7 years	
Human	~5.5 years	~5.5 years

Modified from Dr. Szymanska, DACF from Death C., et al. 2021

Mitigation - Water



- Short term solution
 - Above ground storage tank
- Longer term solution
 - Dig a new well on the property
 - Deepen existing well
- Filtration?
 - Depends on the volume of water being used at the farm
 - Difficult for large scale farm operations
 - Maintenance costs



Thank you!



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