

PFAS Basics



Rachel Leads

Postdoctoral Scholar

Department of Fisheries and Wildlife

leadsra1@msu.edu

Katie King

PFAS Outreach Specialist

Center for PFAS Research

kingka22@msu.edu

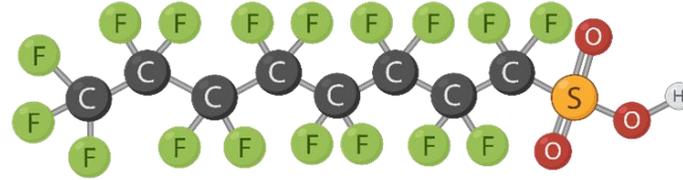
Deil Manliclic

PhD Candidate

Department of Fisheries and Wildlife

manlicli@msu.edu

What Are PFAS?



- Per- and polyfluoroalkyl substances (PFAS)
- Generally, PFAS are a large group of manmade, fluorinated organic chemicals whose properties make them extremely difficult to degrade in the environment
- >12,000 different PFAS
- Resistant to oil, water and heat
- Tend to bioaccumulate in humans, animals and the environment
- Referred to as “forever chemicals”



PFAS Chain Length

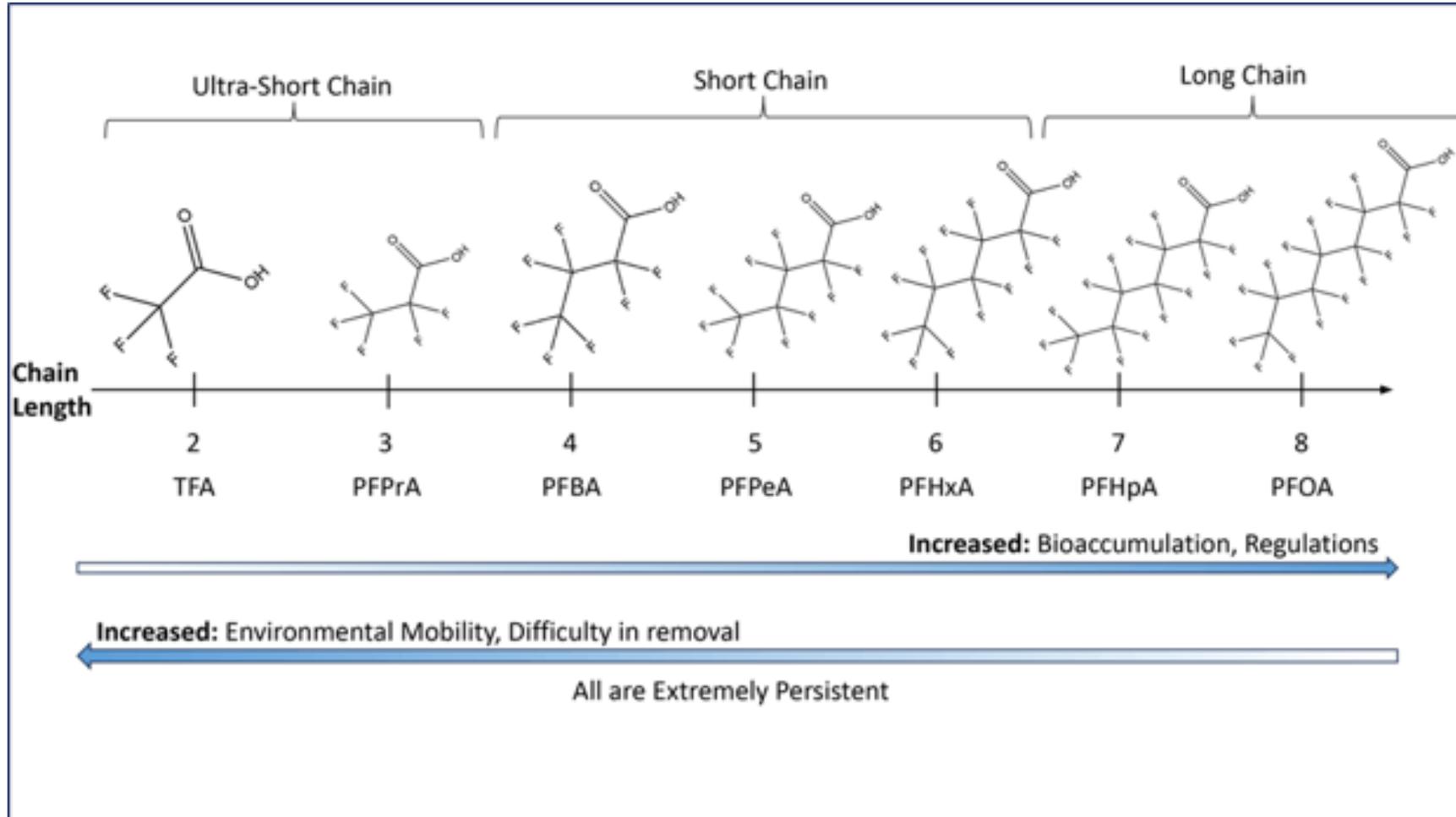
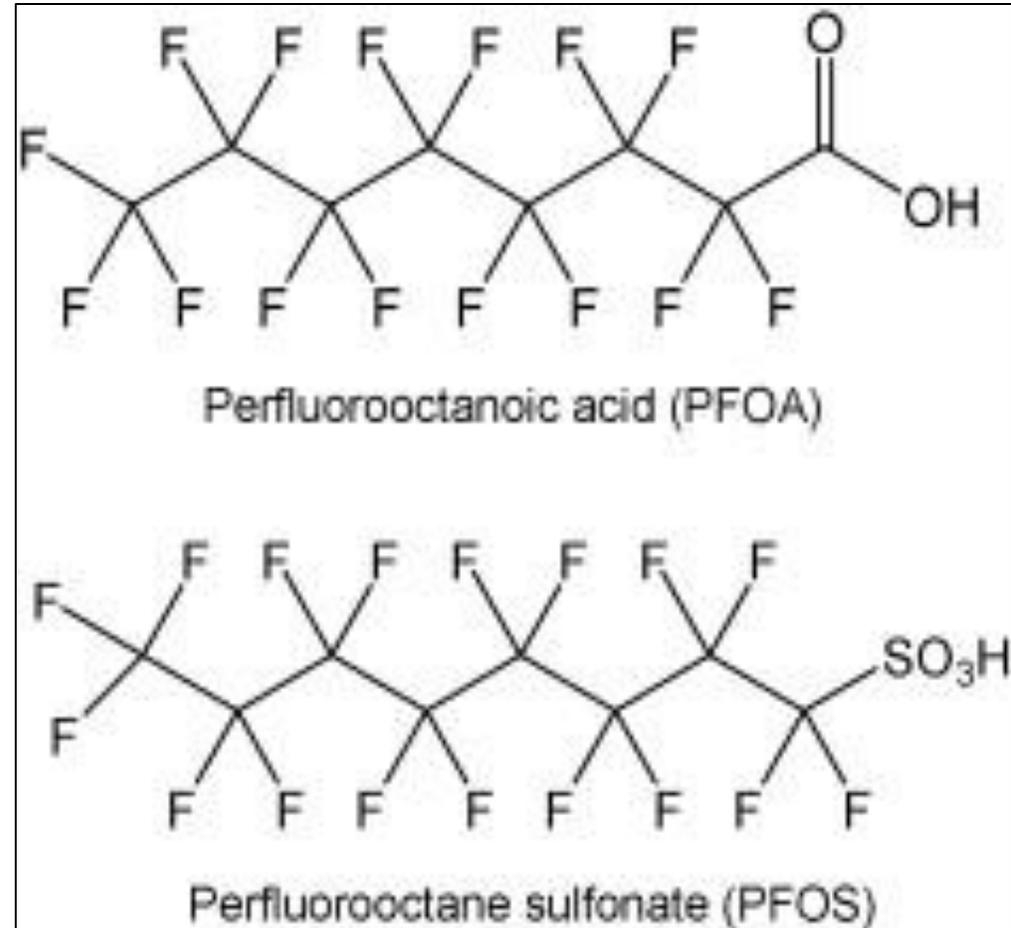


Figure from the Solid Waste Association of North America

PFOA & PFOS

- “Legacy” PFAS that have been used since the 1950s
- Have since been phased out of production in the United States (early 2000s)
- PFOA and PFOS are the two most common types of PFAS found in environmental samples
- Most research currently focuses on these two specific compounds
- Thought to be two of the most toxic and bioaccumulative PFAS compounds

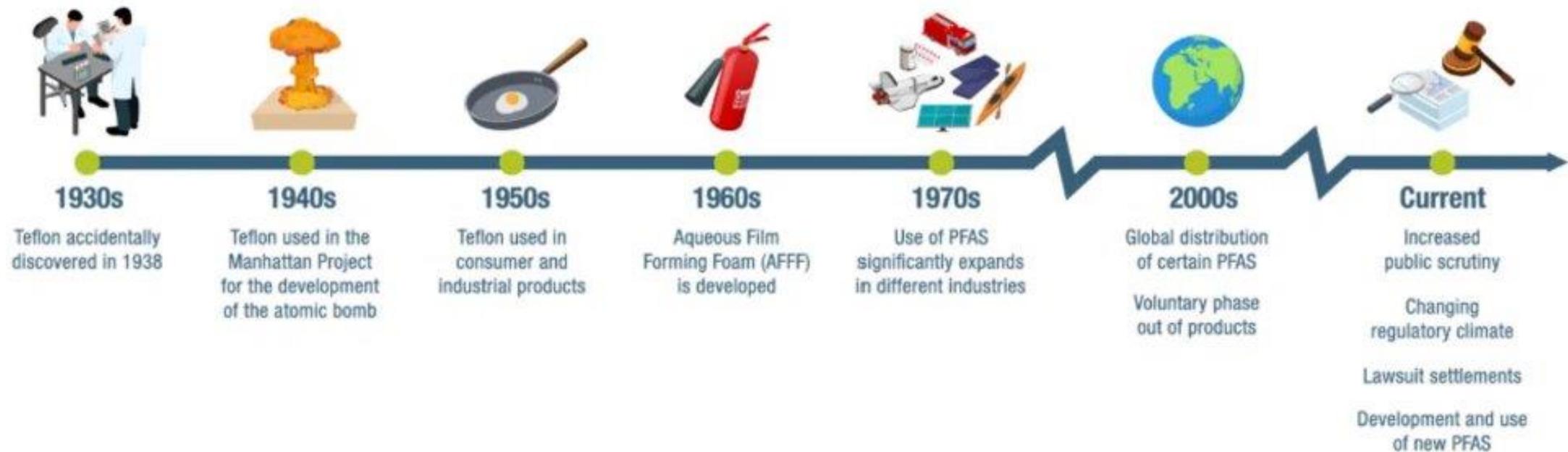


What Products Contain PFAS?



- Due to their oil- and water-resistant properties, PFAS are used in a wide range of products such as:
- Carpeting
- Waterproof clothing
- Waterproof/ greaseproof food packaging
- Cosmetics
- Metal plating
- Firefighting foams (AFFF)
- Non-stick cookware (ex: “Teflon” pans)

PFAS Timeline



Routes of Exposure



Drinking Water

- Water in states with little to no regulations on PFAS from municipal sources
- Private wells pulling from contaminated source



Food

- Fish/seafood in contaminated water bodies
- Food grown in contaminated soil or water
- Food packaging leaching PFAS

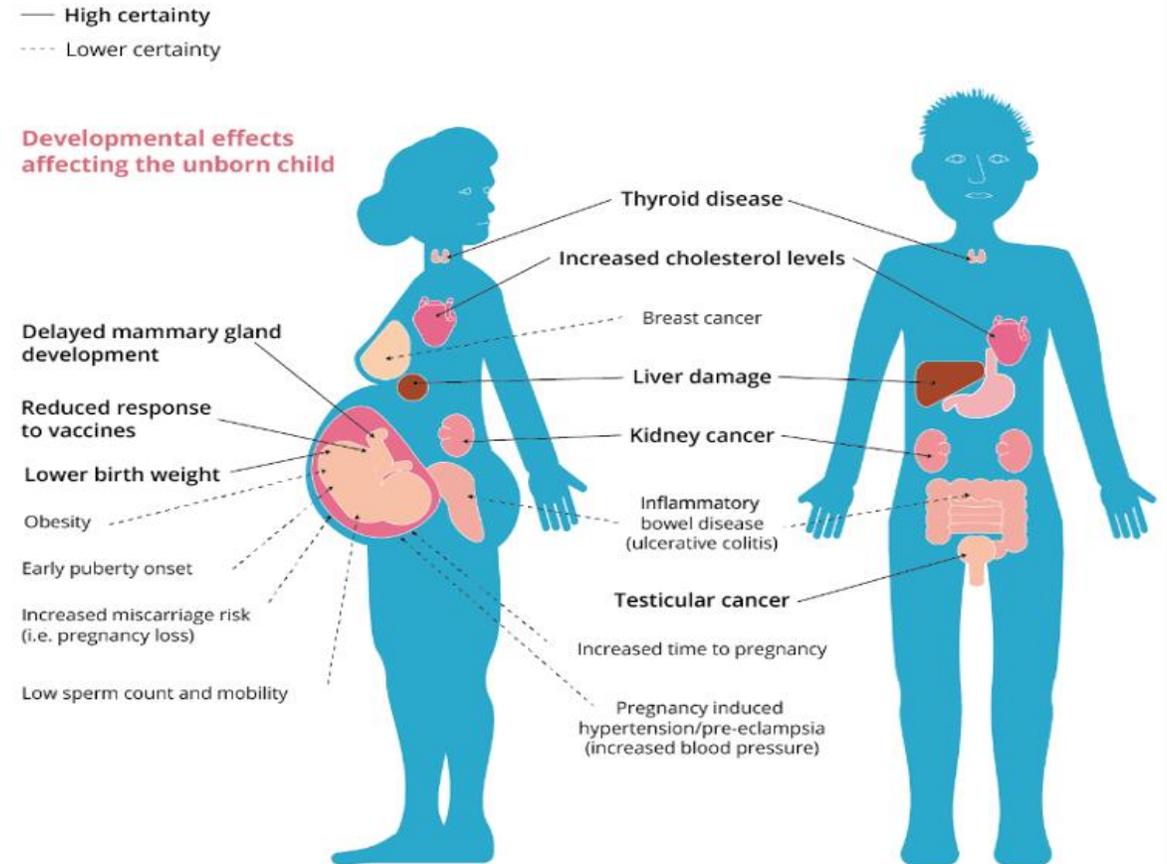


Occupational Exposure

- Firefighters
- Ski waxers
- Chemical manufacturing and processing workers

Health Effects

- An estimated 98% of people in the United States have detectable levels of PFAS in their blood (Lewis et al., 2015)
- These health outcomes are the result of high levels of exposure over long periods of time
- Being exposed to PFAS does not mean you will have an immediate health problem

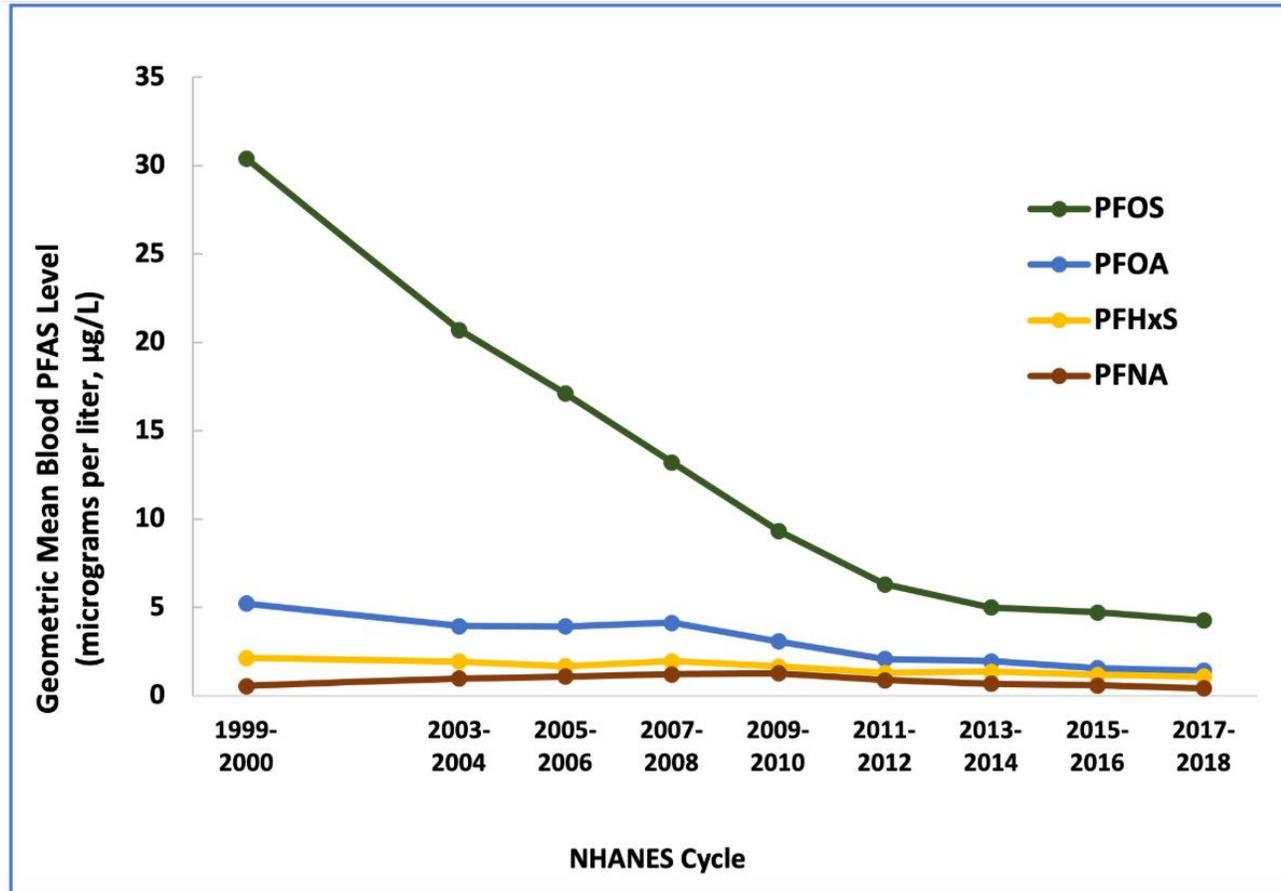


Half-lives in Humans

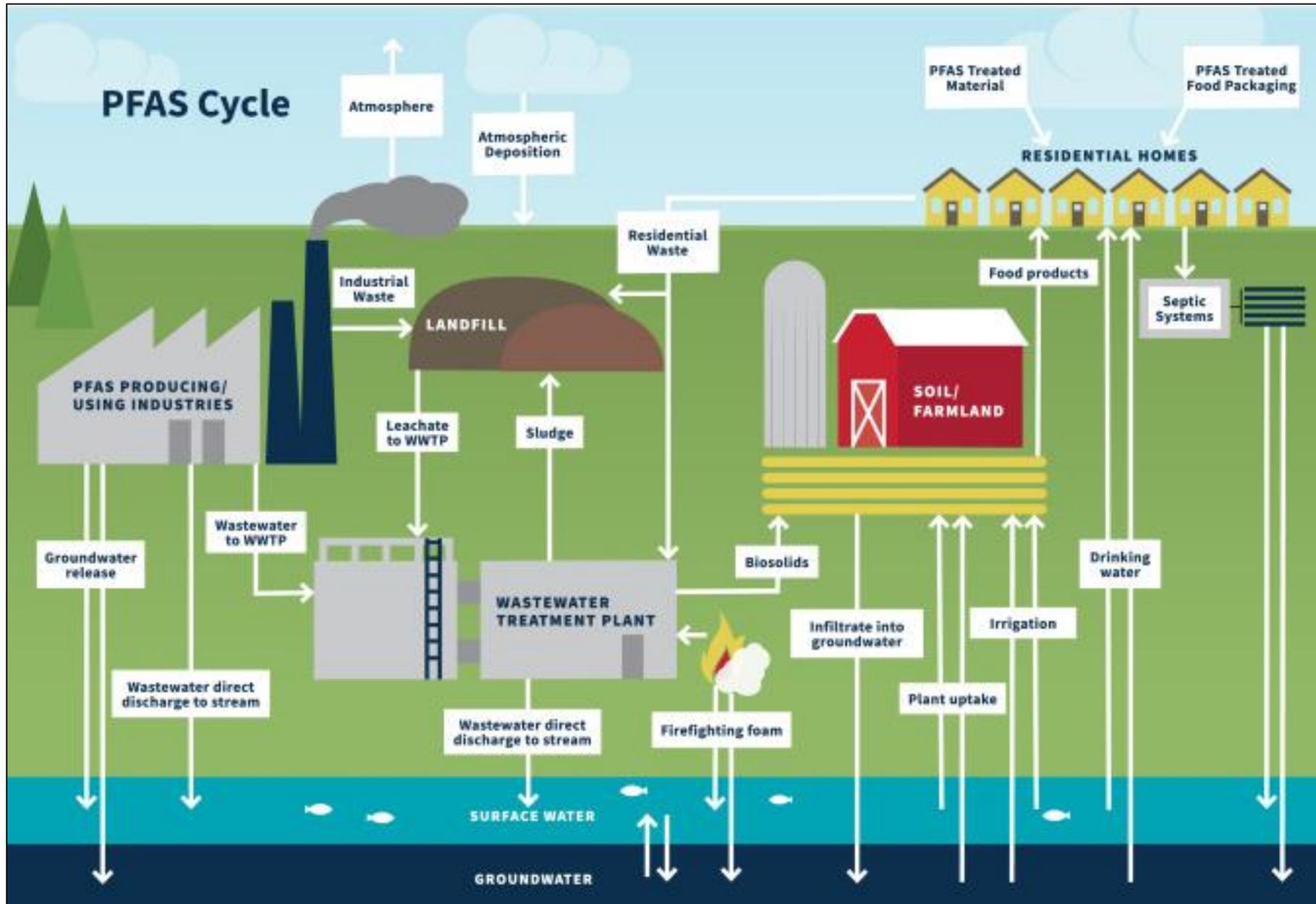
PFAS chemical	Chain length	Est. half-life in humans
PFBS	4	28 days
PFBA	4	3 days
PFHxS	6	5.3-8.5 yrs
PFHxA	6	32 days
PFOS	8	3.4-5.0 yrs
PFOA	8	2.1-3.8 yrs
F-53B	9	15.3 yrs

- Half-life: time it takes for half of a substance to clear from the body
- Half-lives of some PFAS are several years
- In general, half-lives increase with increasing chain length

NHANES Data



- Since 2002, production and use of PFOS and PFOA in the U.S. have declined
- Since then, PFOS and PFOA have declined in the blood of the general population
- Humans are still being exposed to emerging PFAS compounds as PFOS and PFOA are replaced



Units for PFAS Samples

1 ppm = 1mg/L



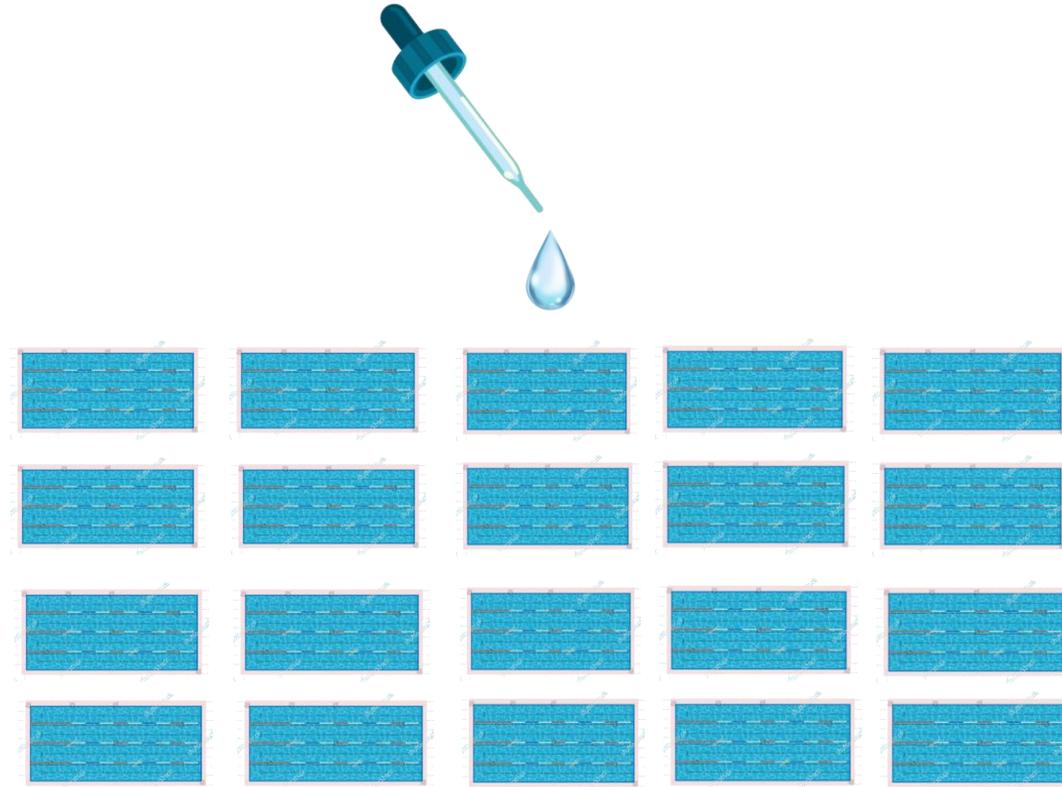
10-gallon aquarium

1 ppb = 1 μ g/L



10,000-gallon pool

1 ppt = 1ng/L



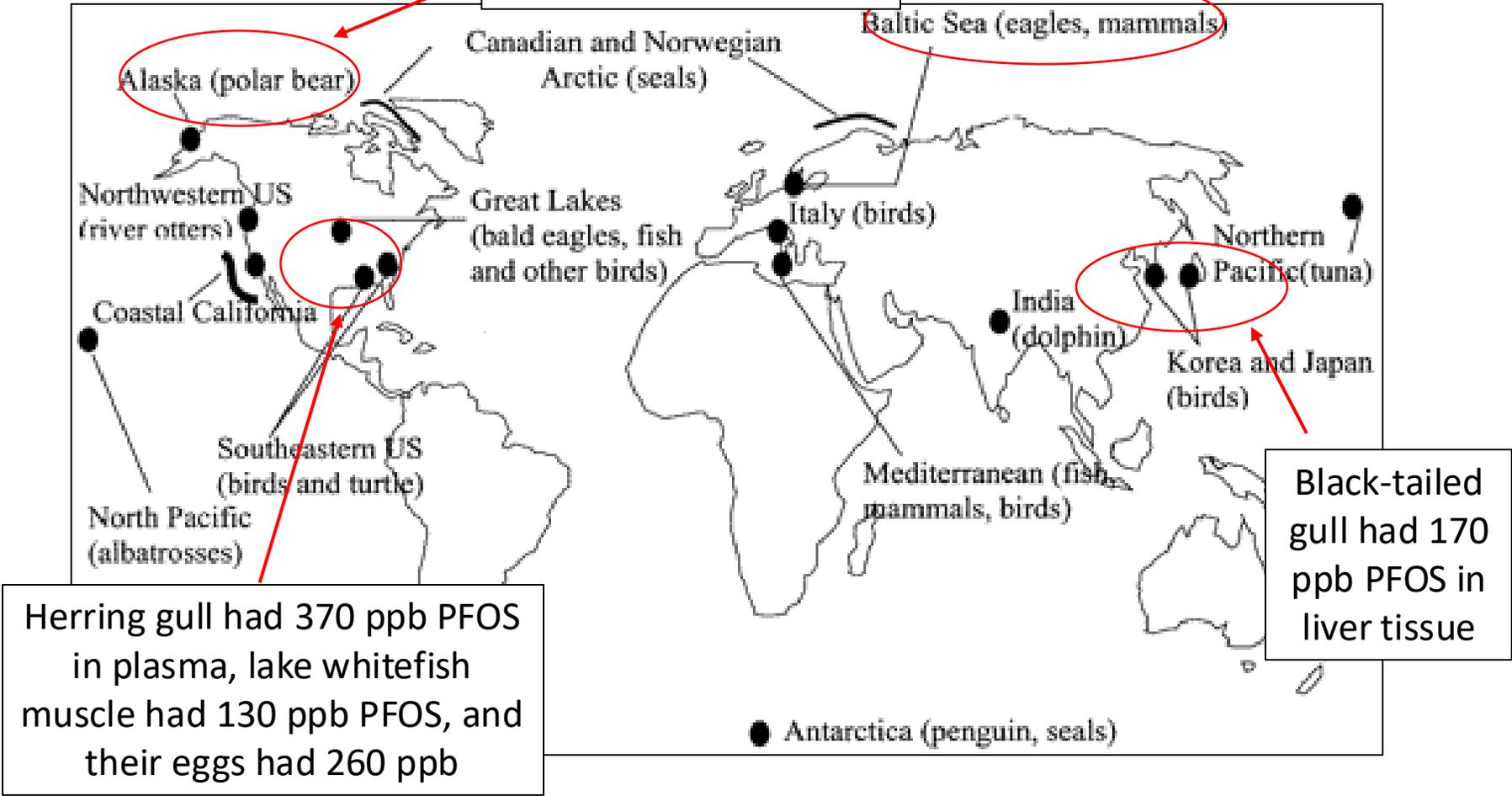
20 Olympic Swimming Pools

PFAS Around the World

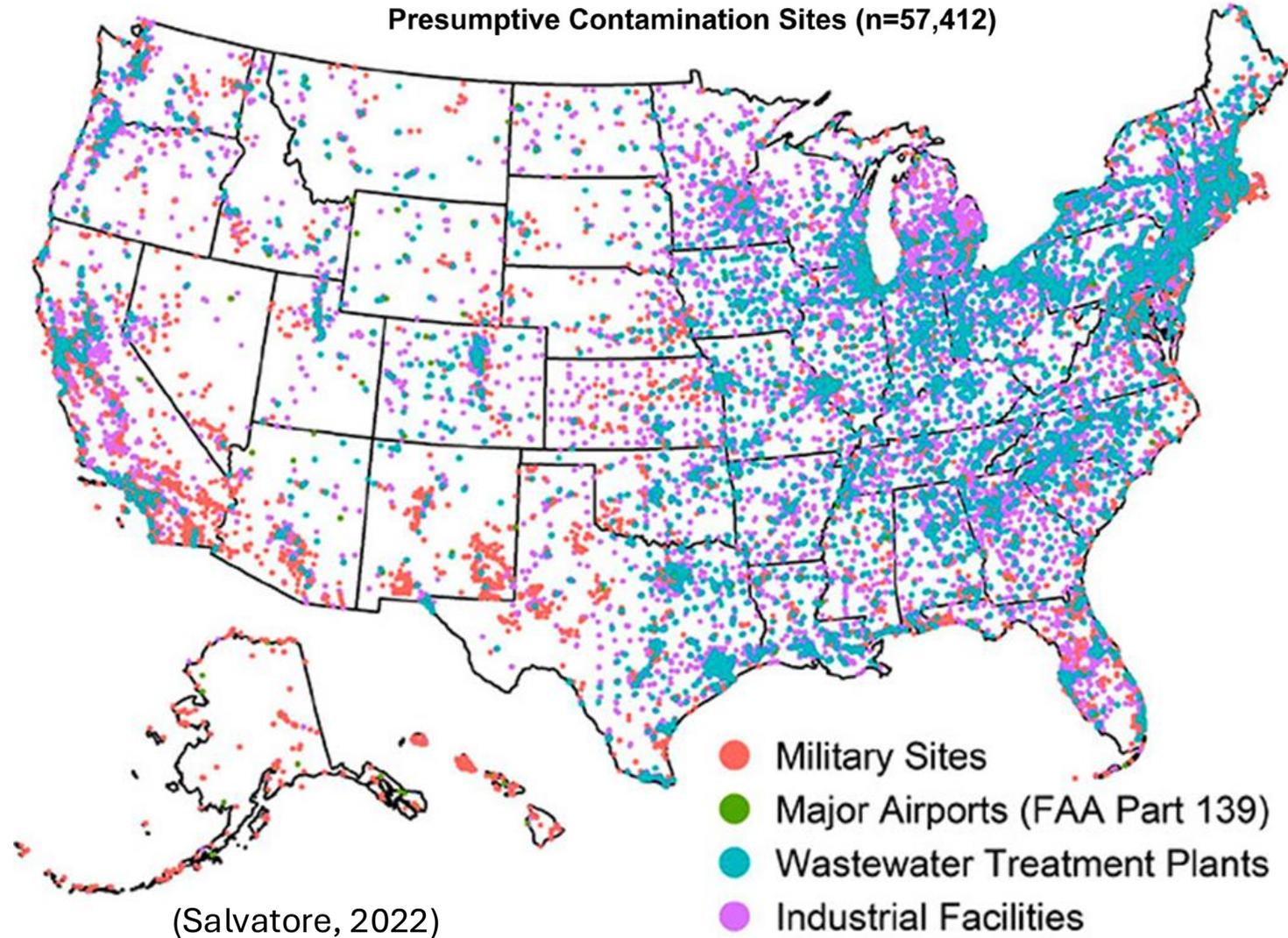
Polar Bear had 350 ppb PFOS in liver tissue

Ringed Seal had 110 ppb PFOS in blood plasma

- PFAS are found in water, air, wildlife, fish and humans across the globe
- Giesy and Kannan found PFAS at detectable levels in remote fish & wildlife (2001)

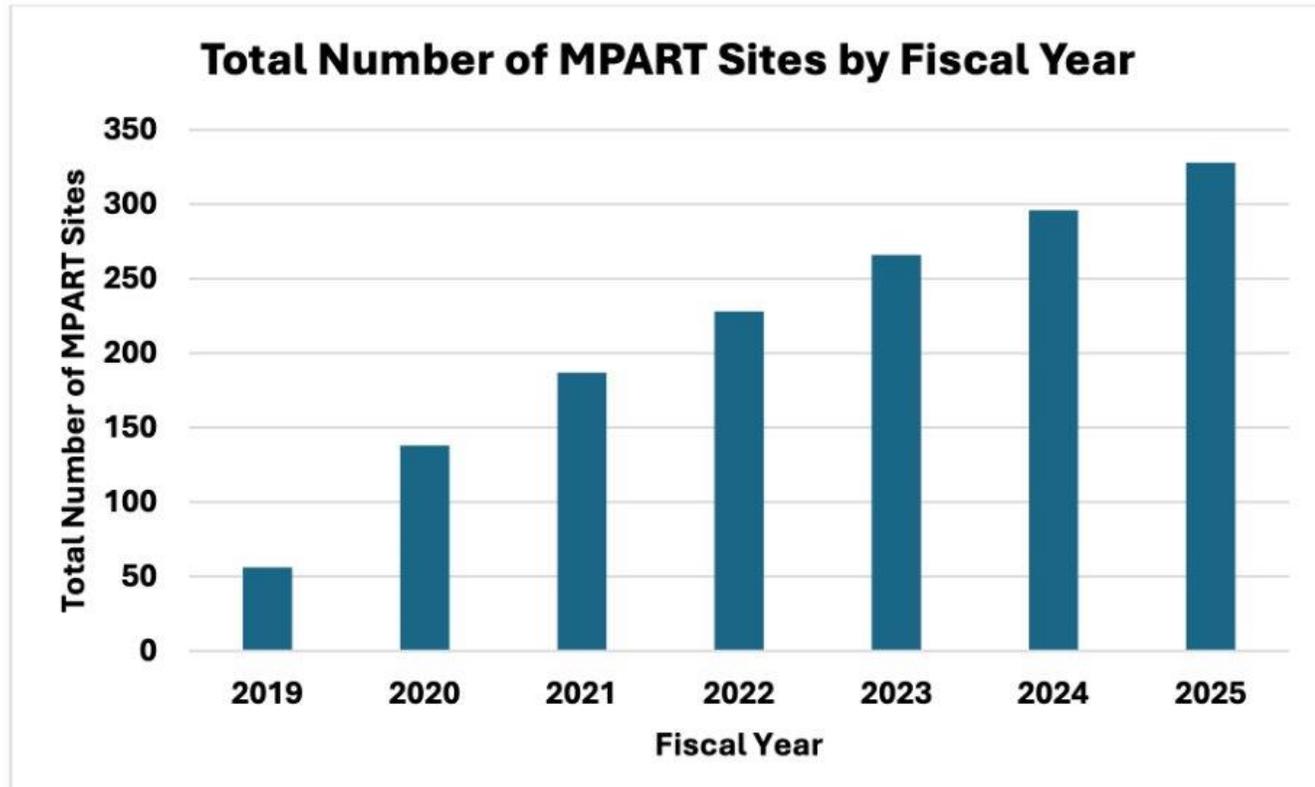


Types of Sites That May Be Contaminated

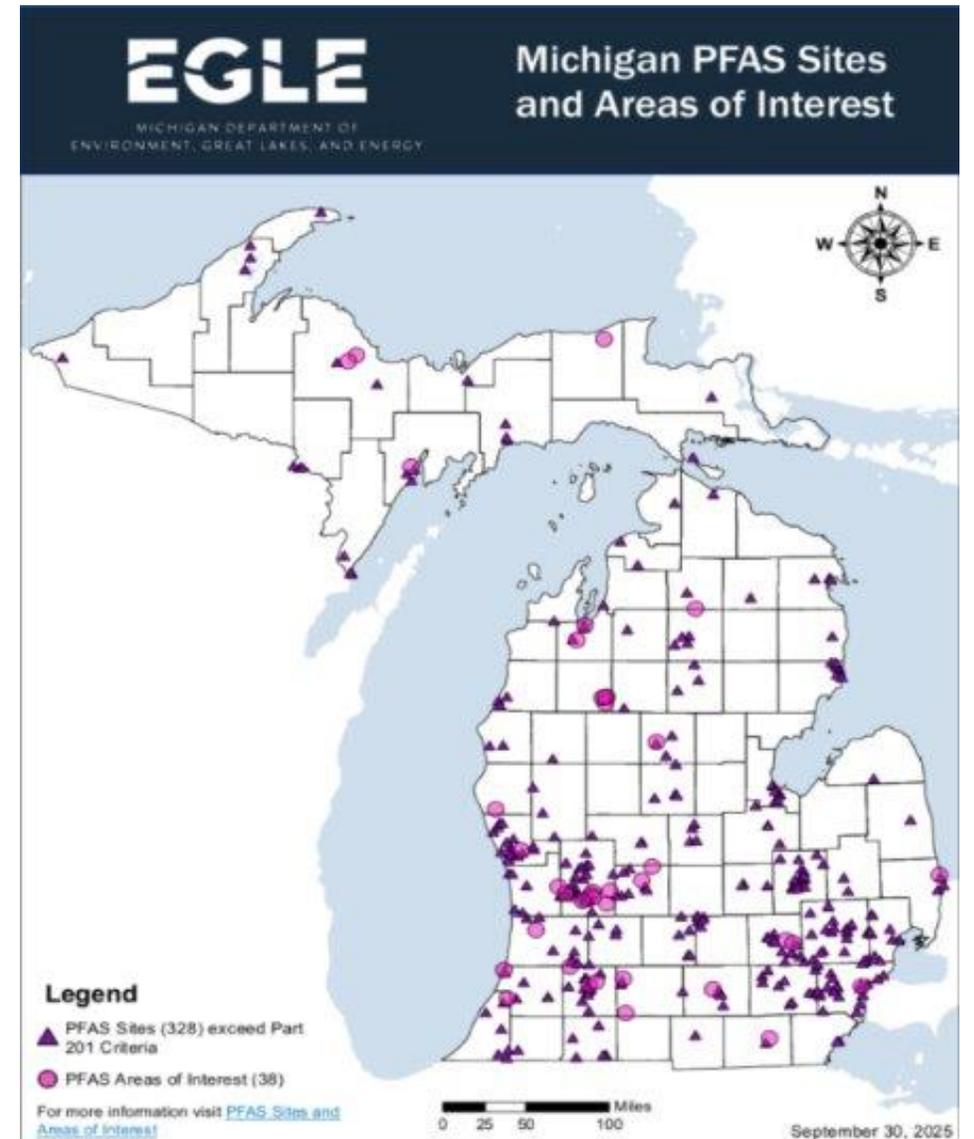


(Salvatore, 2022)

PFAS in Michigan

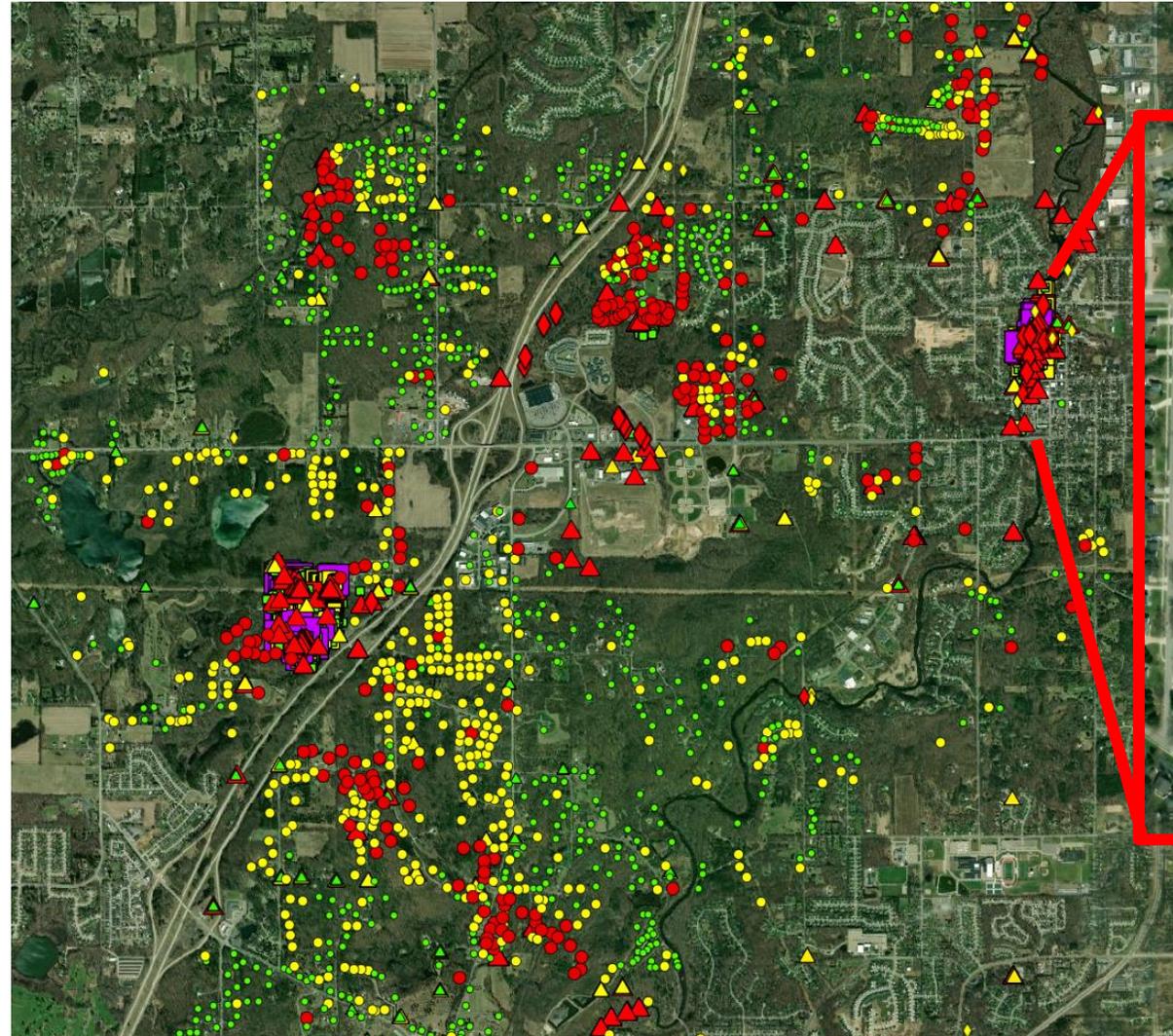


<https://egle.maps.arcgis.com/apps/webappviewer/index.html?id=bdec7880220d4ccf943aea13eba102db>



Major Contamination Sites Throughout MI

- North Kent Study Area
 - Residential Well Sample
 - EGLE Surface Water Samples
- PFOS
 - Wolverine Groundwater Samples
- No Detections of PFNA, PFOA, PFHxA, PFOS, PFHxS, PFBS, or HFPO-DA
 - No Detections of PFNA, PFOA, PFHxA, PFOS, PFHxS, PFBS, or HFPO-DA
 - One or more PFAS Analytes Detected Below Michigan Part 201 Drinking Water Criteria
 - One or more PFAS Analytes Detected Above Michigan Part 201 Drinking Water Criteria
- Wolverine Groundwater Samples
 - ▲ No Detections of PFNA, PFOA, PFHxA, PFOS, PFHxS, PFBS, or HFPO-DA
 - ▲ One or more PFAS Analytes Detected Below Michigan Part 201 Drinking Water Criteria
 - ▲ One or more PFAS Analytes Detected Above Michigan Part 201 Drinking Water Criteria
- PFOS
 - ◆ >12 ppt
 - ◆ >ND to 12 ppt
 - ◆ Non-Detect (ND)
- PFOS
 - Non-Detect (ND)
 - >ND to 250 ppb
 - >250 to 500 ppb
 - >500 ppb



Old Wolverine Tannery



Rockford, MI

Major Contamination Sites Throughout MI



Date: 3/6/2019

Imagery Date: 2010

Reference: Department of The Air Force, Directorate of Engineering & Services, Washington D.C., Strategic Air Command Comprehensive Plan, Base Layout, Small Scale, Wurtsmith Air Force Base, Oscoda, Michigan, FT. Dates 7-Nov-57, Dates 30-Aug-59, Base Comprehensive PLNG Directive AFR 86-4, Updated 1 May 91.

Base Boundary
Former Wurtsmith Air Force Base
 Oscoda, Michigan

MDERG-RAD-SUPERFUND
 Geology and Character
 Site Management CASE



Photo credit: Michigan Department of Environmental Quality

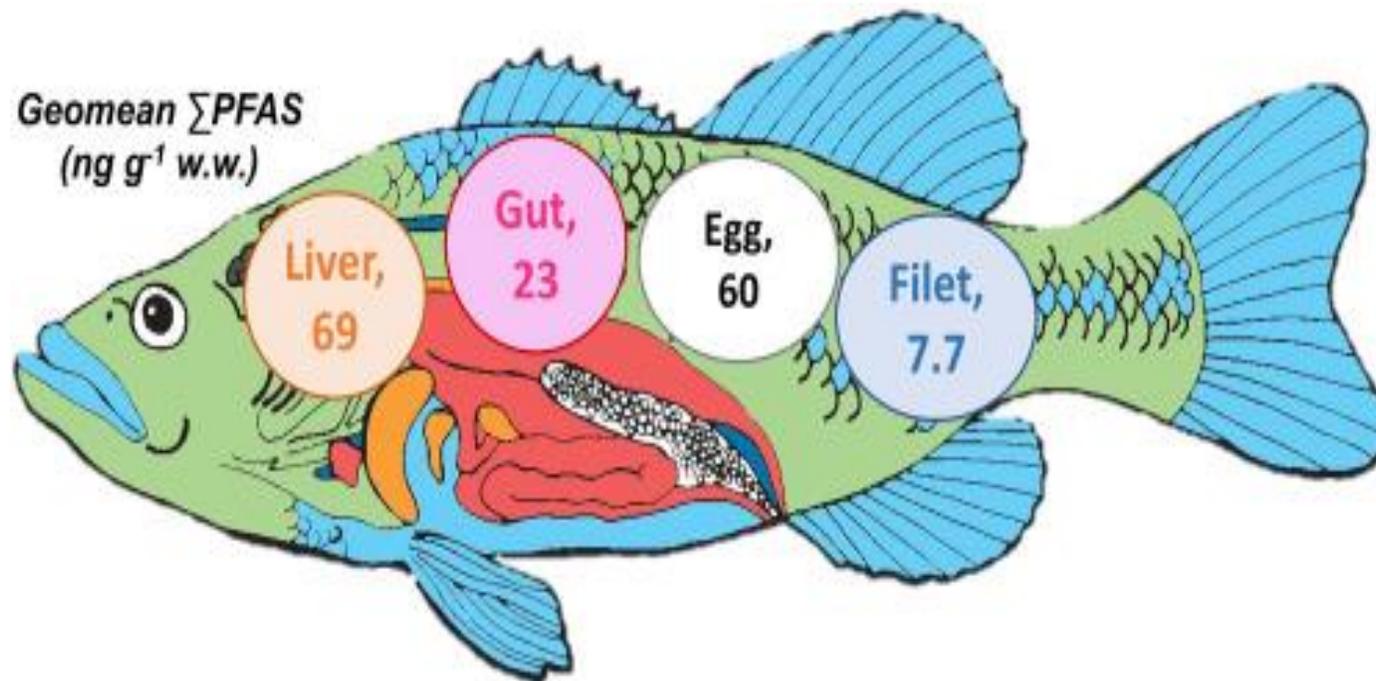
HEALTH ADVISORY

- Do not eat fish or wildlife from Clark's Marsh. High amounts of PFAS may be found in fish and wildlife and could be harmful to your health.
- Enjoy catch and release fishing.
- Foam on the Marsh may have high amounts of PFAS. Rinse off and wash hands to avoid swallowing PFAS.

For more information, call MDHHS at 800-648-6942 or visit Michigan.gov/PFASresponse.

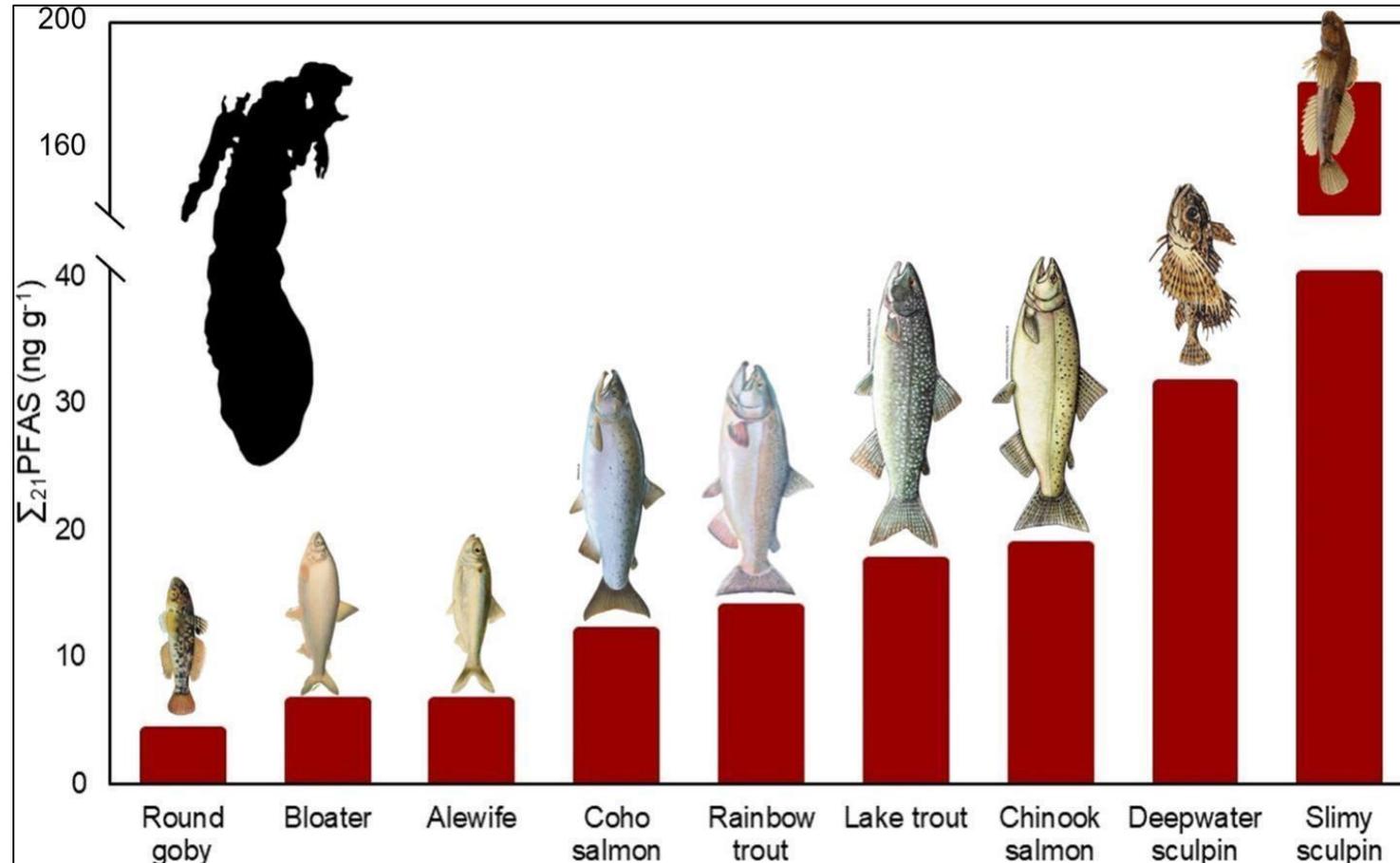
Oscoda, MI

PFAS in Fish & Wildlife



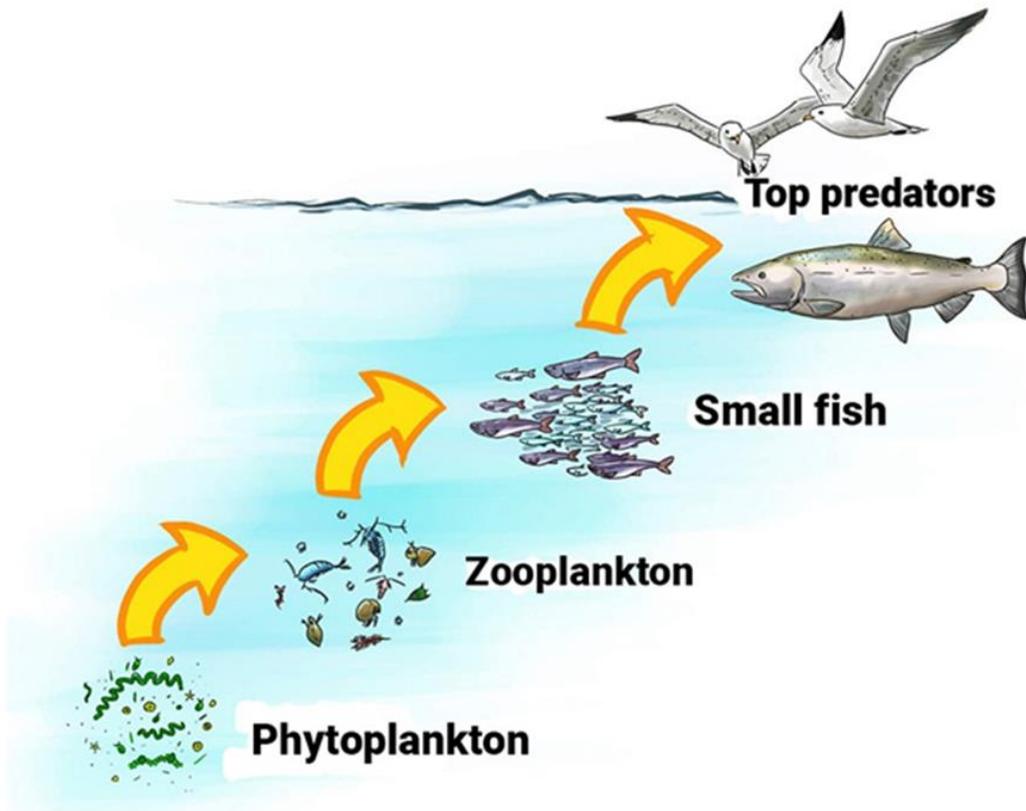
- PFAS typically accumulate at higher concentrations in the internal organs (like liver & kidneys) than in muscle tissue
 - True for many different animals (cattle, fish, deer, poultry, etc.)

PFAS in Fish & Wildlife



- Nine species collected across multiple locations in Lake Michigan (Miranda et al., 2023)
- PFOS was the most abundant PFAS in Lake Michigan fishes
- PFOA was observed in 97% of prey fish and 45% of predators
- High PFAS levels in specific fish likely related to their diet, habitat, movement patterns and physiology

PFAS in Fish & Wildlife



- Avian studies are useful indicators for broader wildlife and public-health risks of ecosystem contamination.
- More than 97% of herring gull eggs tested had measurable amounts of PFAS (Letcher et al, 2015).
 - Highest in eggs collected near Lake Michigan.
- The Game Commission is not a food advisory and there are not any Do Not Eat Advisories issued for wild birds or waterfowl yet.

PFAS in Fish & Wildlife

- Organs (like the liver and kidneys) of deer may contain higher concentrations of PFAS and other chemicals than the muscle
- MDHHS recommends that people do not eat the organs of any wild game statewide



PFAS RESPONSE

TAKING ACTION, PROTECTING MICHIGAN

HEALTH TESTING AND TREATMENT MICHIGAN PFAS SITES FISH AND WILDLIFE FIREFIGHTING FOAM ABOUT MPART

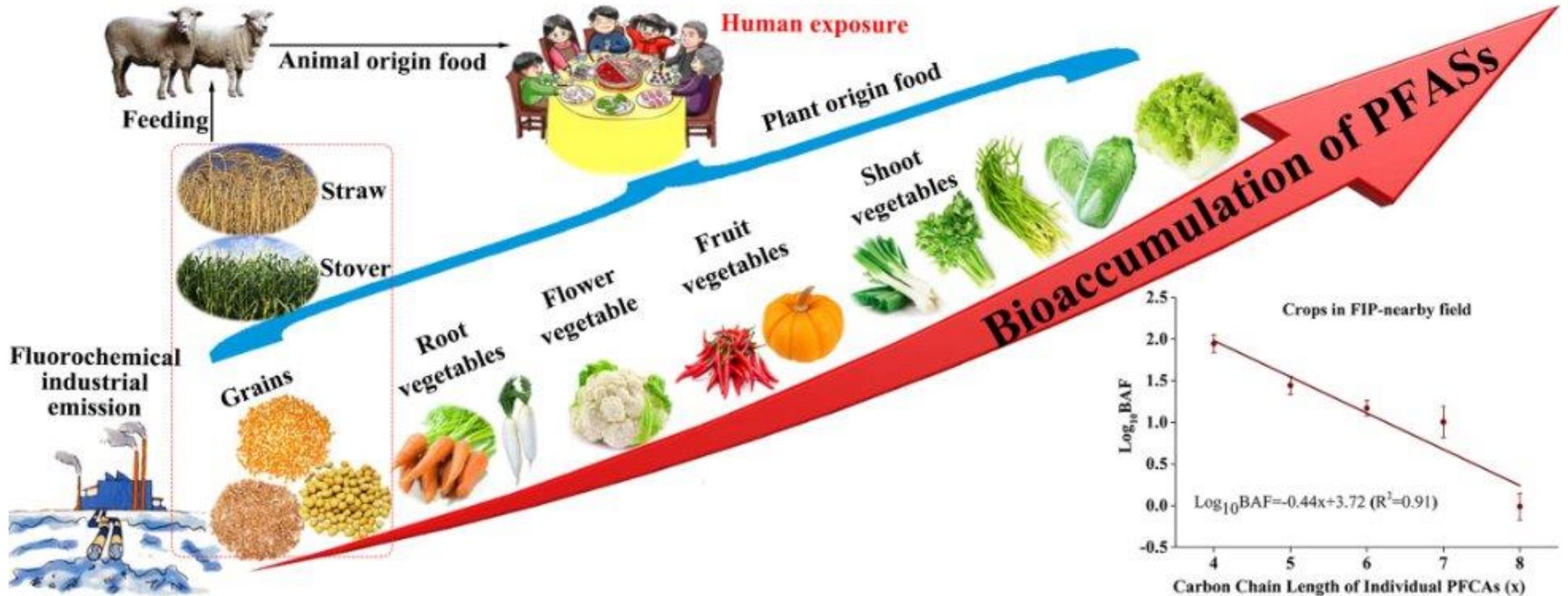
PFAS RESPONSE / FISH AND WILDLIFE

PFAS in Deer

[PFAS IN DEER FAQS >](#) [MAP OF ADVISORY AREA >](#)

As part of Michigan's efforts to identify PFAS in Michigan, deer were tested from areas known to have PFAS contamination in lakes or rivers. In October of 2018, MDHHS and DNR issued a 'Do Not Eat' advisory for deer taken within five miles of Clark's Marsh in Oscoda Township. The advisory is due to high levels of PFAS chemicals found in deer taken within five miles of the Marsh.

PFAS in Crops



PFAS Information for Home Gardeners

- Test water used for gardening for PFAS
 - If there are detections, use filters to remove PFAS prior to watering your garden
- Avoid growing leafy greens if you know there is contamination in soil or water
- Ask if fertilizers, pesticides, or soil amendments have been tested for PFAS
- Avoid using materials in your garden that may contain pfas



Research Articles

Analysis of per- and polyfluoroalkyl substances (PFAS) in the US meat, poultry, catfish, and eggs

Yelena Sapozhnikova  & Kevin Stroski

Pages 1121-1129 | Received 12 May 2025, Accepted 14 Jul 2025, Published online: 25 Jul 2025

 Cite this article  <https://doi.org/10.1080/19440049.2025.2536262>



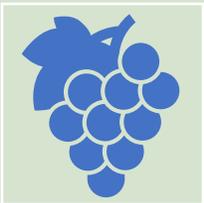
- 86 grocery samples in Philadelphia
- Tested for 74 PFAS (MDL 0.002-8 ng/g)
- No PFAS detected in eggs, chicken, pork
- PFOS found in 25% beef samples (5/20 samples)
 - 0.057-0.145 ng/g or ppb
- Catfish -12 different PFAS detections totaling 1.8 ppb

“Detection of PFAS precursors highlights the need to include these PFAS in future monitoring efforts.”

FDA Total Diet Study



Since 2019, the FDA has collected food samples from across the United States to analyze for PFAS



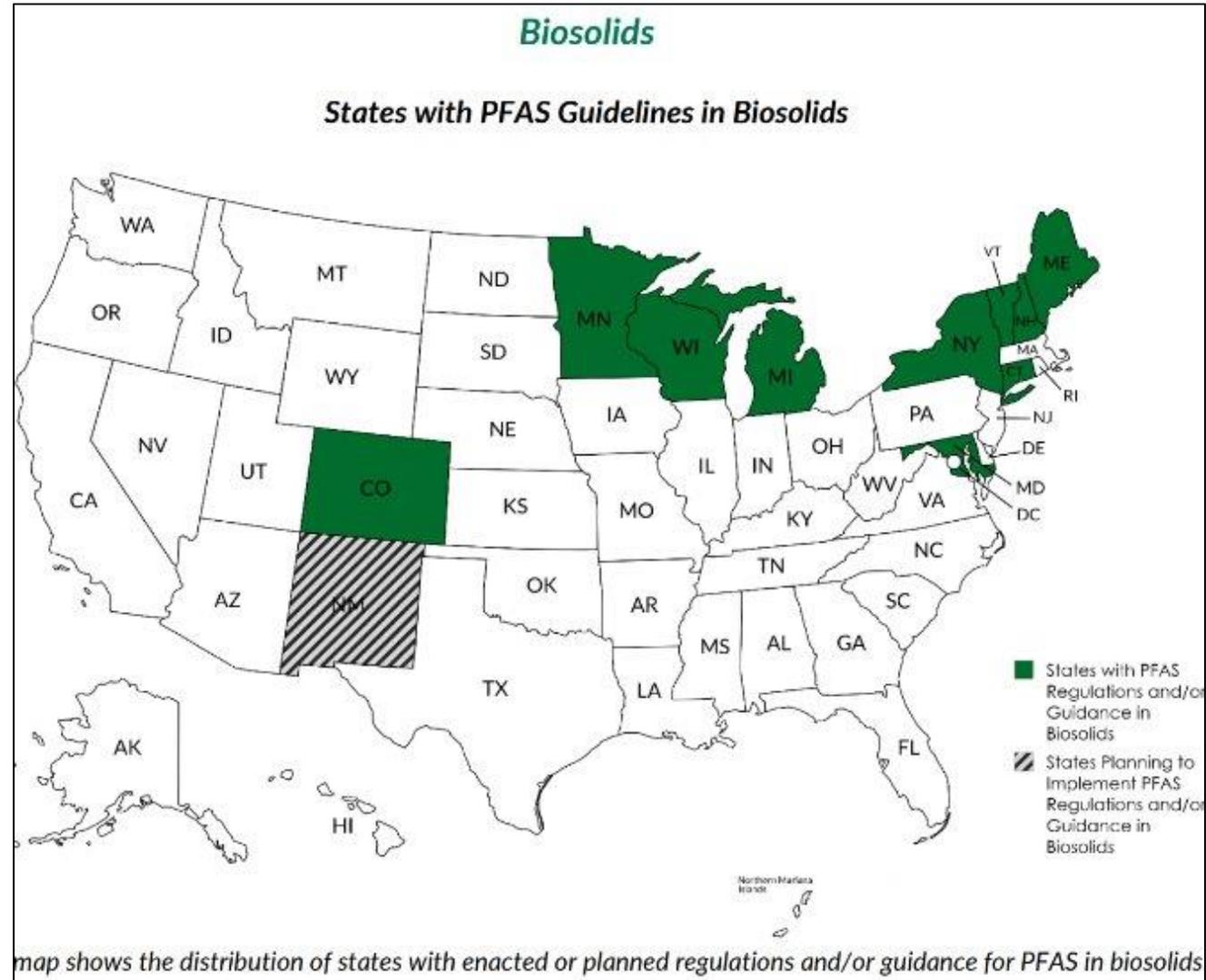
The results help the FDA to identify foods that may be at a higher risk for PFAS contamination



FDA Total Diet Study

- Overall, most foods were non-detect
- 2019
 - Regional sampling with 3/179 showing detections (ground turkey & tilapia)
- 2021
 - Regional sampling with 17/464 showing detections (cod, tilapia, shrimp, salmon, beef & catfish)
- 2024
 - Regional Sampling with 39/542 showing detections (pepperoni, cod, shrimp, tilapia, half & half, beef steak, catfish, ground beef, whole milk, skim milk, kale, clams & chicken breast)
- 2021
 - National sampling with 3/167 showing detections (fish sticks, tuna, protein powder)

Biosolids Guidance Across the United States



Michigan Drinking Water Standards

- *In 2020, EGLE established maximum containment levels (MCLs) for seven PFAS*
- *These apply to ~2,700 **public** drinking water supplies in Michigan*
- *If you have a well, testing and filtration is your responsibility*
- *Compliance is determined based off of the average sample results each year*
- *If levels are above the MCL values, they must treat the water to reduce levels, do additional testing and give public notice*

Specific PFAS	Drinking water MCL (ppt)
PFNA	6 ppt
PFOA	8 ppt
PFHxA	400,000 ppt
PFOS	16 ppt
PFHxS	51 ppt
PFBS	420 ppt
HFPO-DA	370 ppt

ppt = parts per trillion

National Efforts in Drinking Water

- In April 2024, the EPA:
 - Finalized the first-ever national, legally enforceable drinking water standards for PFAS
 - Maximum Contaminant Levels (MCLs) set at 4 ppt for PFOS and PFOA
 - Designated PFOS and PFOA as hazardous substances
- Some states already had their own standards
 - Others have been waiting for federal guidance



PFAS Use and Labeling

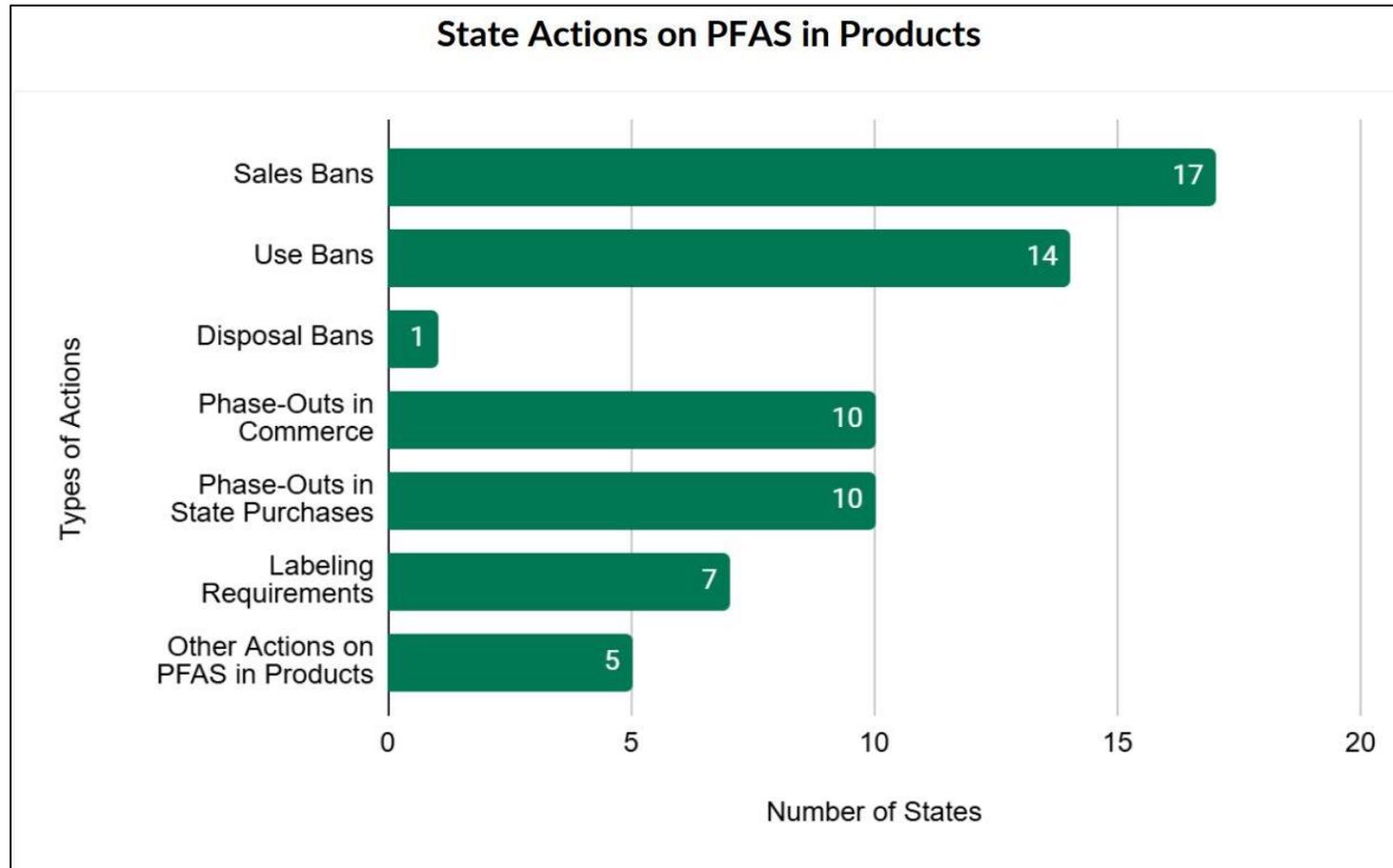


Figure is from the Environmental Council of the States- April 2025

- 27 states reported that they are aware of industries or specific companies that have taken steps to reduce or eliminate PFAS use in products in their state
- Michigan has an executive directive aimed at reducing state purchases with intentionally-added PFAS

Food Safety Regulations

- There are no food safety standards in the US for PFAS in food
- Maine has created action levels for PFAS in beef, chicken eggs, fish and milk (for PFOS only)
- EU has regulatory levels for four PFAS compounds in meats (poultry, pigs, cattle, etc.), eggs, and offal (internal organs)
 - Lower concentrations than Maine
 - Also have investigative levels for milk, fruits, vegetables, starchy roots and tubers, wild fungi, baby food



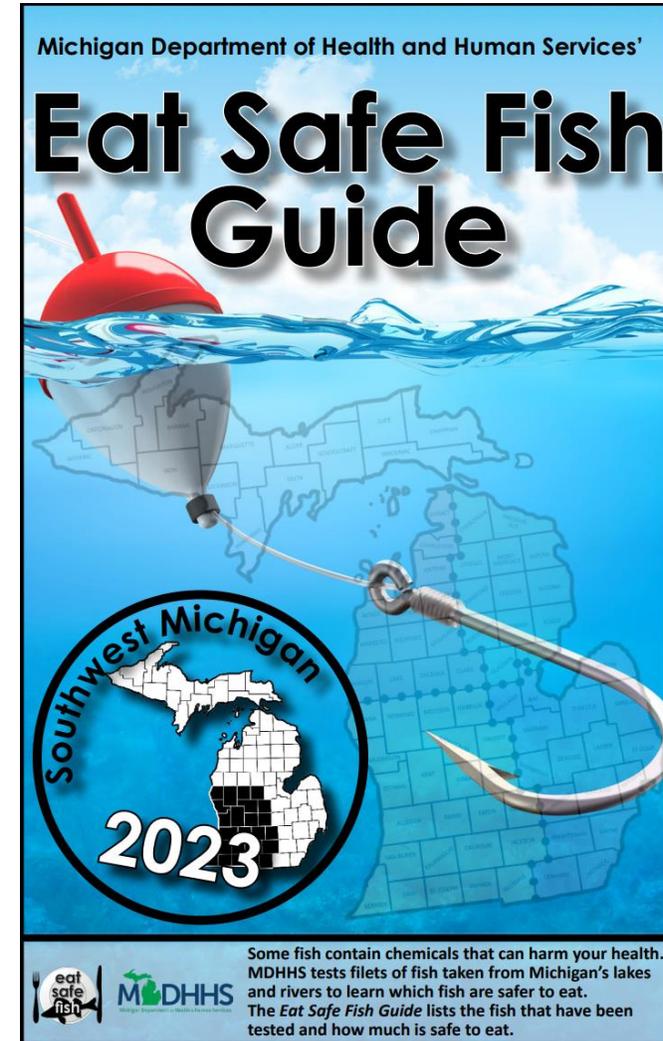
Reducing Personal Exposure

Lake Lansing

Type of Fish	Chemicals of Concern	Size of Fish (length in inches)	MI Servings per Month*
Black Crappie	Mercury	Under 9"	4
		Over 9"	2
Bluegill	PFOS	Any	6 Per Year
Largemouth Bass	Mercury	Under 18"	2
		Over 18"	1
Smallmouth Bass	Mercury	Under 18"	2
		Over 18"	1
Sunfish	PFOS	Any	6 Per Year
White Crappie	Mercury	Under 9"	4
		Over 9"	2

PFOS can't be reduced by trimming and cooking. Do not double MI Servings.

<https://www.michigan.gov/mdhhs/safety-injury-prev/environmental-health/topics/eatsafefish/guides>



Michigan Department of Health and Human Services'

Eat Safe Fish Guide

Southwest Michigan

2023

Some fish contain chemicals that can harm your health. MDHHS tests filets of fish taken from Michigan's lakes and rivers to learn which fish are safer to eat. The *Eat Safe Fish Guide* lists the fish that have been tested and how much is safe to eat.

eat safe fish | MDHHS

Reducing Personal Exposure

- Private well owners should test drinking water for PFAS
- If detections exceed Michigan's maximum contaminant levels (MCLs), use a filter to remove PFAS from water
 - Granular activated carbon (GAC)
 - Reverse osmosis (RO)
 - <https://www.michigan.gov/pfasresponse/-/media/Project/Websites/PFAS-Response/Drinking-Water/PFAS-Filter-Fact-Sheet.pdf>
- Labs that analyze samples for PFAS (\$200-\$400 / sample)
 - https://docs.google.com/spreadsheets/d/e/2PACX-1vQ1OrR0C_kTqzNZ7uL5oz5dvKfcMZjvnujxb0b7hIWtS7reX0YiE5vxFIYFXK6HgvOCF8UX8wJ-YVuH/pubhtml
- Cyclopure home test kit (\$79 / sample)
 - <https://cyclopure.com/product/water-test-kit-pfas/>



TIPS FOR COLLECTING WATER SAMPLES FOR PFAS ANALYSIS

PFAS are used in a variety of different products we use everyday. It is important to understand how to avoid cross contamination when collecting and handling samples intended for PFAS analysis.



WASH HANDS AND WEAR POWDERLESS NITRILE GLOVES

Make sure to use PFAS-free hand soap to wash hands thoroughly and then put on powderless nitrile gloves. PFAS contamination during sampling can occur from a number of common sources, such as food packaging, clothing, dust, personal care products, and certain foods and beverages. Replace gloves if they come in contact with anything that may contain PFAS. Proper hand washing and glove use will minimize accidental contamination of samples.

ENSURE RESULTS REPRESENT THE WATER SOURCE ITSELF

It is recommended that water is flushed from the faucet/ spigot until the water temperature stabilizes prior to sample collection (this may take several minutes) and that samples are collected from the location that is closest to the well. These recommendations help to identify if the water source itself is contaminated without interference from plumbing infrastructure that may contain PFAS.



MINIMIZE THE USE OF THESE PRODUCTS

Avoid using synthetic water-resistant and/or stain-resistant materials (e.g., Gore-Tex™, Scotchgard™, etc.) cosmetics, moisturizers, sun-blocks, insect repellants, fragrances, creams, Teflon® and other fluoropolymer-containing materials, paper packaging for food, new or unwashed clothing, clothing washed with fabric softeners, or waterproof notebooks. Do not use markers other than Fine or Ultra-Fine point Sharpies®, which are PFAS-free.



KEEP SAMPLE BOTTLE CLOSED BEFORE AND AFTER COLLECTION

To avoid cross contamination, avoid any contact with the inside of the lid/cap. After filling the container, cover the sample with the lid or cap immediately. Be cautious of activities like vacuuming, cooking, applying personal care products, using plug-in air fresheners, etc. while collecting samples. Make sure to use the correct sample bottle, write with legible handwriting, and follow all instructions provided by the laboratory or supplier of your test kit to ensure accurate results.

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES AND ENERGY'S SAMPLING GUIDE

Scan this QR code or visit <https://www.michigan.gov/pfasresponse/-/media/Project/Websites/PFAS-Response/Sampling-Guidance/Residential-Well-Technical.pdf?rev=1d6315e9c2864574a0db900499c9da56> for a full guide on how to collect water samples for PFAS analysis.




LABORATORIES IN MICHIGAN THAT DO PFAS TESTING

Scan this QR code or visit <https://docs.google.com/spreadsheets/d/1N1g-a717-dgY6V0rB56GMBRp0KHtk7mwEM0edHzt90Y/edit?usp=sharing> for a full list of laboratories that analyze samples for PFAS compounds.




For more information, contact Faith Cullens-Nobis (cullensf@msu.edu) or Katie King (kingka22@msu.edu).

Michigan State University Extension programs and materials are open to all without regard to race, color, national origin, gender, gender identity, religion, age, height, weight, disability, political beliefs, sexual orientation, marital status, family status or veteran status.

Reducing Personal Exposure

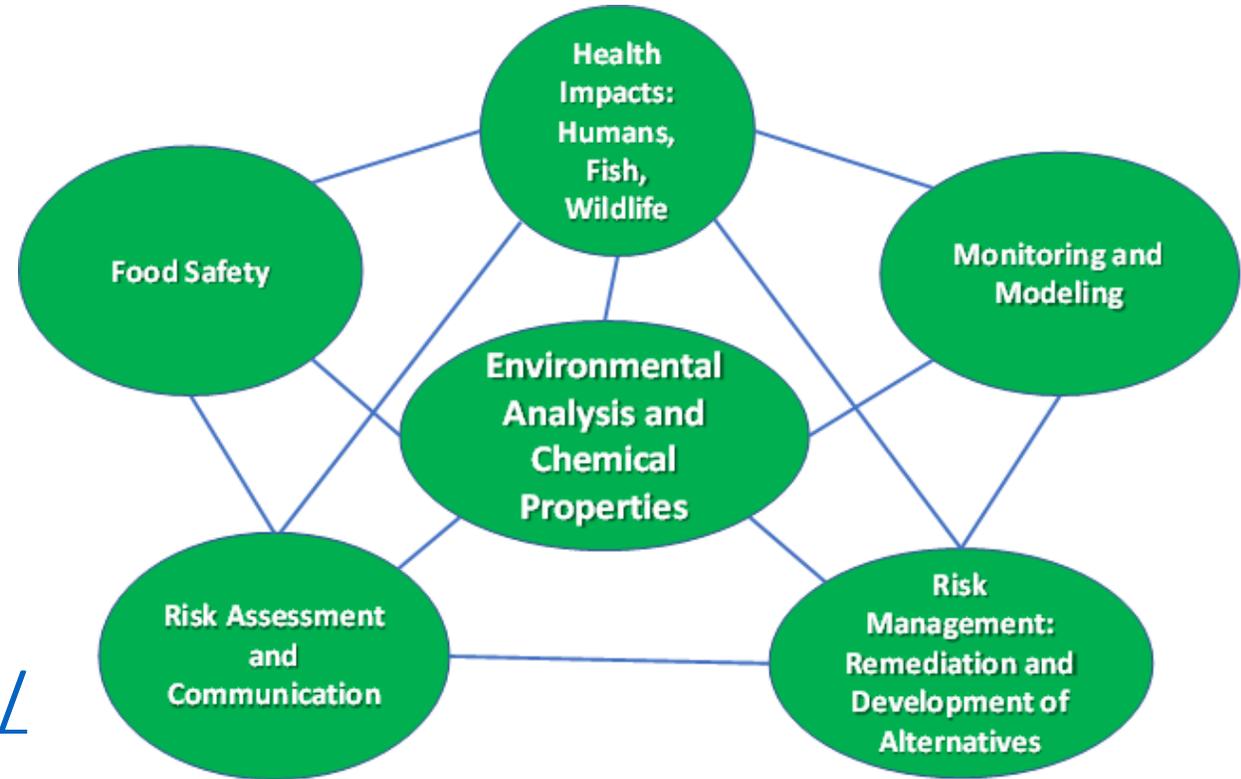
- Purchase PFAS-free products
 - Can be difficult due to labeling
 - Some products will say "PFOS free" or "PFOA free" but may contain other PFAS compounds
 - Excellent resource for finding PFAS free products
 - <https://www.mass.gov/news/pfas-free-buying-guide>

Screenshot of PFAS Free Buying Guide

Products That May Contain PFAS	What to Ask Your Vendors	LOGO of the Third-Party Certification or Standard
<p>Cleaning Chemicals, such as cleaners and degreasers for appliances, carpet and floors, counters and other surfaces, glass, restrooms, toilet bowls, and vehicles, as well as furniture and metal polish</p>	<p>Ask vendors for cleaning products that are certified by:</p> <ul style="list-style-type: none"> • Green Seal, which eliminated all cleaning and personal care products with PFAS from its certified directory in 2022; or • US EPA's Safer Choice Program, which never allowed PFAS as ingredients in its certified products, except for floor finishes. In addition, PFAS are no longer eligible for use in any Safer Choice-certified products. <p>Note: UL is in the process of updating its ECOLOGO standard for cleaning chemicals and may prohibit PFAS in its certified cleaners when it does so.</p>	 

PFAS Research at Michigan State University

- *MSU Center for PFAS Research*
- *50+ faculty members*
- *Research initiatives:*
 - *Agriculture*
 - *Great Lakes and water*
 - *One Health*
 - *Remediation*
- www.canr.msu.edu/pfas-research/



MSU Working Directly With Farmers



- *Our goal is to help farmers looking to test their land or learn more about PFAS*
- *We have some funding from MDARD available to conduct soil and water sampling on farms*
 - *Potentially funding for mitigation*
- *We work with*
 - *Farms that come to us*
 - *Farms that have been identified for potential risk*
- *So far, we have:*
 - *Initiated conversations about potential risk with multiple farmers*
 - *Conducted soil and water sampling at several farms*

The goal is to help farms determine contamination levels, assess risk, and provide mitigation strategies to [KEEP FARMS IN BUSINESS](#) and produce a safe product!

PFAS IN AGRICULTURE WEBINAR SERIES 2026

Register for this free webinar series to get your questions answered about PFAS in agriculture.



TUESDAY, MARCH 17TH



Introduction to PFAS in Agriculture

THURSDAY, MARCH 19TH



PFAS in Crops (Row Crops and Produce)

TUESDAY, MARCH 24TH



PFAS in Livestock

THURSDAY, MARCH 26TH



PFAS in Biosolids and Septage



TUESDAYS & THURSDAYS FROM 10-11 AM



FEATURED SPEAKERS

Faith Cullens Nobis- MSU Extension

Katie King- MSU Center for PFAS Research

Marcus Wasilevich- Michigan Department of Agriculture and Rural Development



CULLENSF@MSU.EDU

Contact Faith with any specific questions you would like to have answered in this series.



ZOOM (REGISTER BELOW)



<https://events.anr.msu.edu/PFASinAg/>

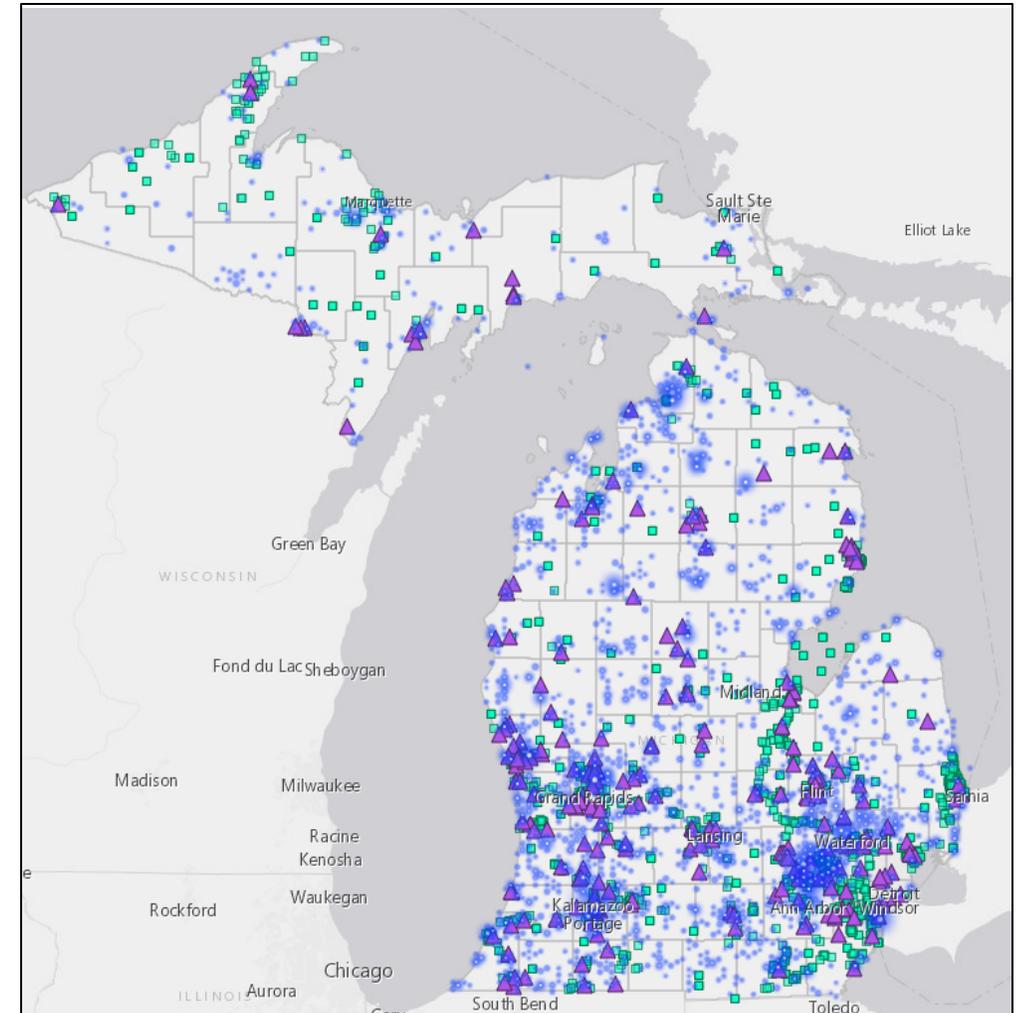
CAN'T MAKE IT?

Zoom recordings will be available on our website:

<https://www.canr.msu.edu/pfas/resources>

Resources

- *MSU Center for PFAS Research*
 - <https://www.canr.msu.edu/pfas-research/>
 - *Keep up to date on PFAS Research at MSU and upcoming events and webinars*
- *MSU Extension*
 - <https://www.canr.msu.edu/pfas/pfas-research>
- *Michigan PFAS Action Response Team*
 - <https://www.michigan.gov/pfasresponse>
 - *Interagency collaboration to deal with PFAS contamination in Michigan*
- *PFAS and Agriculture Policy Workgroup*
 - <https://farmland.org/pfas>
- *MPART PFAS Map*
 - [MPART: PFAS Geographic Information System](#)





Rachel Leads
Postdoctoral Scholar
Department of Fisheries and Wildlife
leadsra1@msu.edu

Katie King
PFAS Outreach Specialist
Center for PFAS Research
kingka22@msu.edu

Deil Manlicic
PhD Candidate
Department of Fisheries and Wildlife
manlicli@msu.edu