



# PFAS in Livestock Systems



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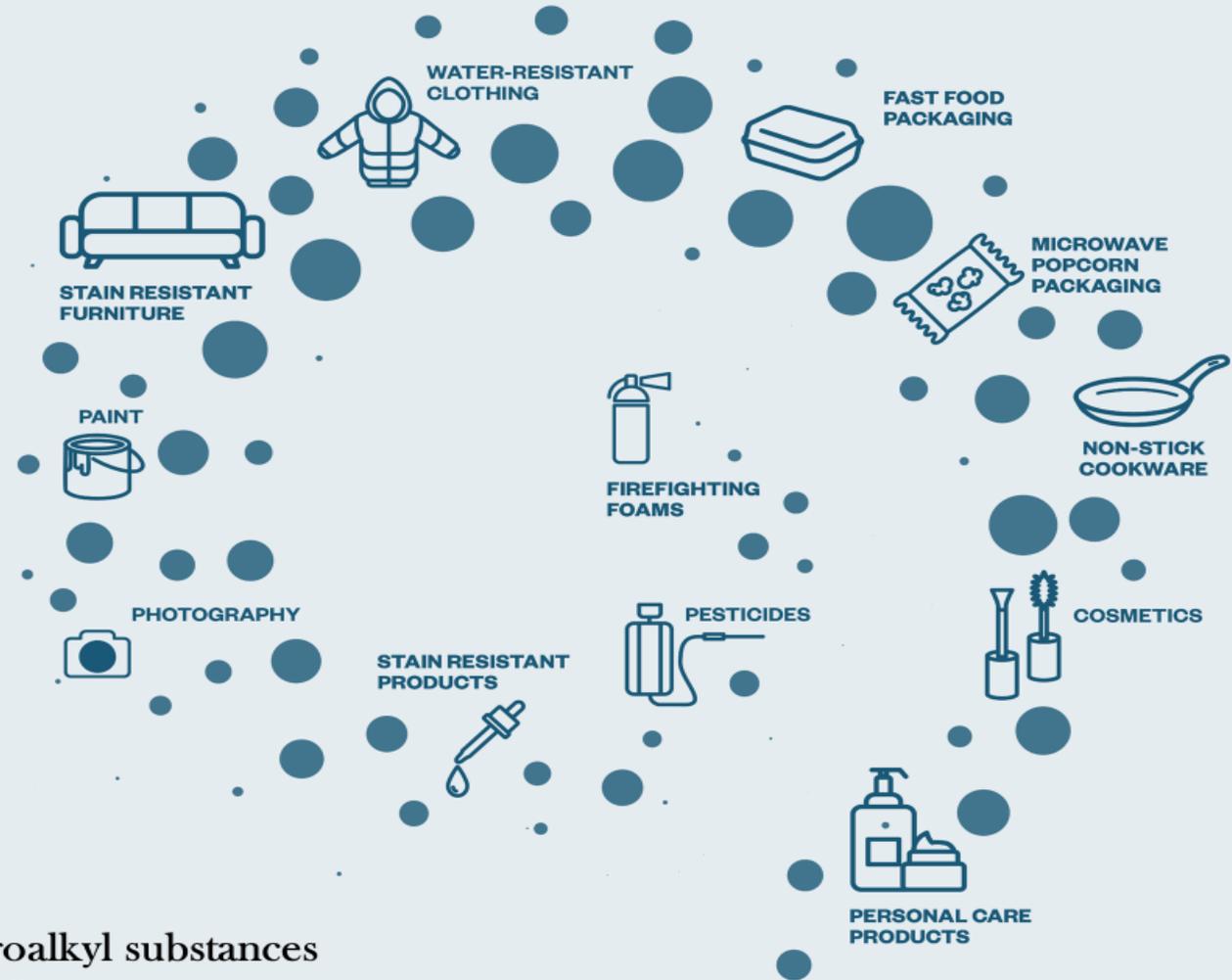
approx. **15,000** chemicals (CompTox, USEPA, 2021)

have **highly desirable properties**

(i.e., water-, heat-, oil – resistant, extremely stable, difficult to break, etc.)

most of them end up in **freshwater**

**bodies** (Armitage et al. 2009; Ruyle et al. 2003)



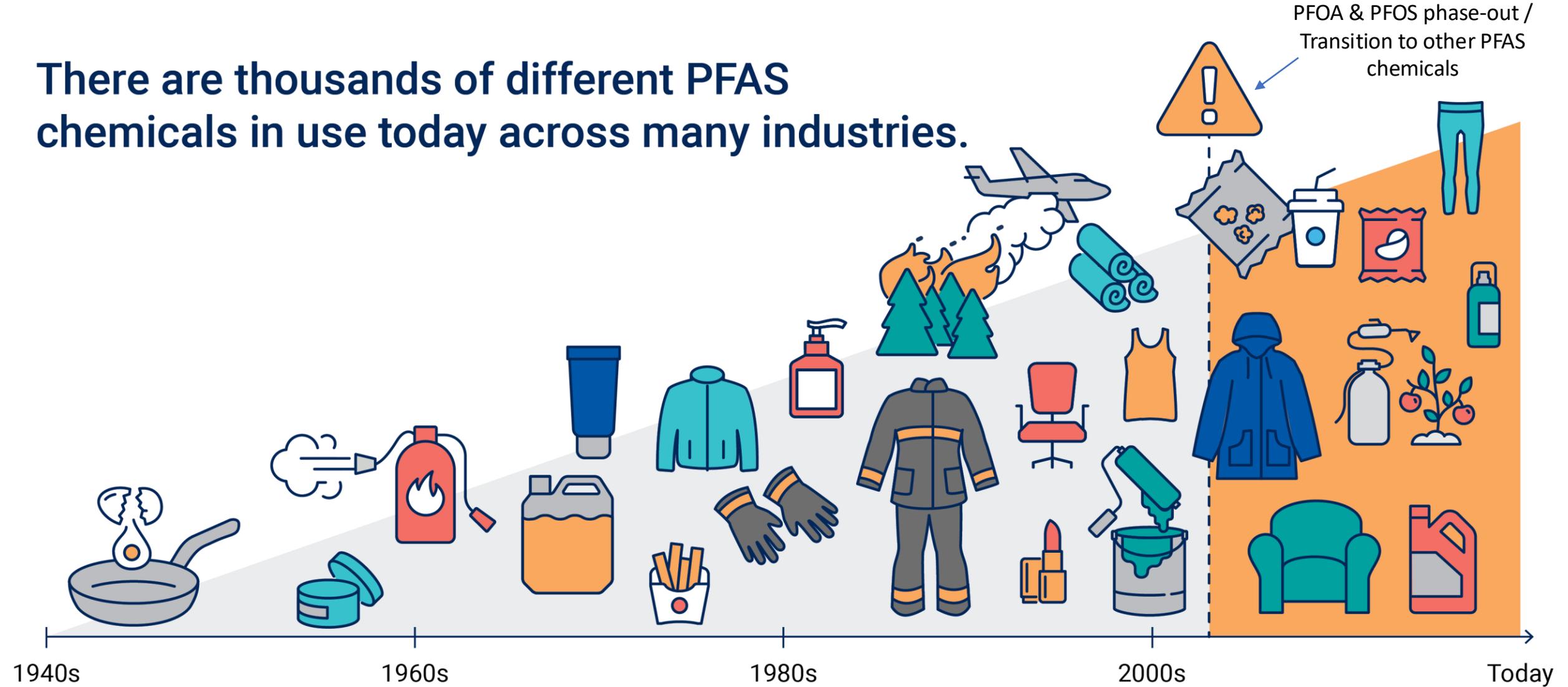
# PFAS

Per- and polyfluoroalkyl substances  
“forever chemicals”



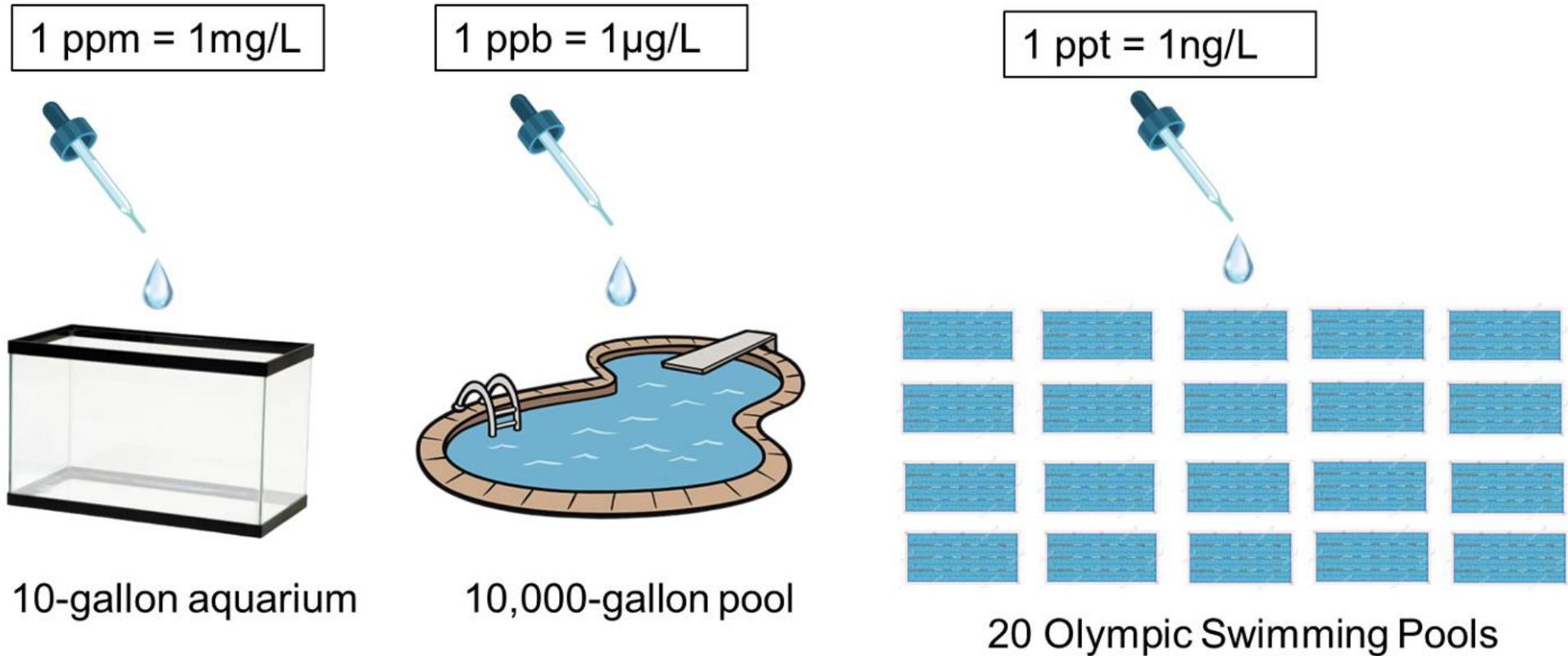
There are thousands of different PFAS chemicals in use today across many industries.

PFOA & PFOS phase-out /  
Transition to other PFAS  
chemicals



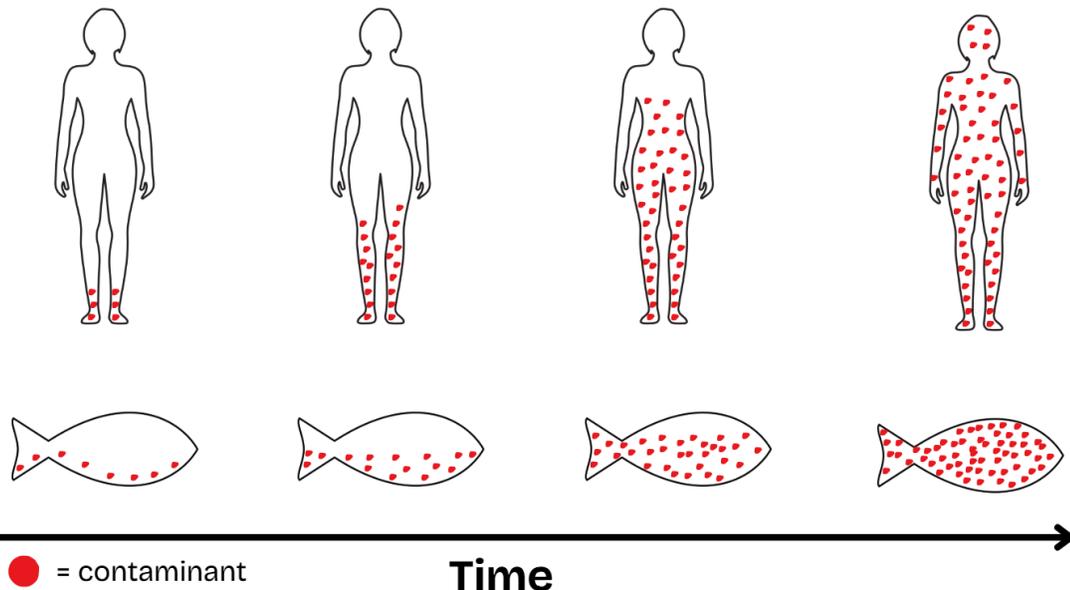


# How to Understand PFAS Concentrations





# Bioaccumulation

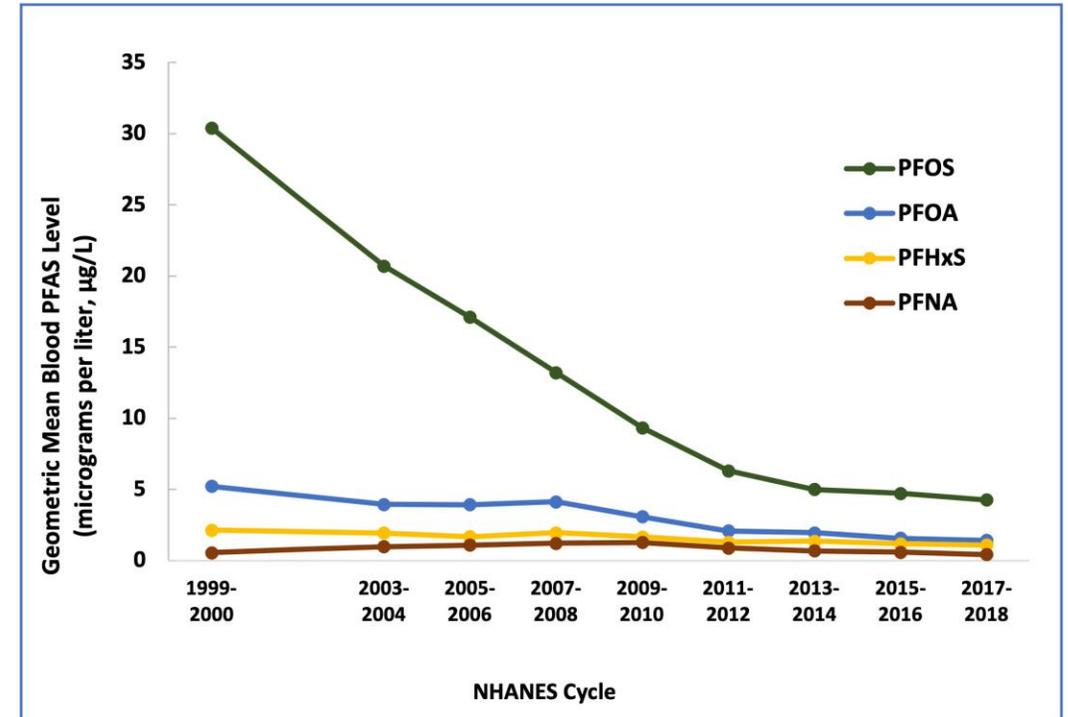


- *Gradual buildup of contaminants within a single organism over time*
- *Occurs when organisms take in more chemicals than they excrete*
- *Chemicals like PFAS can be stored in tissue, organs and blood rather than being excreted*



PFAS can accumulate and persist in the bodies of humans and animals, remaining for long periods without breaking down.

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

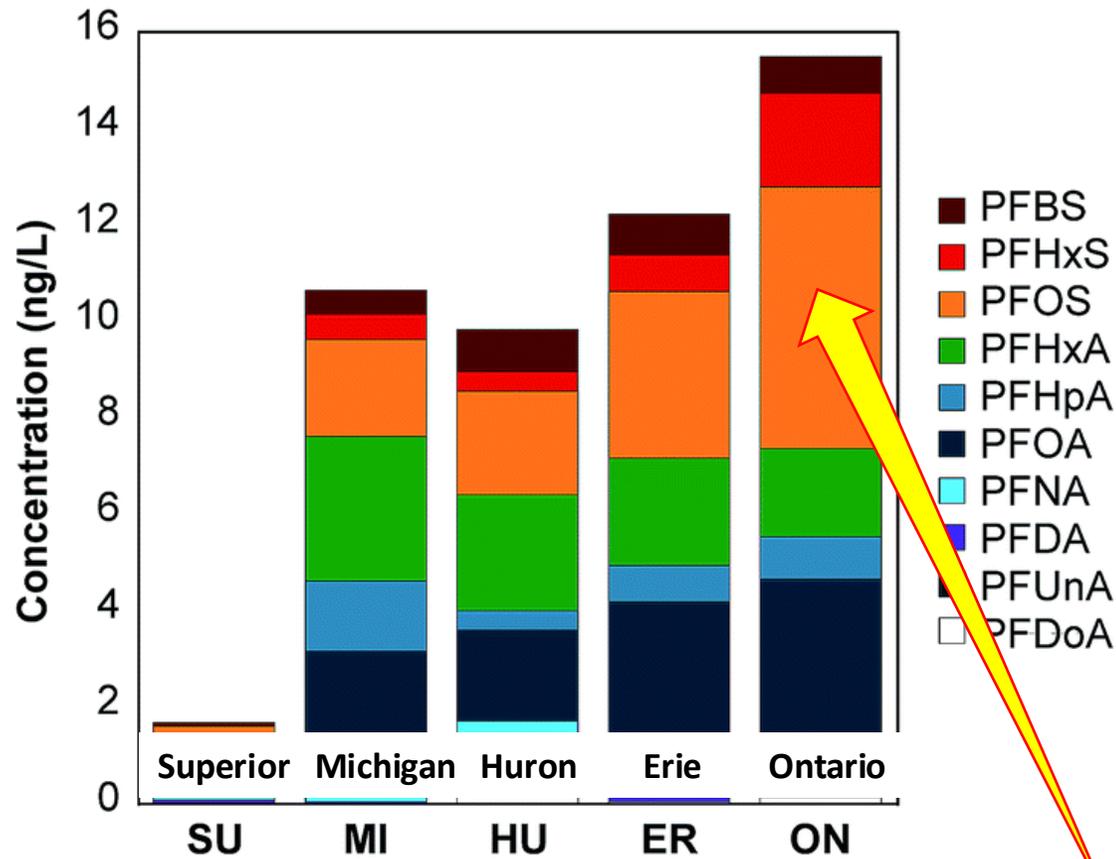


97-99% of humans have detectable PFAS in their blood

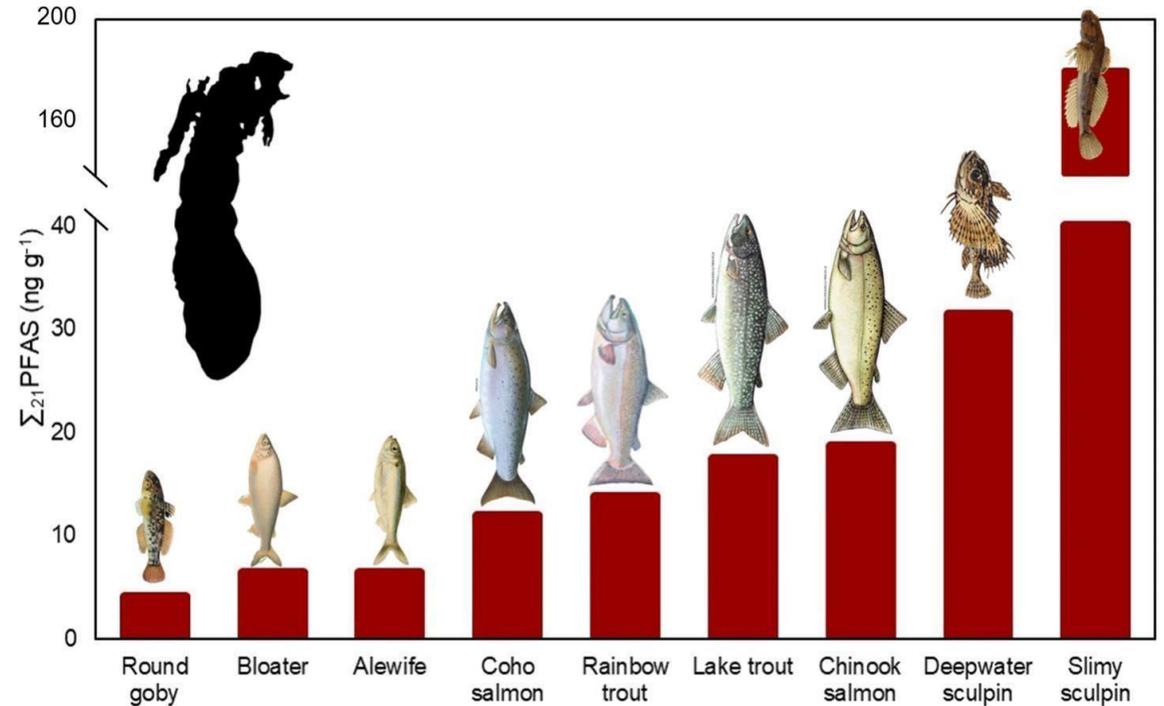
(CDC, 2025)



# PFAS in the Great Lakes



(Adapted from Remucal, 2019)



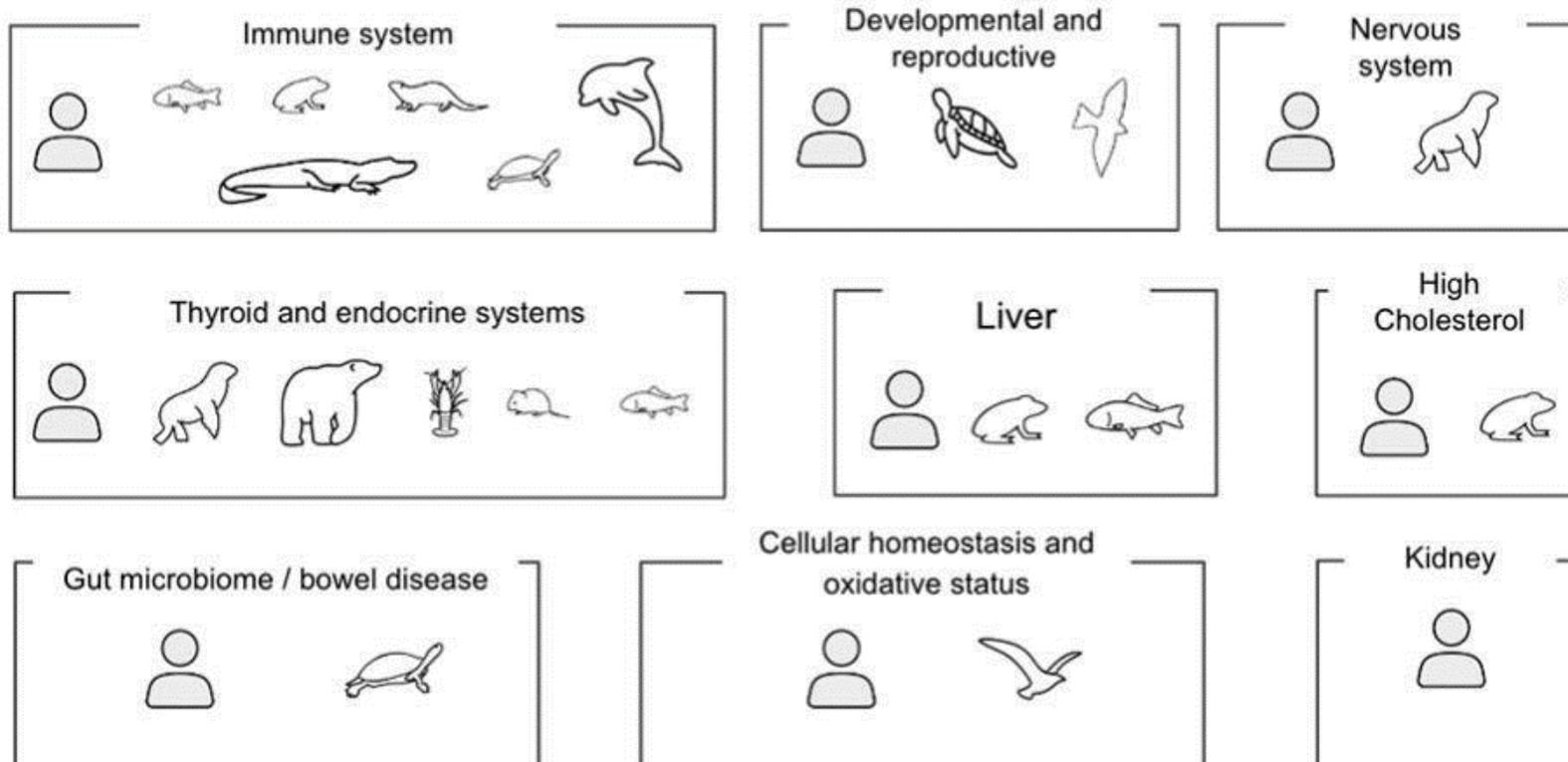
(Miranda et al., 2023)

**PFOS** is one of the most prevalent types of PFAS



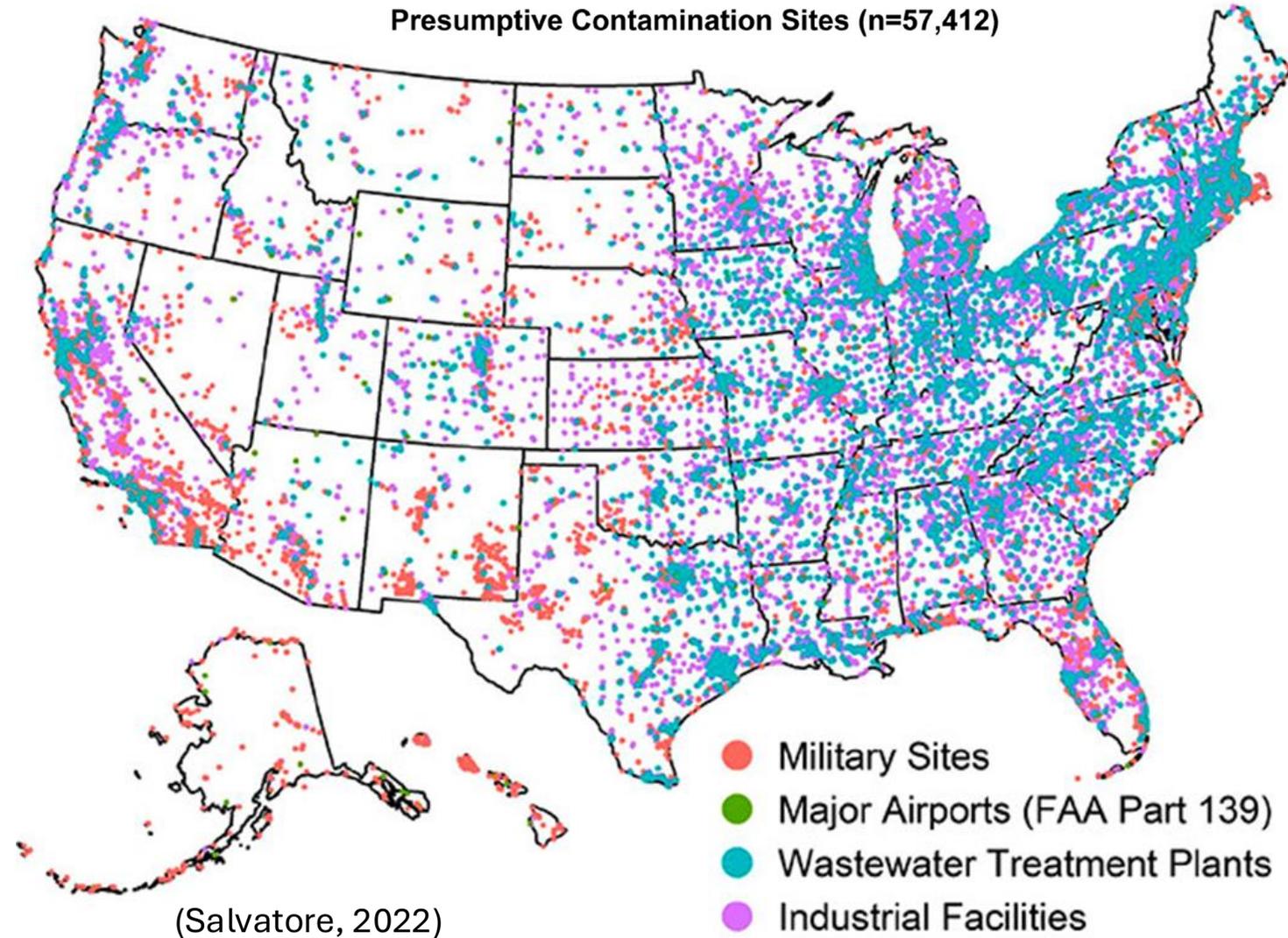
# Toxicity

## Shared health effects of PFAS

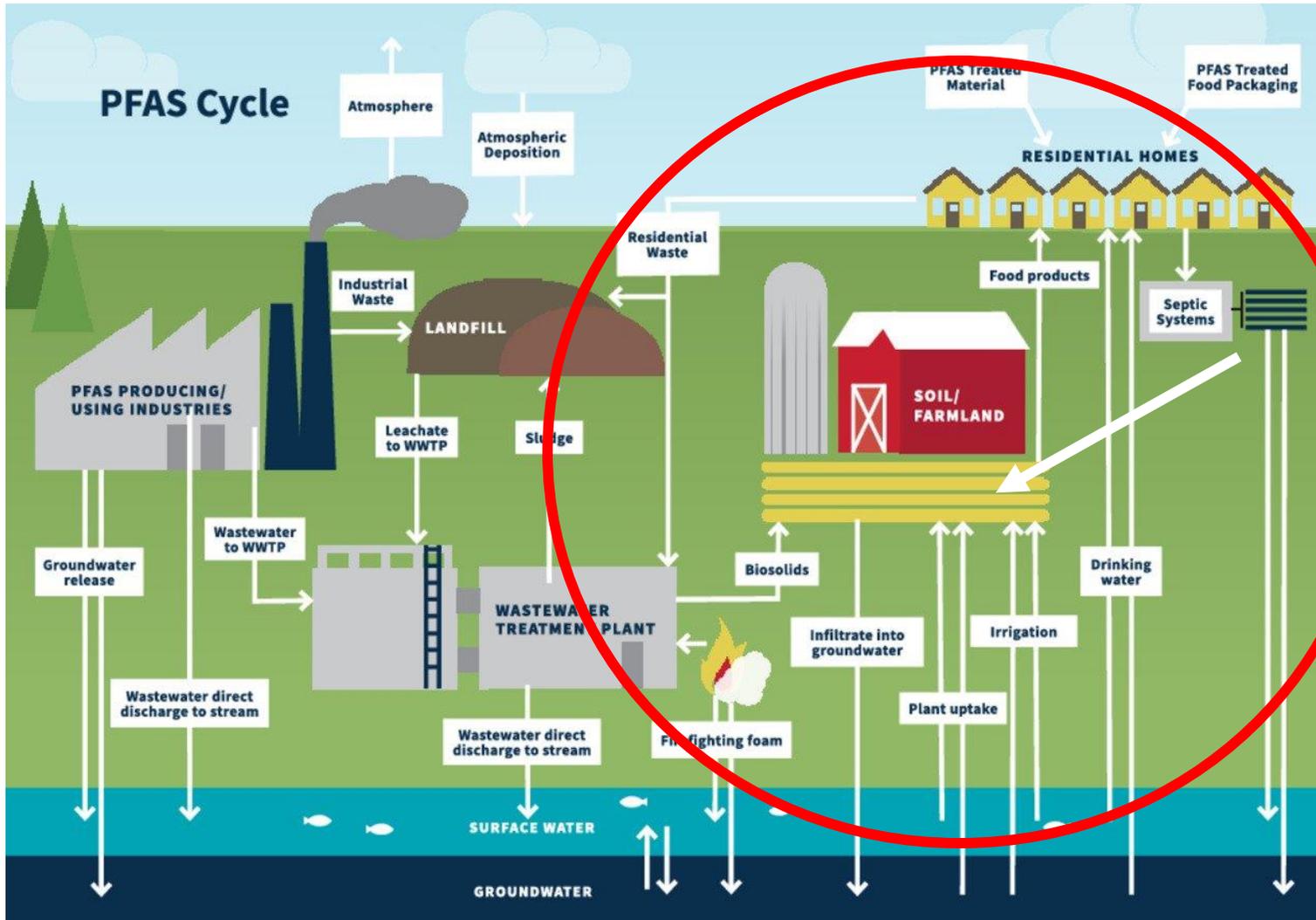




# Types of Sites That May Be Contaminated



(Salvatore, 2022)

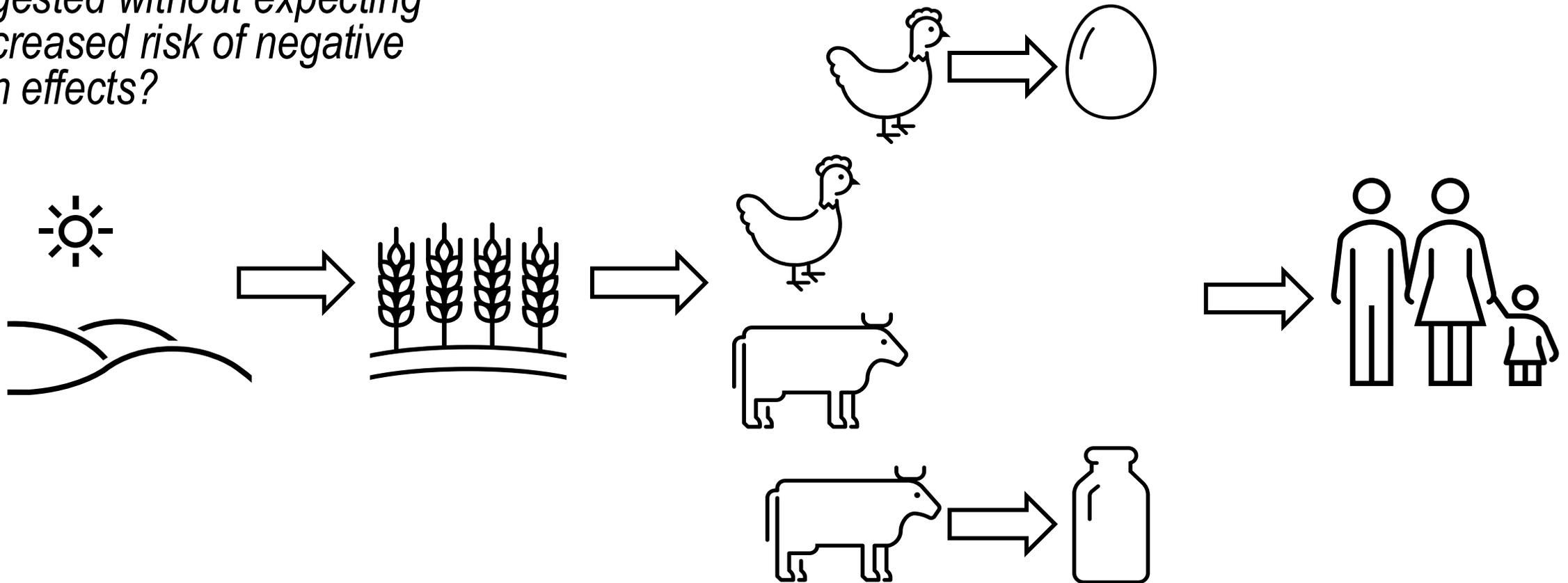


- Estimated 5% (or more) of cropland in US has applied contaminated biosolids?? (Environmental Working Group)
- Contamination from other land application materials
  - Paper pulp
  - Septage
- Contamination from water supply
  - Groundwater
  - Surface water
  - Rainwater
- Contaminated from legacy pesticide applications??



# Calculating the risks of PFAS in food

*How much of a chemical can be ingested without expecting an increased risk of negative health effects?*





# 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

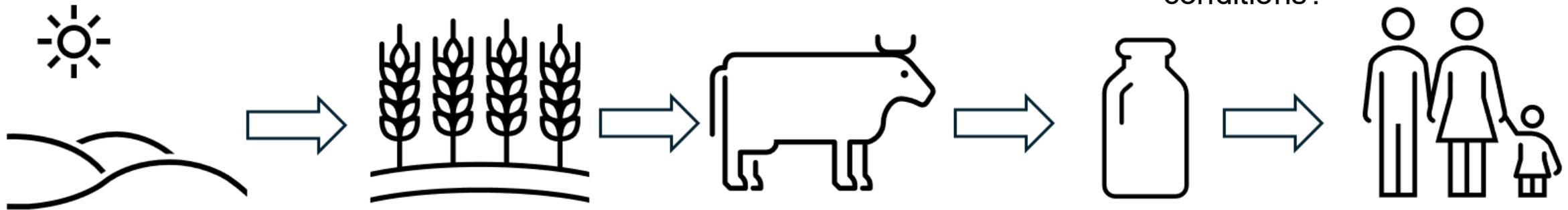
\*Sum of four PFAS (PFOS, PFOA, PFNA and PFHxS) with a tolerable weekly intake of 4.4 ng/kg-bw/week, effects on the immune system considered the critical effect.



# Calculating the risks of PFAS in food

- What specific PFAS chemicals are being consumed?

- Not all analytes are equal



- Who is consuming the PFAS?

- Child or an adult?
- Underlying health conditions?

- How much of the food is consumed?

- 90<sup>th</sup> Percentile?

- What is the total dose of PFAS?

- Background exposures?



# PFAS Food Safety Standards in the European Union, 2023

Product	Maximum Level or Indicative Level (ppb)				Sum of Four
	PFOS	PFOA	PFNA	PFHxS	
Meat of Bovine, Pig, or Poultry	0.30	0.80	0.20	0.20	1.3
Meat of Sheep	1.0	0.20	0.20	0.20	1.6
Meat of Game Animals	5.0	3.5	1.5	0.60	9.0
Eggs	1.0	0.30	0.70	0.30	1.7
Milk*	0.02				

\*Indicative Level



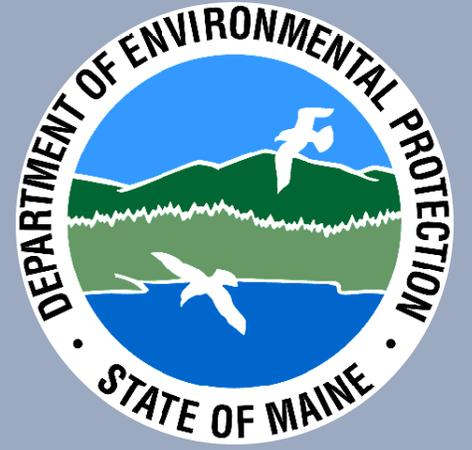
## Case Study: 100% Grass Fed Organic Dairy Farm in Maine







MAINE DEPARTMENT OF  
**AGRICULTURE  
CONSERVATION  
& FORESTRY**





# Maine-Action Levels

USA – No Federal Regulations

Fish Tissue Action Level (ng/g wet weight)	
Compound	Action Level
PFOS	3.5

Milk <sup>4</sup> (ng/l or ppt)	
Compound	Action Level
PFOS	210

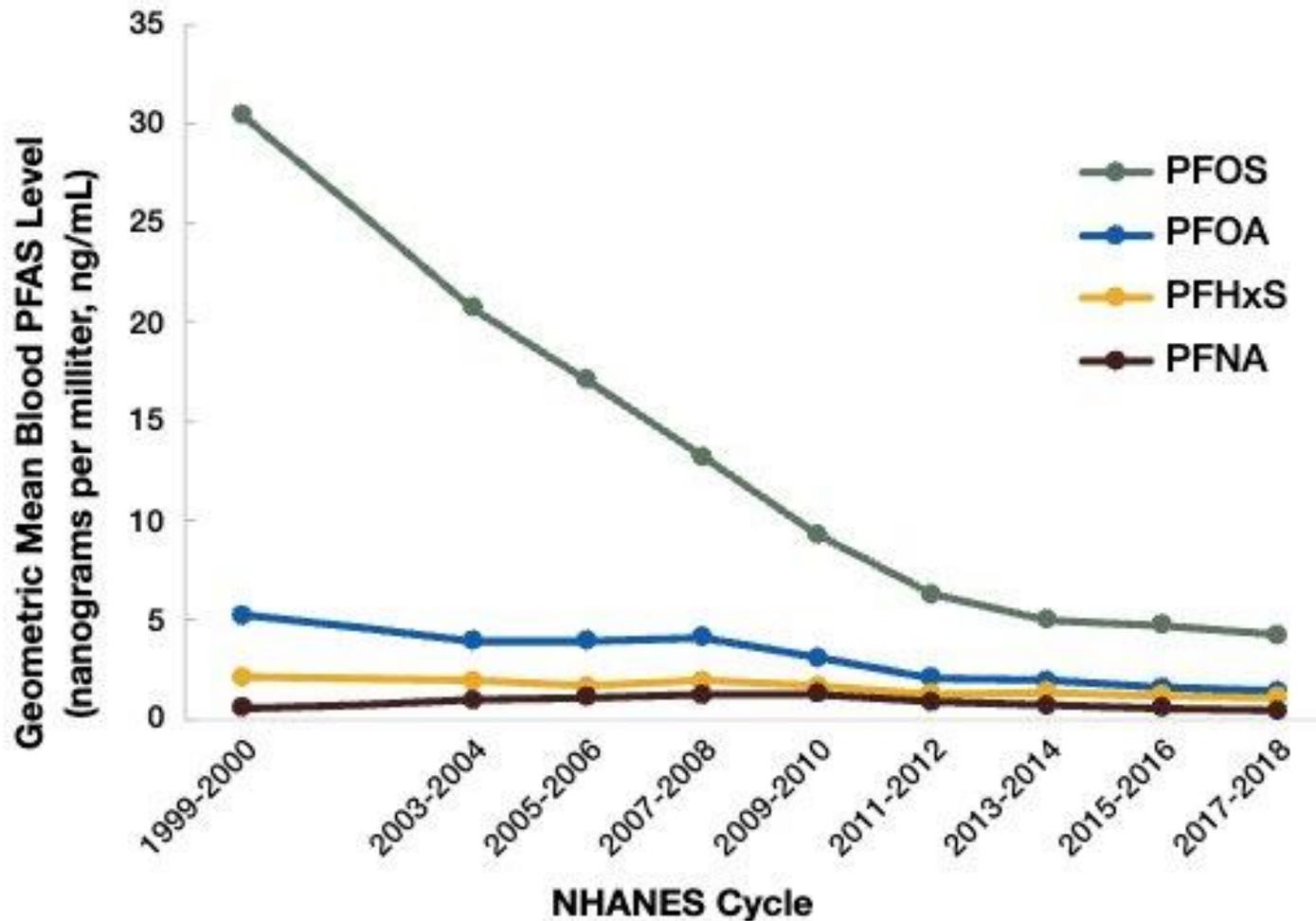
Beef <sup>5</sup> (ng/g)	
Compound	Action Level
PFOS	3.4

Chicken Eggs (ng/g or ppb)	
Compound	Action Level
PFOS	4.7

These action levels are established as guidance for determining whether a product should be considered adulterated, and therefore should neither be sold or delivered for sale



### Geometric Mean PFAS Blood Levels in the United States



*Family screened for PFAS in their blood bc they were eating their products (1690 ppt in milk, 3.4+ ppb in meats)*

- 11-27 ppt PFOS
- 6.4-12 ppt PFOA



## Early 2022

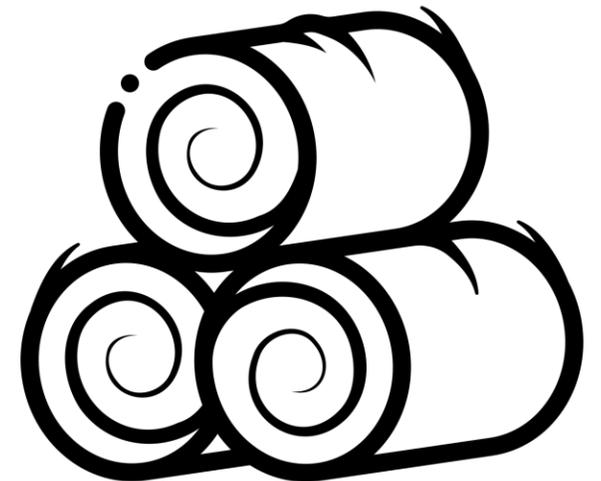
### *Milk 1690 ppt PFOS*

- *Immediately stopped sales*
- *Decided to keep cows and deurate with clean feed*
- *Dumped milk*
- *Disposed of meat (landfill)*

*Turn around time for testing was a challenge ~ 3-4 weeks*

*Purchased a new herd of milk cows and kept on clean feed*

- *Purchased hay from a neighbor tested 45-55 ppb PFOS*
  - *Soil 200 ppb PFOS*
- *Had fed 50 bales dairy cows and ewes*
- *312 bales landfilled*
- *New hay (ND) purchased by DACF*





## PFOS concentration in the soils on the farm

- *Worked closely with DACF to get all soils tested*
- *Tested fields based on the way they were historically farmed*
- *Even though pastures near the barns were licensed for spreading, they were never spread*
  - *Tested ND- 0.38ppb*
- *DACF recommended soils with concentrations over 6.8 ppb not be used for pasture based dairy*

### Testing results - PFOS

*Land they own:*

- **ND- 0.4ppb** - 159 acres
- **2.53- 6.75ppb** - 39 acres
- **6.96 - 14.3ppb** – 76 acres

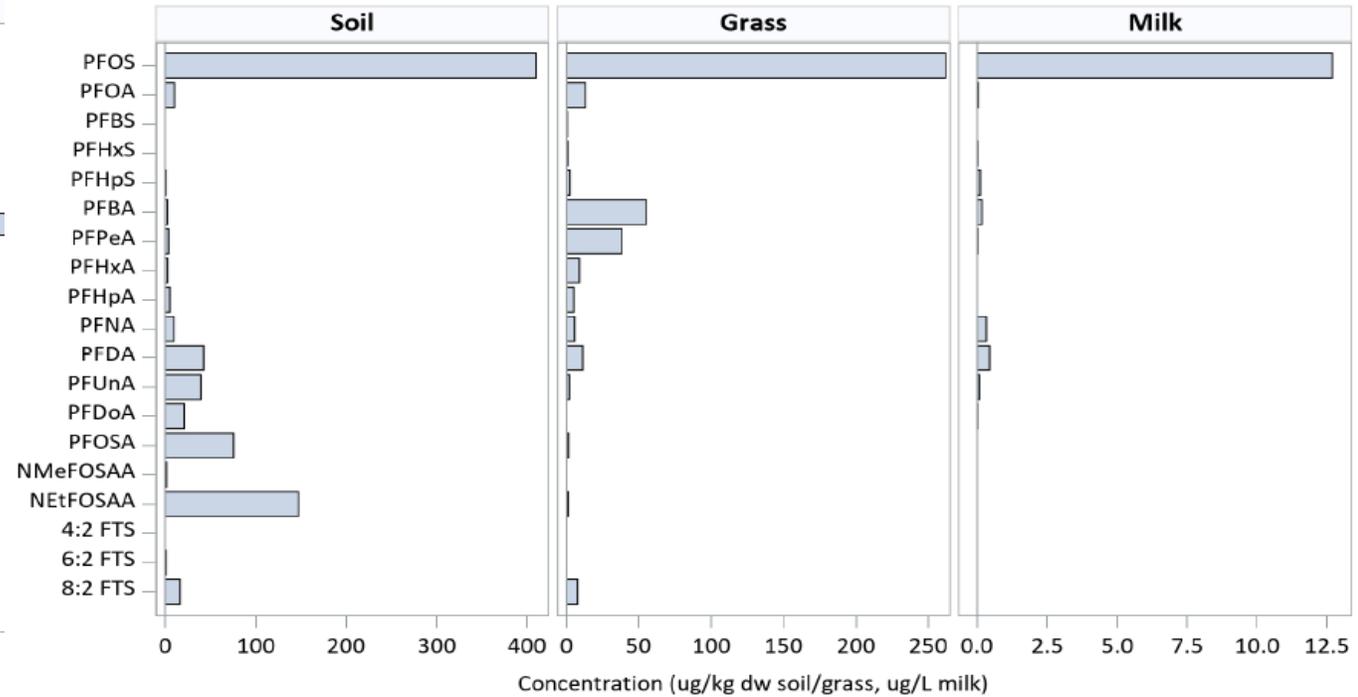
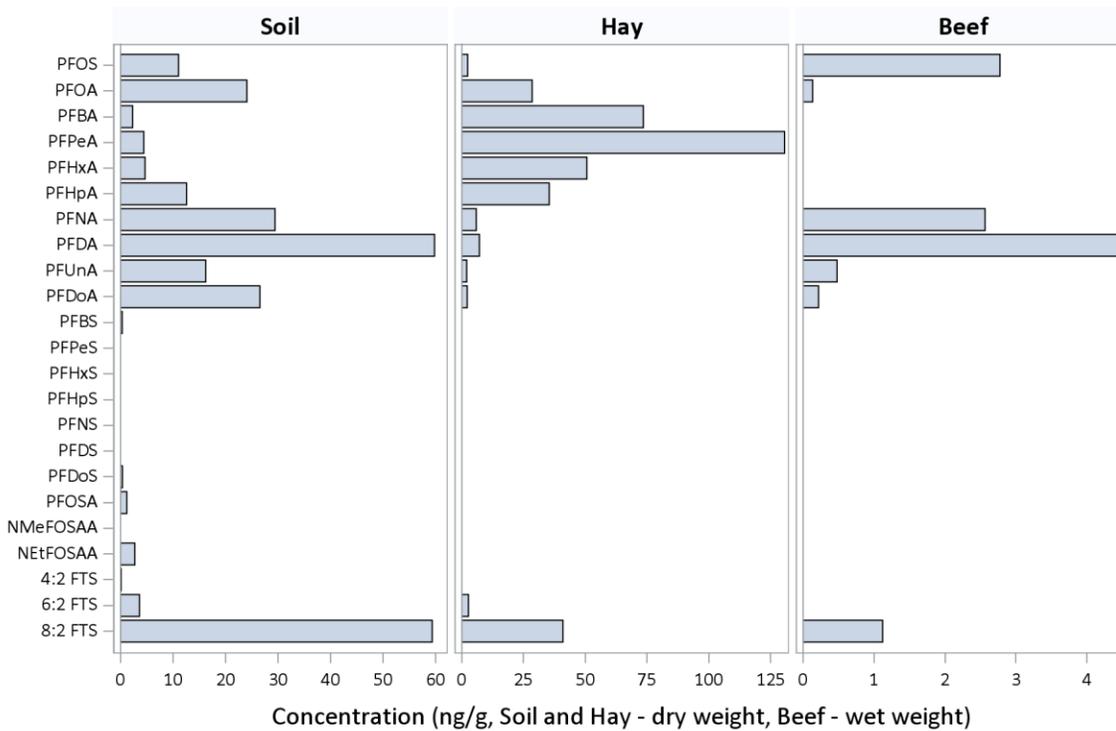
*Land they rent:*

- <1.0ppb – 284 acres
- 1.0- 4.6ppb – 48 acres



# PFAS move differently between media

## Migration to beef and milk on farms





## Pigs

- *Pigs had been fed contaminated skim milk*
- *ND in the meat*
- *Pigs pastured in fields with 9 ppb PFOS in the soil were contaminated*
- *Pastured pregnant sows produced contaminated piglets, but decontaminated to ND after being raised on clean land*





# Chickens

- *Eggs and meat - ND*
- *Careful to pasture on only ND soil because chickens dig in soil to eat bugs and worms*

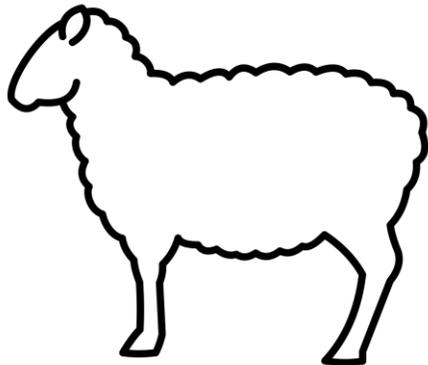




## Sheep and Beef

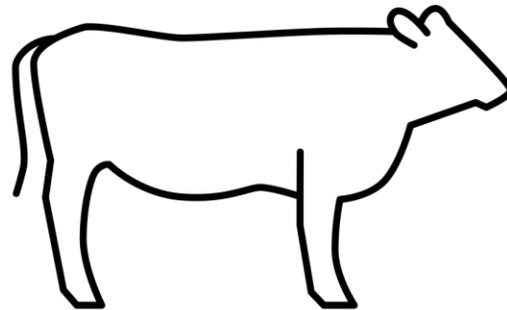
- *Sheep-*

- *Fed ~50ppb hay*
  - *Meat ND- 0.95 ppb PFOS*
- *Milk was contaminated but depurated quickly*
- *Lambs nursing those ewes – ND*



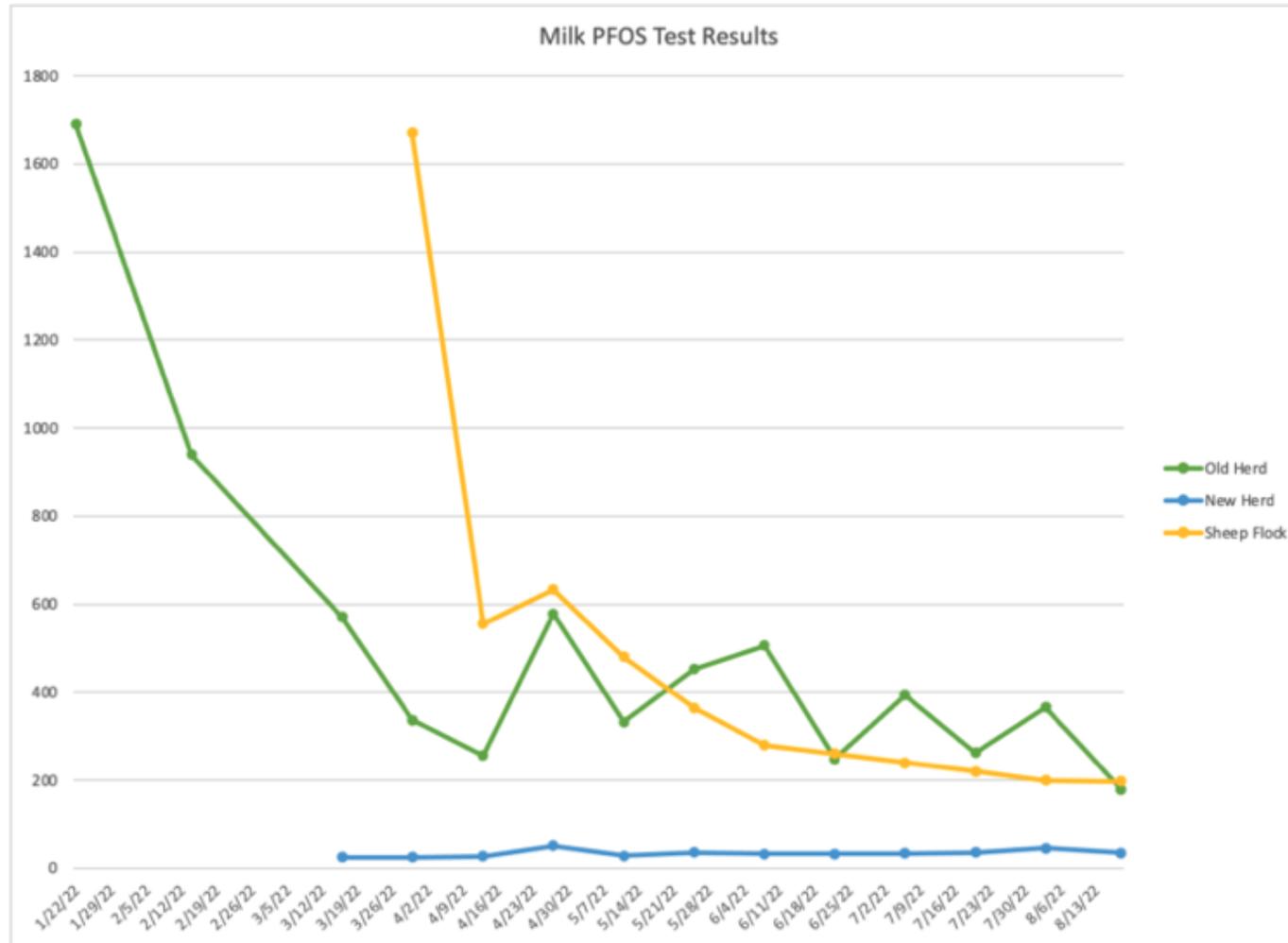
- *Cattle that were contaminated-*

- *Dec 2021 – herd bull 4.46 ppb PFOS*
- *Jan 2022 – nurse cow 10.6 ppb PFOS*
- *June 2022 - cows ND- 2.2 ppb PFOS*
  - *Fetus (2) - ND*



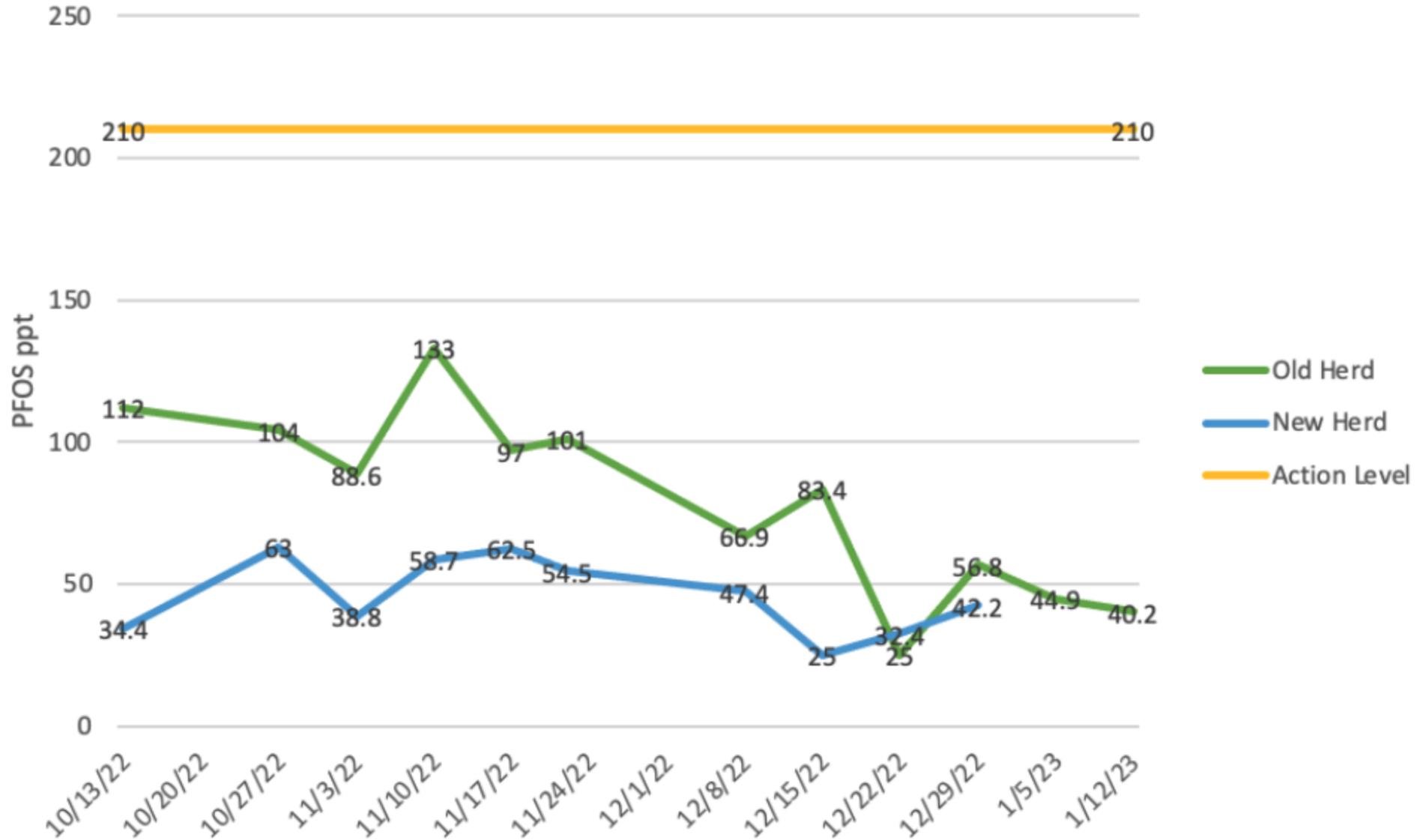


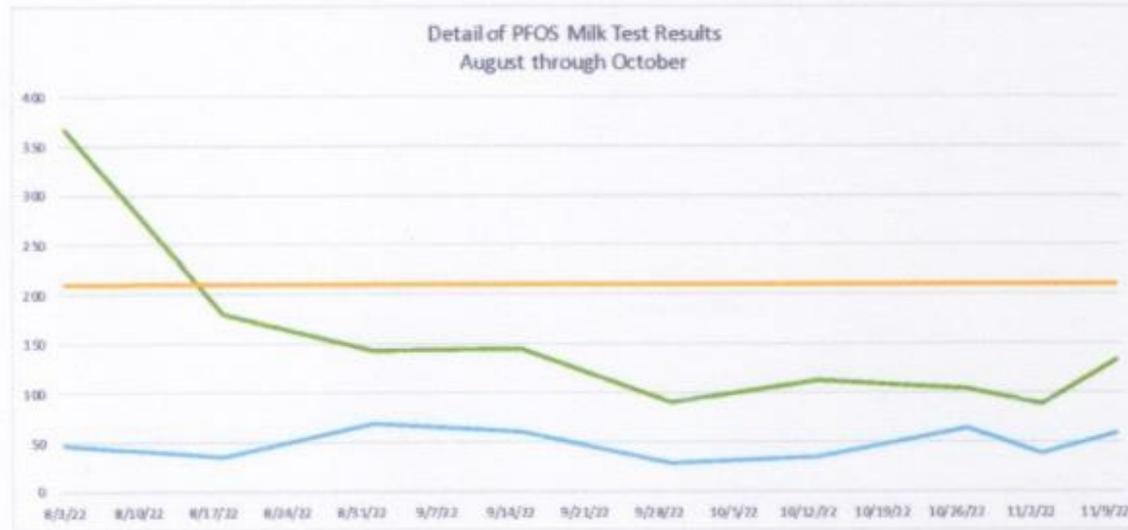
# January – August 2022





### Detailed PFOS Milk Test Results





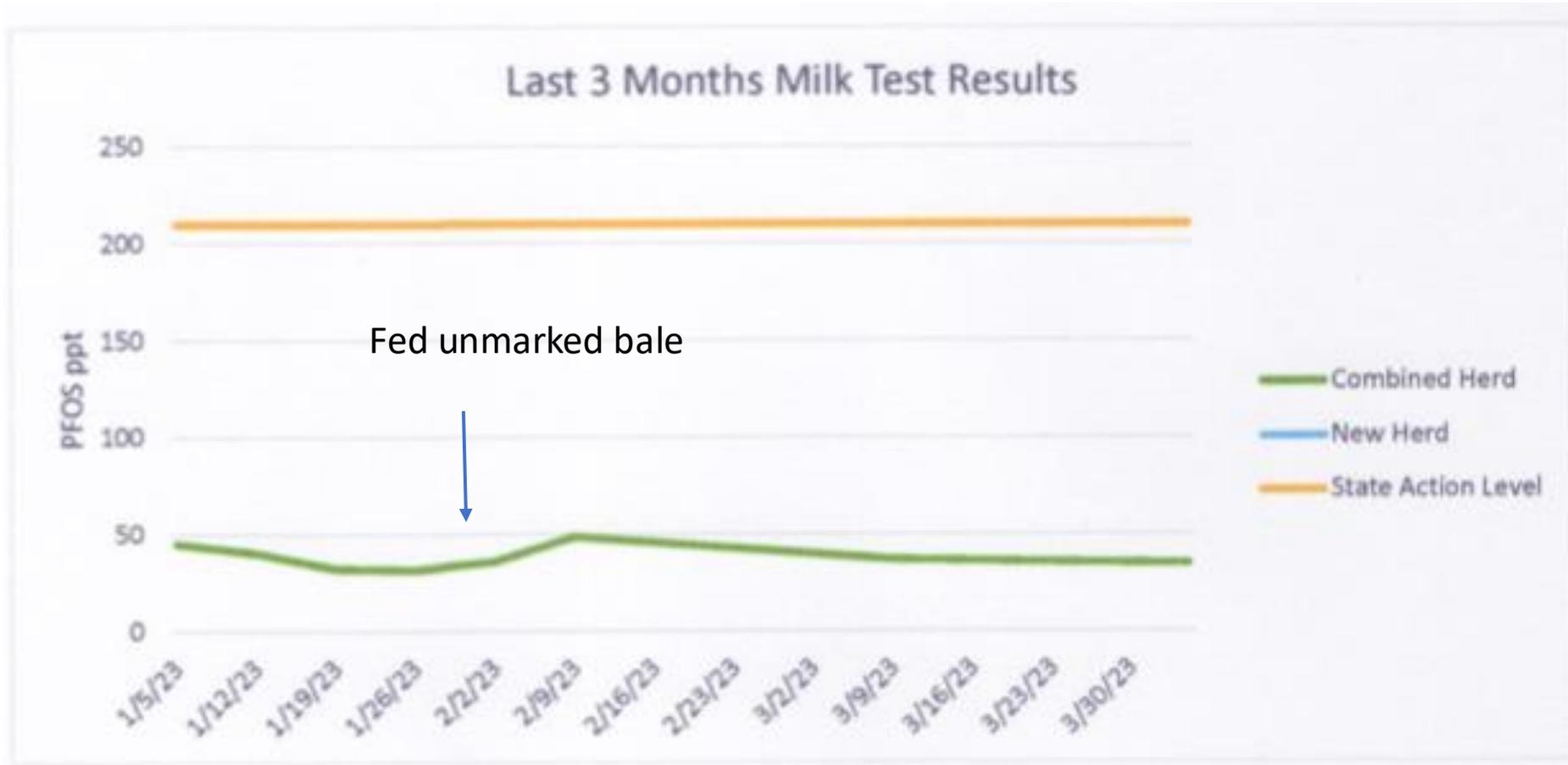
## CONCLUSION

We didn't even know what PFAS were in the beginning of 2021. Now we know many of the PFAS compounds personally. We have learned so much in 2022 and I hope that if you are still reading this, you also have a passion for learning and improving.

**Together we can make a difference, and together we can face the challenges that lie ahead.**



# January – March 2023

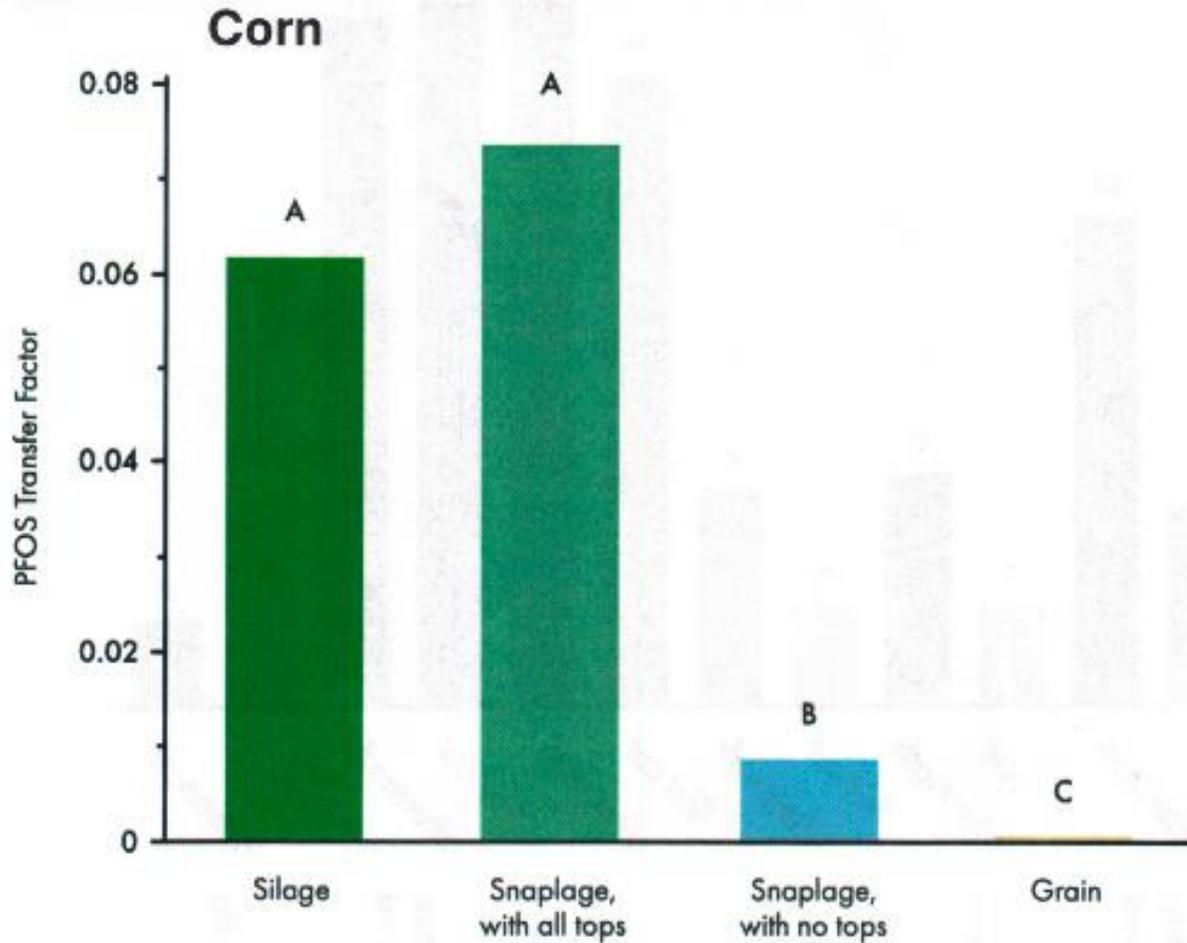


# Feed storage





PFAS Forage Management Trial



Snaplage = stalk, ears, and husks. Because most combine snapper headers also collect some "tops" (stems and leaves above the ears), these were also collected and analyzed separately.

For more information, contact [ellen.mallory@maine.edu](mailto:ellen.mallory@maine.edu).

This project was/is supported by the Maine Food and Agriculture Center, American Farmland Trust, USDA-NIFA, and USEPA.



- *DACF funded investments in grain growing equipment and infrastructure to utilize higher PFOS ground*
- *Now growing wheat, barley, oats and corn on fields that had sludge*
  - *Working with the state to test the grains*
- *Grew dry beans on soils with 10.9ppb PFOS = Non detect!*
- *Change cropping plans*
  - *Non-detect fields prioritized for grazing*
- *Business is strong!*
  - *Dairy products*
  - *Eggs*
  - *Beef*
  - *Pork*
  - *Lamb*
  - *Dry beans*
  - *Wheat flour*
  - *Rye flour*
  - *Corn meal*





## Maine Dairy Farm

- *Farm posted PFAS info on website to be transparent with customers*
- *Use “PFAS tested” label they created*
- *Active in the PFAS Fund Advisory Committee to help Maine address PFAS contamination in a proactive and comprehensive way and to support other farms facing PFAS contamination*





# Maine Dairy Farm

*How do we carry on with so many challenges?* We have a GOAL.

**Our goal is to prove that when you care enough about LIFE, soil, plants, animals, and people, you can overcome anything and there IS a way FORWARD for repairing our soils and feeding our PEOPLE.**

We wouldn't be accomplishing our goal without our hard-working team and amazing support from our community.

- Northern Tilth helped us with our initial PFAS testing.
- Maine Farmland Trust and MOFGA gave us immediate financial support when we discovered the contamination and stopped selling everything in February.
- The Department of Agriculture, Conservation, and Forestry (DACF) have supported us with PFAS testing and additional financial support.
- Herring Brothers has helped us work with the state to test animals at slaughter.
- Maine Center for Disease Control has helped us with number crunching, studying results, and providing suggested action levels that are a starting point and more than other states have.



# PFAS in Food



Since 2019, the Food and Drug Administration (FDA) has been testing a variety of foods as part of the Total Diet Study (TDS)

- The FDA has found **no indication** that the PFAS at the levels found in the limited sampling of foods collected for the TDS present a human health concern
- The highest concentrations of PFAS appeared mostly in seafood



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.”



# MSU and MPART are working to develop a strategy for working with farms

*MSU can provide:*

- *Education*
- *Risk assessment*
- *Sampling*
  - *Soil*
  - *Water*
- *Follow up discussions*
- *Mitigation strategies*
  - *Funding for infrastructure changes*





**CEU Tracking Number:** MI 56998 **Approved CEUs:**

**Meeting Title:** Introduction to PFAS in Agriculture-PFAS in Livestock Systems

**Location:** Online

**Meeting Date:** 03/24/2026 10:00 AM to 11:00 AM

NM	SW	PM	CM	PD
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**Please scan code through the CCA App on your mobile device to receive CEUs immediately.**

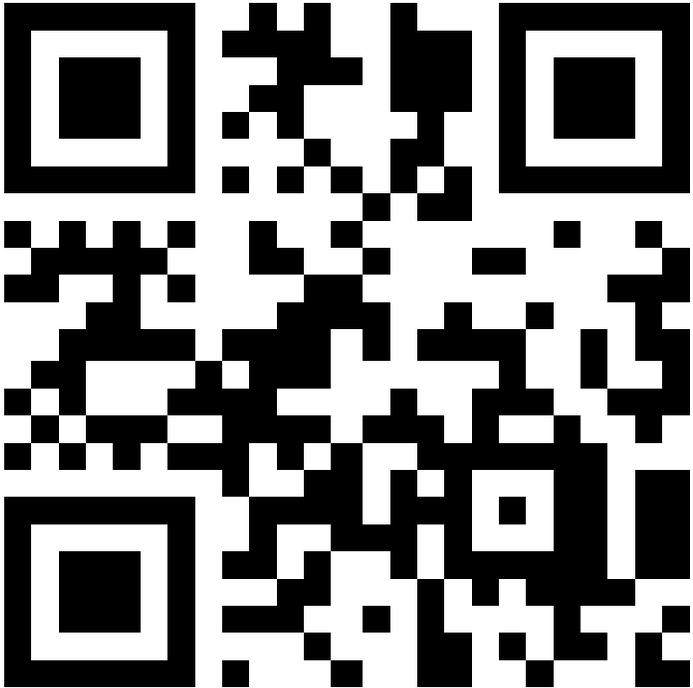
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**mail:**  
U.S. Department of Agriculture  
Office of the Assistant Secretary for Civil Rights  
1400 Independence Avenue, SW  
Washington, D.C. 20250-9410; or

**fax:**  
(833) 256-1665 or (202) 690-7442;

**email:**  
[program.intake@usda.gov](mailto:program.intake@usda.gov).

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