

Maine's PFAS Response for Agriculture Program Launch & Lessons Learned

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Bureau of Agriculture, Food and Rural Resources (BAFRR) Maine Department of Agriculture, Conservation and Forestry (DACF)

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What are PFAS?

- PFAS = per- and poly fluoroalkyl substances
- Defined by Maine statute as any member of the class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom
- Used in consumer products grease and water repellant, heat resistant due to a strong C-F bond = very difficult to break





Why are we finding PFAS in agriculture?

- They are present in our wastewater in septic tanks and in treatment plants.
- PFAS has been found at former military sites, closed unlined landfills, in firefighting foam.
- Found in groundwater and soils where materials containing PFAS were utilized or disposed (i.e., sludges).
- Can enter plants → animals
 → humans





What are the health impacts?



Increased cholesterol levels



Decreased vaccine response in children



Small decreases in infant birth weights

Increased risk of kidney or testicular cancer



Changes in liver enzymes

Taken from the Agency for Toxic Substances and Disease Registry (U.S. CDC) - Potential health effects of PFAS chemicals | ATSDR (cdc.gov)



Increased risk of high blood pressure or pre-eclampsia in pregnant women



Timeline of Maine's Response

2016: Discovery of impacted dairy farm.

- Creation of milk PFOS Action Level (210 ppt)
- 2019: Governor Mills PFAS Task Force created.
 - Recommendations regarding safe drinking water and food and identifying and investigating PFAS in the environment.
- 2020: Retail milk testing identifies second dairy farm with high PFOS. Third dairy discovered thereafter.
 - Creation of beef PFOS Action Level (3.4 ppb)







Timeline of Maine's Response

2021: Legislature approves budget for multi-agency response

• Public Law 2021, Chapter 478: An Act To Investigate PFAS Substance Contamination of Land and Groundwater effective Oct. 18

2022: DACF hires PFAS Response team members and PFAS Fund Director

2022: Ban on Land Application of Sludge, effective Aug. 8

2023: Finalize PFAS Fund Plan (\$60 million)

2024: Half of all licensed application sites must be completed by DEP

2025: All licensed application sites must be completed by DEP

7,600 farms in Maine. Vast majority likely not impacted. Not a "Maine issue."



Multi-Agency... truly!

Maine DACF –

- Working directly with commercial farms
- Conducting sampling of farm products, soils, and irrigation water
- Regulating acceptable concentrations of PFAS in farm products
- Financial support mechanisms in place

Maine DEP –

Testing permitted sludge and septage sites, home wells, landfill leachate

Maine Drinking Water Program –

 Responsible for public drinking water program oversight, including PFAS testing







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Multi-Agency... truly!

Maine CDC –

- Recommends action levels and screening levels for farm commodities and agronomic pathways
- Consults with Maine DACF regarding site-specific farm scenarios
- Advises individuals with concerns regarding their health

Inland Fisheries and Wildlife –

• Testing wildlife and issuing consumption advisories

Coordination with other Maine organizations, other state agricultural agencies, and federal agencies







PFAS in Maine: Where Are We?

- DEP has completed Tier 1 and 2 sampling
- DEP Tier 3 sampling has begun
- When a farm is involved, DACF is notified
- DACF has contacted 150+ farms, including self-testers
- > 60 farms have at least one test exceeding a screening level – many can adjust and continue with technical and financial support
 - 4 have ceased, 3 significantly downsized



DACF's Farm-Specific Response

We support farms by identifying PFAS contamination, pursuing strategies to reduce or eliminate PFAS, and providing technical and financial assistance to retain farm viability.

- Data is key. Comprehensive, ongoing sampling.
- Every farm is different.
- Animals can depurate (!)
- Not all PFAS are the same.
 - PFOA doesn't readily accumulate in beef
 - Low uptake in asparagus, garlic, potatoes, grains, corn





Details Matter

PFAS Concentrations in Produce





Details Matter





Samples Collected and Sent to Commercial Labs for PFAS Analysis						
Matrix	2020	2021	2022	2023		
Plasma	3	24	98	74		
Serum	3	0	115	207		
Muscle (including biopsies &						
packaged meat and organs)	0	58	133	75		
Soil	0	9	473	530		
Plants	0	15	356	174		
Milk	3	2	186	150		
Water	0	0	35	30		
Total tests:	9	108	1396	1240		



Producer Examples

Beef:

- \circ $\,$ Contaminated water and hay fields.
- Installed water filter, provided clean feed, recommended grazing/feeding strategies
- Live muscle biopsies (no longer need to perform).
 Serial blood samples. Slaughter sample. Result: below the Action Level/ND.

Vegetable:

- Water contamination (9,000 ppt). Minimal soil contamination.
- Trucked water. Installed system.
- Updated greenhouse for year-round harvesting and to reduce water usage.







CASE STUDY – BEEF FARM



Phase 1: Data Collection

DACF contacts the owner, collects basic contact information, agricultural information, schedules initial site visit, and develops sampling plan.









Phase 2: Analysis and Response

Sample Analysis shows detectable levels in freezer beef, but below current action threshold.

Analytical Instrument		Sciex 6500+ (AF) LC/MS/MS
% Moisture		0.00
Matrix		SOLID BEEF
Sample Size		2.200
Size Unit-Basis		g
Analyte	CAS No.	Result (ng/g_Wet)
-		
PFBA	375-22-4	0.182 U
PFPeA	2706-90-3	0.182 U
PFHxA	307-24-4	0.182 U
PFHpA	375-85-9	0.0909 U
PFOA	335-67-1	0.114 J
PFNA	375-95-1	2.57
PFDA	335-76-2	4.81
PFUnA	2058-94-8	0.469
PFDoA	307-55-1	0.177 J
PFTrDA	72629-94-8	0.227 U
PFTeDA	376-06-7	0.0909 U
NMeFOSAA	2355-31-9	0.227 U
NEtFOSAA	2991-50-6	0.227 U
PFOSA	754-91-6	0.0909 U
PFBS	375-73-5	0.0455 U
PFPeS	2706-91-4	0.182 U
PFHxS	355-46-4	0.182 U
PFHpS	375-92-8	0.182 U
PFOS	1763-23-1	2.68
PFNS	68259-12-1	0.182 U
PFDS	335-77-3	0.182 U
4:2FTS	757124-72-4	0.318 U
6:2FTS	27619-97-2	0.182 U
8:2FTS	39108-34-4	0.831
HFPO-DA	13252-13-6	0.182 U
Adona	919005-14-4	0.318 U
9CI-PF3ONS	756426-58-1	0.227 U
11Cl-PF3OUdS	763051-92-9	0.227 U



Phase 2: Analysis and Response





Phase 3: Mitigate and Monitor



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Phase 3: Mitigate and Monitor





Phase 4: Not of Current Concern

Beef Farm 2023 PFOS Serum Sample Results					
	6/28/23	9/18/23			
Animal ID	Serum Concentration				
486	9	6.5			
487	14	8.2			
488	13	7.8			
489	9.7	6.3			
490	13	8.1			
491	9	6.4			



Poll Question

Response Assistance to Date

Farm Viability / Infrastructure

- \$1 Million
- Clean feed, new equipment, greenhouses, water delivery.....

Water Filtration

- \$100,000
- Installation and O&M

Income Replacement

- \$1.5 Million
- 12-month window



Total over \$3 Million



Financial Support from DACF



Four categories of support:

- Direct assistance to impacted farms*, \$30.3M
- Land acquisition & management, \$21.5M
- Research to support on-farm decision making, \$11.2M
- Health initiatives, \$7.3M

Funding: \$60M from the State, ~\$5M from USDA

*Response provides additional funding



The PFAS Fund is Currently Accepting Applications:

- Administrative cost grants
- Income replacement (up to 2 years)
- Professional & technical services (e.g. business planning, marketing)
- Infrastructure (projects valued above \$150,000)
- Loan assistance
- Land purchases



Some more about what we've been learning...



Heterogeneity of Land Application





- DEP soil sample approach based on published nutrient management sample guides
- 10-part composites not always reproducible
- Data quality objective good for DEP (evaluating relative risk to groundwater) but not for DACF/CDC trying to make recommendations to farmers
- DEP's objectives relative risk to groundwater ideally targets portion with highest PFAS

Slide credit: Chris Evans, Maine DEP



Heterogeneity of Land Application





Credit: Rich Meinert, Univ. of Connecticut

Slide credit: Chris Evans, Maine DEP







Heterogeneity and Choice of Grid Size





Slide credit: Chris Evans, Maine DEP







What are the options to get dairy cows below 210 ppt?



Good news: when you eliminate or reduce a herd's exposure to PFAS contamination, levels in milk decline.

- This is due to a process called depuration, which is the excretion of PFAS (milk, manure, etc.)
- Requires strategic management of exposure sources- sourcing clean hay, keeping herds grazing on clean or low level fields.

Progress in Reducing PFOS in Milk Takes Time



Maine Department of Health and Human Services

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Bunker Silo Cross Sections





Second-cut hay may have higher PFAS levels than first-cut.



Corn snaplage is a good choice for PFOS contaminated soil.



Tall fescue mayaccumulate PFOS morethan other grasses.

Potatoes, asparagus, corn, grain, and apples are examples of crops that seem safer to grow on PFAS contaminated soils.



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