Responding to PFAS on Dairy Farms in Maine

Rick Kersbergen, Maine DACF Consultant and Umaine Extension Professor Emeritus

Acknowledgements to: Andy E. Smith, Maine Center for Disease Control (CDC) and Tom Simones, Maine CDC Staff at Maine Department of Agriculture Conservation and Forestry

Amanda E. Beal, Commissioner
Craig Lapine, Director, 18 Elkins Lane, Augusta, ME 04333, (207) 287-3200, www.maine.gov/dacf
Nancy McBrady, Deputy Commissioner (DACF)

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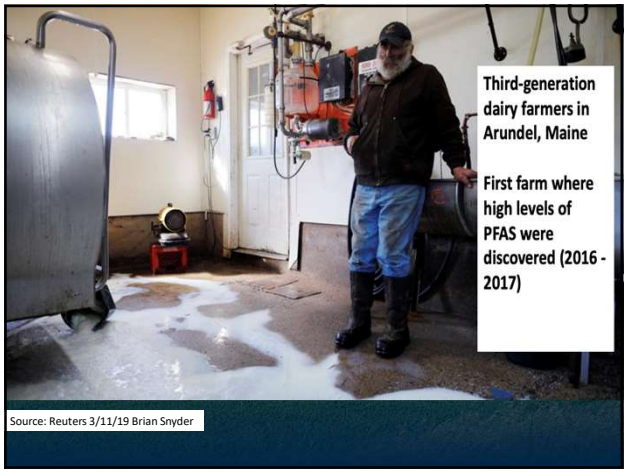

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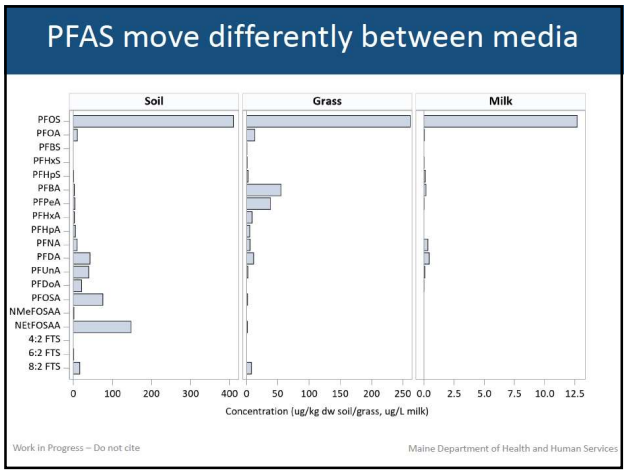
PFAS move differently between media



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Units of Measure

Very important to understand…

Soil/meat/forage etc. measured in ppb
Parts per Billion
Micrograms PFAS per kilogram soil (ug/Kg)

Liquids (water/milk) measured in ppt
Parts per Trillion
Nanograms PFAS per Liter (ng/L)

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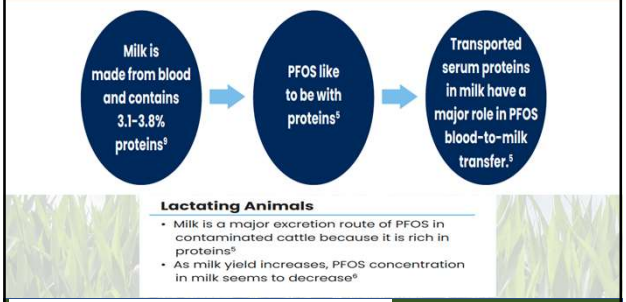
Dairy animals can be exposed to PFAS if they eat or drink contaminated feed or water.[1] Long chain PFAS such as perflourooctane sulfonic acid (PFOS) accumulate in dairy animals because they mostly are not urinated and are re-circulated through the enterohepatic cycle (EHC).[2] PFOS is present in milk even after the animal consumes clean feed because it can take 39-106 days for 50% of the accumulated PFOS to clear from blood.[5]



Lactating Animals

- Milk is a major excretion route of PFOS in contaminated cattle because it is rich in proteins[5]
- As milk yield increases, PFOS concentration in milk seems to decrease[6]

From: "PFAS and Dairy Animals" A. Jimenez, Pereira, G., and Romero, J. 2023 UMaine Extension and School of Food and Agriculture

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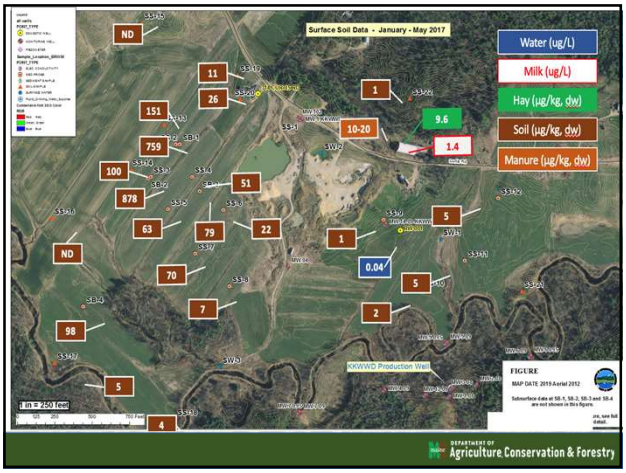

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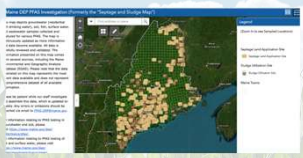
Response to PFAS Contamination

- Governor's PFAS Task Force in March 2019. Recommendations regarding safe drinking water and food and identifying and investigating PFAS in the environment.
- Retail milk testing (2022) led to identification of two additional dairy farms with PFOS contamination of their milk.



DEP PFAS map led to identify some additional dairy farms with contamination

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How much is too much PFOS in milk?

Maine's current adulteration level for milk <u>at the farm</u>

Maine DACF in conjunction Maine CDC has set an adulteration level for milk at 210 *ng/L*

The Maine "team" has successfully depurated 3 of the 5 dairy operations that had exceeded the 210 *ng/L* adulteration level

"Forever chemicals are not forever in cows"

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Soil to Milk Exposure Pathway

Soil → Hay/Corn → Cow → Milk → Child

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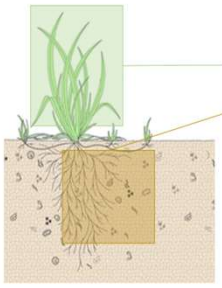
Plant Transfer Factor for Forage Crops



$$\frac{[Plant_{PFAS}\ dw]}{[Soil_{PFAS}\ dw]}$$

The Transfer Factor (TF) for forage crops is on a dry weight basis as forage intake for livestock is provided as dry weight.

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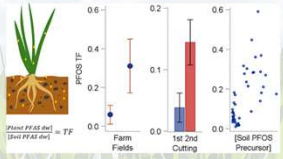
Uptake of Per- and Polyfluoroalkyl Substances in Mixed Forages on Biosolid-Amended Farm Fields

AGRICULTURAL AND ENVIRONMENTAL CHEMISTRY
October 8, 2024. Vol 72/Issue 42

https://pubs.acs.org/doi/10.1021/acs.jafc.4c02078



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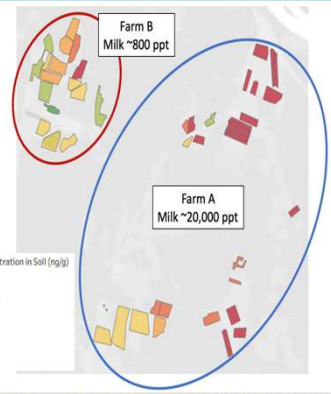

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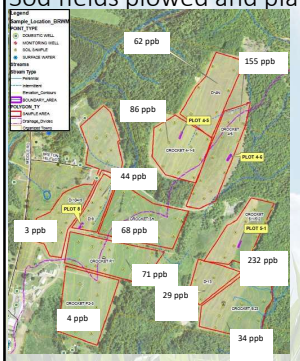
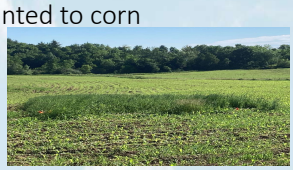
Sod fields plowed and planted to corn





Farm had additional acreage on "non-contaminated" land to provide alternative forage sources for the dairy herd

2021 cropping year involved planting corn for silage on all heavily contaminated land, but pre-harvest testing indicated PFOS levels were still too high to safely feed the herd

Farm harvested the corn as "snaplage"

150 dairy cow organic farm in Central Maine

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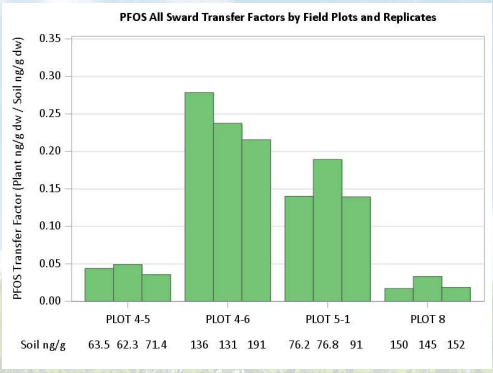
Field Plot All Sward PFOS Transfer Factors

Co-located soil and forage samples from 1X1 ft quadrats



Data courtesy of Maine CDC

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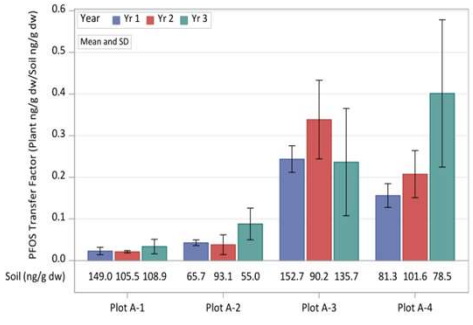
Field Plots Grass PFOS TFs Over 3 Years



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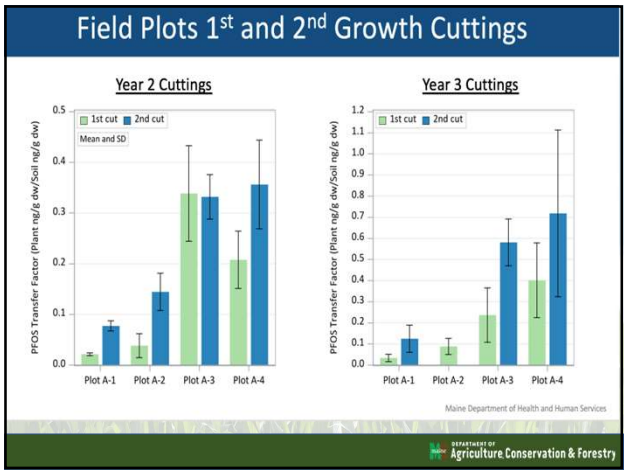
Field Plots 1st and 2nd Growth Cuttings
Year 2 Cuttings
Year 3 Cuttings
1st cut
2nd cut
Mean and SD
PFOS Transfer Factor (Plant ng/g dw/Soil ng/g dw)
Plot A-1
Plot A-2
Plot A-3
Plot A-4
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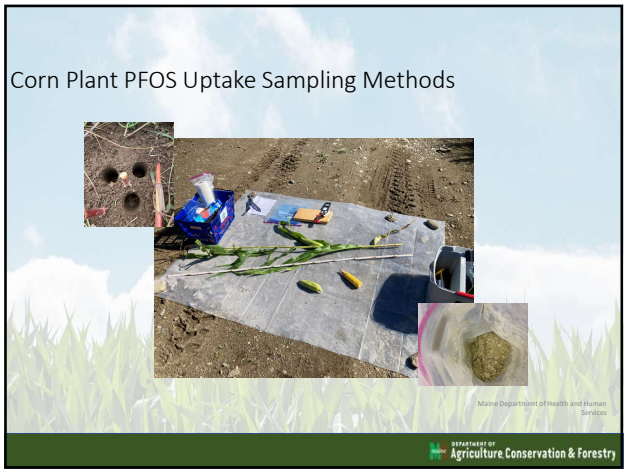
Corn Plant PFOS Uptake Sampling Methods
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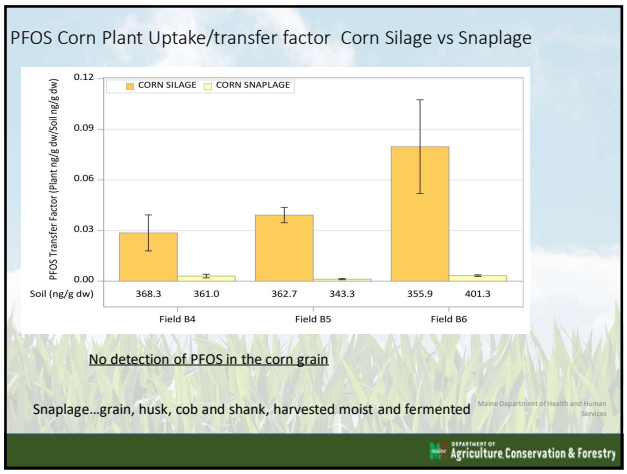
PFOS Corn Plant Uptake/transfer factor Corn Silage vs Snaplage
CORN SILAGE
CORN SNAPLAGE
PFOS Transfer Factor (Plant ng/g dw/Soil ng/g dw)
Soil (ng/g dw)
368.3
361.0
362.7
343.3
355.9
401.3
Field B4
Field B5
Field B6
No detection of PFOS in the corn grain
Snaplage…grain, husk, cob and shank, harvested moist and fermented
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What has been discovered?

Forage grasses and legumes tend to have a high potential to uptake PFAS from the soil and therefore from a crop management perspective grasses and legumes grown in contaminated soil have the highest risk as a potential contamination source for milk.

Corn silage has a lower potential to uptake PFAS and hence has a lower potential to contaminate milk

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Corn grain has an even lower potential, so corn harvested as grain, snaplage or high moisture ear corn will have much lower levels of PFAS than corn silage when grown at the same soil contamination level

Although not quantified, the potential for soil contamination or dirt in your forages harvested from contaminated fields will increase the risk for contaminated milk.

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--150 cow organic dairy
--Shipping about 9,000 pounds of milk per day
--Traditional diet of about 65% forage (haylage/corn silage) 35% grain concentrate
--Well water approx. 30 ppt for "sum of 6 PFAS" including PFOS
--Water treatment installed soon after discovery of milk contamination (fall 2020)
--Initial tests of bulk tank milk were approximately 800 ppt PFOS
--We assumed a ½ life of PFOS in dairy animals to be 60-90 days
--Farm received payments for discarded milk through the DIPP program (Dairy Indemnity Payment Program)for 12 months https://www.fsa.usda.gov/Internet/FSA_File/dipp.pdf

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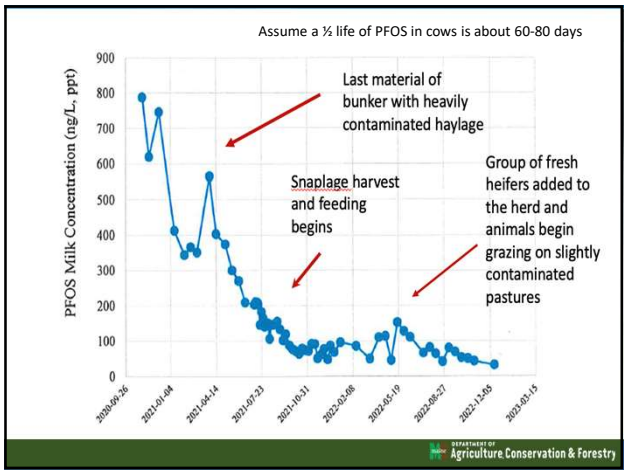
Assume a ½ life of PFOS in cows is about 60-80 days
PFOS Milk Concentration (ng/L, ppt)
900
800
700
600
500
400
300
200
100
0
Last material of bunker with heavily contaminated haylage
Snaplage harvest and feeding begins
Group of fresh heifers added to the herd and animals begin grazing on slightly contaminated pastures
2020-09-26
2021-01-04
2021-04-14
2021-07-23
2021-10-31
2022-02-08
2022-05-19
2022-08-27
2022-12-05
2023-03-15
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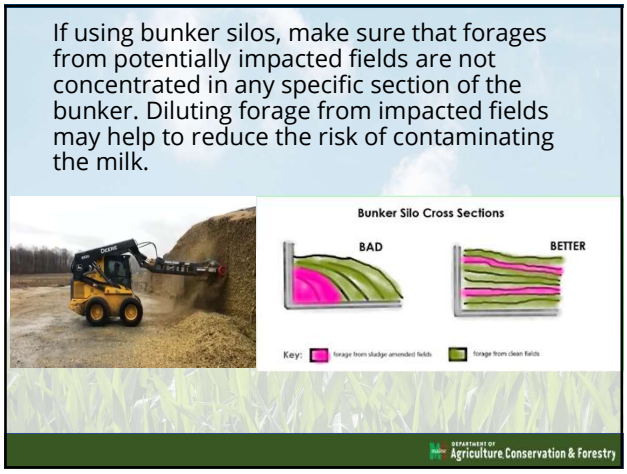
If using bunker silos, make sure that forages from potentially impacted fields are not concentrated in any specific section of the bunker. Diluting forage from impacted fields may help to reduce the risk of contaminating the milk.
Bunker Silo Cross Sections
BAD
BETTER
Key:
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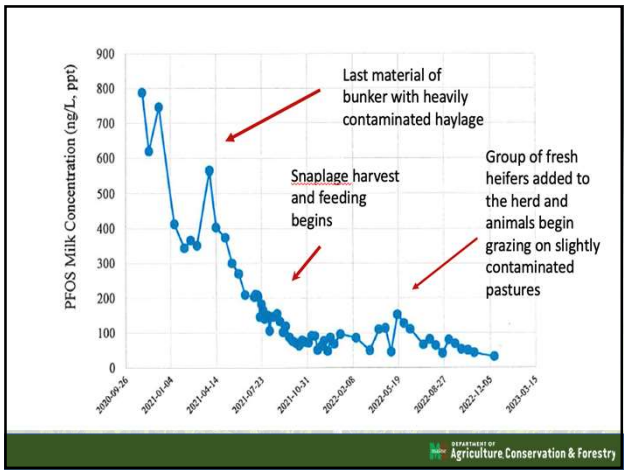
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For fields that have a history of biosolid applications, consider the following forage crop production and harvest changes

- Test the suspect field soils for PFAS levels.
- If you find higher than background levels in the soil and it is currently producing a perennial forage (grass/legume), consider rotating that field into corn silage.
- If soils are highly contaminated, even corn silage could also result in contaminated milk, so harvest the crop as either snaplage, high moisture ear corn or even corn grain. Snaplage can be easily harvested and stored in bunker silos, so the investment in moving to this harvest and storage method would only require the use of a snapper head on your chopper and good bunker silo management.

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If baleage or dry hay is used as a forage storage system, it is critical that bales or lots of hay are labeled as to the source, especially from those fields with a history of biosolid applications or known soil levels.

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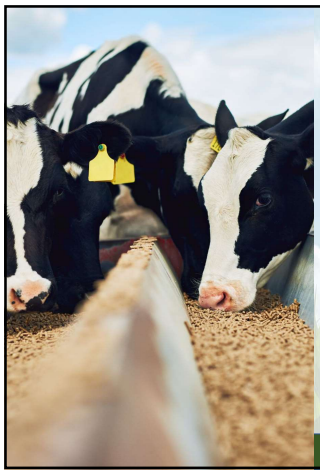

All farms will be impacted differently, depending on the level of contamination, forage sources and ration inputs

Some farms have discussed harvesting the contaminated feed and using it for feeding heifers or dry cows. This is not a solution to the problem and should be avoided. We have found that while the heifers were on clean feed for 8-10 months after being fed contaminated feed (both milk when they were calves and forage), their milk contained high levels of PFOS when they first freshened!

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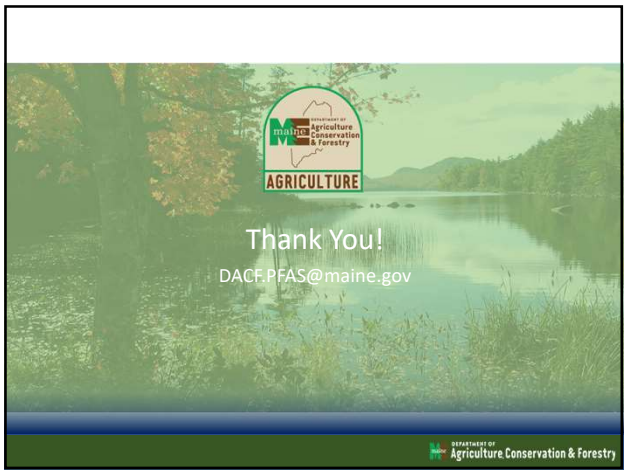
AGRICULTURE
Thank You!
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