BE CERTAIN

September 26, 2023

PFAS – We Found it, What Now?

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Agenda

- Defining PFAS background and significance
- Quantifying background
- Investigation/remediation implications
- Implications
- Planning and Response
- Discussion, Questions

Defining PFAS Background

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PFAS Aren’t a Secret, They’re Everywhere

https://www.progressive-charlestown.com/2022/07/what-weve-learned-about-pfas.html

- Aerospace
- Automotive
- Biosolids
- Firefighting/first responders
- Healthcare/pharmaceutical
- Metal plating, wire coating
- Mining – odor/dust control, enhanced recovery
- Oil and gas
- Paints, varnishes, sealants, waxes, polishes
- Textiles and carpets
- Weather resistant equipment

What is Anthropogenic Background?

- Natural Background: Hazardous substance naturally occurring (deposited by geologic forces)
- Anthropogenic Background: Human activities deposit a natural or synthetic hazardous substance at a location
  - Multiple diffuse sources
  - Atmospheric deposition
  - Cannot be reliably traced back to a distinct source
- Well established concept for oil/petroleum, nitrates, etc.

We already recognize “ambient” conditions for other COCs

- Natural
  - Naturally occurring metals
  - Radon
- Anthropogenic
  - Metals
  - PAHs
  - Regulatory exemptions for:
    - Urban Fill
    - Biosolids applications
    - Pesticide applications consistent with labeling
    - Higher standards in industrialized areas

Background Metal Concentrations in Oklahoma Soils

Published May. 2018 | **Id: PSS-2276**

By Hailin Zhang

groundwater

Estimating Background and Threshold Nitrate Concentrations Using Probability Graphs

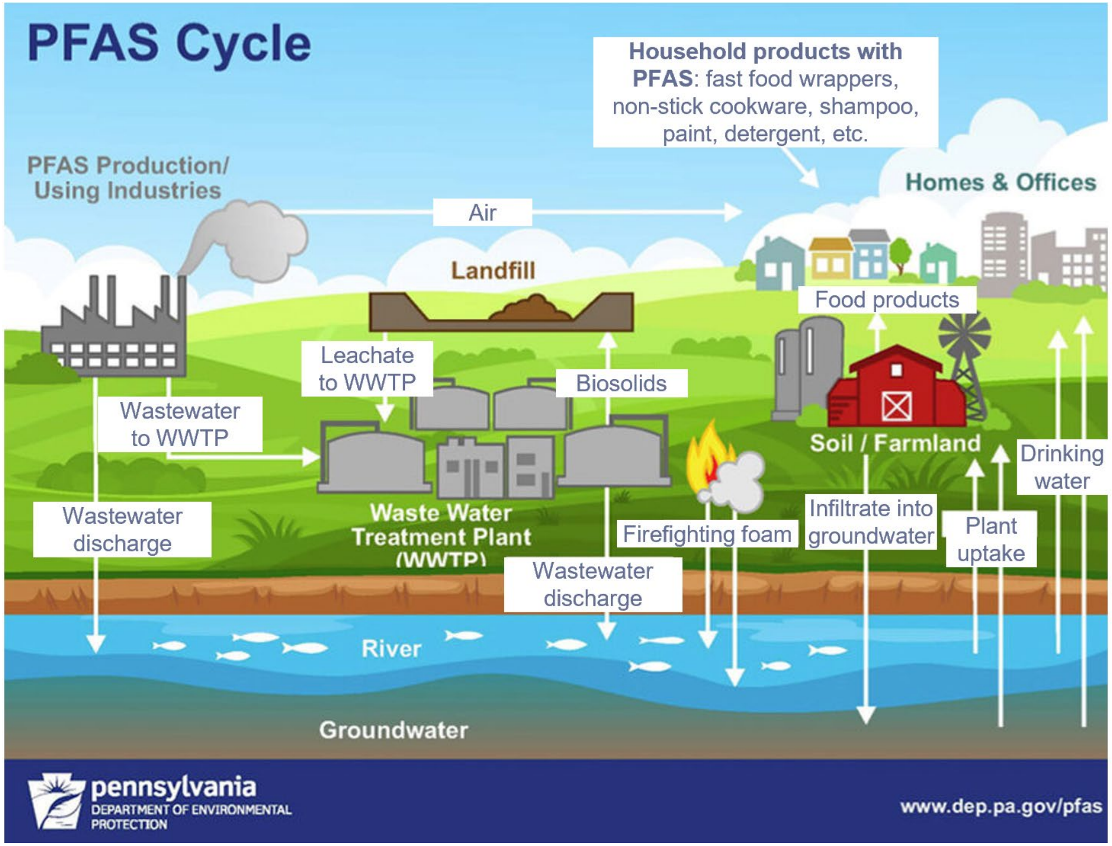
by S.V. Panno[1], W.R. Kelly[2], A.T. Martinsek[3], and K.C. Hackley[4]

“For sites with naturally-occurring contaminants, KDHE/BER ***may allow the background concentration to be the cleanup goal in that medium****. To establish Tier 1 cleanup levels,* ***background concentrations*** *of naturally-occurring contaminants* ***must be determined*** *at the site.*

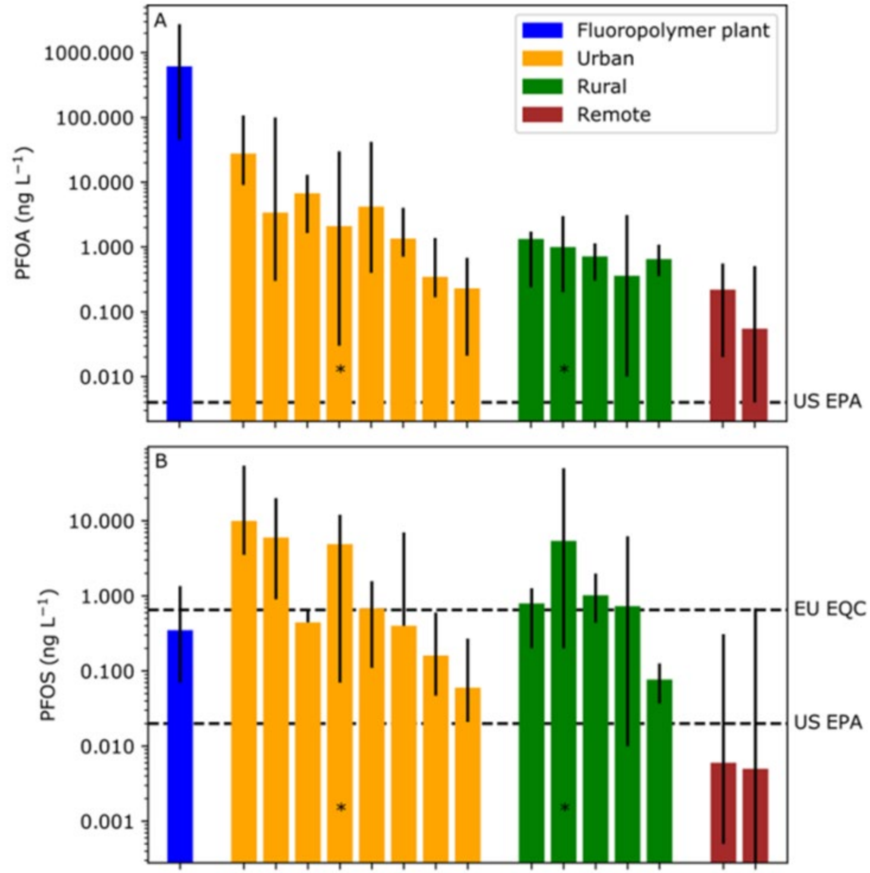
– 2021 Kansas RSK Manual, 6th Version

So why is PFAS background a thing?

- Timing
  - 70-year history
  - Different chemistries
- Magnitude of release
  - Up to 10,000 lbs/year from single plant
- Mobility and recalcitrance
- Concept has been in literature
- Recent studies to quantify



Results in Precipitation



Cousins et al., 2022
Global locations 2010 – present

Results in Precipitation

Summary of PFAS Concentrations by Location

PFAS	Concentration (ng L^{-1})[a] at Location Shaker Heights, OH	Willoughby, OH	Wooster, OH	Ashland, OH	Rockford, OH	Whitestown, IN	Jackson Hole, WY
TFA	430	100	340	370	200	80	470
	50-1200	70-170	110-1100	60-1100	80-750	4-170	270-850
PFBA	2	0.7	60	2	2	2	5
	2×10^{-3} -6	0.02-1.2	9-290	0.5-4	0.3-8	0.02-3	0.2-20
PFPeA	0.7	0.5	30	1	0.7	0.2	1
	0.08-2	0.2-1	4-120	0.2-5	0.2-2	1×10^{-2} -0.4	0.3-2
PFHxA	2	0.9	20	1	0.5	0.6	1
	0.2-10	0.1-4	3-80	0.5-2	0.2-0.8	0.05-0.8	0.6-1.4
PFHpA	2	0.8	10	0.6	0.4	0.5	2
	0.3-8	0.2-3	2-50	0.2-1	0.08-0.7	0.4-0.9	1-2
PFOA	2	1	8	1	0.6	0.5	2
	0.3-8	0.4-3	1-30	0.5-3	0.2-1	0.03-0.9	1-3
PFNA	0.8	0.4	4	0.5	0.4	0.2	1
	0.08-3	0.1-0.6	0.4-10	0.2-1.3	0.1-0.9	0.01-0.4	0.5-1.3
PFDA	0.9	2	3	0.6	0.4	0.2	7
	0.1-3	0.1-9	0.5-9	0.2-1	0.1-1	0.02-0.4	0.2-20
PFOS	4	8	9	3	2	1	20
	2-7	4-11	0.5-12	0.7-9	0.2-10	0.07-3	0.4-50
HFPO-DA	2	1	1	0.8	0.9	2	2
	0.2-5	0.2-3	0.5-3	0.3-2	5×10^{-4}-3	0.2-3	0.4-3

[a] Mean and range of detected concentrations in ng L^{-1}. PFAS abbreviations are defined in the SI.

Pike et al., 2021

Results in Soils: State Investigations

Reference	Location	No. PFAS Analytes	PFOS (µg/kg)	PFOA (µg/kg)	∑PFAS (µg/kg)
Llorca et al., 2012	Antarctica	18	0.31 – 0.54	ND	1.26 – 1.76
Strynar et al., 2012	Global	13	ND – 10.1	0.764 – 31.7	7.81 – 129
Rankin et al., 2016	Global	32	ND – 3.13	ND – 3.44	0.055 – 14.47
Groh et al., 2016	Germany	20	2.0 – 8.0	ND – 2	2.0 – 10.0
Wang et al., 2018	China	2	ND – 0.002	ND – 0.009	ND – 0.011
Zhu et al., 2022	Vermont	17	0.106 – 9.79	0.052 – 4.9	0.54 – 35
Sörengård et al., 2022	Sweden	28	ND – 1.7	ND – 0.57	0.29 – 8.63
Sanborn, Head & Associates, Inc., 2022	Maine	28	ND – 5.32[1]	ND – 5.29[1]	ND – 19.64[1]
Michigan Project	Michigan	28	ND – 0.88	ND – 0.36	ND – 2.016

ND = non-detect; not detected above the method detection limit

1. Sample identified as an outlier in Maine study not included in this table

Complication of PFAS Anthropogenic Background

9/10/22, 10:13 AM Temporary background values for PFAS in Dutch soil | RIVM

National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport

RIVM Committed to *health and sustainability*

Temporary background values for PFAS in Dutch soil

Publication date 12/03/2019 - 14:20

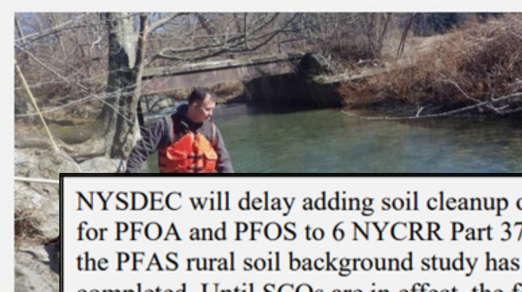
RIVM has derived temporary background values for two types of PFAS in Dutch soil: PFOS (perfluorooctane sulfonate) and PFOA (perfluoro octanoic acid). For PFOS, RIVM recommends a temporary background value of 0.9 micrograms per kilogram of soil and 0.8 micrograms per kilogram of soil for PFOA. Based on this advice, the Ministry of Infrastructure and Water Management has decided to set a new temporary standard for PFAS in soil and dredging material.

NEW YORK STATE OF OPPORTUNITY. | Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

April 2023



NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:

Results in Groundwater

PFAS Compound	Mean (ng/L)	95% Confidence Interval (ng/L)	# Sample Locations
PFOS	46	48	1,043
PFOA	13	5	1,051
PFNA	3.4	1.6	677
PFHxS	6	1	732
PFBS	8.9	1.9	668
HFPO-DA	0.060	NA	30

Johnson et al.
Study of literature values from wells with no local PFAS source

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PFAS Background: Summary

- Anthropogenic background is from multiple diffuse sources
  - No distinct source
  - Can vary by region and within a region
  - “Clean edge” may not be discernable
- Many current/proposed regulatory levels < PFAS background levels
- Increasing awareness and location specific studies are underway
  - Regulatory implications unclear
- At some sites PFAS detections above regulatory standards may be an ambient condition not reasonably attributable to any specific source or responsible party

Investigation/Remediation Implications

Step 1. "Prove the Negative"

– Demonstrate that you did not use or store PFAS-containing materials at your site

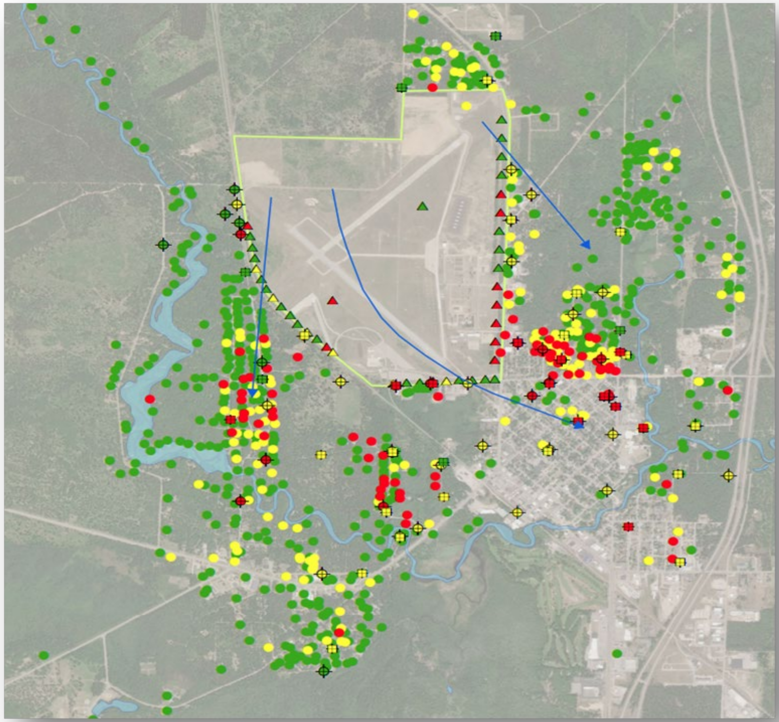
– Archival review of inventories (often incomplete histories)

Budget Division: [NAME]
Department Name/Number: [NAME/NUMBER]
Building Name/Number: [NAME/NUMBER]
Supervisor: [NAME]
Date: [DATE]

Cas No	Manufacturer's/Supplier's Chemical Name	Manufacturer's Name	Supplier	Maximum Quantity (L or kg)	DG Class	Sub risk	PG	UN No	Haz Sub Y/N	Poison Schedule	Current MSDS/SDS (Yes or No)	Room Number/ Location
64-19-7	Acetic acid	Acetic acid	Ajax Merck	2.5L	8	3	II	2789	Yes	6	16/08/11	Lab 301
50-78-2	Acetyl salicylic acid	Aspirin	Bayer	0.3kg	6.1	nil	III	3249	Yes	2	15/06/12	Lab 301
7664-41-7	Ammonia Anhydrous Liquefied	Ammonia (gas)	Quenos	43L	2.3	8	nil	1005	Yes	6	2/03/13	Cyl cage
nil	Ammonia solution 32%	Ammonia solution 32%	Ajax Finechem	2.5L	8	nil	III	2672	Yes	6	31/01/12	Lab 301
71-43-2	Benzene	Benzene	Acros	5L	3	nil	II	1114	Yes	7	5/06/12	Lab 301
10043-52-4	Calcium chloride	Caltac	APS Specialty Chemicals	.5kg	nil	nil	nil	nil	Yes	nil	23/04/10	Lab 301
630-08-0	Carbon monoxide	Carbon monoxide	Matheson	12L	2.3	2.1	nil	1016	Yes	nil	21/04/10	Cyl cage
67-66-3	Chloroform	Chloroform	Ajax	2.5L	6.1	nil	III	1888	Yes	6	26/04/13	Lab 301
50-99-7	D-(+)Glucose	D-Glucose	ICN	1 kg	nil	nil	nil	nil	No	nil	21/07/11	Lab 301
3615-56-3	D-(+)Sorbose	D-Sorbose	ICN	3kg	nil	nil	nil	nil	No	nil	12/05/10	Lab 301
7664-39-3	Hydrofluoric acid	Hydrofluoric acid	APS Specialty Chemicals	1L	8	6.1	I	1790	Yes	7	10/03/13	Lab 301
87-79-6	L-Sorbose	Sorbin	Sigma	5kg	nil	nil	nil	nil	No	nil	30/03/11	Lab 301
7783-54-2	Nitrogen trifluoride	Nitrogen trifluoride	Air Liquide	0.8L	2.2	5.1	nil	2451	Yes	nil	24/06/10	Lab 301
7647-14-5	Sodium chloride	Common Salt	APS Specialty Chemicals	50kg	nil	nil	nil	nil	No	nil	24/06/10	Lab 301

Step 2. Site Investigation/Sampling

- Investigate potential source areas on-site
  - You will detect PFAS
- Delineate nature and extent
  - Investigate off-site
  - You will continue to detect PFAS
- Complete delineation = defined geometry to lowest applicable criteria
  - Not always achievable given the low limits



Step 3. Data Interpretation

- Traditional methods to understand fate and transport
  - Hydrogeology
  - Chemical transformation
  - Aerial flux
  - Surficial/storm water migration
- With PFAS, may reveal anomalies indicative of multiple sources
- Can be other point-source releases and/or diffuse sources:
  - Aerial deposition from unidentified atmospheric releases (10+ miles away)
  - Residential releases
  - Consolidation/migration through urban storm water systems
    - Ditches, drains
  - More…

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Step 4. "Prove the Negative" (again)

- What is potentially mine?
  - What could originate elsewhere?
- Forensic tools are available
  - Many scenarios can include a multitude of overlapping potential point and diffuse sources
- Limited regulatory acceptance/protocol to account for diffuse sources/background

The Heart of the Challenge

How do we protect public health while also ensuring fair limits on liability?

- rely on the science and establish regulatory protocols considering anthropogenic PFAS background?

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Implications

- EPA's "Whole of Agency" approach
- PFAS added to EPA's list of enforcement priorities
- Efforts to reduce/eliminate PFAS from POTWs
  - Industrial dischargers
  - Pretreatment requirements
- Potential state requirements
- Low concentrations proposed and under discussion
- Potential Third-Party liabilities
- Scientific methods in flux
- Requirements in flux
- Risk communication challenges

Regulatory implications

- POTW dischargers
- NPDES direct dischargers
- CERCLA and environmental remediation
- RCRA and waste management
- State requirements

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Investigation topics

- Identifying the investigation goal
- Planning for the response to the investigation results
- Will you have to disclose?
  - When and to whom?
  - Under what authorities?
- Required or voluntary?
- Confidentiality and privilege considerations

Planning and Response

- Consider attorney-client privilege issues
- Consider prospects for litigation
- Identify potential other contributors
- Source reduction
- Finding alternatives
- Follow regulatory developments; comment on draft rules, guidance, protocols
- Weighing and balancing risks and alternatives
- **Bottom Line: Sometimes, there will be no clear answers**

Discussion, Questions