Per- and Polyfluoroalkyl Substances: From Operational Use of AFFF to Impacted Water Supply to Class Action Lawsuit

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NRC admits it's the source of Mississippi Mills water contamination

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The National Research Council has formally acknowledged to residents of the town that its National Fire Laboratory is the source of contamination in the residents' wells.

"It's kind of like a truth and reconciliation process," Mayor Shaun McLaughlin said Friday. The NRC acknowledges its role, "now let's move forward to fix it."

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1. Background

- Historical use of aqueous film forming foam (AFFF) at federally-owned testing/training facilities resulted in PFAS in groundwater
- Residential properties are located downgradient, which rely on groundwater as a potable water source
- Challenges with communicating information to affected residents and other stakeholders given evolving scientific knowledge on PFAS

How are engineers and scientists supporting their clients, while trying to further close data gaps and respond to requests from multiple parties with diverging priorities?

2. Confounding Sources

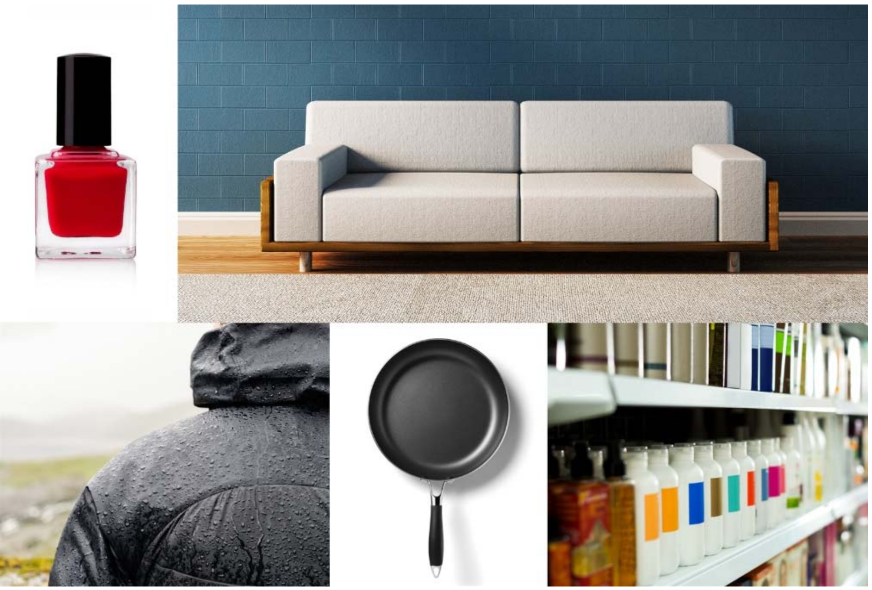
Source: Minister of Public Works and Government Services Canada 2007
Cat. No. TU3-5/05-3E
ISBN 978-0-662-47298-8

Off-Site historical activities may not be identified as part of a traditional Phase I ESA.

Beyond target operations, several other confounding sources could contribute to PFAS in the environment:

- Off-site fires with possible use of AFFF
- Runway excursions and response
- Compressor stations on natural gas pipelines
- Landfills
- Biosolids applications
- Septic Fields

3. Complex Sampling Requirements



Source: open access images – bing.com

Sampling requirements have been very conservative because of widespread sources of PFAS

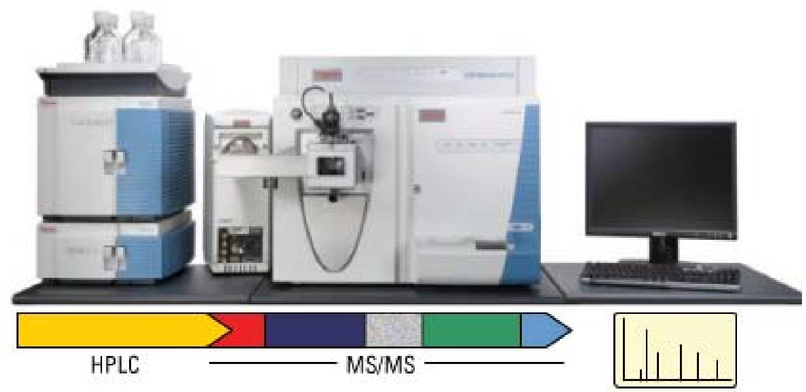
- Consumer goods
- Industrial products

Combine the potential for cross contamination from sampling equipment with ever decreasing **laboratory detection limits** will make you question **attribution…**

Important to understand PFAS (branched vs linear, anions vs acids)

4. Analytical Techniques

- Detection limits are getting lower and so are trigger values
- Over 3000 PFAS exists; however, laboratories have limited suites of parameters they can analyze
- Total Oxidizable Precursors (TOP) Assay
  - Some PFAS can degrade to PFAA (Perfluoroalkyl Acids) – "PFAA precursors"
  - TOP Assays (LC/MS) test presence of PFAA precursors
    - May be better for soils than GW
    - Does not represent biotransformation under natural conditions



Source: open access images – bing.com

5. International Regulatory Values

Groundwater

Location	Standard/ Guidance	Type/Medium	Concentration (µg/L)		
			PFOA	PFOS	Other
US EPA	Lifetime health advisory	Drinking water	0.07	0.07	
	Regional screening value	Groundwater	0.4	0.4	401 (PFBS)
Canada	Screening value	Drinking water	0.2	0.6	0.2 (PFNS), 30 (PFBA), 15 (PFBS), 0.6 (PFHxS), 0.2 (PFHxA), 0.2 (PFPeA), 0.2 (PFHpA)
Australia	Health-based	Drinking water	0.56	0.07	0.07 (PFHxS)
	Health-based	Recreational water	5.6	0.7	0.7 (PFHxS)
Germany	Health-based	Drinking water	0.3/0.1	0.3/0.1	
UK	Health-based	Drinking water	10	0.3	
Netherlands	Health-based	Drinking water		0.53	
Sweden	Health-based	Drinking water		0.09	
Denmark	Health-based	Drinking water/ groundwater	0.1	0.1	0.1*
Italy	Health-based	Drinking water	0.5		7 (PFBA), 3 (PFBS), 1 (PFHxA), 3 (PFPeA)

Source: ITRC PFAS Regulations, Guidance and Advisories Fact Sheet (November 2017)

5. International Regulatory Values

Soil

Location	Standard/ Guidance	Concentration (mg/kg)		
		PFOA	PFOS	Other
US EPA	Groundwater protection	0.000172	0.0017	0.13 (PFBS)
	HH soil screening value	1.26	1.26	1260 (PFBS)
Canada	Soil screening value	0.85	2.1	
Australia	Interim screening value	16	6	6 (PFHxS), 60 (6:2 FTS)
Western Australia	Interim screening value	40	4	4 (PFHxS)
Denmark	Soil screening values	0.4	0.4	0.4 (PFNA, PFBA, PFBS, PFPeA, PFHxS, PFHxA, PFHpA, PFOSA, PFDA, 6:2 FTS)

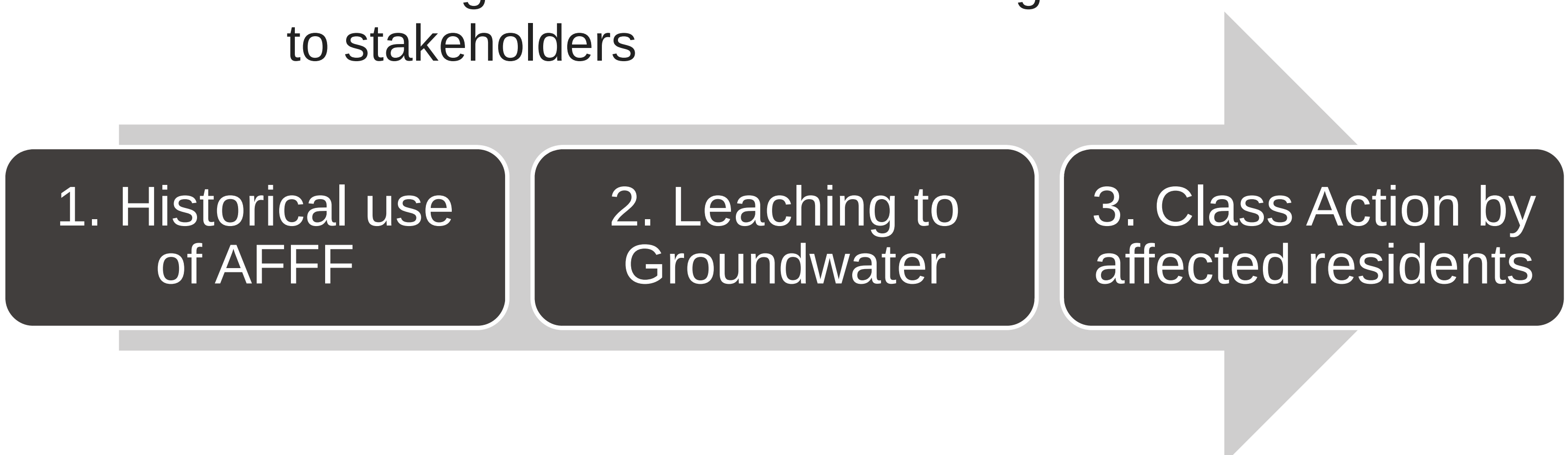
Source: ITRC PFAS Regulations, Guidance and Advisories Fact Sheet (November 2017)

6. Communication Challenges

1. Sampling and analytical techniques evolving and practitioners are constantly trying to keep up

2. New trigger values/guidelines are being developed by jurisdictions based on evolving science/rationale

3. Challenges when communicating uncertainties and results to stakeholders



Uncertainty

Uncertainty *is "the state, even partial, of deficiency of information related to understanding or knowledge of an event, its consequence, or likelyhood"*[1]

- The terms Risk and Uncertainty are inseparable
- You need to understand the main types (1. **Natural variability**; 2. **Model and Parameter uncertainty**; and 3. **Deep Uncertainty**) and sources of uncertainty to assess, characterize, reduce, communicated, and tie into decision-making
- Determine how much effort (**merits vs costs**) to put into reducing the uncertainty – and accept that deep uncertainties are unlikely to be able to be reduced during a project timeframe

1. Standards New Zealand (2009)

Communicating Scientific Uncertainty

"*risk communication (was) still more art than science, relying as it often does in practice on good intuition rather than well-researched principles*"[2]

- Understand the type and source of uncertainty and whether the uncertainty analysis is qualitative or quantitative
- Trust is of central importance to risk management and communication
  - The lower the trust, the higher the perception of risk
  - Knowledge and expertise, honesty and openness, and concern and care

2. Spiegelhater et al., 2011

You have assessed the site; now what? Limited Remediation Options

Incineration

- Permanent
- Expensive
- Regulated

Landfilling

- Is this a good practice?
- What about leachate collection and treatment?

Adsorption

- Long-term risk management option
- Need to monitor for breakthrough
- Spent adsorbent needs to be dealt with
    - Incineration
    - Landfilling ?

You have detections or even exceedances; now what?

Parameters with no regulatory information

- Leads to communication challenges when detectable concentrations are reported for parameters with no available screening values/guidelines
- Limited literature information available to evaluation potential risk
- Does this mean that non-detections are the number to be considered for these parameters?

For parameters with regulatory information

- If detected but below regulatory numbers, can practitioners disregard these parameters
- Science/regulatory values are evolving

Your client is facing a Class Action Lawsuit; now what?

- Difficulty communicating science to clients is challenging, more challenging explaining these limitations to lawyers
- Potential risks to human health are likely driving legal decision and the value of the litigation (cost)
- But in the absence of good toxicity data, what does that mean?

Uncertainties and Litigation

- US studies have shown PFAS in humans (blood)
- Is this a result of releases or commercial production?
- Likely difficult to differentiate between the sources, so how does this impact communication and litigation
- As practitioners, we are approached to give answers but this can be difficult
  - Can’t include/exclude potential exposure
  - We can focus on what is detected and where we understand exposure pathways and the source and continue to monitor

The Precautionary Principle

Ask yourself:

1. When being wrong in one direction could carry more serious consequences than being wrong in the other, what would you do?
2. In case of social controversy, what *should* I do?
3. When public distrust in outcomes show that risks can be expected, decide what uncertainties need to be communicated and how (not “one size fits all”)

We have evolved from thinking that all we need is to:

- communicate “good results and good science”, to
- “comparing the risks to other risks *accepted* in the past”, to
- the need for two-way communication and stakeholder engagement – make them **PARTNERS**

7. Some Lessons-Learned

- If the data look “off” – question it
- Build your team with experts: Engineers and Scientists, Toxicologists, Communications Experts
  - Treat communication as part of scientists’ professional responsibility and understand the direct costs of analysis and message development
  - Develop a Communication Plan **specific to the target audience**
- Stay on top of the literature and standards/guidelines
- Assume an Adaptive Management Approach will be needed
- In the absence of an easy fix, ask yourself “so what” to plan your next steps
  - Politically
  - Scientifically (remediation/risk management)
  - Socially
  - Legally

Acknowledge Limitations and Ignorance…

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Thank You – Questions

References

1. Standards New Zealand. 2009. AS/NZS ISO (Australian Standard/New Zealand Standard) Risk management – Principles and Guidelines. Wellington: Standards New Zealand
2. Spiegelhalter D, Pearson M, Short I. Visualizing uncertainty about the future. Science 2011; 333(6048):1393-1400.