

AFFF Transition and ECCC's PFAS Risk Management Plan Phase 1: Regulatory, Technical and Practical Considerations

Harris Switzman, M.A.Sc., P.Geo., ENVSP

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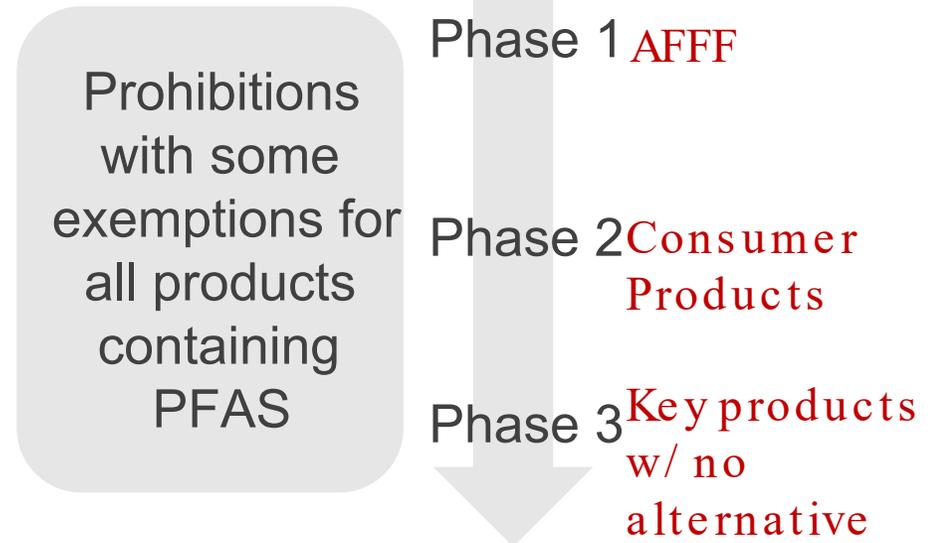
James Jorgensen, Calgary Airports





ECCC is proposing for the full class of PFAS substances to be deemed “Toxic substance” under the Schedule 1 to the Canadian Environmental Protection Act.

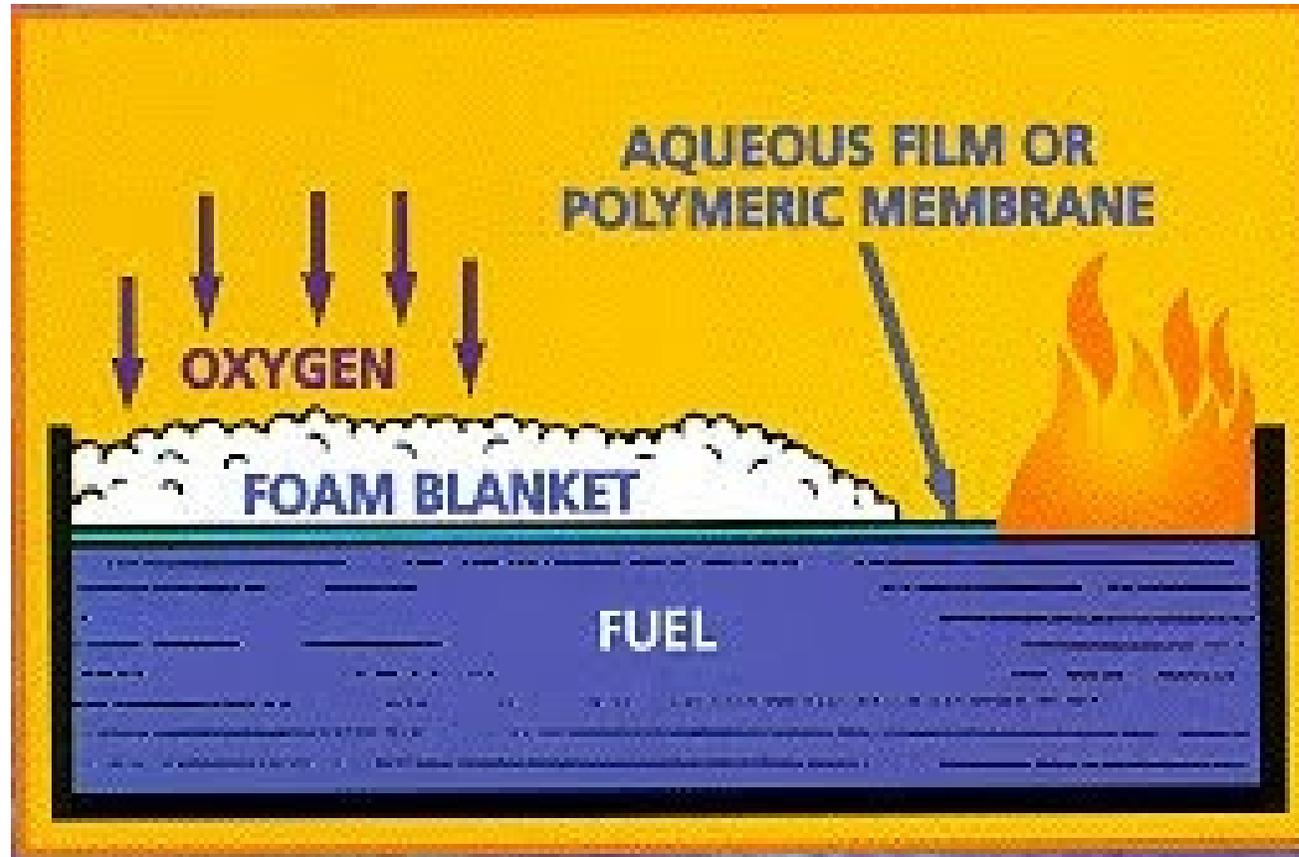
Risk Management Approach



Who needs to think about risk related to AFFF?

Proposal is to: “prohibit the manufacture, use, sale and import of PFAS, not currently regulated under CEPA, in firefighting foams, such as C6 AFFF, through new regulations”

**CLASS B
FOAMS**



**CLASS B
FOAMS**



- cosmetics
- natural health products and non-prescription drugs
- food packaging materials, food additives, and industrial food contact products such as paper plates, cups and bowls
- paint and coating, adhesive and sealant and other building materials available to consumers
- consumer mixtures such as cleaning products, waxes and polishes
- textile uses (including personal protective equipment such as firefighting turnout gear)
- ski waxes



Facility Types with Class B Foam

Airports and Aviation Facilities

Airports have aircraft hangars and fueling areas requiring AFFF for jet fuel fire suppression.

Petroleum and Chemical Plants

Oil refineries and petrochemical plants use AFFF due to high risks of flammable liquid fires.

Marine and Shipping Terminals

Ports and tanker loading areas use foam systems to reduce fire hazards during cargo operations.

Emergency Response Agencies

Fire departments maintain AFFF stockpiles to quickly respond to flammable liquid fire incidents.

Chemical Manufacturing

Chemical plants handle reactive solvents and chemicals that require Class B AFFF fire protection.

Paint and Coatings Facilities

Large volumes of flammable solvents in paint production drive the need for effective foam fire systems.

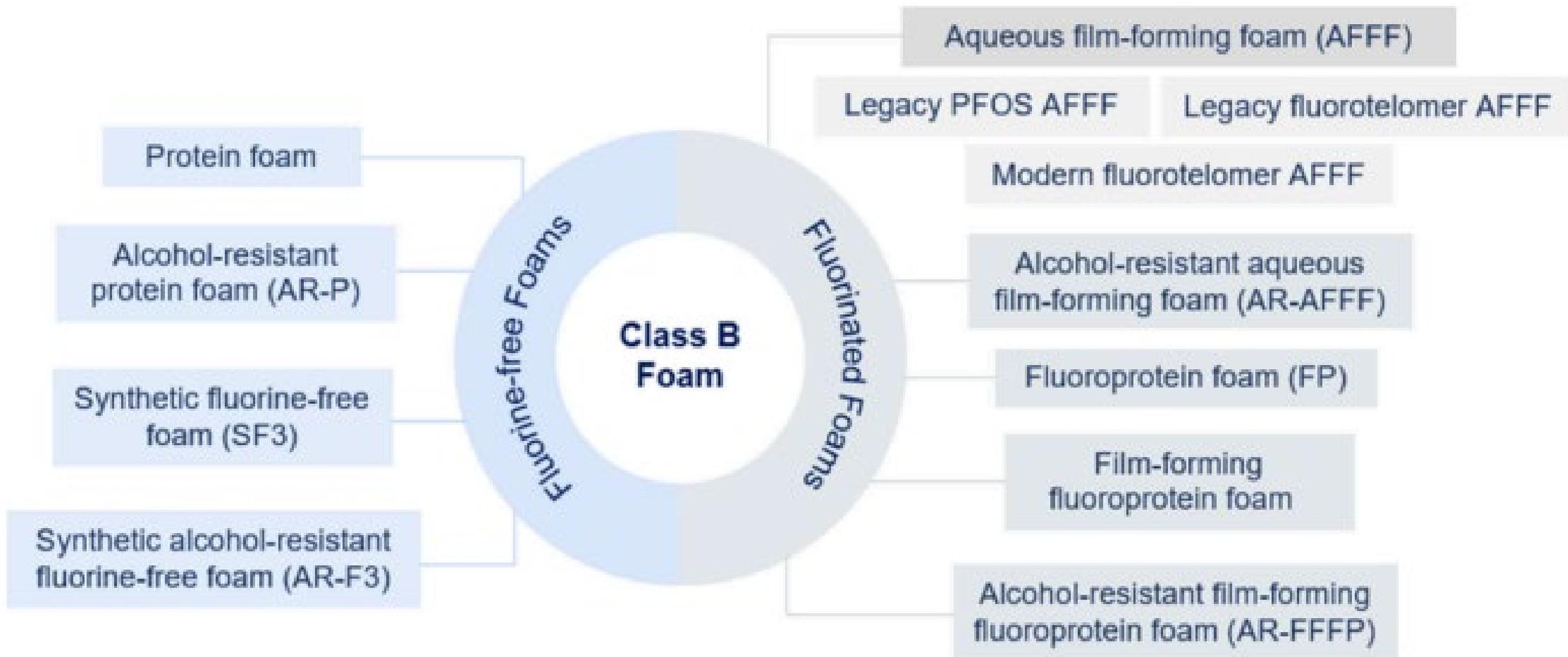
Automotive and Aerospace Manufacturing

Facilities using hydraulic fluids and solvent-based agents require rapid fire suppression like AFFF systems.

Food Processing Fire Hazards

Food plants with large oil storage need specialized foam systems to mitigate fire risks effectively.





From: Jahura, F. T., Mazumder, N. U. S., Hossain, M. T., Kasebi, A., Girase, A., & Ormond, R. B. (2024). Exploring the Prospects and Challenges of Fluorine-Free Firefighting Foams (F3) as Alternatives to Aqueous Film-Forming Foams (AFFF): A Review. In ACS Omega (Vol. 9, Issue 36, pp. 37430–37444). American Chemical Society. <https://doi.org/10.1021/acsomega.4c03673>



**My facility / facility of interest
has a Class B foam fire
suppression system**

**Do we currently
use AFFF?**

PFOS Foams
'C8' Foams
'C6' Foams

**Have we used AFFF
in the past?**



Use/sector	Transitional period(s)
(a) Portable fire extinguishers	18 months
(b) Municipal fire services	18 months
(c) Civilian aviation	3 years
(d) Other industries	3 years
(e) Civilian ships already in service at the coming into force	6 years
(f) Defence (military aviation, ships and other applications)	6 years
(g) Installations belonging to the offshore oil and gas industry	6 years
(h) Facilities in highhazard industries	6 years

... Starting in 2029

[Table 3 from Environment and Climate Change Canada. 2025. Consultation Document on Phase 1 of the Risk Management of Perand Polyfluoroalkyl Substances \(PFAS\), Excluding Fluoropolymers: Prohibition of the Use of PFAS not Currently Regulated in Firefighting Foam](https://www150.comms.ca)

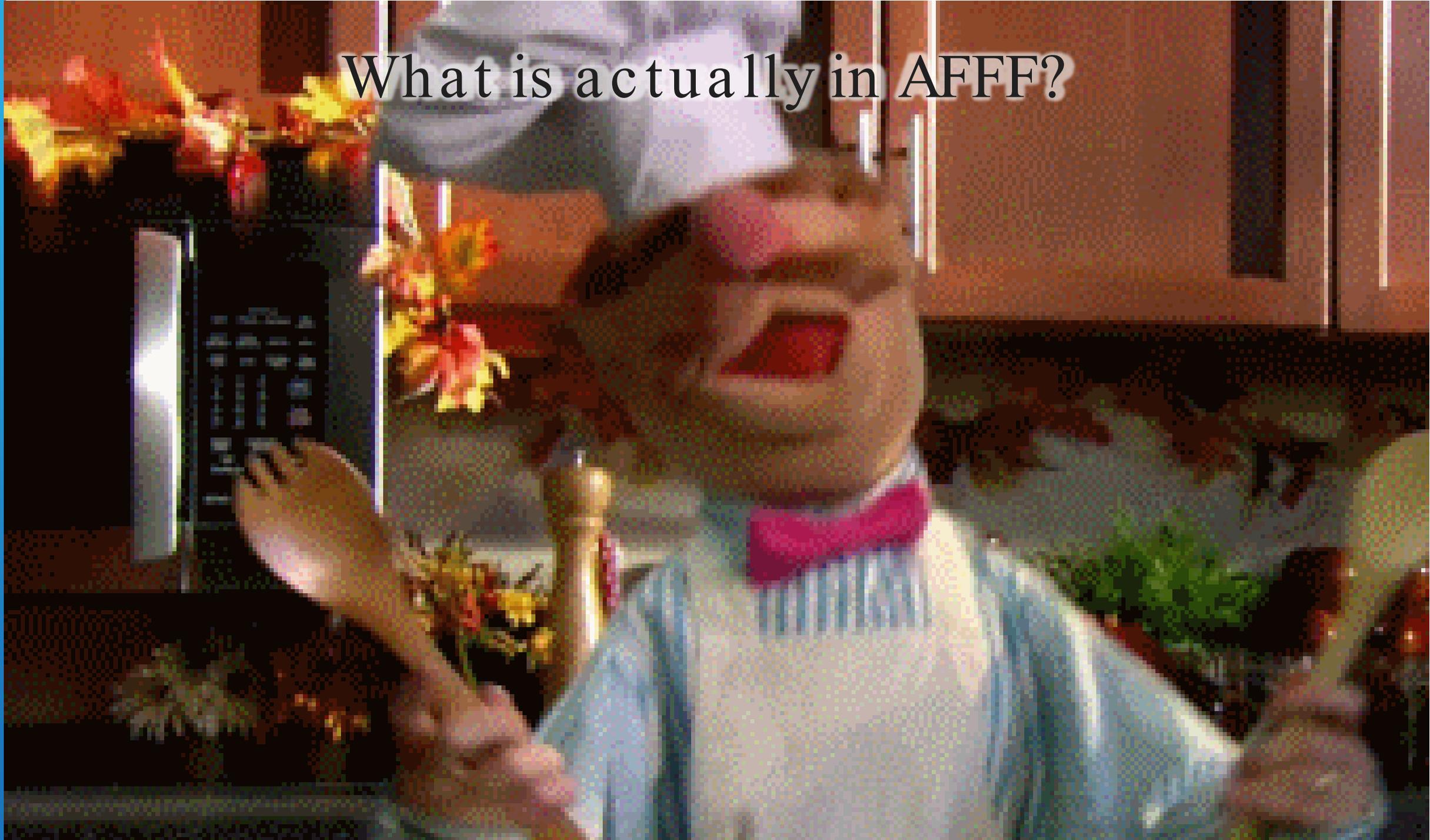


How Clean is Clean Enough?

PFAS	Maximum concentration limits
PFOS; its salts and related compounds	<ul style="list-style-type: none"> •0.025 mg/kg (0.0000025 % w/w) for the sum of PFOS or any of its salts; 1 mg/kg (0.0001 % w/w) for the sum of PFOS related compounds
PFHxS; its salts and related compounds	<ul style="list-style-type: none"> •0.025 mg/kg (0.0000025 % w/w) for the sum of PFHxS or any of its salts; 1 mg/kg (0.0001 % w/w) for the sum of PFHxS related compounds
PFHxA; its salts and related substances	<ul style="list-style-type: none"> •25 ppb for the sum of PFHxA and its salts; 1,000 ppb for the sum of PFHxA related substances
PFOA; its salts and related compounds	<ul style="list-style-type: none"> •0.025 mg/kg (0.0000025 % w/w) for the sum of PFOA or any of its salts •1 mg/kg (0.0001 % w/w) for the sum of PFOA related compounds •When they are present in firefighting foam for liquid fuel suppression and liquid fuel fire (Class B fires) already installed in systems: 1 mg/kg (0.0001 % w/w) of PFOA or any of its salts; 10 mg/kg (0,001 % w/w) of any individual PFOA related compound or combination of PFOA related compounds; until August 3, 2028 •When they are present in fluorine firefighting foam and originate from firefighting equipment which has undergone cleaning in accordance with the best available techniques: 10 mg/kg (0.001 % w/w) for the sum of the concentration of PFOA, its salts and PFOA related compounds
PFCAs (C9-14); their salts and related substances	<ul style="list-style-type: none"> •25 ppb for the sum of C9-14 PFCAs and their salts; 260 ppb for the sum of C9-14 PFCAs related substances
All PFAS	<ul style="list-style-type: none"> •1 mg/L for the sum of all PFAS; 50 mg/L for the sum of all PFAS in fluorine firefighting foams originating from equipment which has undergone cleaning in accordance with the best available techniques, excluding portable fire extinguishers. (This limit is accompanied by a 5-year review clause at the latest)



What is actually in AFFF?



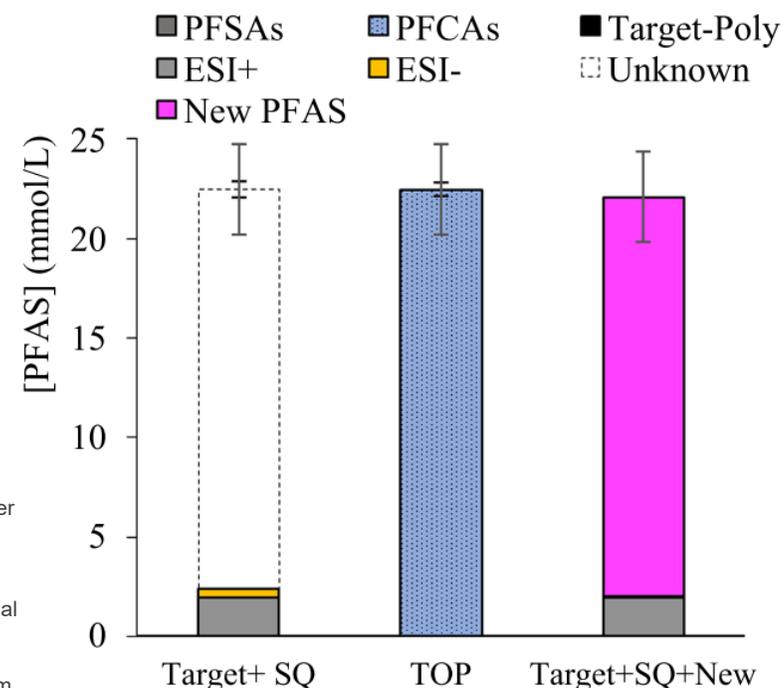
What is actually in AFFF?

AFFF SDS Composition Information (Ansolite C6)



Chemical name	CAS No.	weight-%
2-(2-Butoxyethoxy)ethanol	112-34-5	5 - 10
Lauryl Imino Propionate, Sodium Salt	14960-06-6	1 - 5
Polyfluorinated alkyl betaine	Proprietary	1 - 5

- No two foams are alike
 - C6 foams are comprised of approximately 90% of PFAS in commercially available foams were found to be 4:2 and 6:2 fluorotelomers (Gharehveran et al. 2022, Ruyle et al. 2021)
 - In a MIL-spec foam, over 90% of analysed PFAS were unknown (Shojaei et al. 2022) →

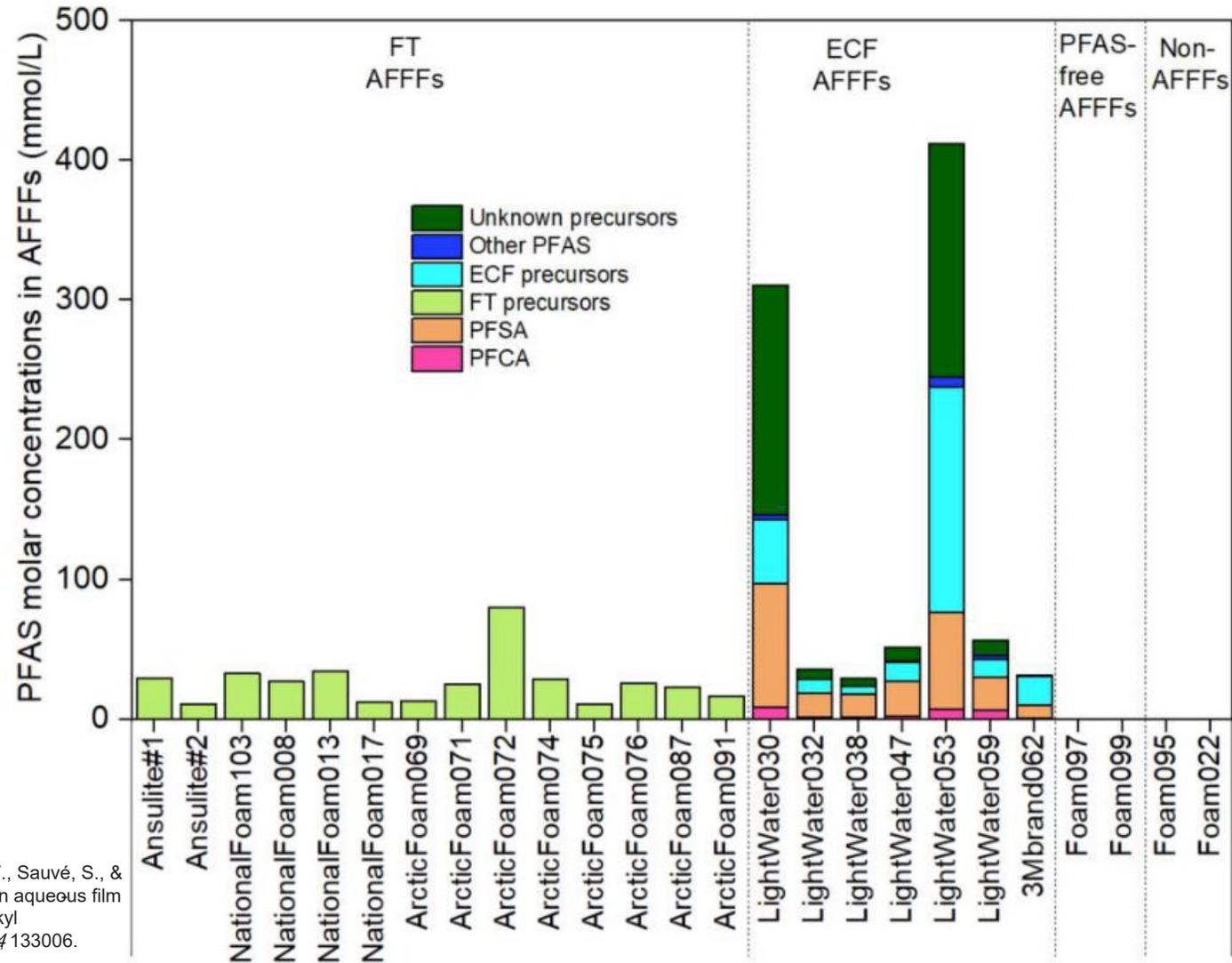


Ruyle, B. J., Thackray, C. P., McCord, S., Pinar, M. J., Maughan, K. A., Fenton, S. E., & Sunderland, E. M. (2021). Reconstructing the Composition of Perfluoroalkyl Substances in Contemporary Aqueous Film Forming Foams. *Environmental Science and Technology Letters*, 8(11), 5965. <https://doi.org/10.1021/acs.estlett.0c00798>

Shojaei, M., Joyce, A. S., Ferguson, P., & Guelfo, J. L. (2022). Novel per- and polyfluoroalkyl substances in an active C6 based aqueous film forming foam. *Journal of Hazardous Materials Letters*, 212, 100061. <https://doi.org/10.1016/j.hazl.2022.100061>

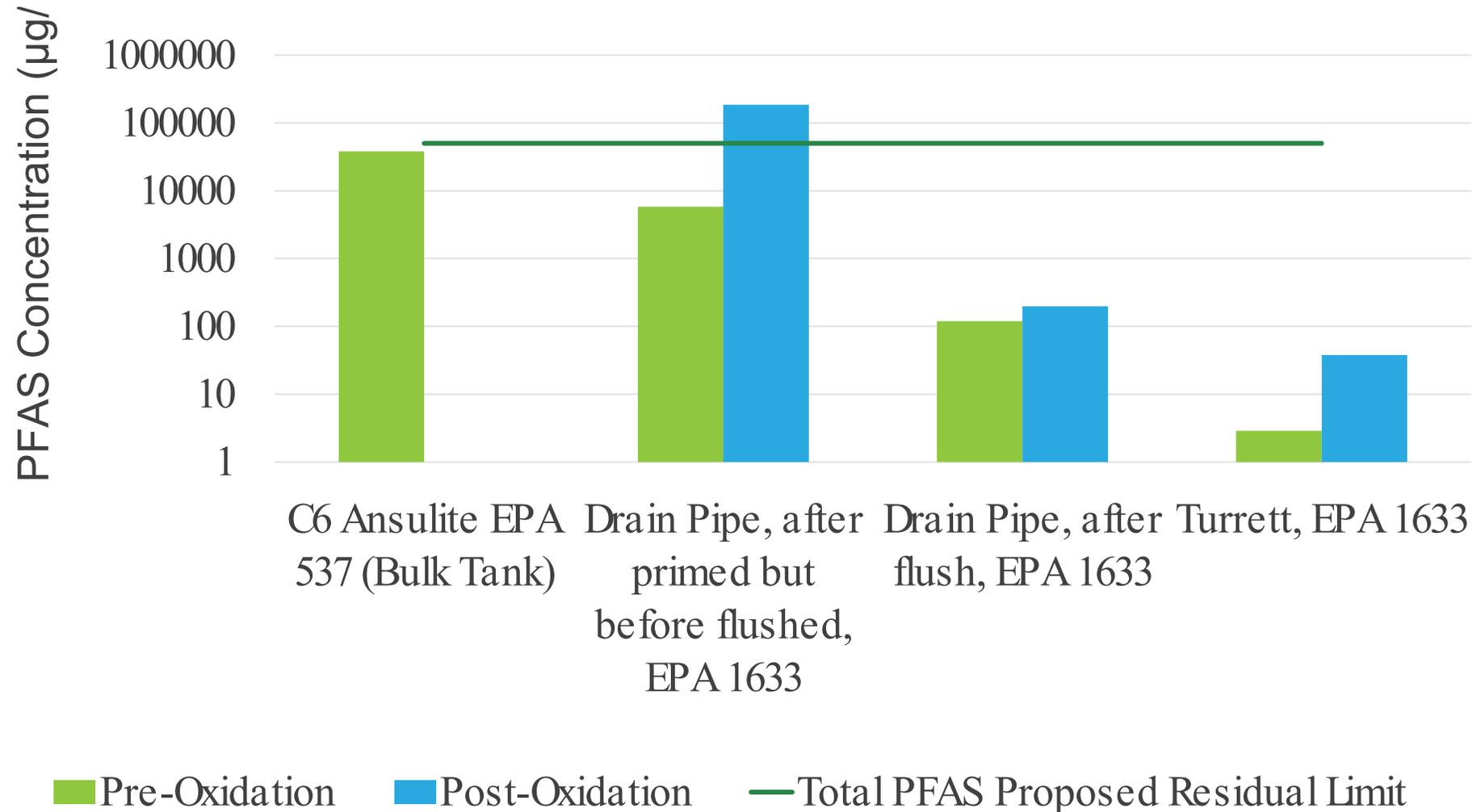
Gharehveran, M. M., Walus, A. M., Anderson, T. A., Subbiah, S., Frigon, M., ... & Suski, J. G. (2022). Per- and polyfluoroalkyl substances (PFAS) aqueous film forming foam formulations: Chemical composition and biodegradation in an aerobic environment. *Journal of Environmental Chemical Engineering*, 10(10), 108953. <https://doi.org/10.1016/j.jece.2022.108953>

What is actually in AFFF?



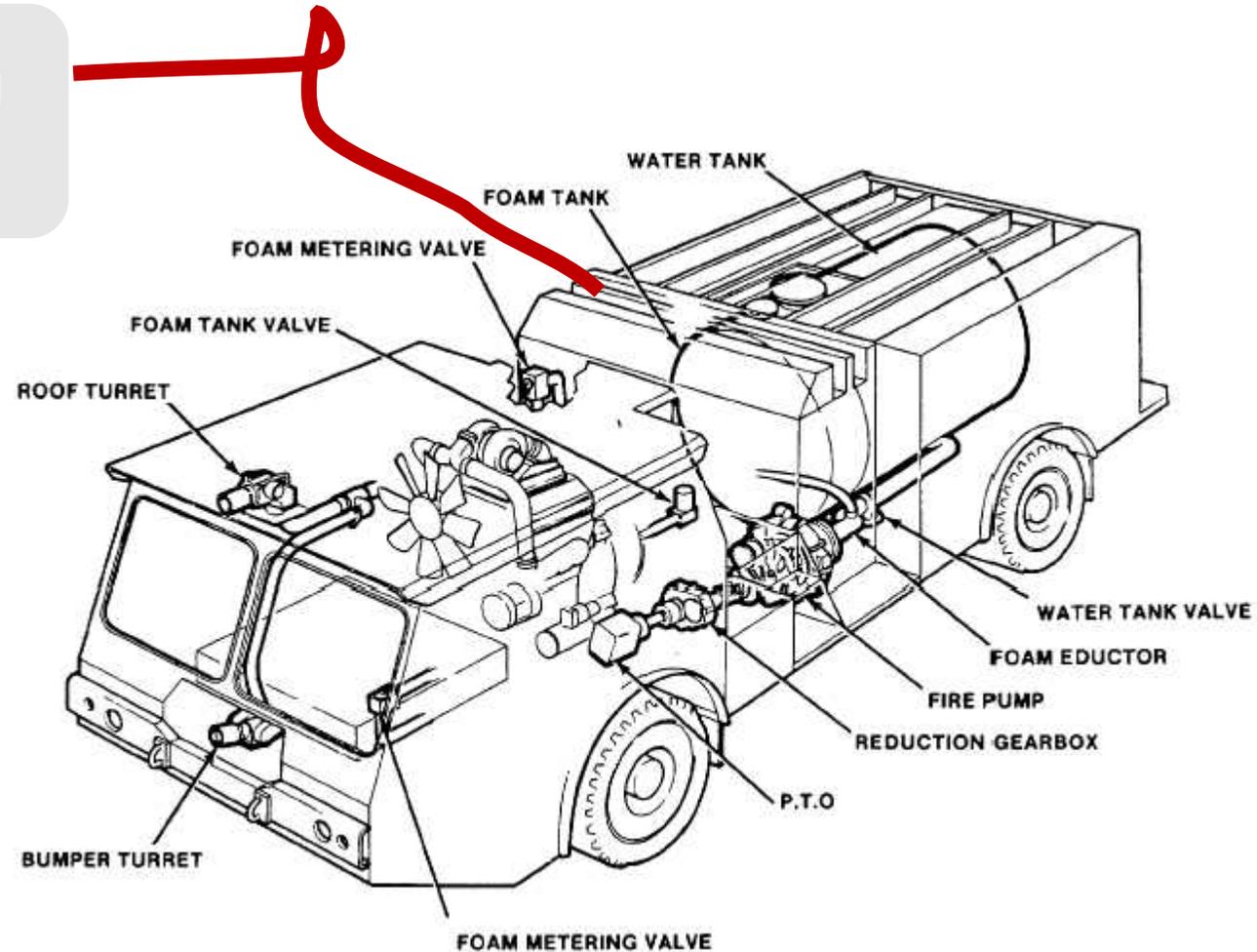
Liu, M., Glover, C. M., Munoz, G., Duy, S. V., Sauvé, S., & Liu, J. (2024). Hunting the missing fluorine in aqueous film forming foams containing per- and polyfluoroalkyl substances. *Journal of Hazardous Materials*, 464, 133006.

Sampling Location and Analysis Matters.

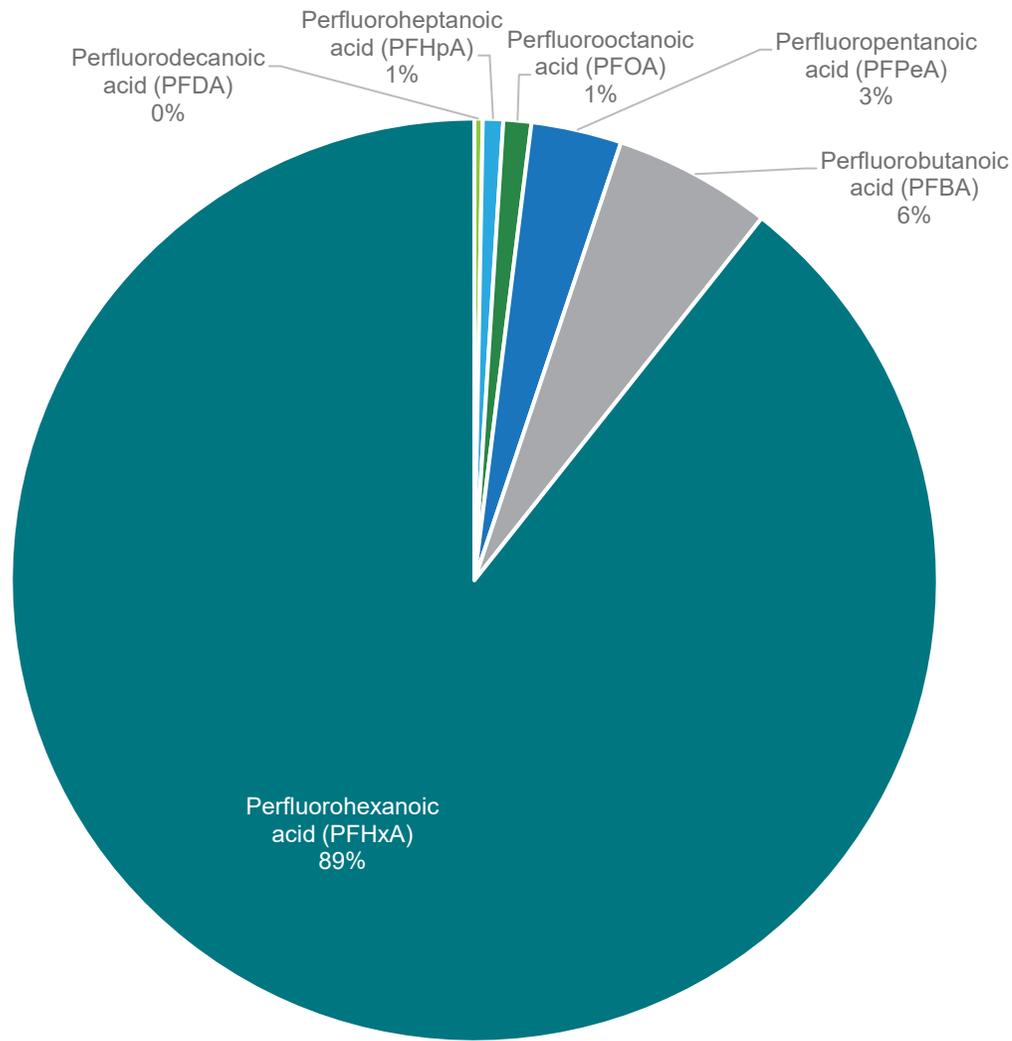


Sampling Location and Analysis Matters.

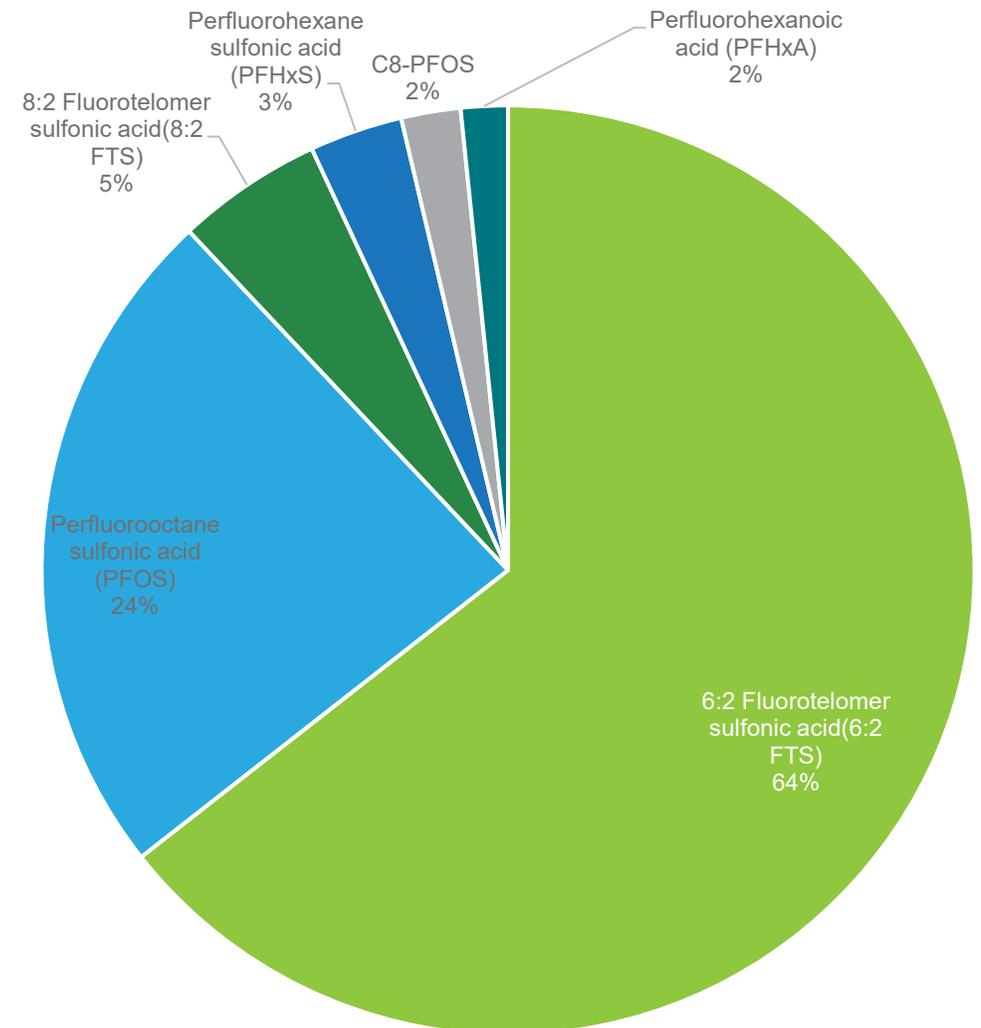
Bulk Foam Storage



Sampling Location and Analysis Matters.



C6 Ansulite EPA 537 (Bulk Tank)



Drain Pipe, after primed but before flushed, EPA 1633



Sampling Location and Analysis Matters.

To swab or not to swab...



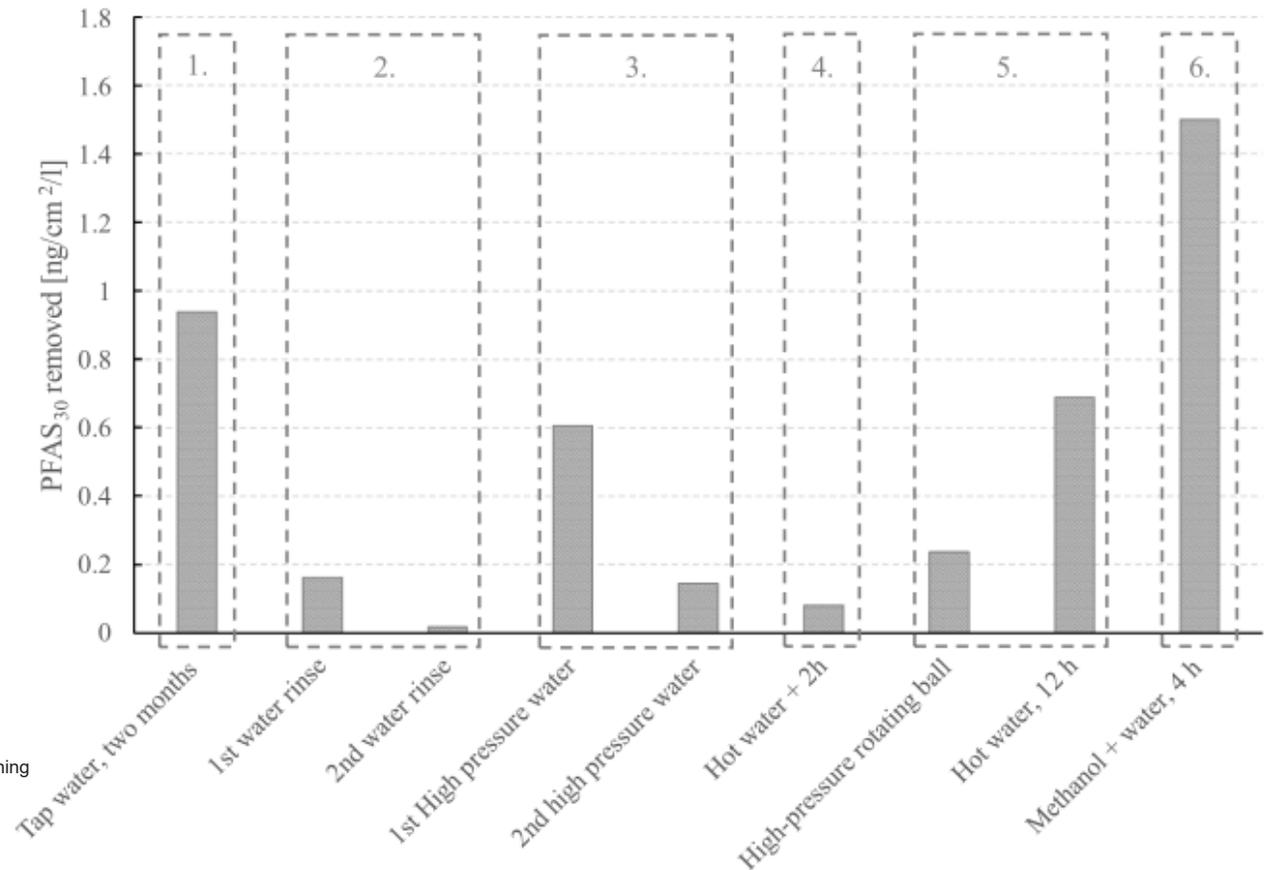
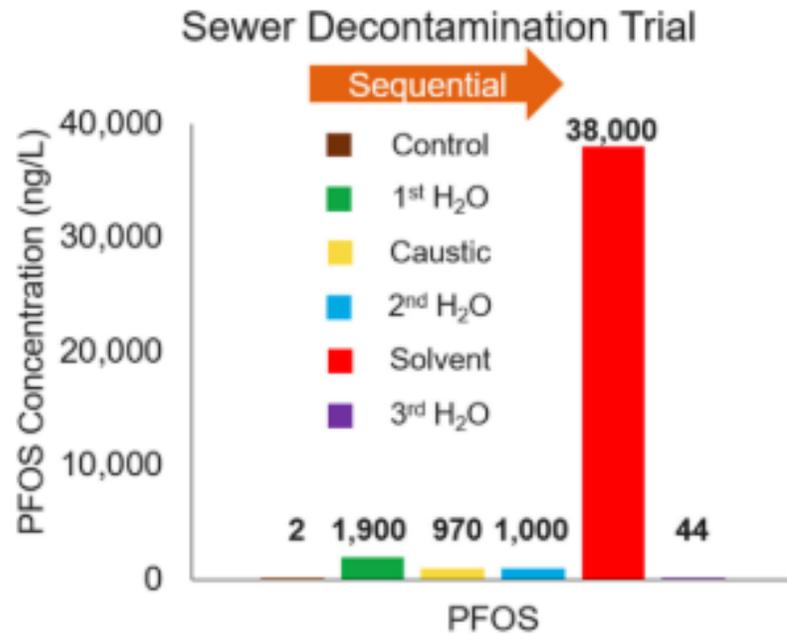
“present in fluorine-free firefighting foam and originate from firefighting equipment which has undergone cleaning in accordance with the best available techniques”



Transition Options

Dispose of contaminated assets

Decontaminate



Dahlbom, S. (2025). Decontamination of PFAS-contaminated firefighting equipment: A review. *Journal of Hazardous Materials*, 438983.

Horst, J., Quinnan, J., McDonough, J., Lang, J., Storch, P., Burdick, J., & Theriault, C. (2021). Transitioning Per- and Polyfluoroalkyl Substance Containing Fire Fighting Foams to New Alternatives: Evolving Methods and Best Practices to Protect the Environment. *Ground Water Monitoring & Remediation*, 41(2).

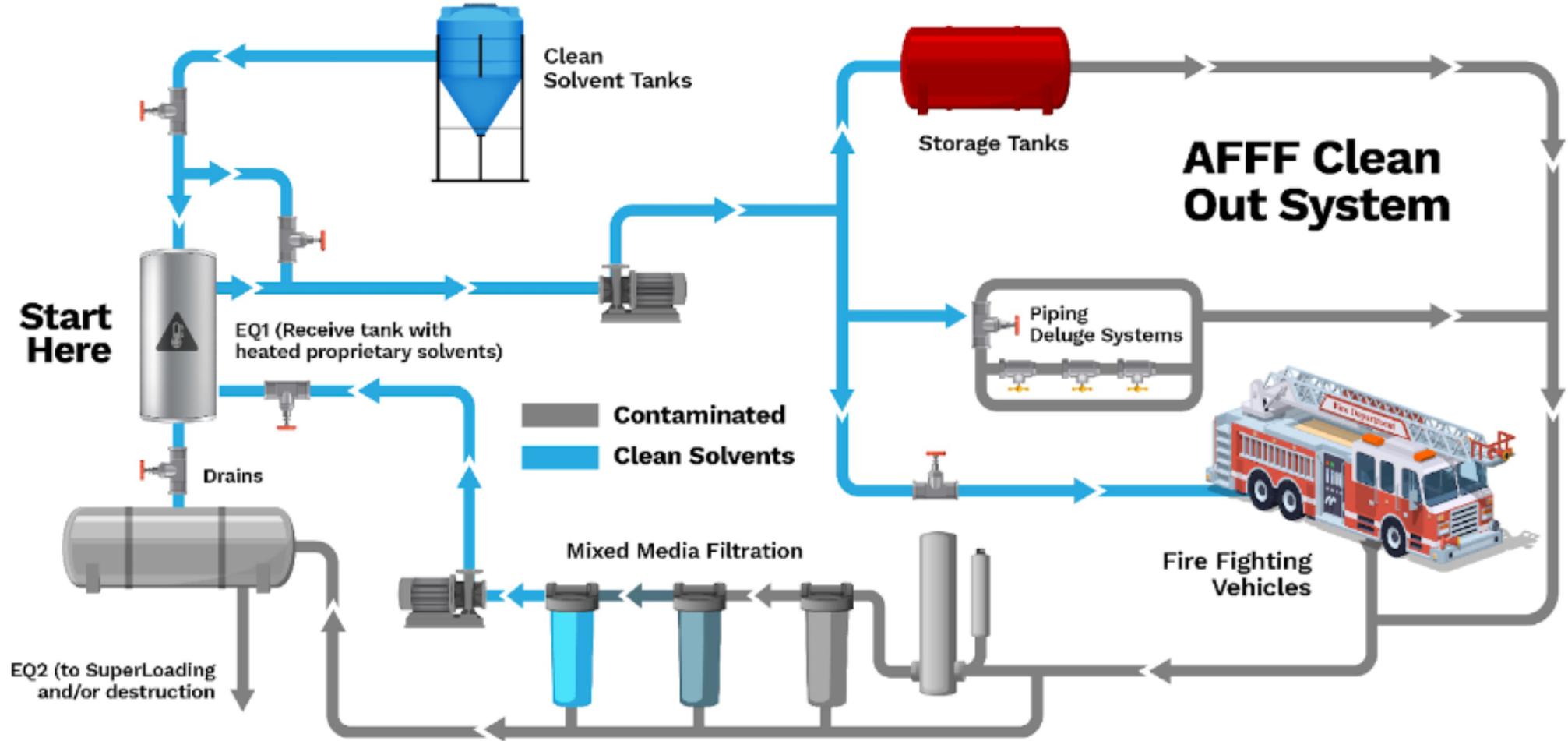


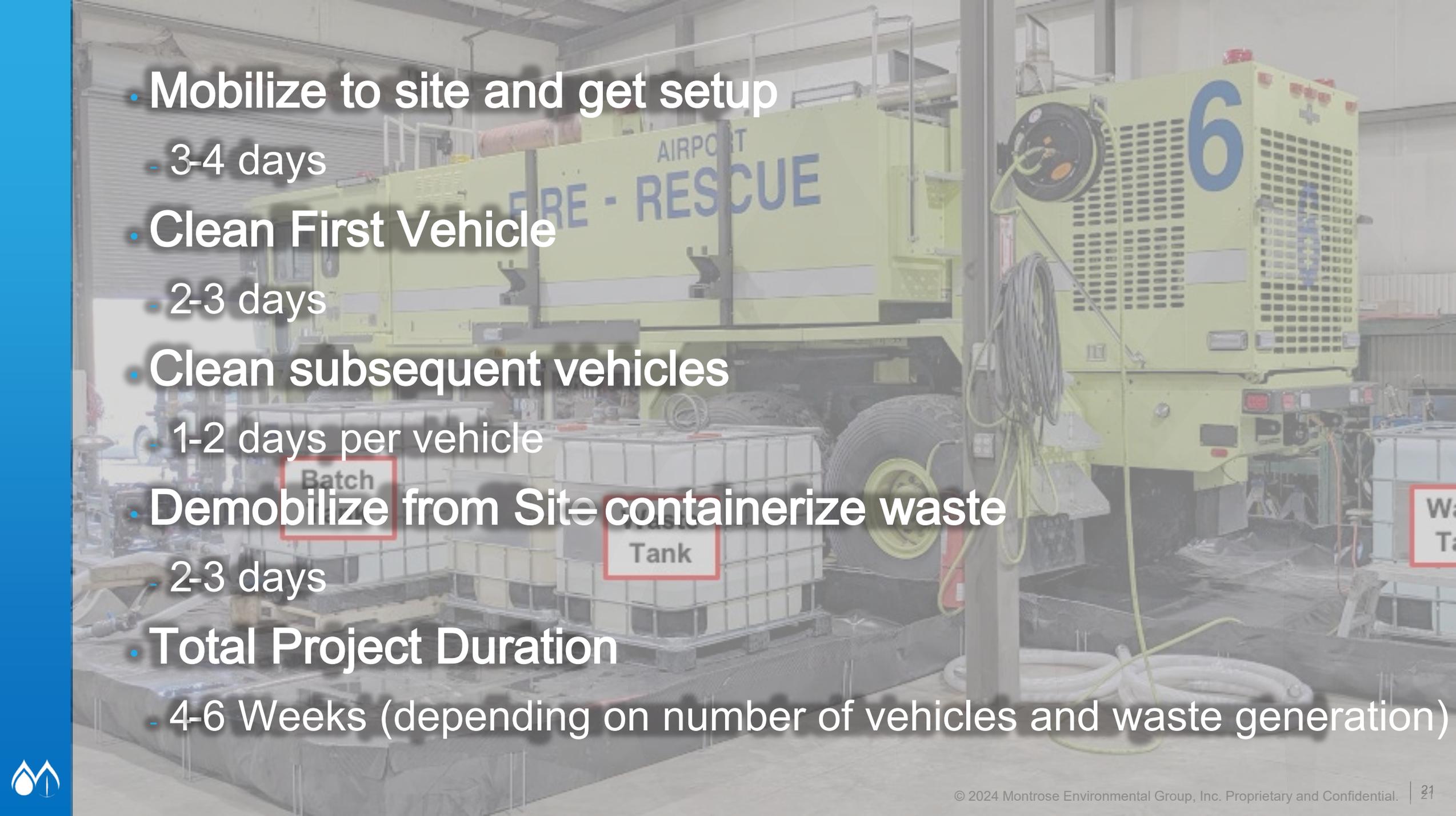


Solvent + Heat + Time +
Agitation



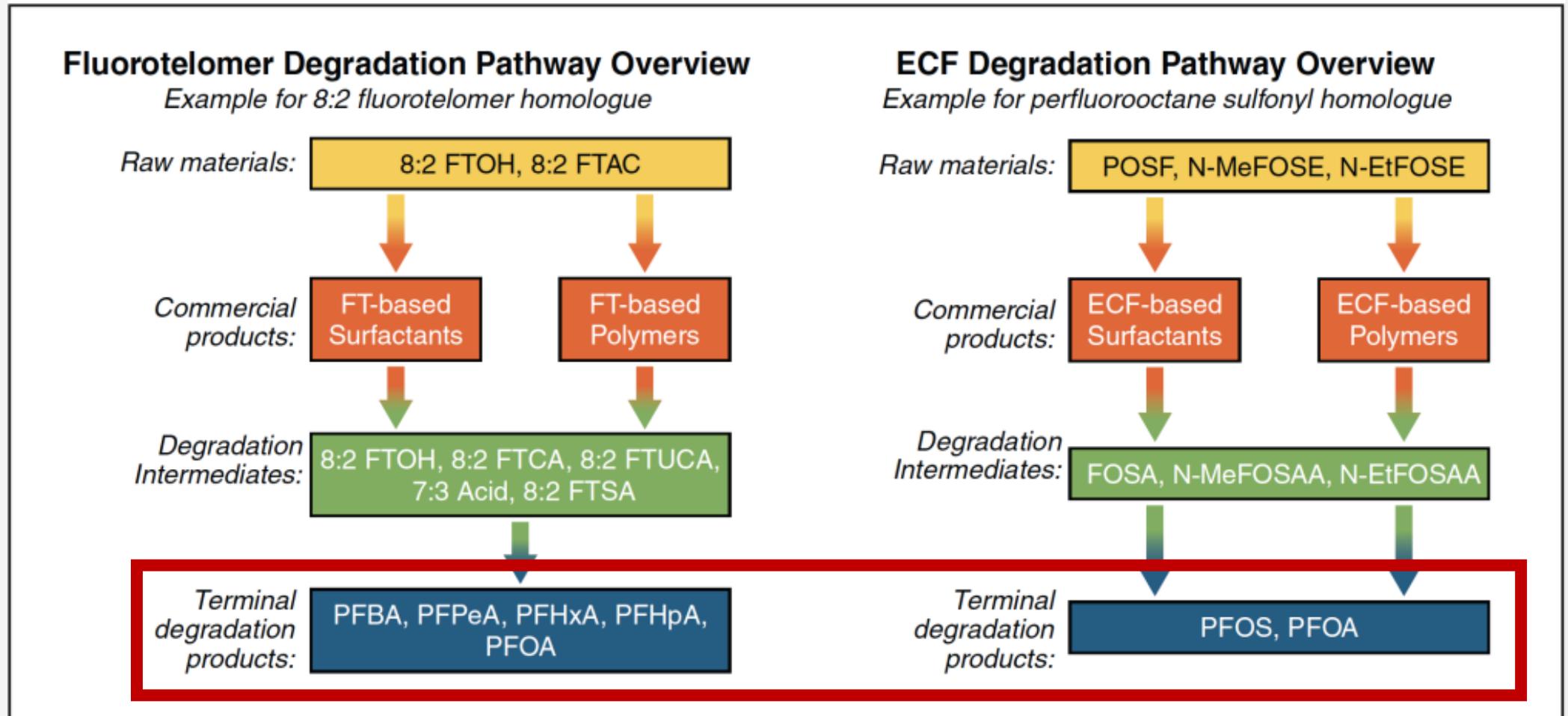
Process Example



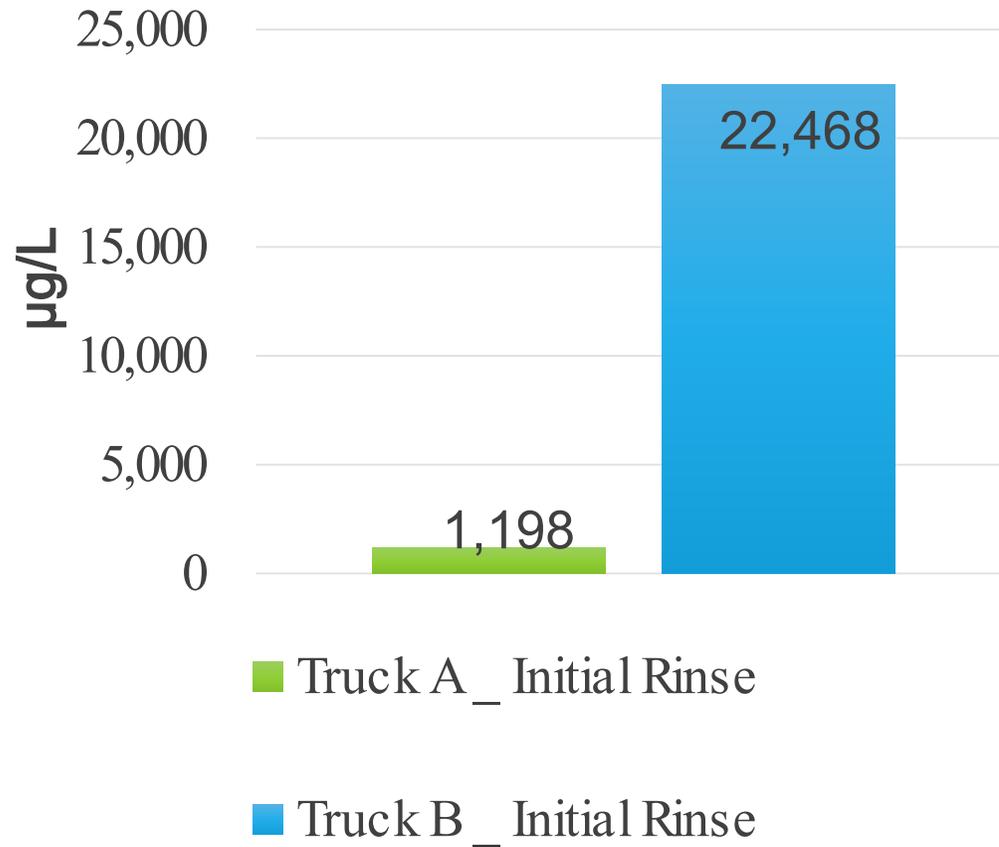
- 
- Mobilize to site and get setup
 - 3-4 days
 - Clean First Vehicle
 - 2-3 days
 - Clean subsequent vehicles
 - 1-2 days per vehicle
 - Demobilize from Site containerize waste
 - 2-3 days
 - Total Project Duration
 - 4-6 Weeks (depending on number of vehicles and waste generation)



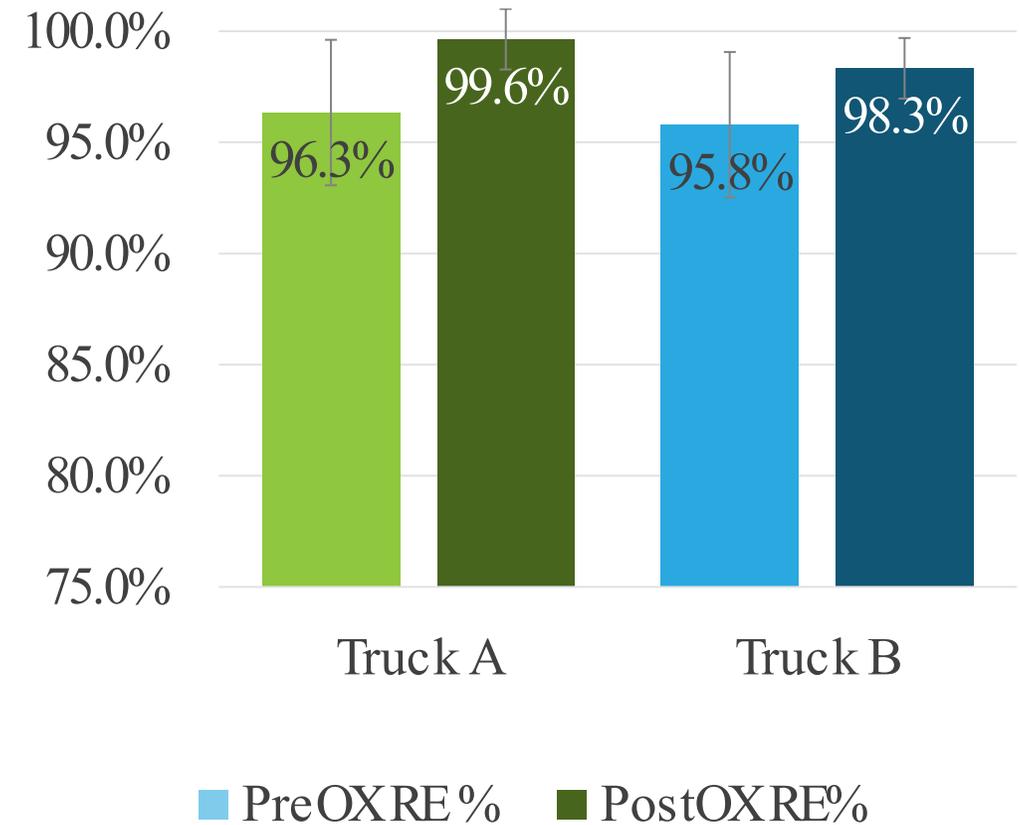
Analytical Methods to Confirm Decontamination



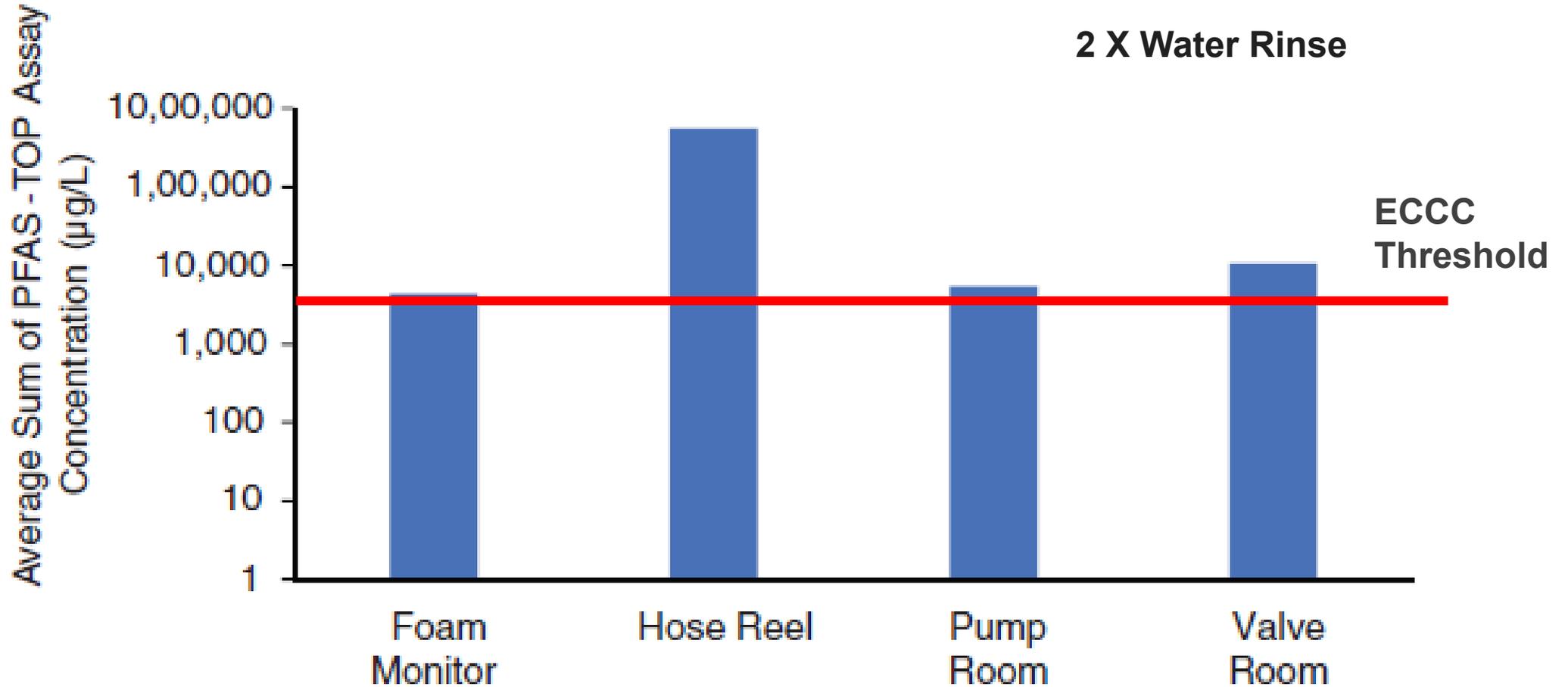
Truck A & B Initial Conditions µg/L



Removal Efficiency Total PFAS



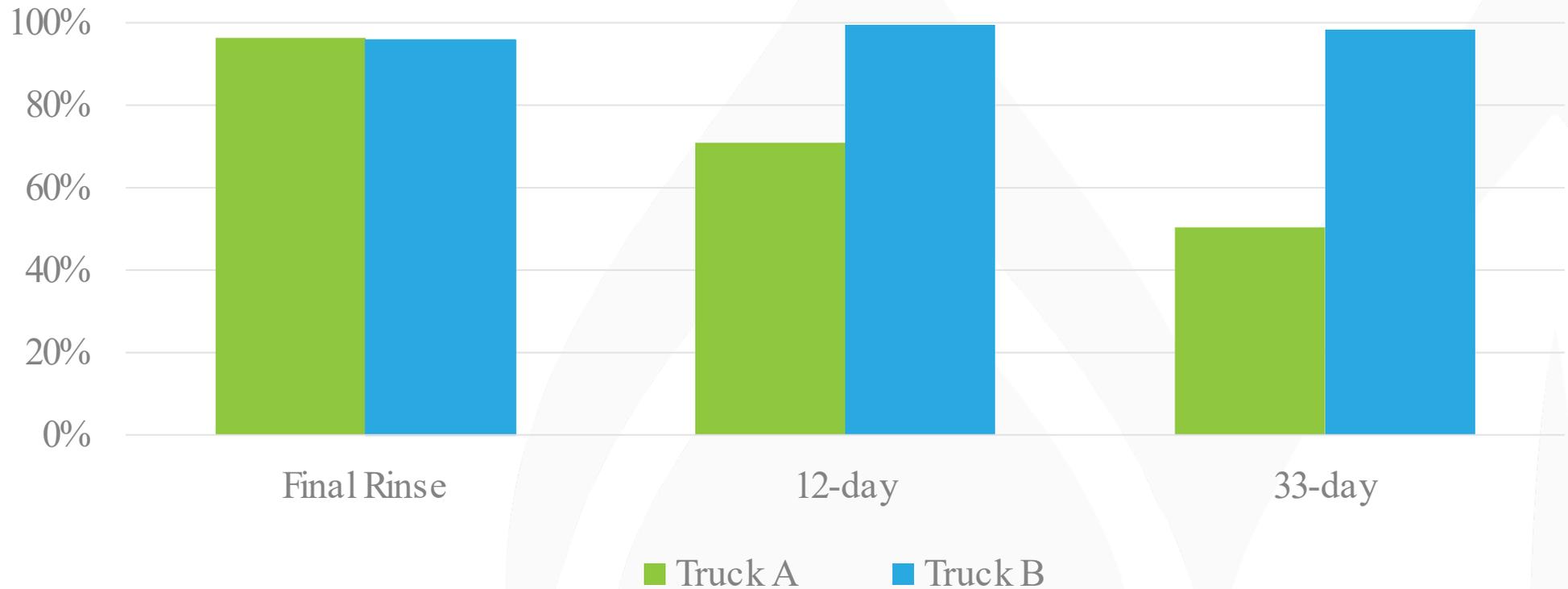
Rebound



Horst, J., Quinnan, J., McDonough, J., Lang, J., Storch, P., Burdick, J., & Theriault, C. (2021). Transitioning Per- and Polyalkyl Substance Containing Fire Fighting Foams to New Alternatives: Evolving Methods and Best Practices to Protect the Environment. *Ground Water Monitoring & Remediation* (41).

Removal Efficiency (%)

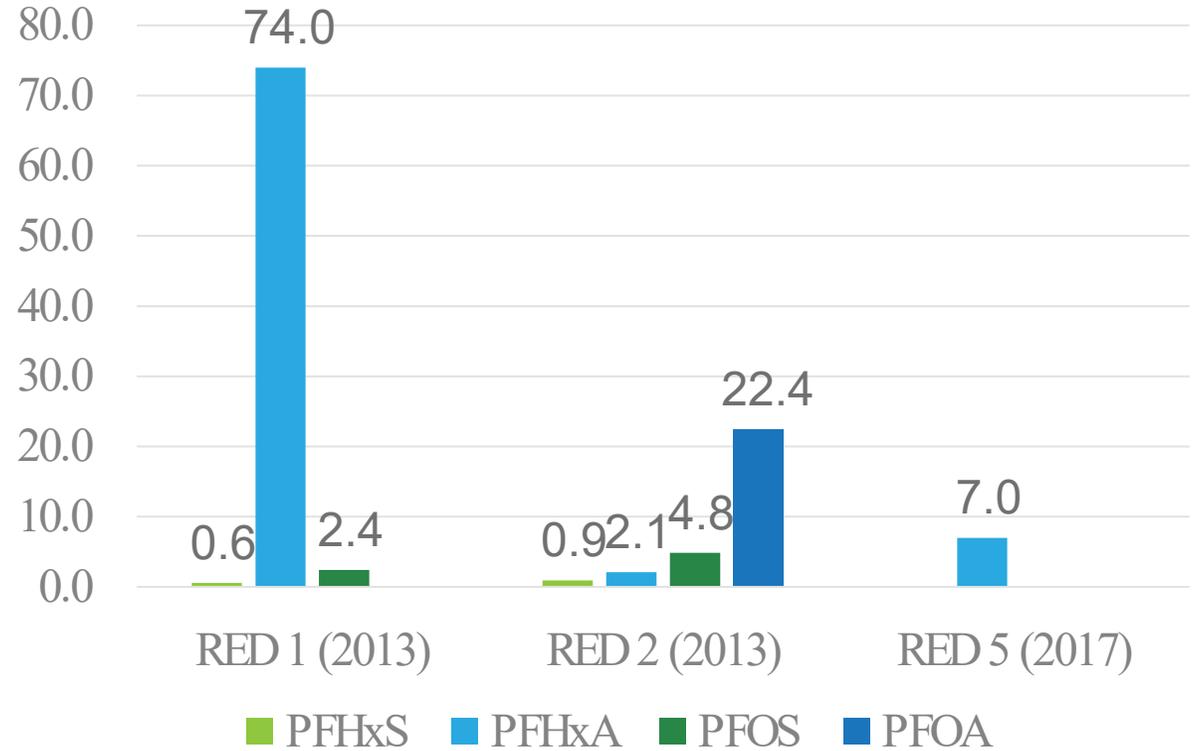
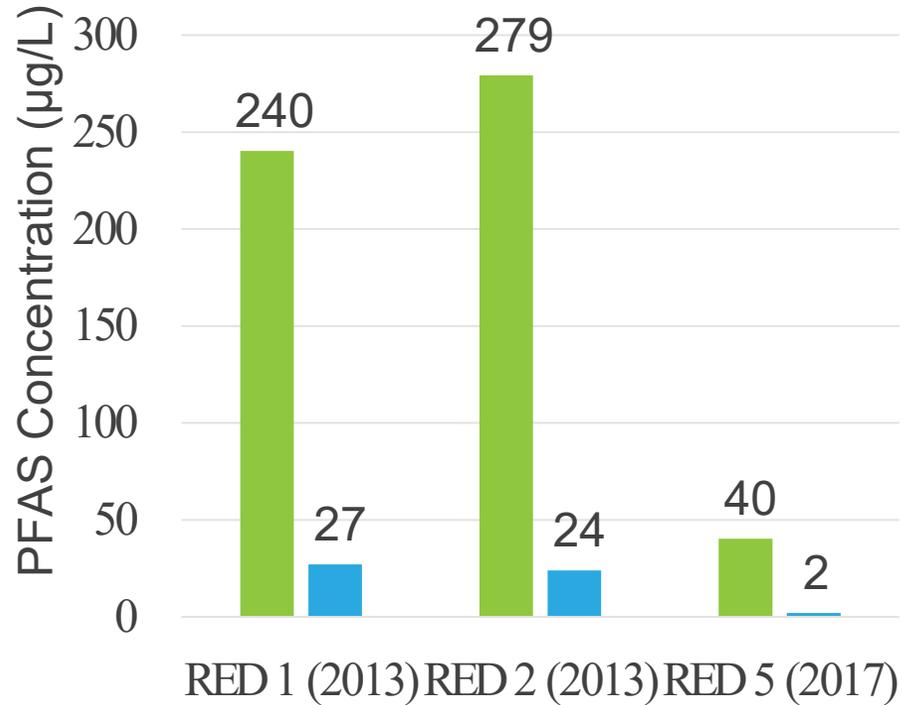
Truck A (3x water rinse) vs Truck B (ECT2 method)



- ECT2 cleaning solution <2% after 33 days, Cold Water at 50.3% rebound



Rebound

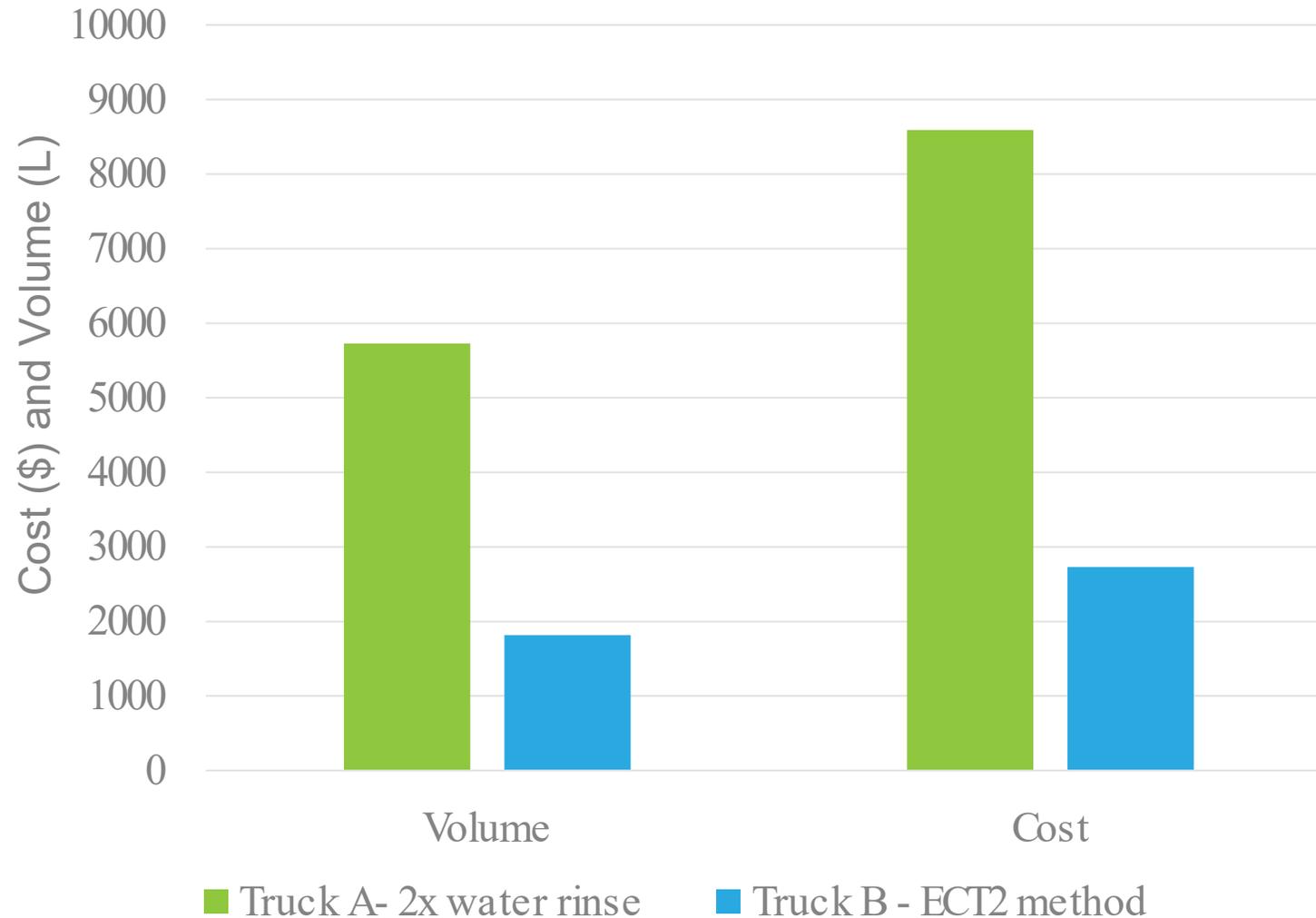


- Total 1633 PFAS - 9 months post
- Total 1633 PFAS - immediately following transition

- Proprietary cleaning solution/method with no heat and minimal agitation showed 8 x rebound 9 months after cleaning
- Sample taken from the foam



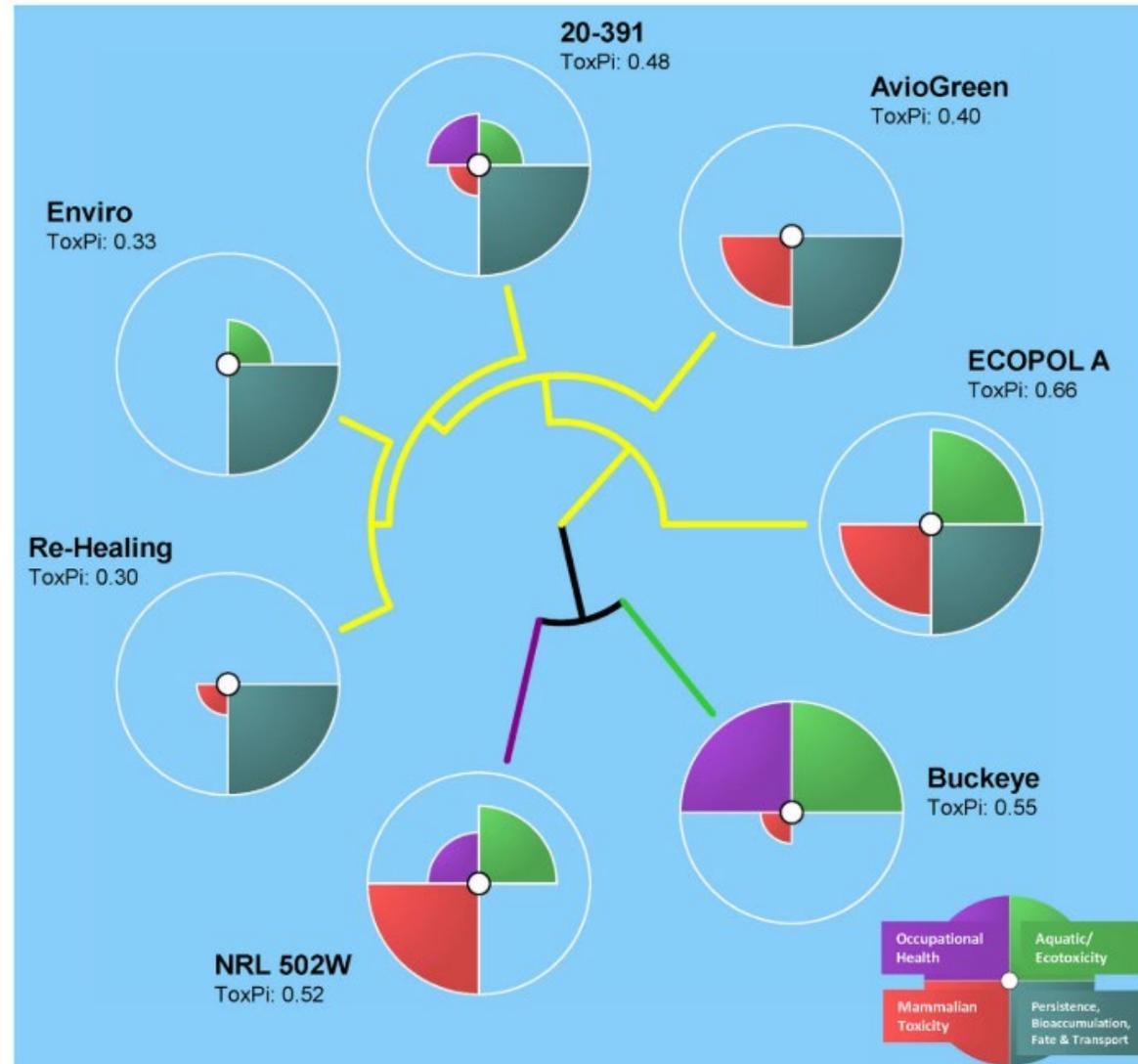
Disposal and Destruction



- 2-4 deep well injection options in Northern AB
- Incineration is either in the US or Ontario



Risks with F3 Foams



Holden, L. A., East, A. M., Carizzano, A. M., & Quinn, M. J. (2023). Toxicology assessment for six per- and polyfluoroalkyl (PFAS)-free aqueous film forming foam (AFFF) products. *Integrated Environmental Assessment and Management*, 16(6), 1609-1618. <https://doi.org/10.1002/ieam.4750>

Round-up

Regulations are coming, but there is still time

18 months–6 years depending on facility type.

What is your strategy?

Replace assets, decontaminate, consider timing and cost of alternatives.

If decontaminating, consider heat + solvents + time

Multiple technologies and processes exist, including concentrating technologies like foam fractionation.

Sampling locations and analysis

Need to characterize total PFAS using TOF or TOPA. Sampling matrix for regulatory purposes should be foam.

F3 foams are not risk free

Elevated acute exposure toxicity and uncertainty in terms of fate, transport and bioaccumulation.





Harris Switzman, M.A.Sc., P.Geo. ENV SP
Associate Consultant
hswitzman@montrose-env.ca

