



Portable PFAS Analysis

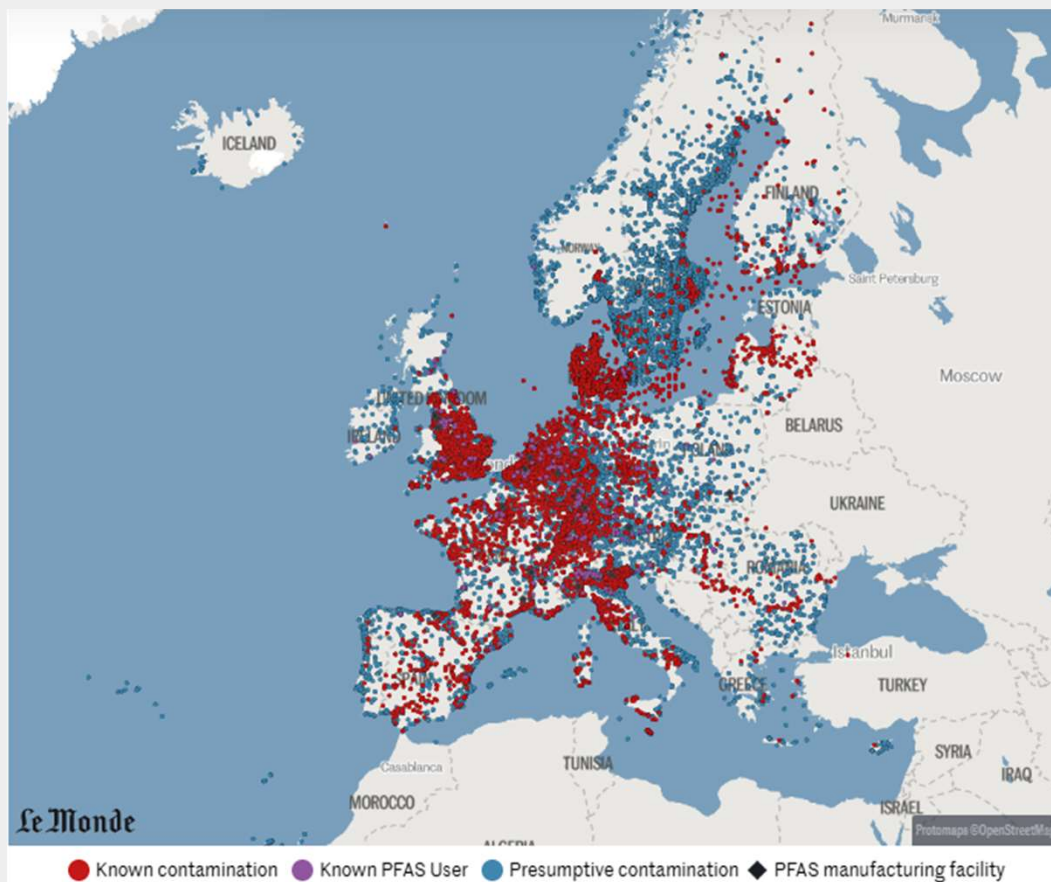
June 17, 2025

Agenda

- **PFAS Analytical Toolbox**
- **Field Screening: FRED-PFAS introduction and capabilities**
- **Case Study 1 - TRS Group US Airport AFFF Transition**
- **Case Study 2 - Water Treatment Client Industrial Wastewater**

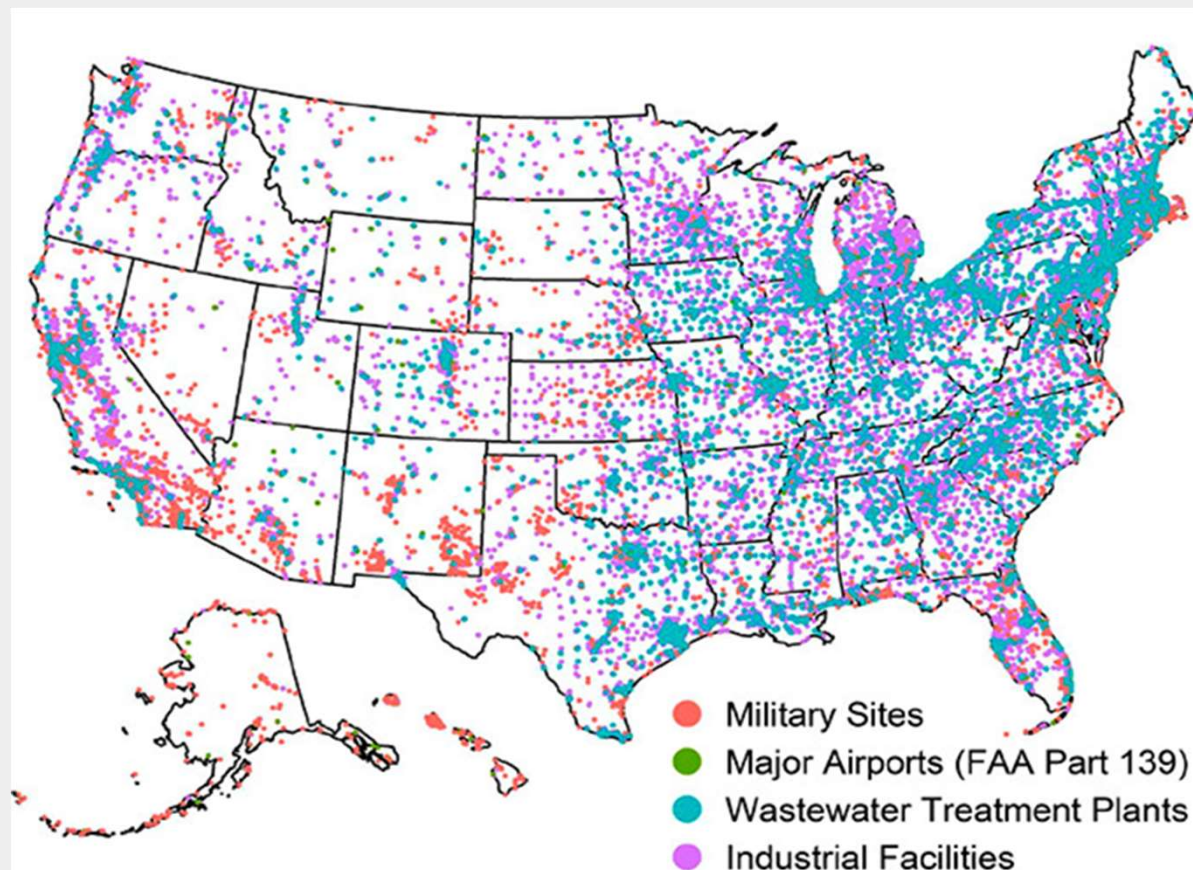
The Expanding PFAS Challenge

Europe: >23,000 sites where PFAS contamination has been detected. Additional >21,000 presumptive PFAS contamination sites



Source: Forever Pollution Project

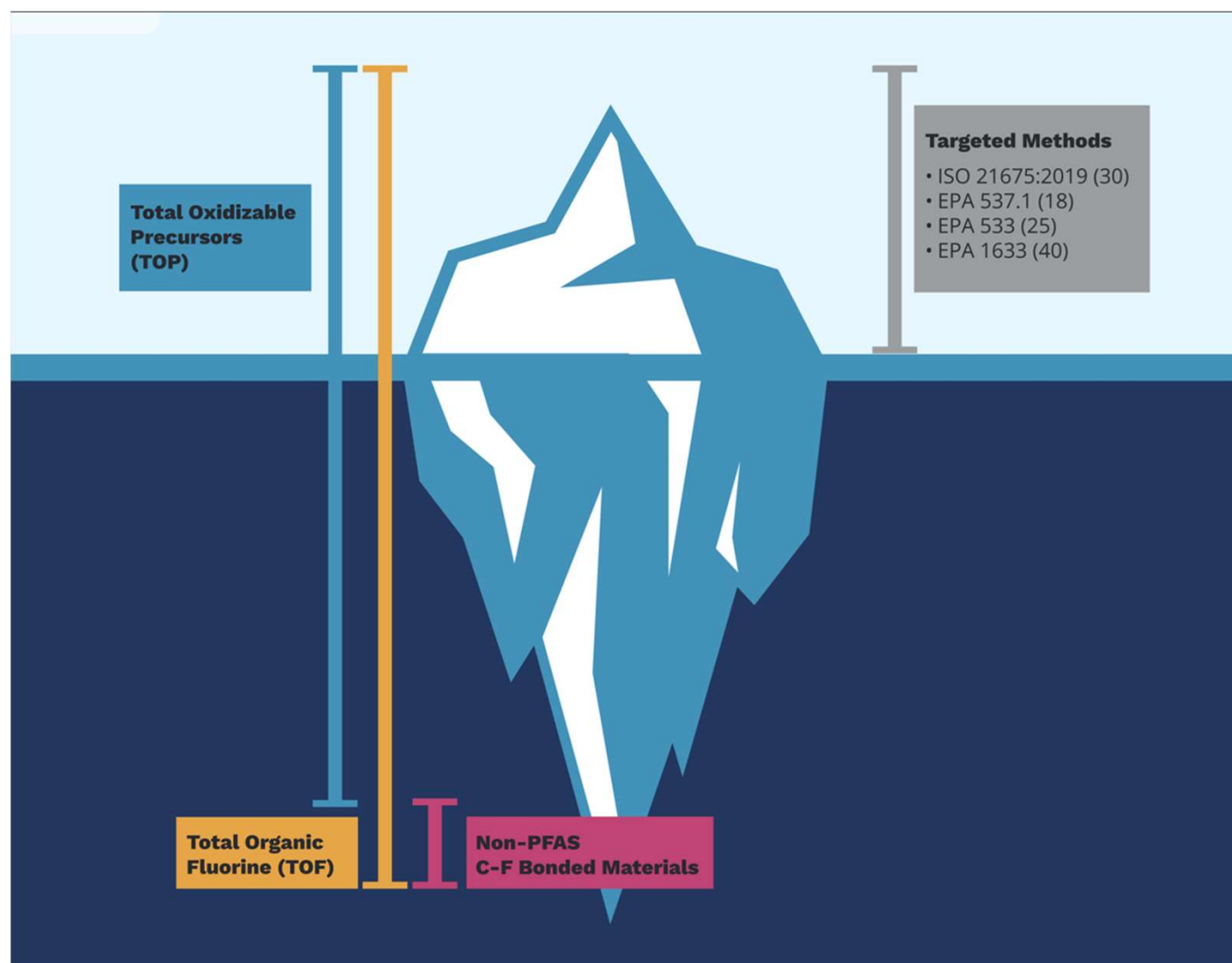
USA: >57,000 presumptive PFAS contamination sites. PFAS-contaminated drinking water estimated to affect ~200M people



1 Le Monde, 'Forever pollution': Explore the map of Europe's PFAS contamination (2023). [Link](#)

2 Environmental Science & Technology Letters, Presumptive Contamination: A New Approach to PFAS Contamination Based on Likely Sources (2022). [Link](#)

The PFAS Analytical Toolbox



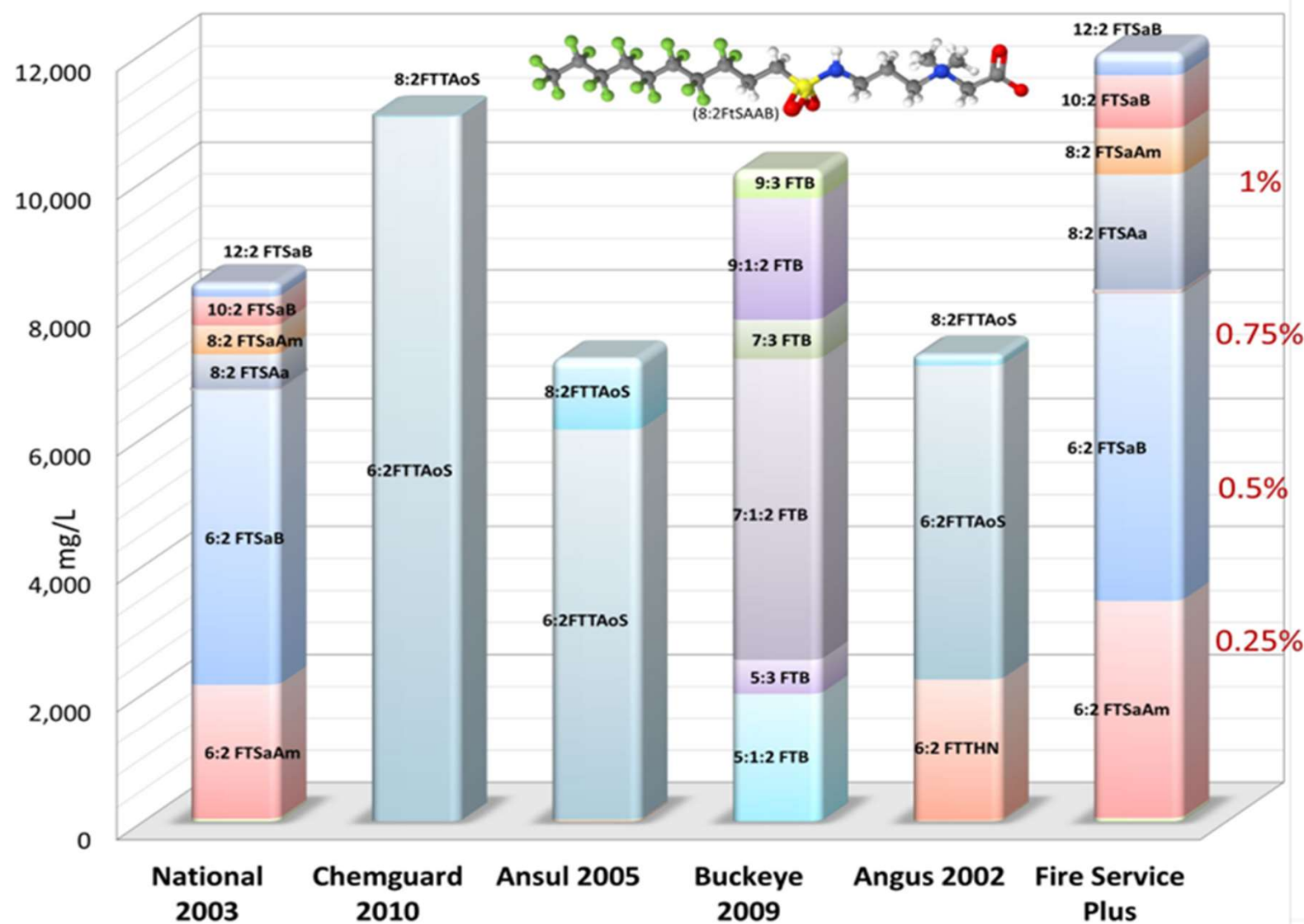
Targeted Analysis

- Methods: **ISO 21675:2019, EPA 1633, EPA 537.1, EPA 533, Total Oxidizable Precursors (TOP)**
- Select PFAS species are measured individually
- Measured with liquid chromatography- tandem mass spectrometry (LC-MS/MS) in the laboratory

Total Measurements

- Methods: **Total Organic Fluorine (TOF), EPA 1621 (Absorbable Organic Fluorine)**
- Non-Targeted Fluorine Methods provide “Total PFAS” output
- Measured with Combustion Ion Chromatography (CIC)

AFFF Foams are made with precursors



Most recent AFFF foams are high in **precursors**.

These precursors degrade into regulated compounds (PFHxS, PFOA, PFBA, etc).

It is important to **understand precursor presence** in AFFF-impacted matrices.

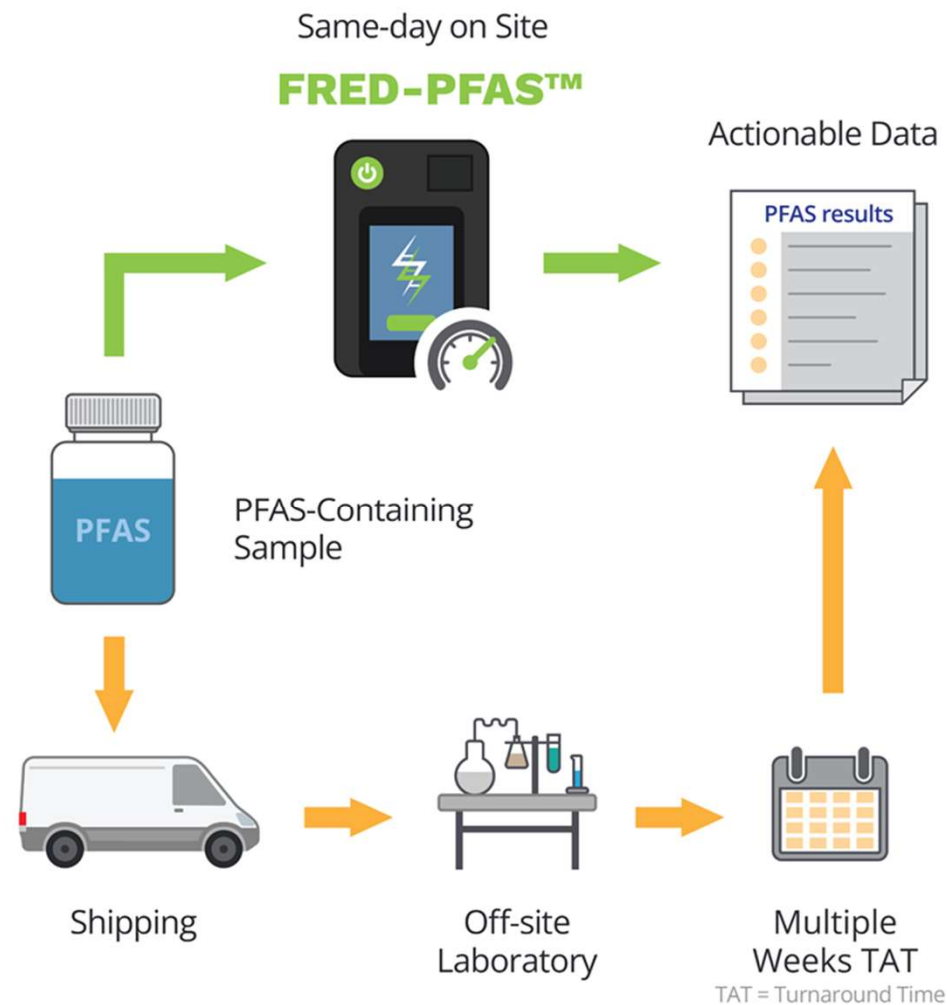
Laboratory Results Take Weeks

LC/MS based methods dominate the market

Method	Results	Laboratory Turn Around Time
ISO 21675: 2019	Targeted 30 PFAS	2-6 weeks
EPA 1633	Targeted 40 PFAS	2-6 weeks
Total Oxidizable Precursors (TOP) Assay	Total (1633 + Precursors) Best for AFFF	4-12 weeks
Total Organic Fluorine (TOF)	Total Fluorine	2-4 weeks

All require highly trained professionals and lots of time.

What if there was a Field Screen for PFAS?



Same-day onsite PFAS Screening can:

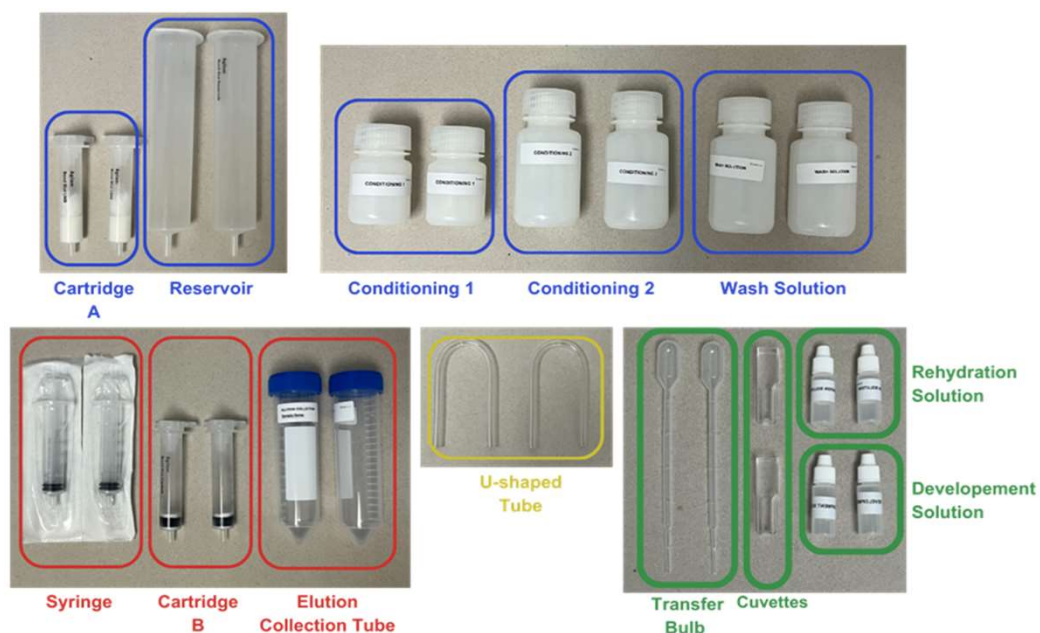
- Create **dynamic workflows** for proactive decision-making in the field
- Complement targeted laboratory analysis
- **Expedite** project timelines
- **Save** on project costs
- Relax REACH regulations for AFFF foam transition projects by using **best available technologies**

Introducing FRED-PFAS

FRED-Capture and FRED-Fluor Devices

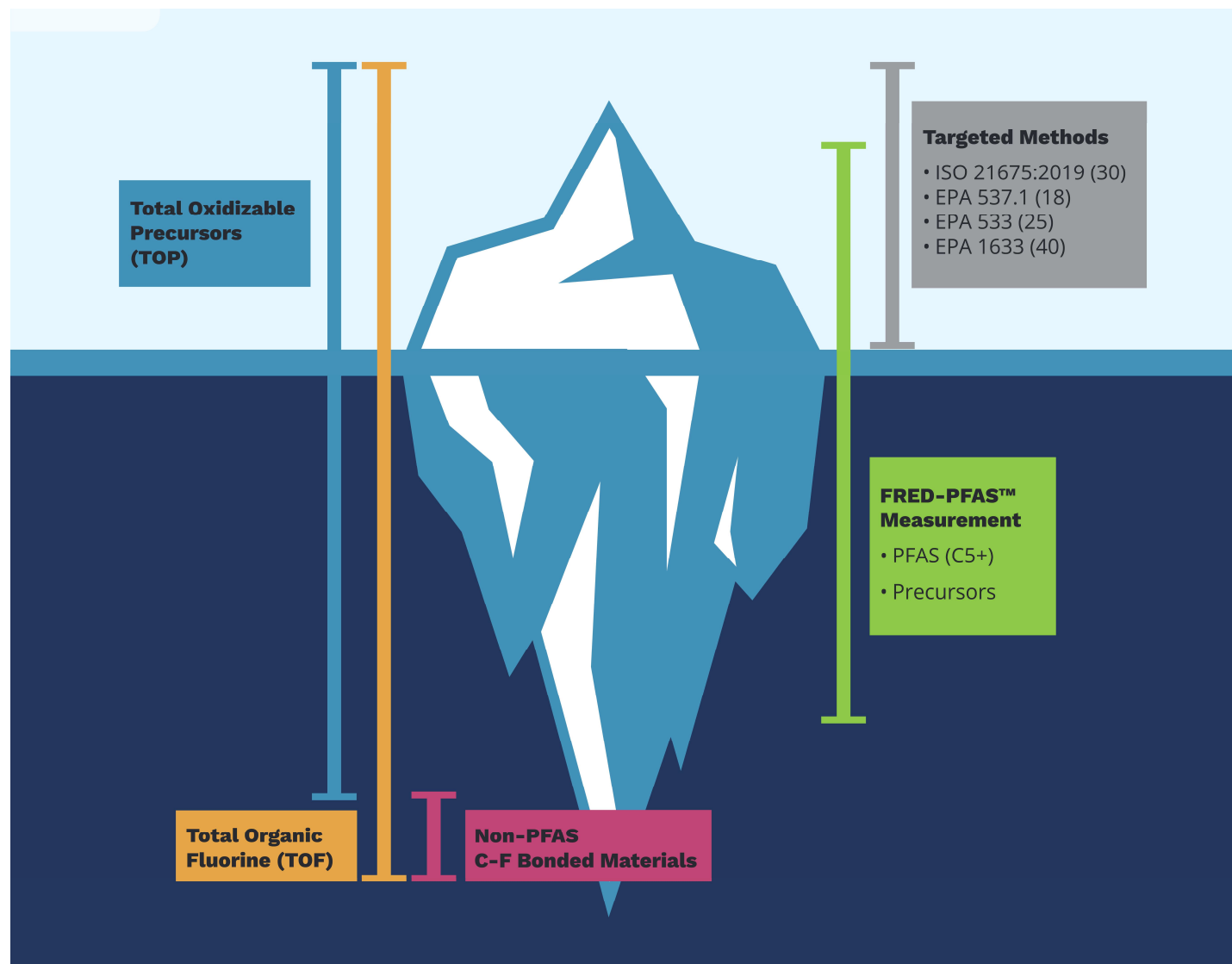


Consumable Reagent Packs



- Rugged and Field-Capable
- Lightweight (5.4 Kg)
- Simple 5-step manual process
- Fast Screening (12 tests/day/unit)
- 1,000 ng/L Limit of Detection

The New PFAS Analytical Toolbox



FRED-PFAS output is akin to a Total PFAS Measurement

- Non-Targeted **Screening Tool**
- **Highly selective** to fluorocarbon backbones of PFAS molecules
- Detects C5+ PFAS and Precursors
- Works well in **AFFF-impacted matrices** and **“clean” industrial matrices**

Applications

AFFF changeout

Accelerate project timelines,
early indicators on efficacy of
cleaning regimes.



Treatment Operations

High concentration
remediation and industrial
feed monitoring optimization



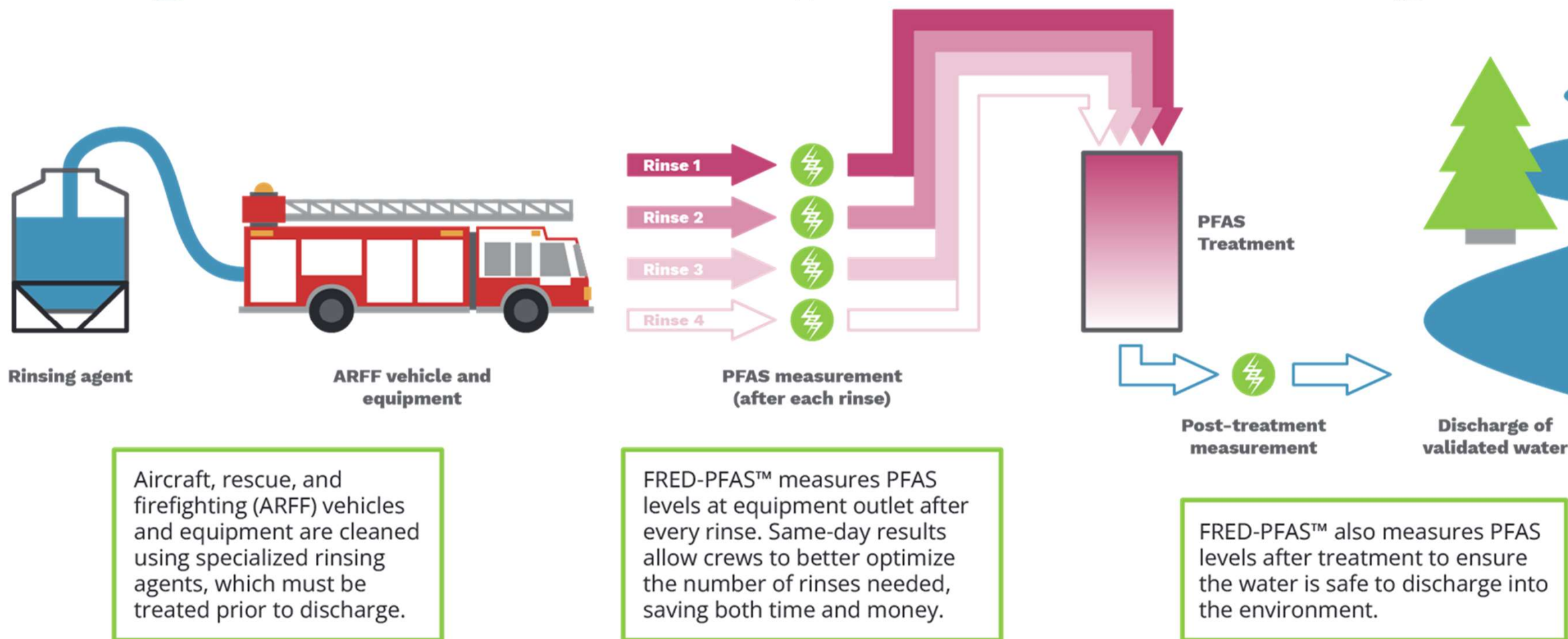
Site investigations

Optimize mobilizations and
plume delineation



Case Study 1

Using **FRED-PFAS™** To Optimize AFFF Changouts



 = FRED-PFAS™ measurements taken

Firefighting Truck AFFF Transition at an Airport

Start Date: September 2024

Objective: Accelerate the rate of ARFF Truck cleanout through rapid cleanout data.

Partner:  **TRS** Group
Accelerating Value

(PerfluorAd™ distributor in North America)

Success Metrics:

Reproducibility: Within **50% RSD** based on 4 replicates

Accuracy: Compare a mean of 4 replicates to EPA 1633 PFAS sum and TOF

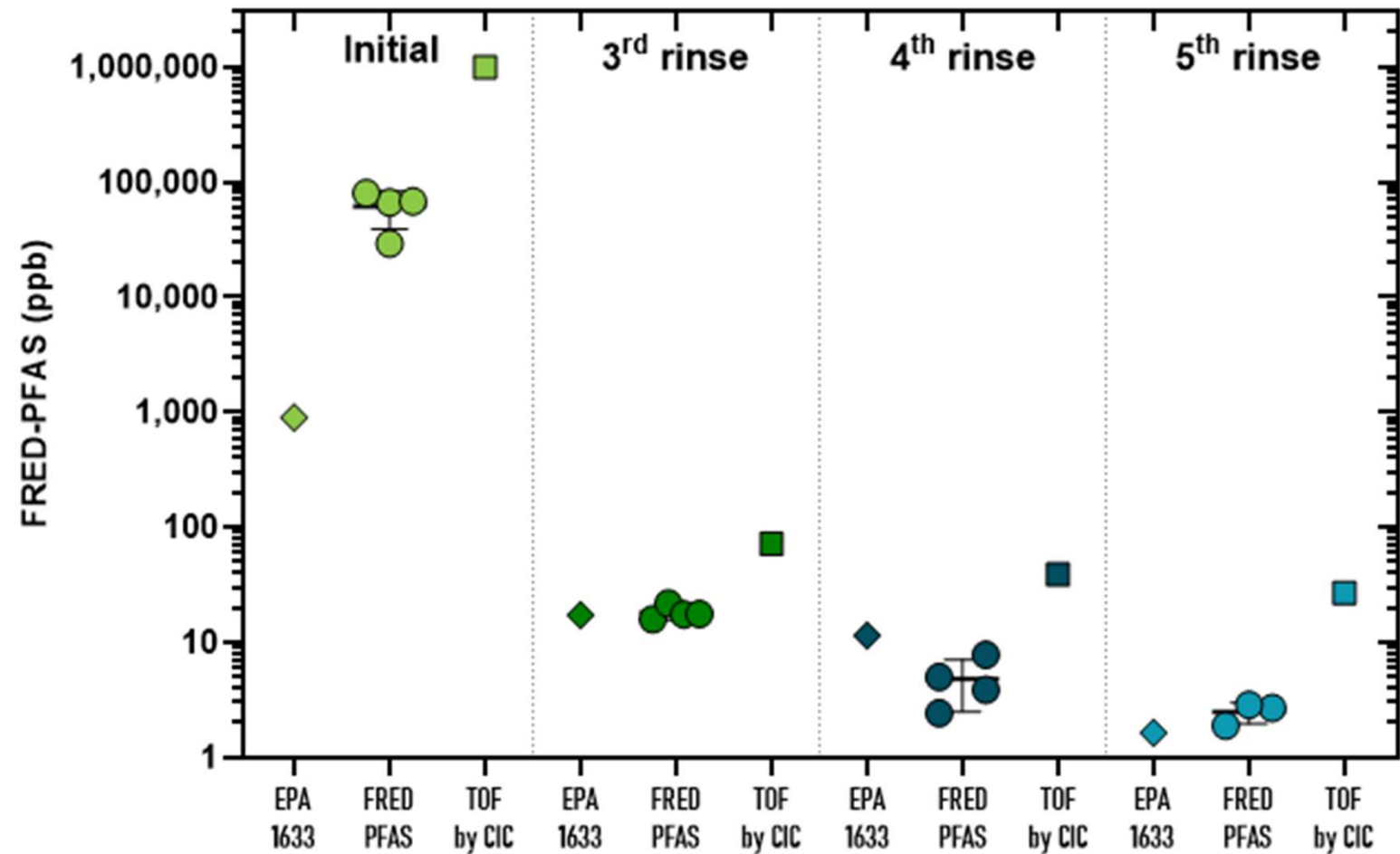
Ease of use: ≤ **4 hours** per set of tests.

Active Operator Time: < **120 minutes** per 2 samples.

Value: Allow the TRS team to Optimize Treatment & de-mobilize their system with confidence



Results



The Initial sample contained high levels of precursors not detected by Method 1633. **FRED-PFAS captured precursor presence.**

FRED-PFAS measured consistently close to method 1633 in cleaner matrices (less PFAS, fewer precursors post **PerfluorAd™**)

TOF results are higher due to the presence of other fluorine containing materials/surfactants in AFFF.

FRED-PFAS Summary of Results

Repeatability: Within **50% RSD** based on 4 replicates
13.9% to 47.81%

Ease of use: **≤ 4 hours** per set of tests.

3 Hours Per Set of Tests, 16 samples in 7 hours

Active Operator Time: **< 120 minutes** per 2 samples.

90 Minutes / Operator

Accuracy: Compare a mean of 4 replicates to 1633 value

FRED-PFAS trended with TOF and 1633, in some cases as closely as 1 ppb

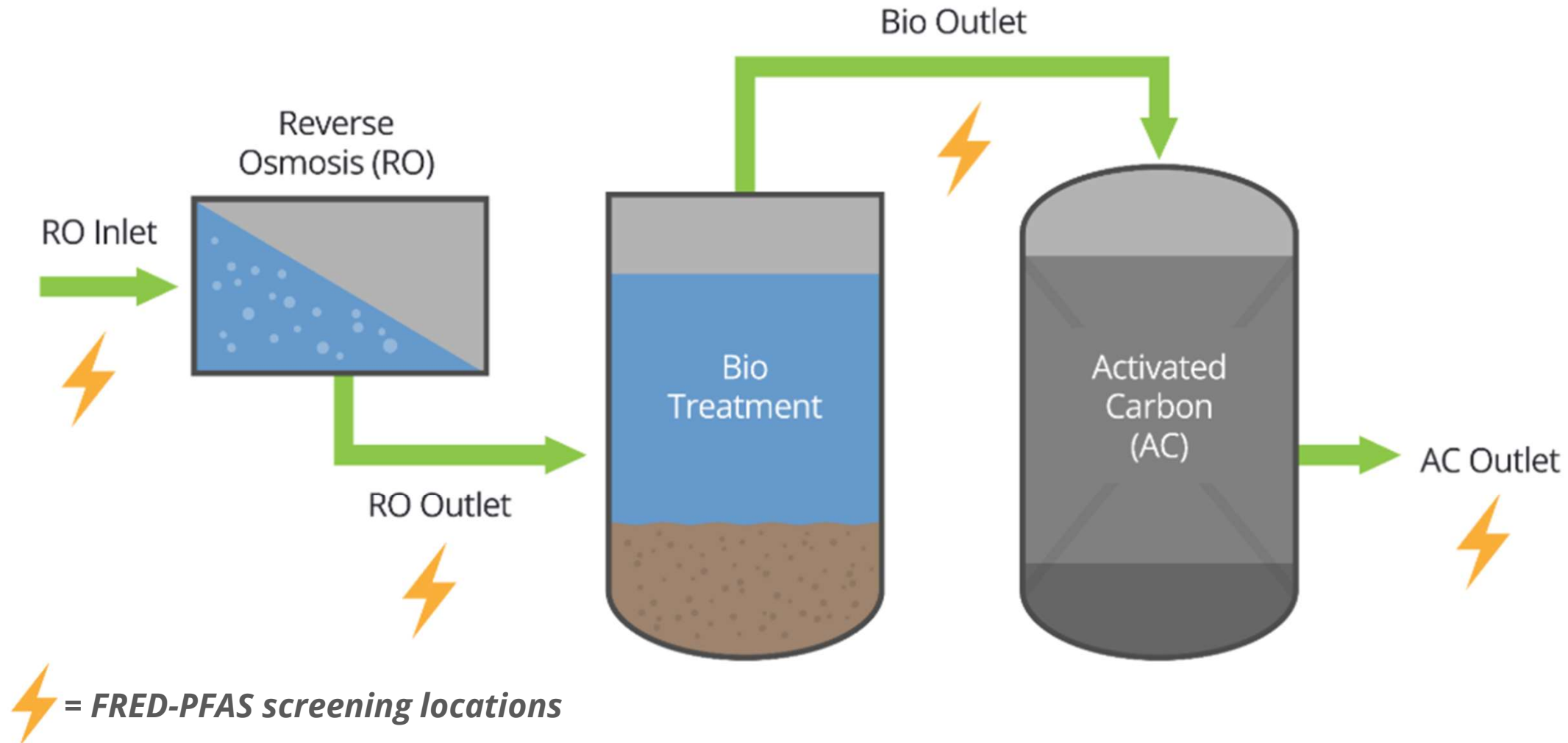
Project Benefits to Consultant and Airport:

Ability to de-mobilize faster, without waiting weeks for results.

Ability to put firetruck back in service faster, saving up to \$10,000/day on ARFF rental.

Case Study 2

Using **FRED-PFAS™** in Industrial Wastewater



Industrial Wastewater PFAS Screening

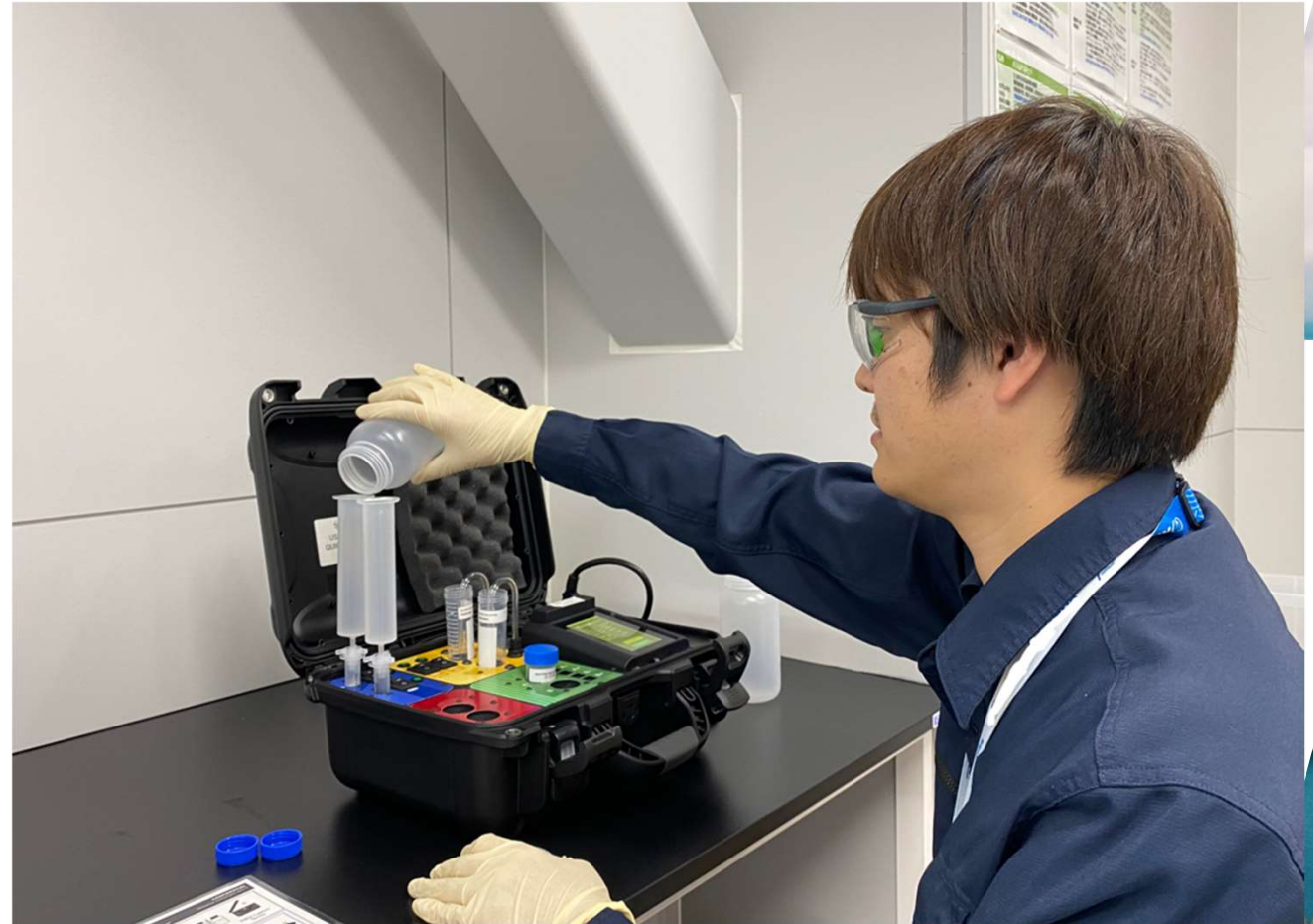
Start Date: March 2025

Objective: Validate FRED-PFAS accuracy and precision on industrial wastewater process streams

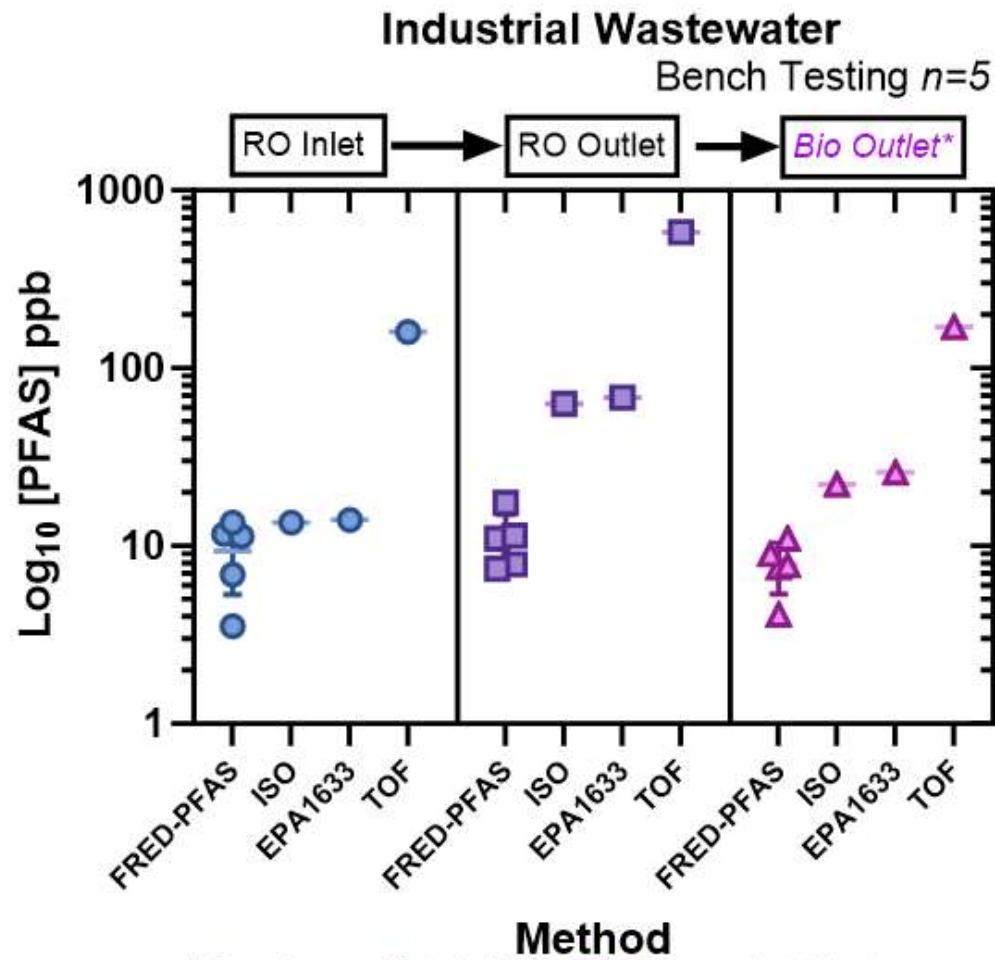
Partner: Leading Wastewater Treatment Equipment and Services Provider in Asia

Success Metrics:

- **Accuracy:** $\pm 50\%$ relative error (%RE) whereby accuracy refers to the degree of closeness between a measured value and the “true value”. In this context, the “true value” is defined as the chosen concentration of 50:50 PFOA:PFOS spike calculated as $\% \text{ relative error} = (\text{absolute error} / \text{“true value”}) \times 100$.
- **Precision:** $\pm 35\%$ relative standard deviation (%RSD) for multiple repetitions.



Results - Samples tested at client facility by FREDsense operators

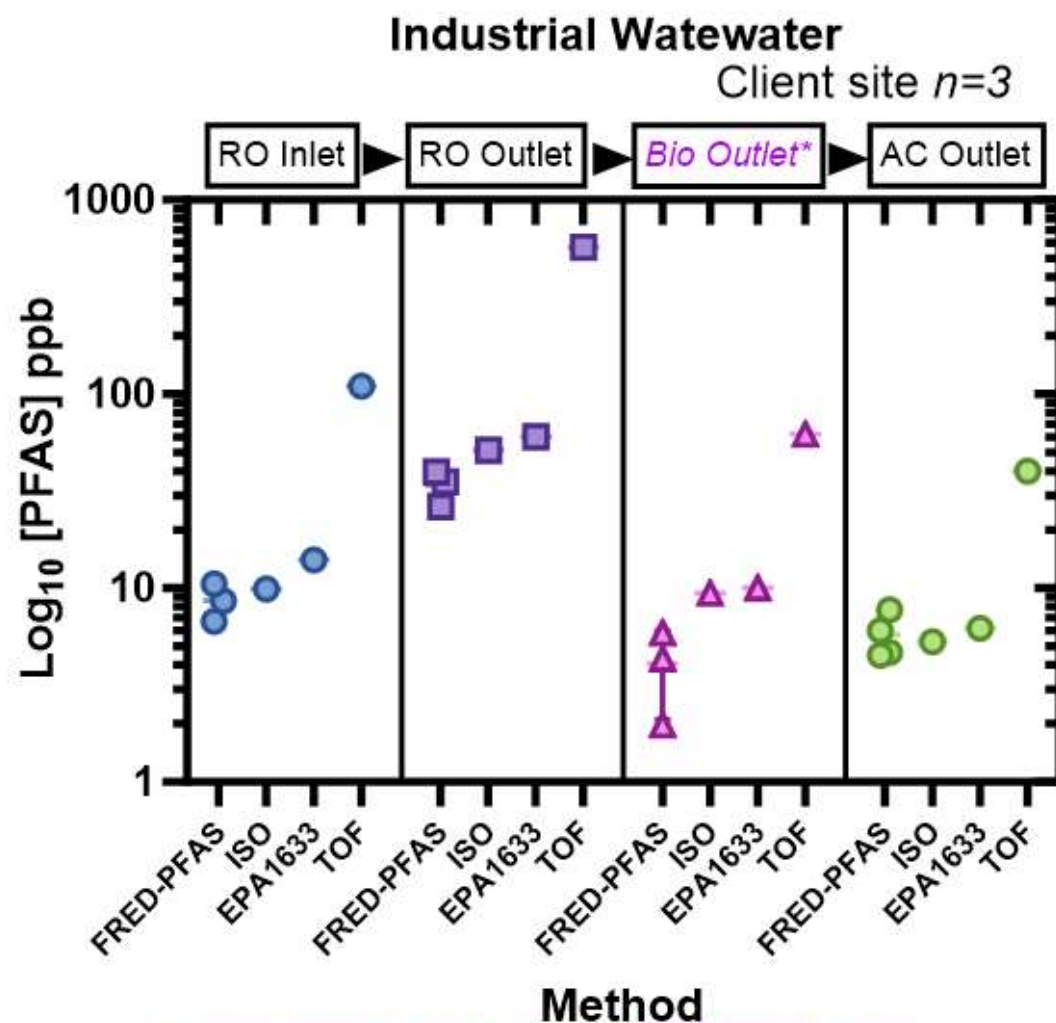


* Sample was diluted 4X. No PFAS removal at this step.

The results showed **strong correlation between FRED-PFAS and laboratory methods** ISO and EPA1633, with the exception of RO Outlet.

This particular sample displayed a yellow color which may indicate the presence of some sensor inhibitors in the RO concentrate, such as organic matter or others.

Results - Onsite Samples by Client Operators



* Sample was diluted 4X. No PFAS removal at this step.

Testing showed that **precision metrics were met for all samples except sample 3 (Bio Outlet)**, which had higher standard deviation likely due to lower sample concentration.

Spike recovery showed good results at the client site.

FRED-PFAS Summary of Results

Success Metrics:

- **Accuracy:** $\pm 50\%$ relative error (%RE) on spiked samples.
 - **Met all but one sample point (RO inlet)**
- **Precision:** $\pm 35\%$ relative standard deviation (%RSD) for multiple repetitions.
 - **Met for of 7 of 11 samples** (with as low as 9.4% RSD in the best case and 48.5% RSD in the worst case)
 - FRED-PFAS variability was prominent in the Bio outlet and RO Inlet sample points, likely due to a matrix interference.

Questions?

For more information, contact:

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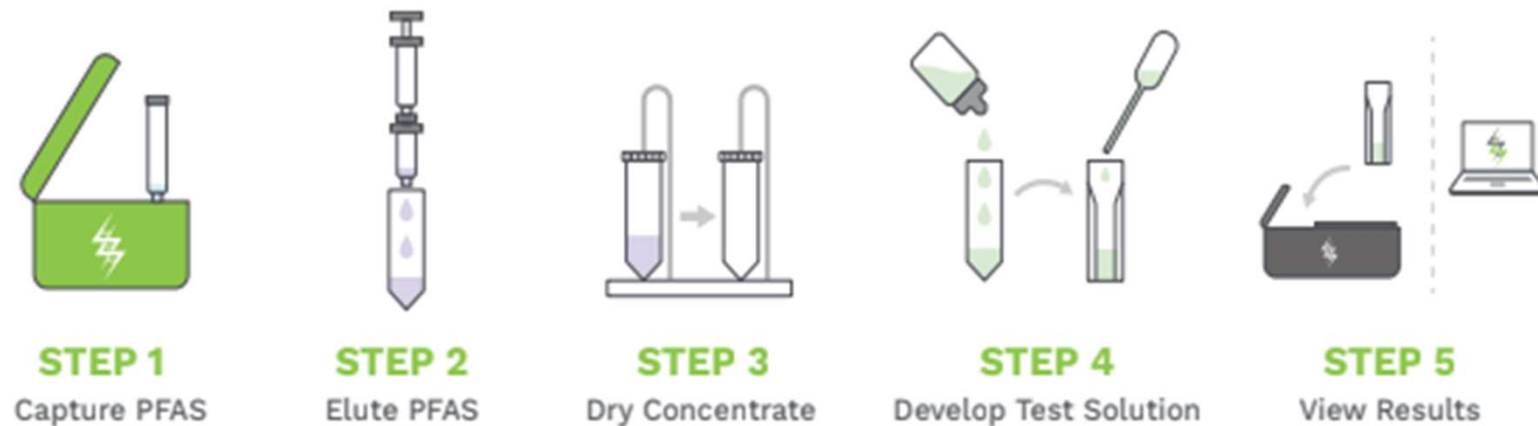


Supplementary slides



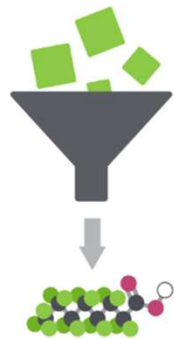
FRED-PFAS: The First Field Screening Method

- Measure down to **1,000 ppt** in real-world matrices with results in 3 hours
- Accurate and reproducible measurements designed for use by operators and consultants
- Comparable to Third Party Lab Data
- Simple **5-Step process** from Sample Collection to Results



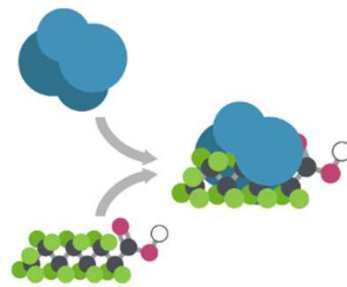
FRED-PFAS Detects PFAS Molecules

- Developed “binding systems” to detect the **fluorocarbon backbones** of PFAS molecules
- **Fluorescent detection** methods allow for versatile products
- **Total PFAS** measurement system, measuring both terminal and precursor PFAS



1. Concentrate

Process, filter, and isolate PFAS compounds from a water sample



2. Capture

Our patented biochemical system binds to the PFAS compound



3. Detect

The bound PFAS molecule produces a detectable signal

