State of the Science and Regulatory Landscape on PFAS Treatment technologies and Management in Residuals, Including Spent GAC:

Traditional Methods and Innovative Alternatives with a Focus on Non-Organic Regeneration

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Northwest Remediation Conference
TECHNOLOGIES • TECHNIQUES • REGULATIONS

EA Engineering, Science, and Technology, Inc.

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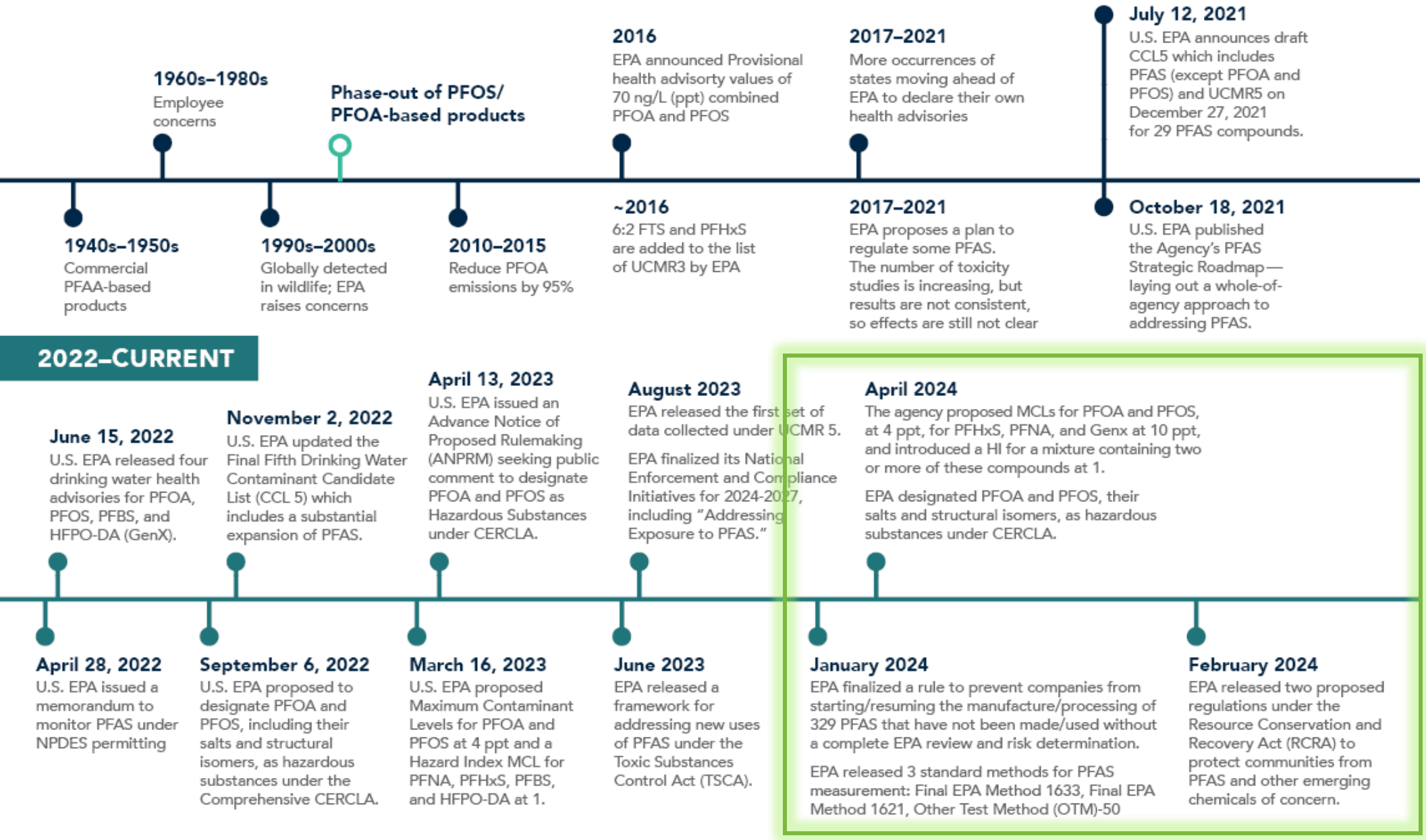
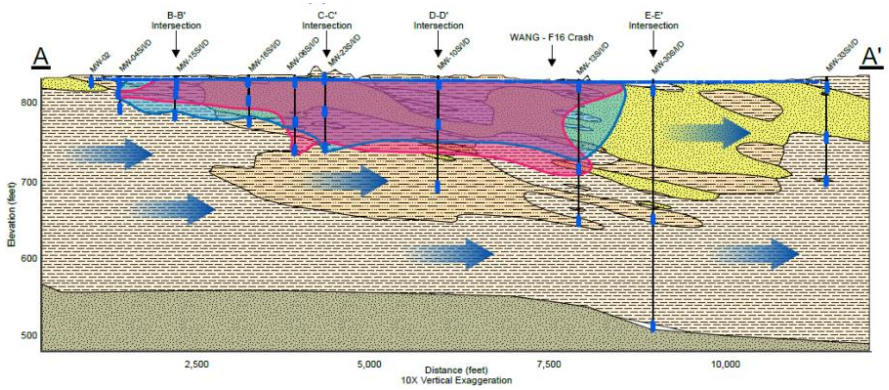
History & Regulations of PFAS



Superfund Cleanup Process



- PFAS Profile
- Source Pollution vs Background
- Forensics
- Risk Assessments
- Conceptual Site Models

1 Preliminary Assessment/ Site Inspection

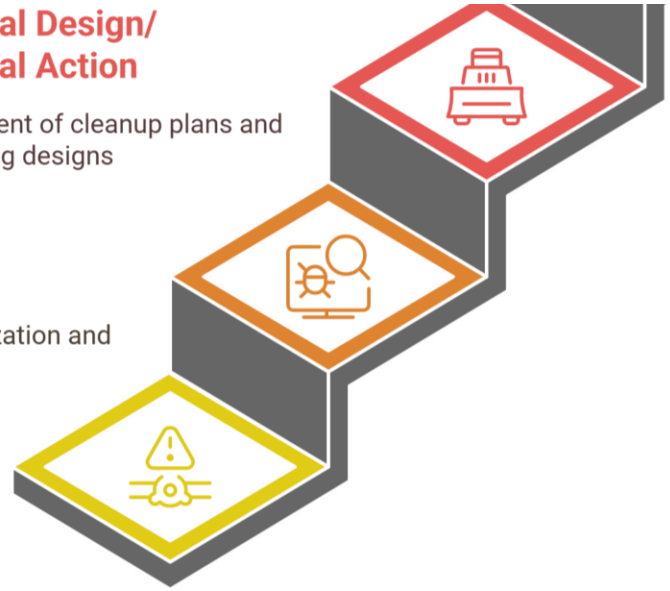
Initial site evaluation to identify potential hazards

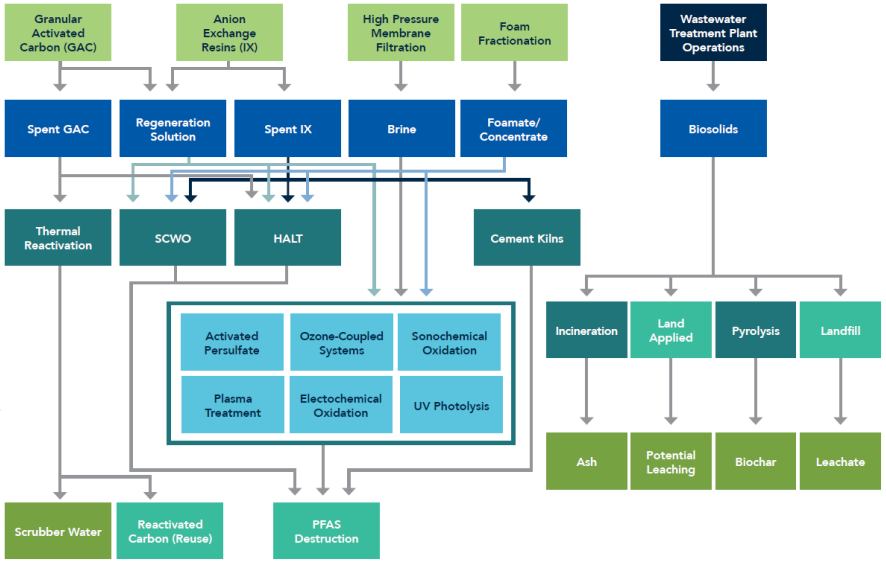
2 Remedial Investigation/ Feasibility Study

Detailed site characterization and threat assessment

3 Remedial Design/ Remedial Action

Development of cleanup plans and engineering designs

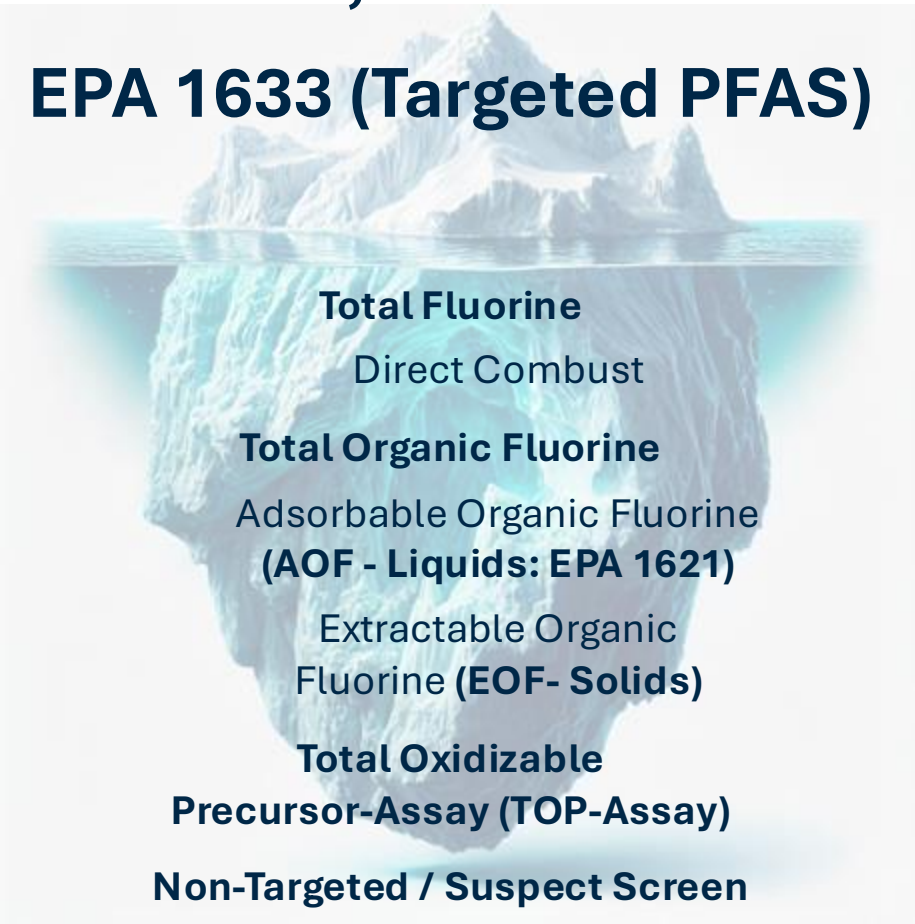




PFAS Analytical

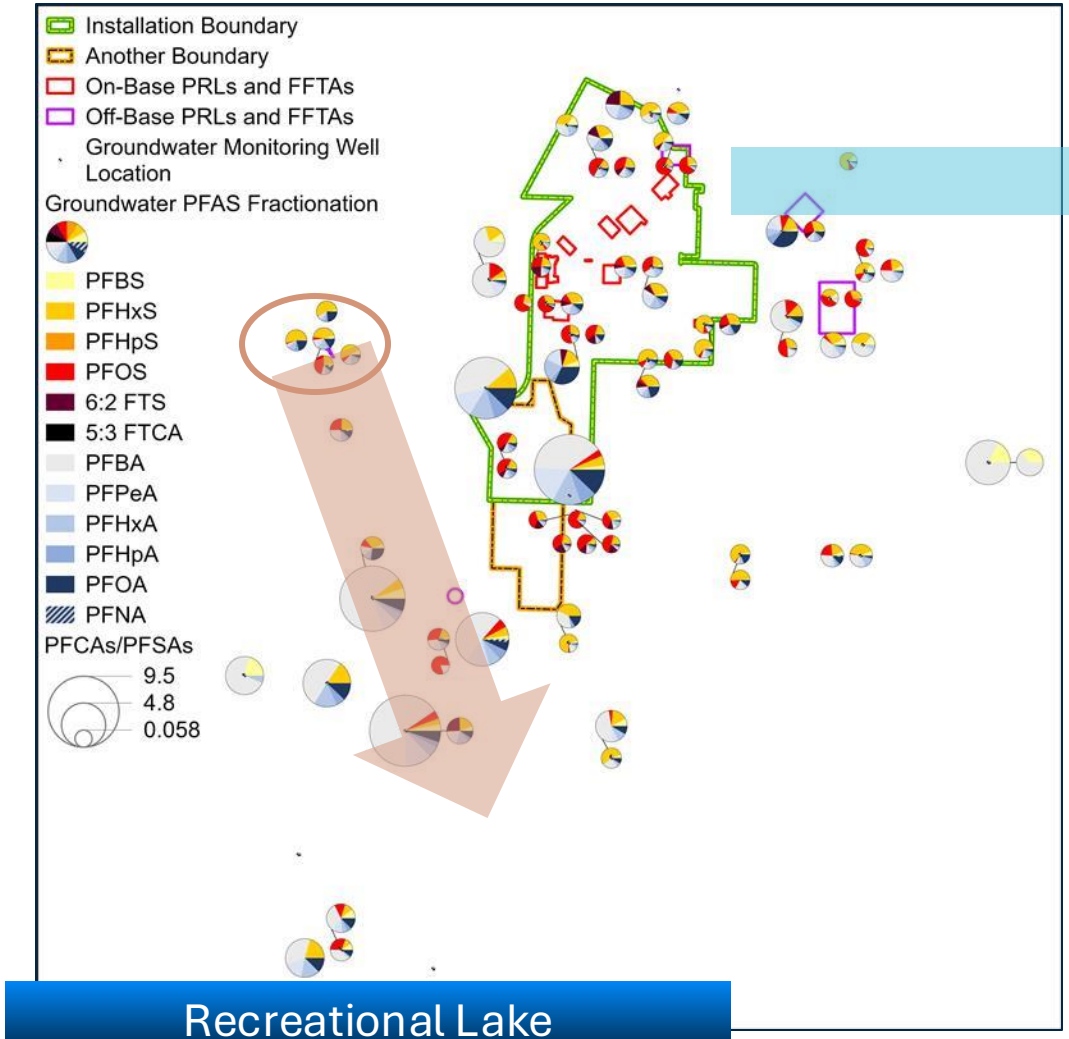
Importance of an Informed Analytical Regime

~10,000 PFAS



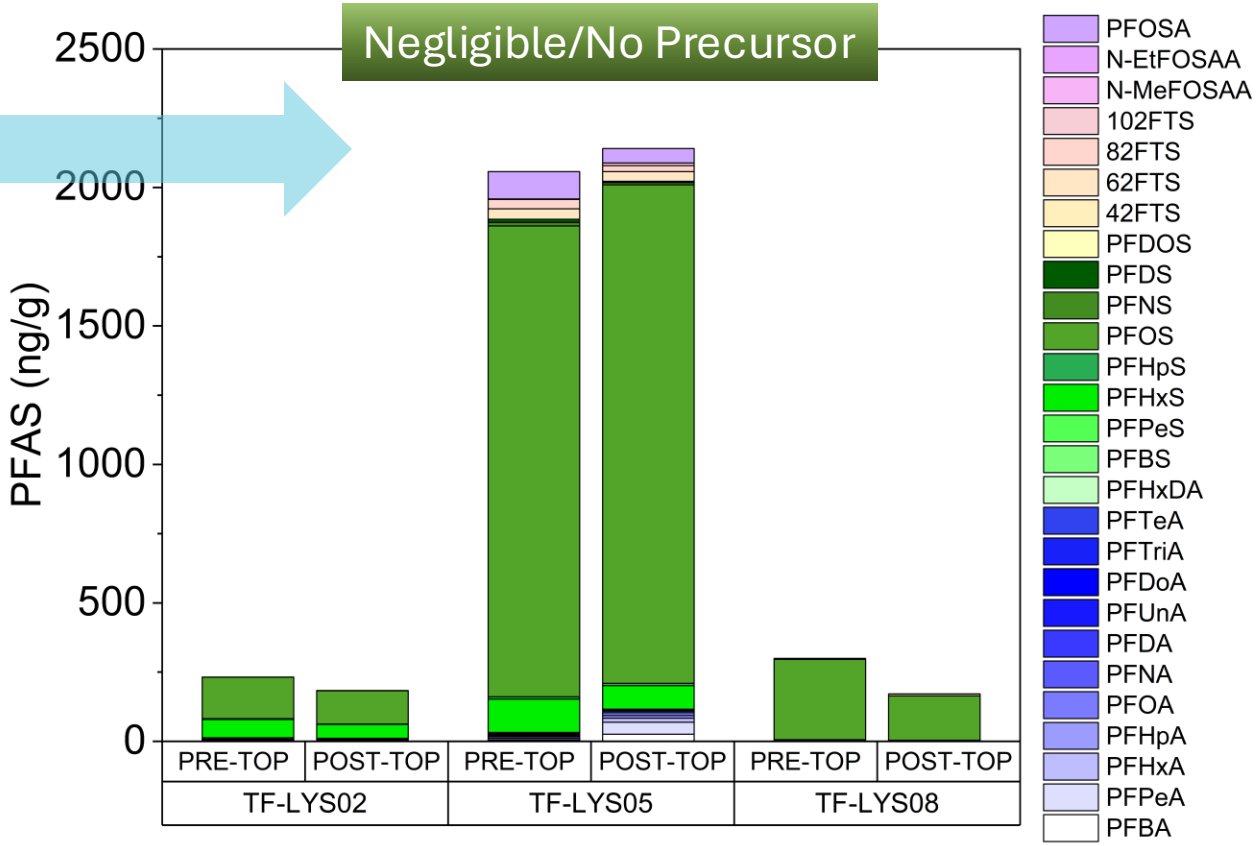
- **QA/QC**
  - **Interferences**
  - **Contamination**
    - ❖ Sample Collection
    - ❖ Processed Blanks
    - ❖ Surrogate Recoveries/Isotope Dilution

Visualization of Analytical Results



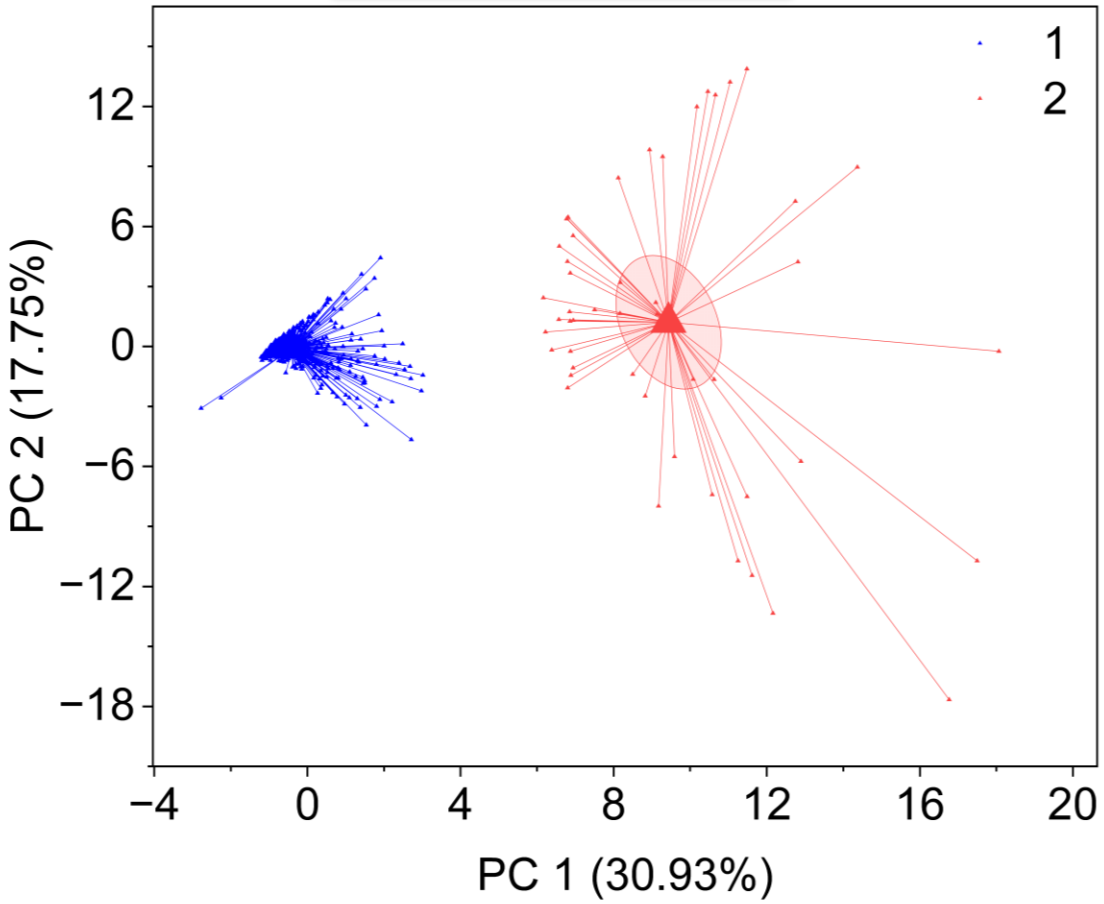
Recreational Lake Contamination with PFCAs

Negligible/No Precursor

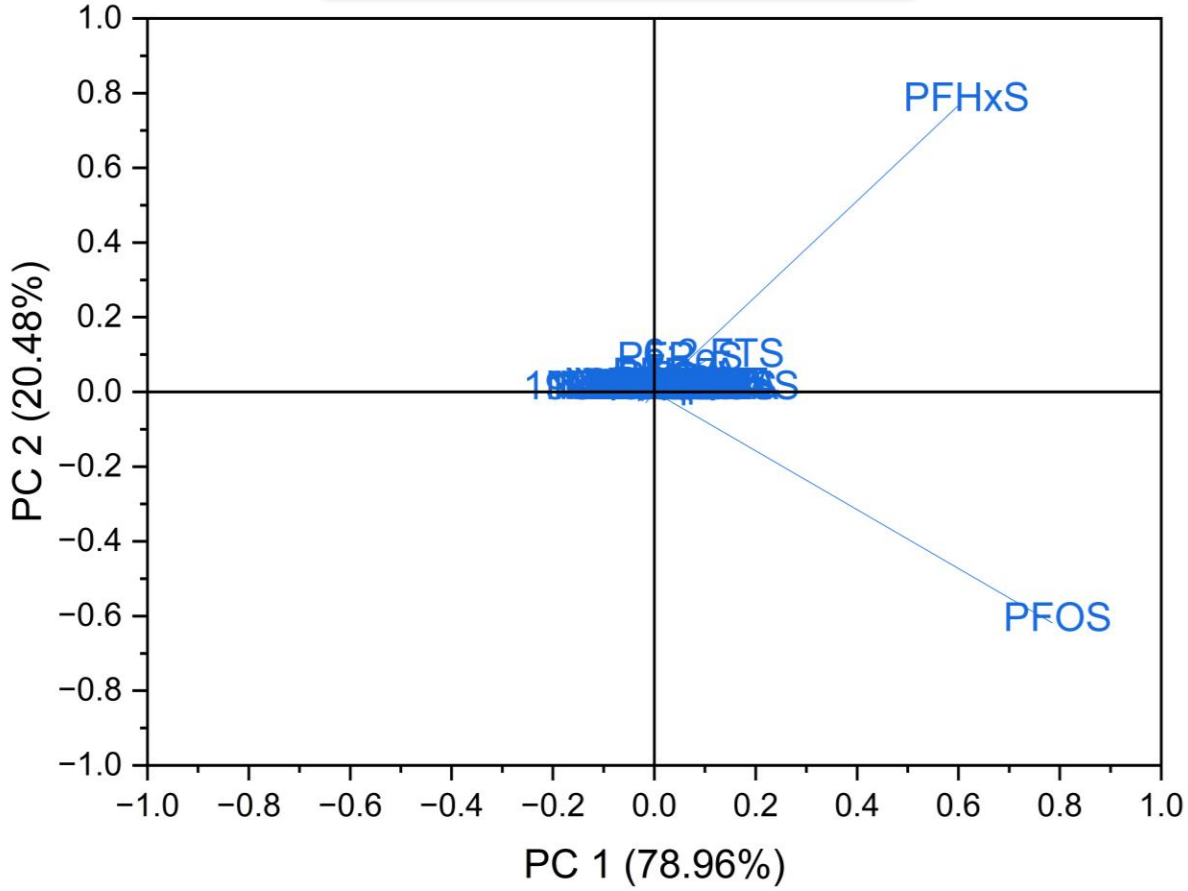


Leveraging ML Techniques

K-Means Clustering

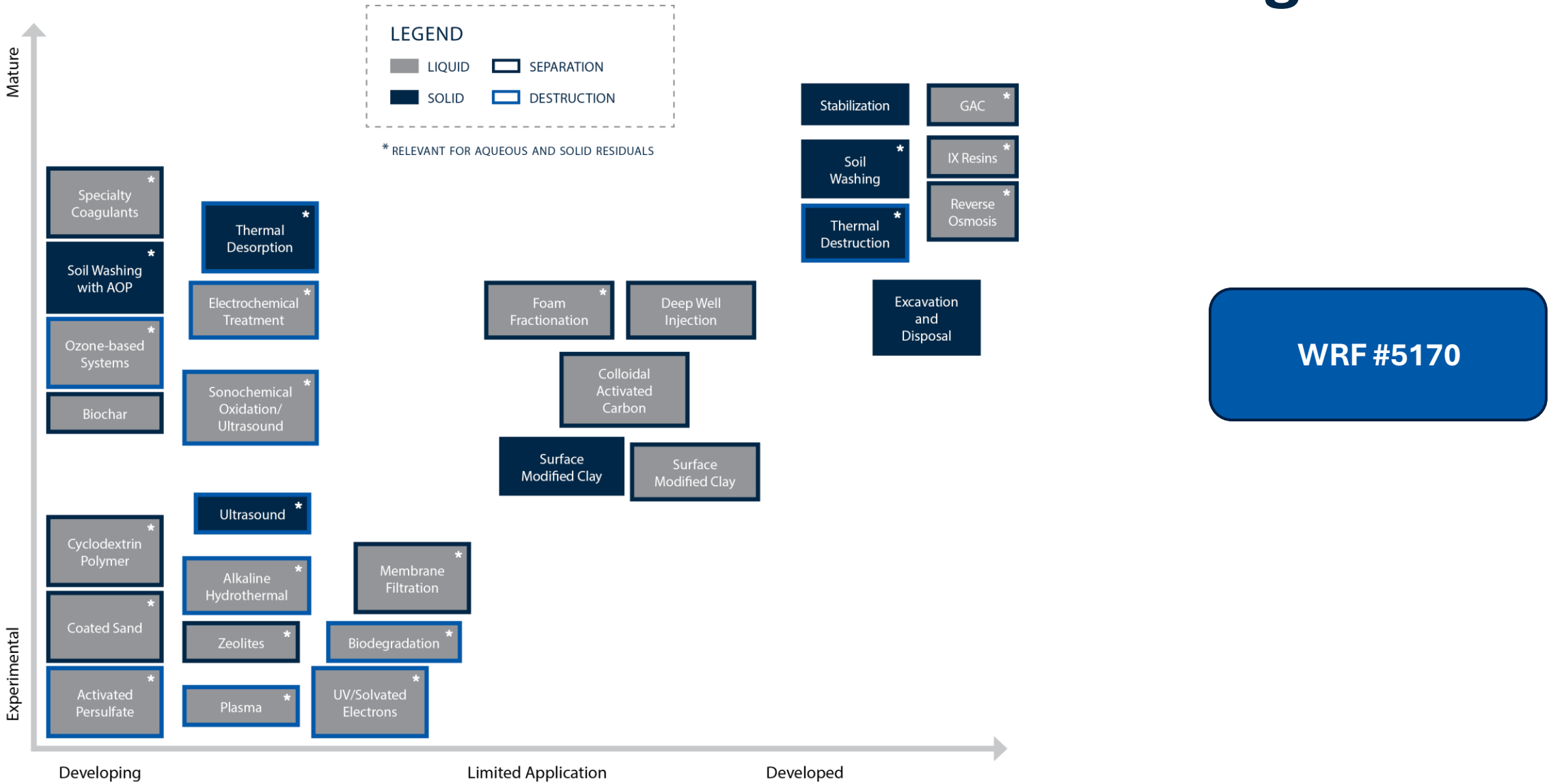


Biplot Visualization of PCA



Treatment Technologies for PFAS

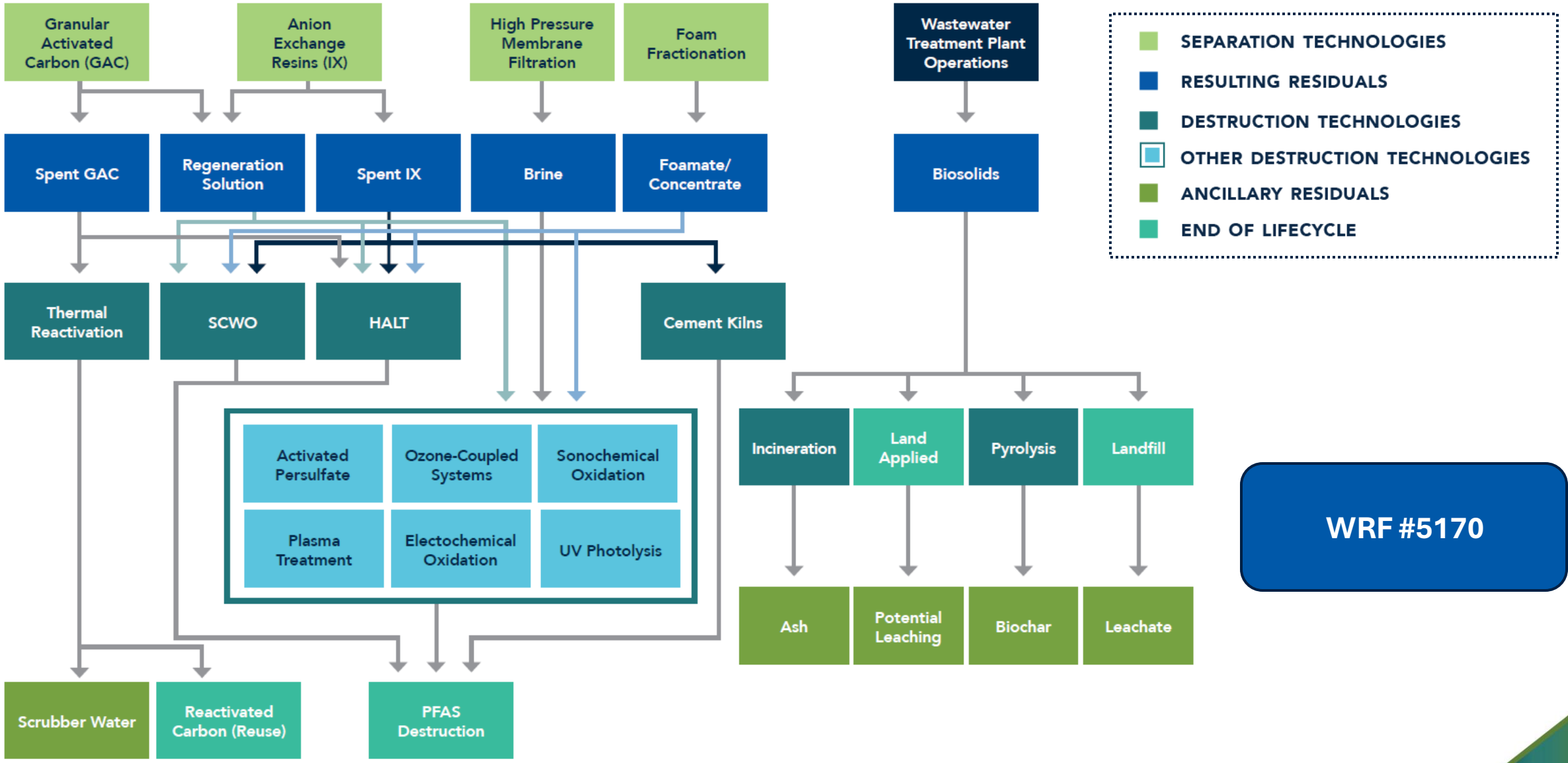
PFAS Removal and Destruction Technologies



WRF #5170

Modiri et al., 2024, **State of the science and regulatory acceptability for PFAS residual management options: PFAS disposal or destruction options** Chemosphere, 368, 143726.

PFAS Residual Management



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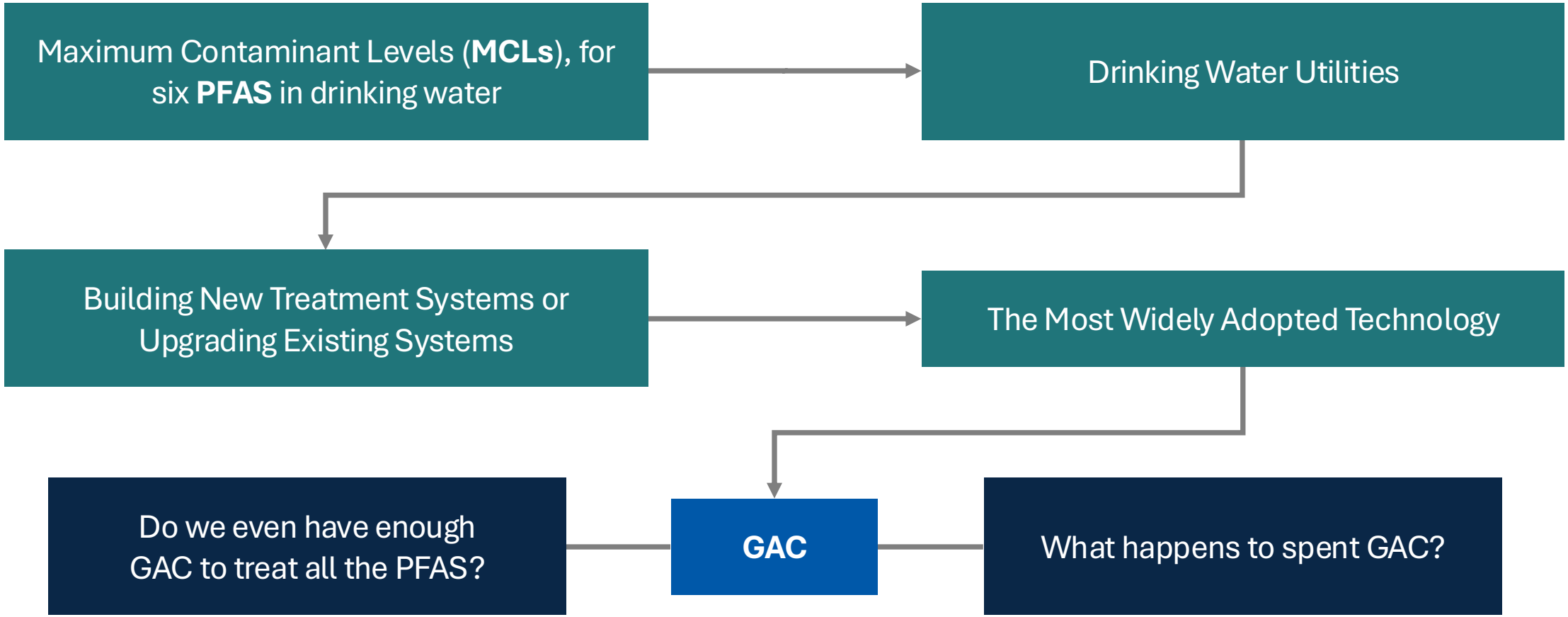
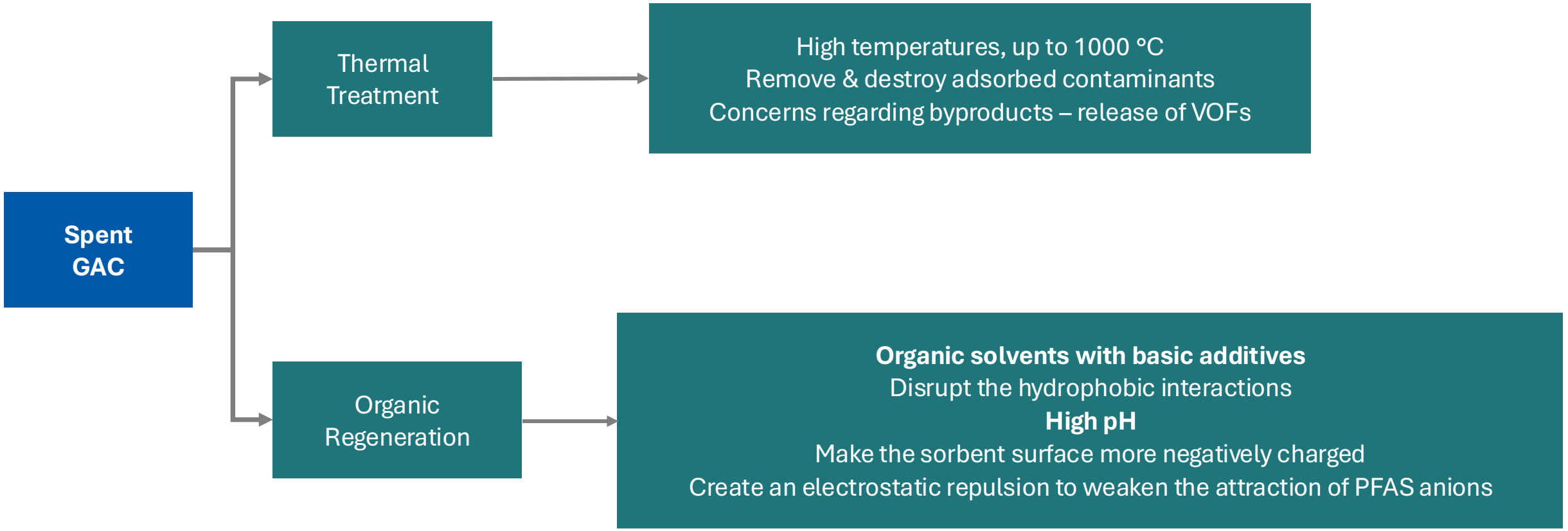
Granular Activated Carbon



Current Strategies for Spent GAC



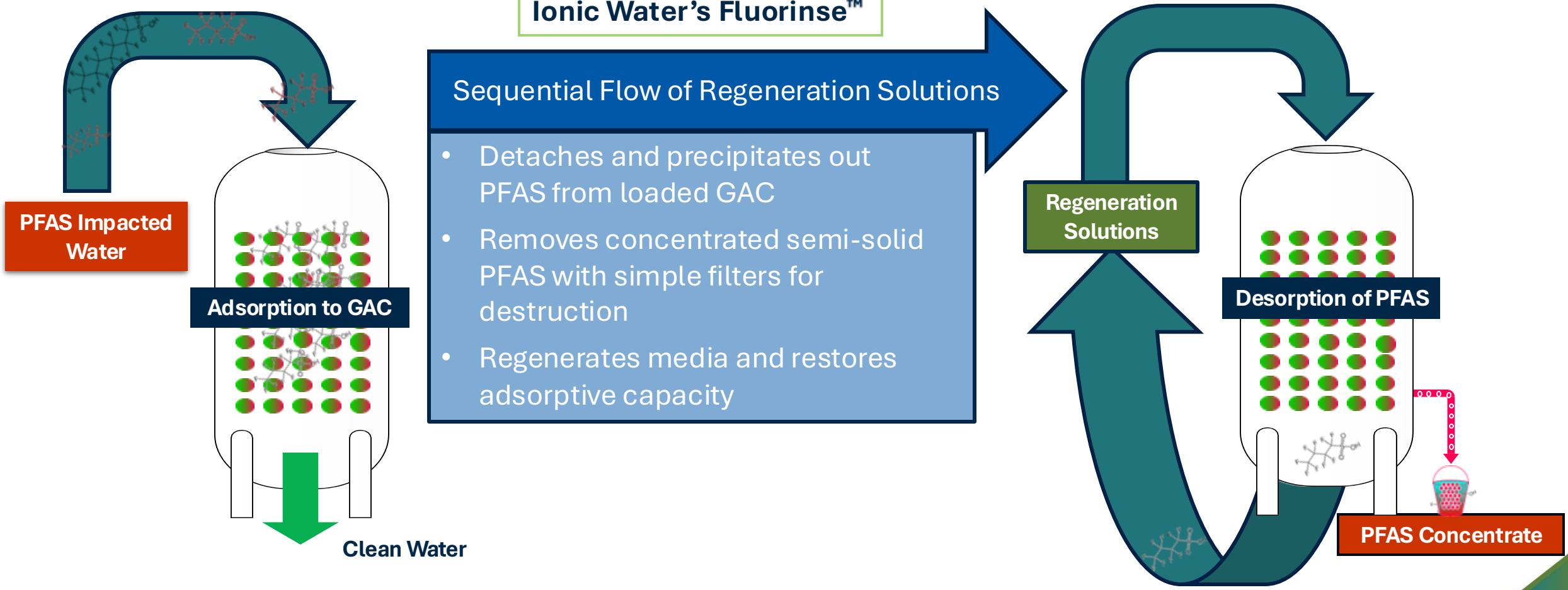
A technology that can be used on-site and does not require solvent or high temperature!

Novel Non-Organic Regeneration – Fluorinse™

Ionic Water's Fluorinse™

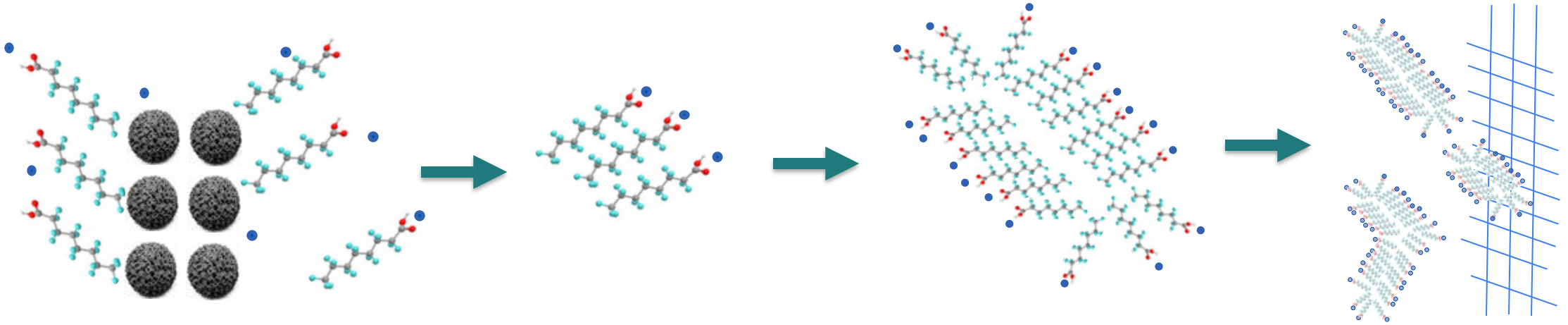
Sequential Flow of Regeneration Solutions

- Detaches and precipitates out PFAS from loaded GAC
- Removes concentrated semi-solid PFAS with simple filters for destruction
- Regenerates media and restores adsorptive capacity



Patent No: US 11958763. Issued April 2023

Chemistry Behind Fluorinse™ Method



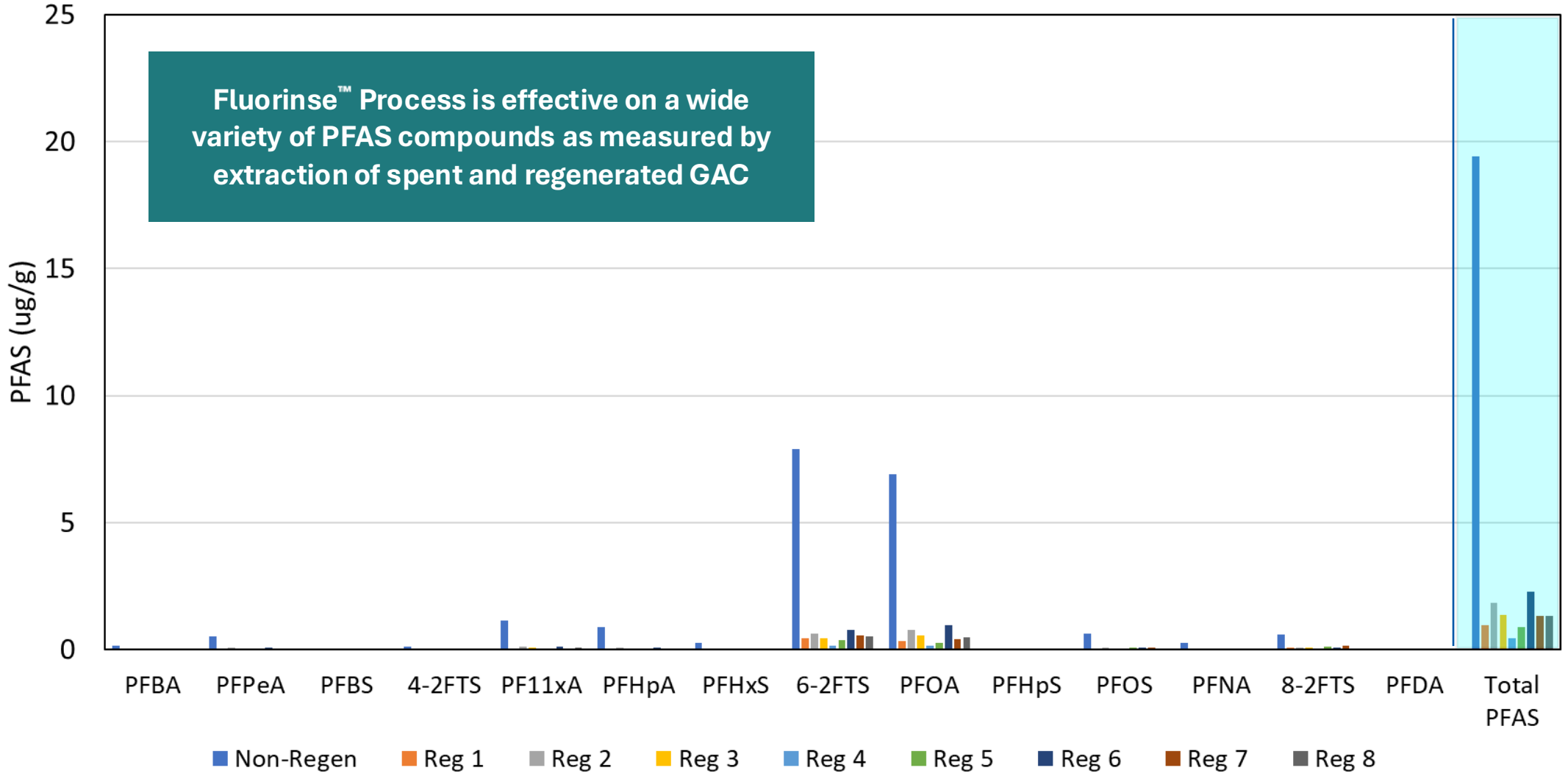
1. Cations in Fluorinse™ have higher affinity for PFAS than GAC => **PFAS desorbs**

2. Desorbed PFAS are flushed from column and agglomerate to reduce polar interactions with water

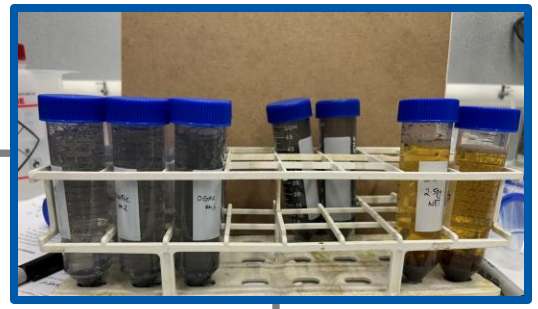
3. Outside of column, PFAS forms larger agglomerates and ripens

4. Agglomerates are filtered with standard pore size bag filter from regeneration fluid before recirculation

Different Non-Organic Regeneration Recipes



Analytical Challenges



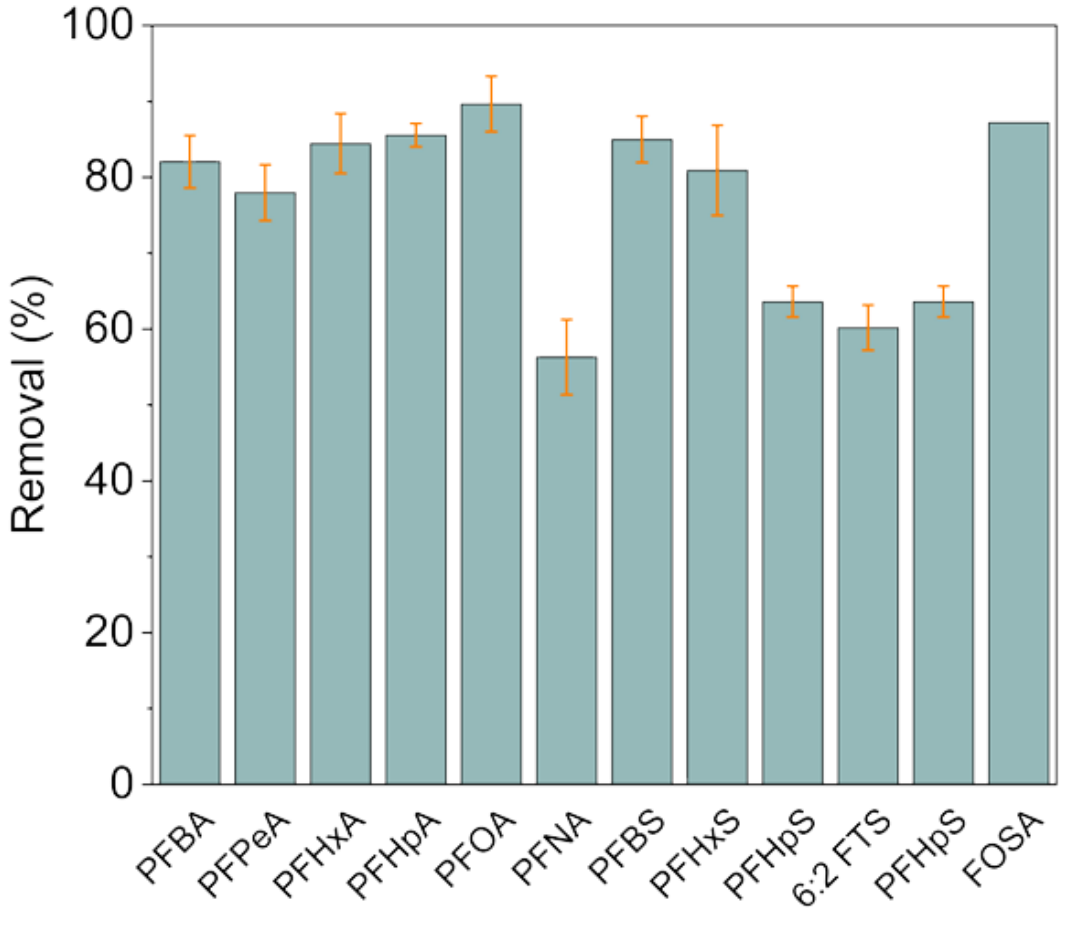
GAC Extraction

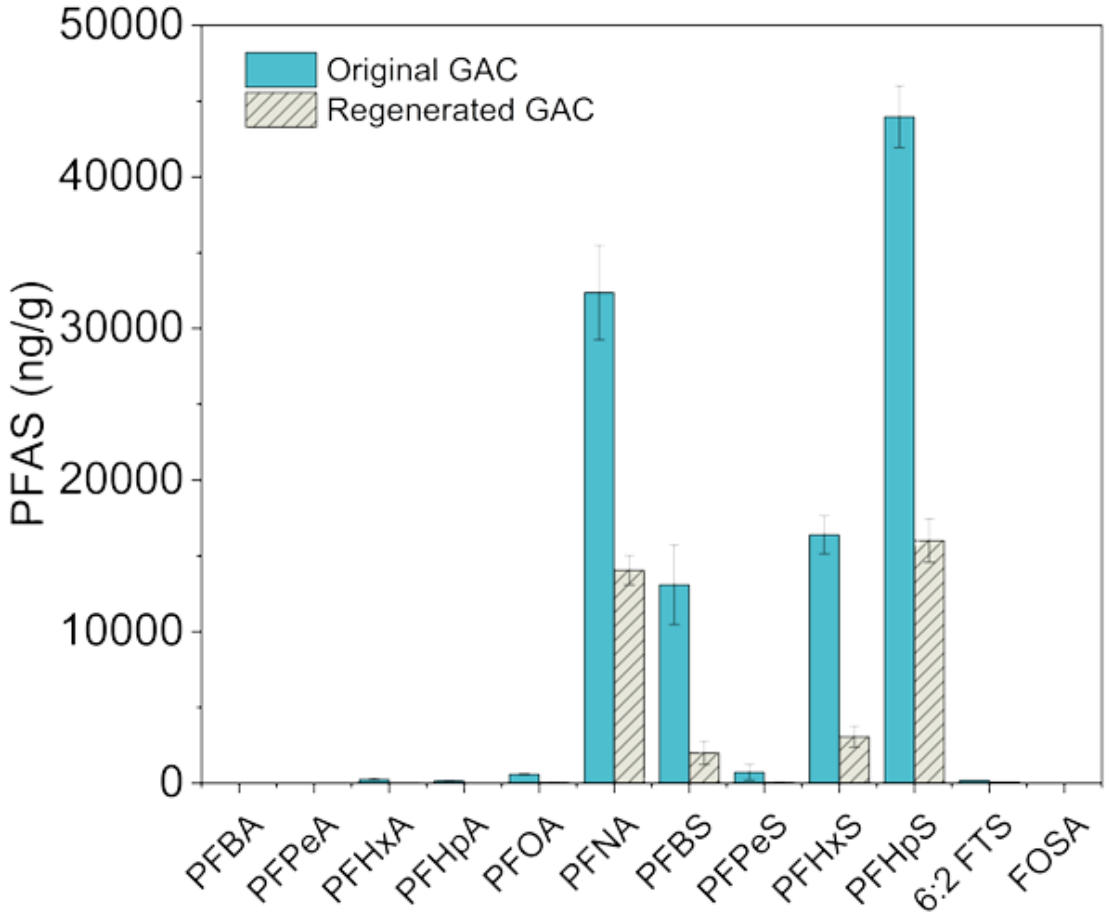
- Low Surrogate Recoveries
- Underestimation of PFAS Concentrations in Spent GAC

Regeneration Solutions

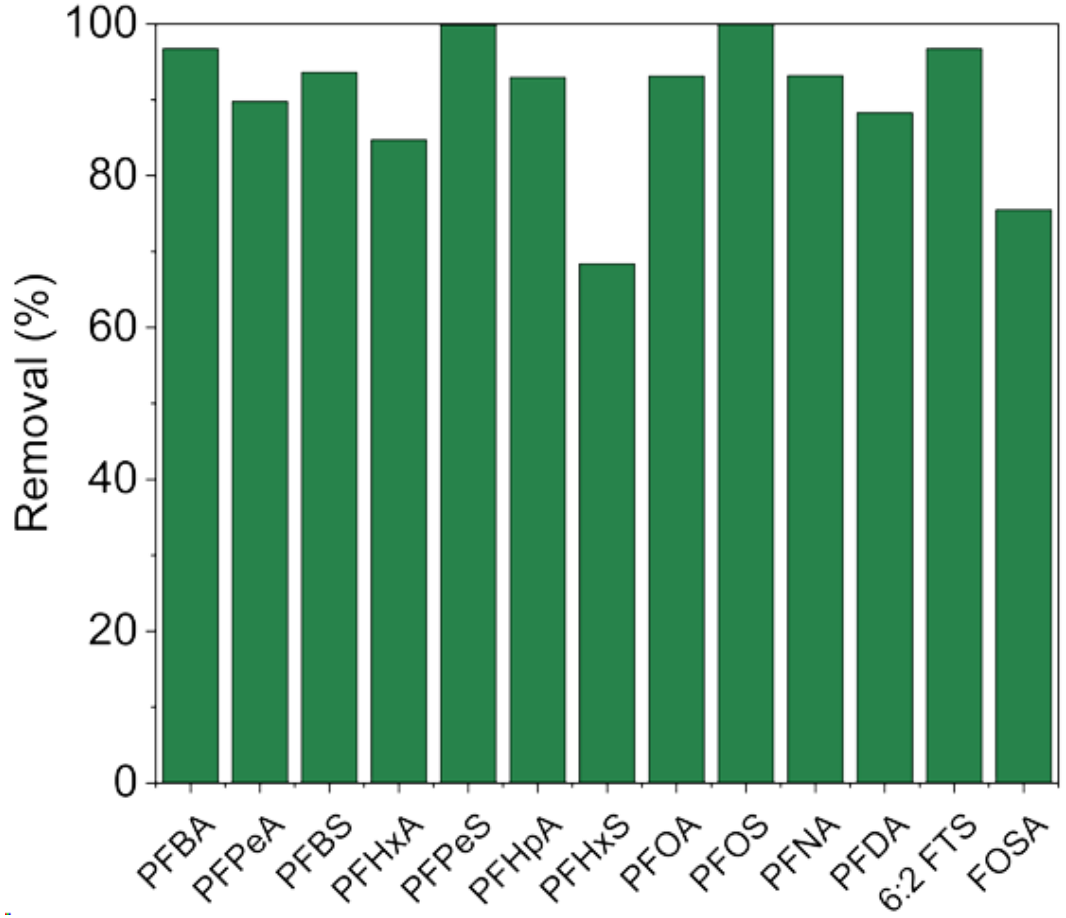
- High pH
- Ionization Problem with Direct Injection/ Solid Phase Extraction

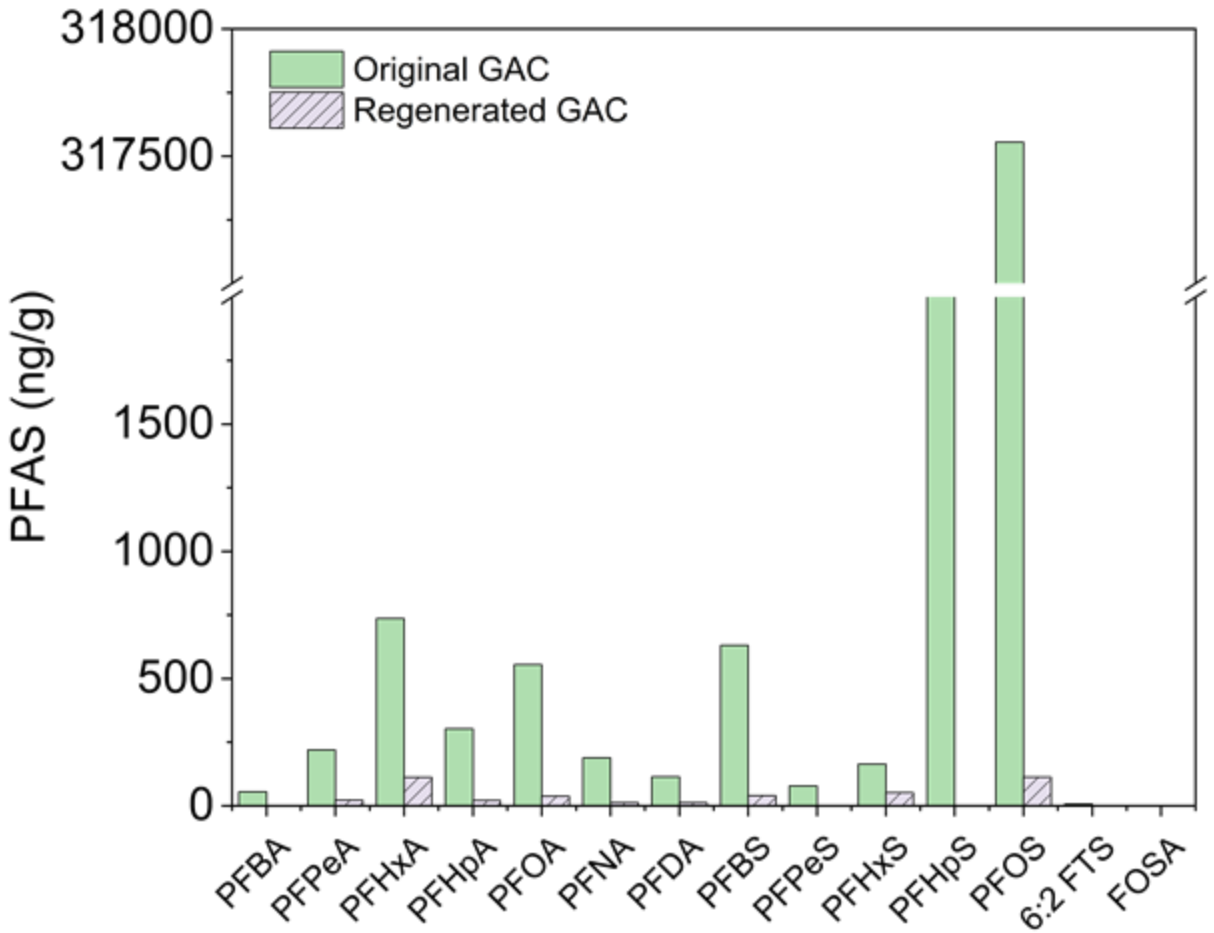
Virgin GAC with Spiked PFAS



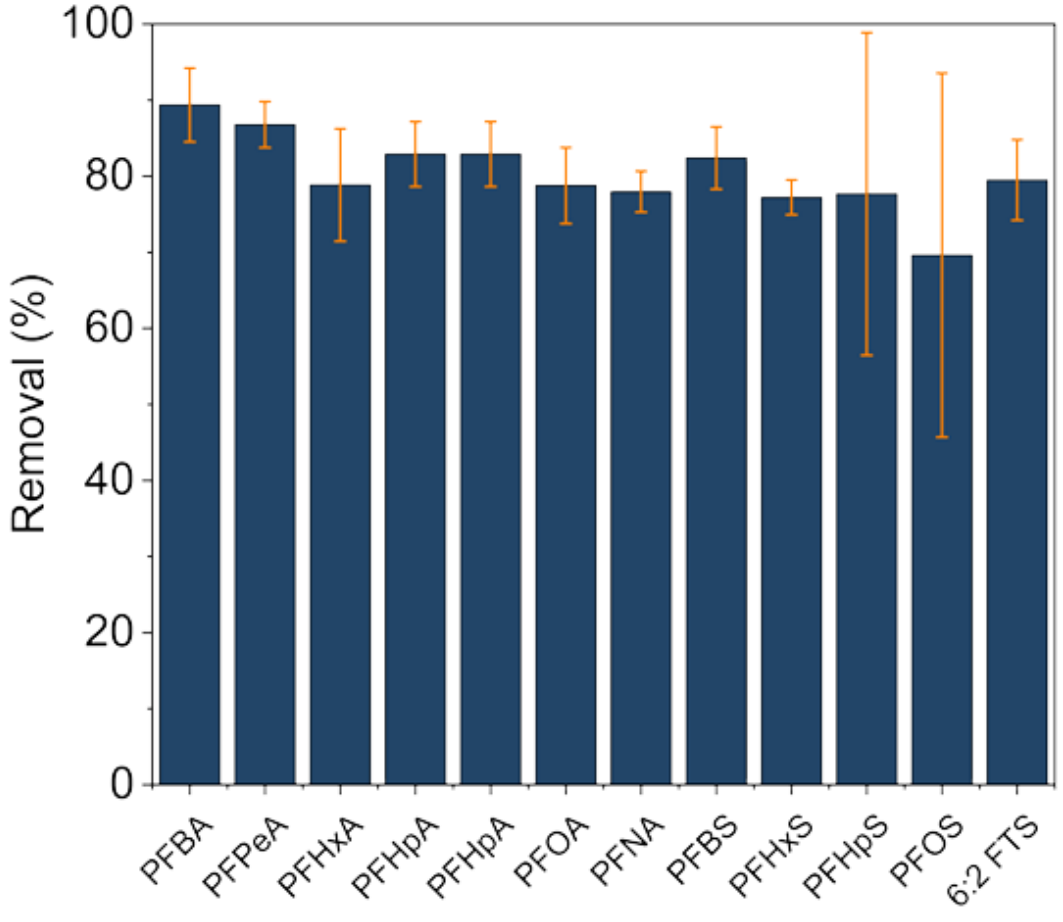


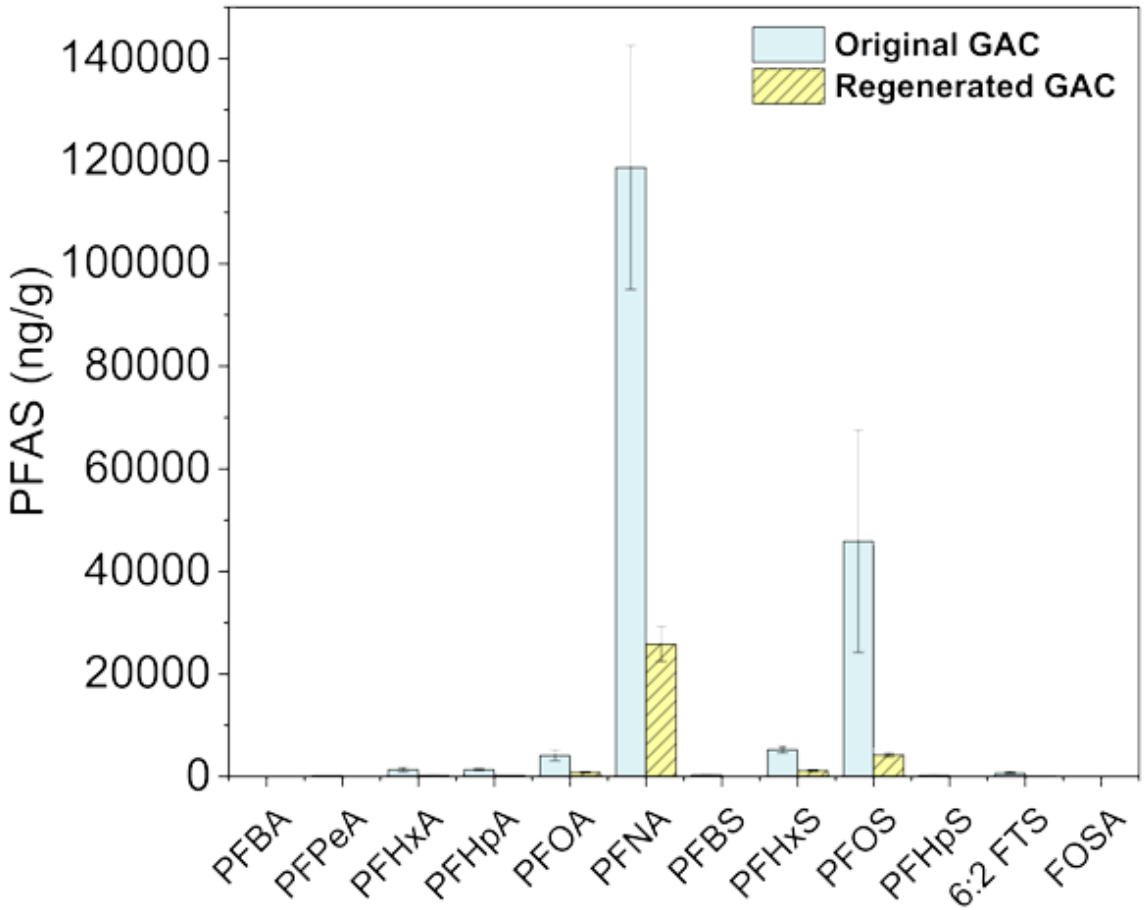
Spent GAC from a Public Drinking Water Facility





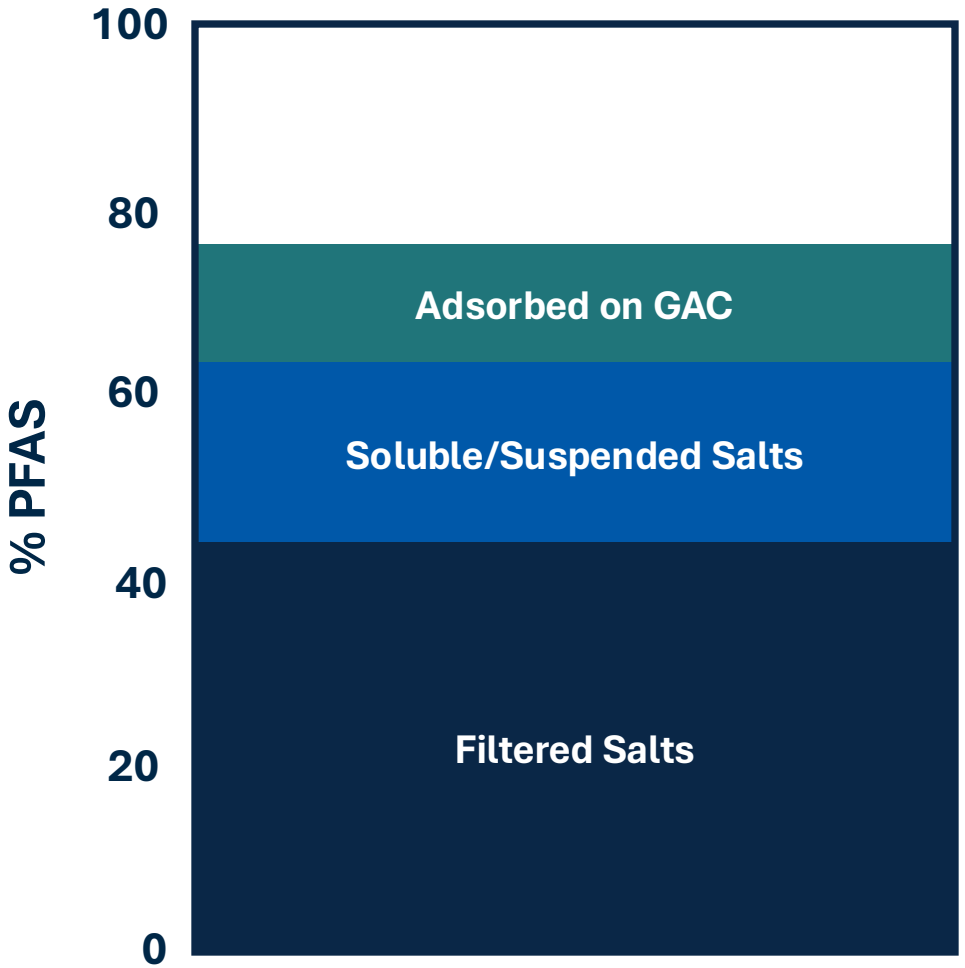
AFFF-Impacted GAC from DOD Sites





Total PFAS = ~15 mg/kg

Preliminary Mass Balance – Beaker Study

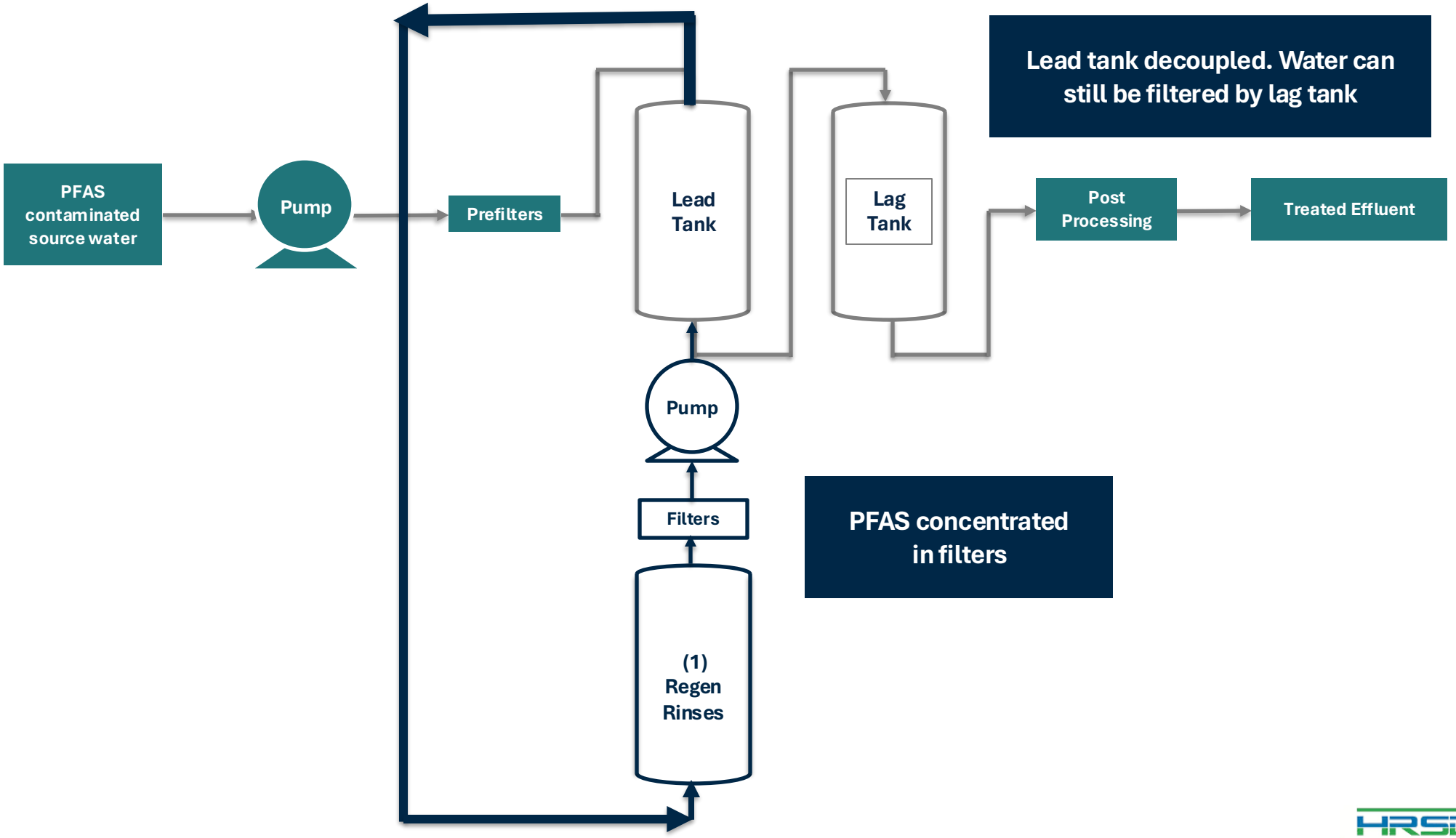


Potential Sources:

- Unfiltered precipitates
- PFAS adhering to glassware
- Analytical method artifacts

Optimizing analytical methods will serve in better understanding the PFAS mass in each phase.

On-Site Regeneration



On-Going Efforts

- Optimization of regeneration volume
- Engineering/Piloting/Scale up
- Evaluating the effectiveness of **Fluorinse™ Process** on ion exchange resins
- Partnership with destruction technologies
- Partnership with GAC companies to optimize the GAC surface for PFAS treatment and subsequent regeneration

QUESTIONS

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