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Treat PFAS

Partner with Xylem for full lifecycle expertise, services & aftermarket support to treat water for residential, municipal, industrial, & commercial applications.

WEFTEC 2024

PFAS

New Rule & Xylem Solutions

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So what is PFAS?

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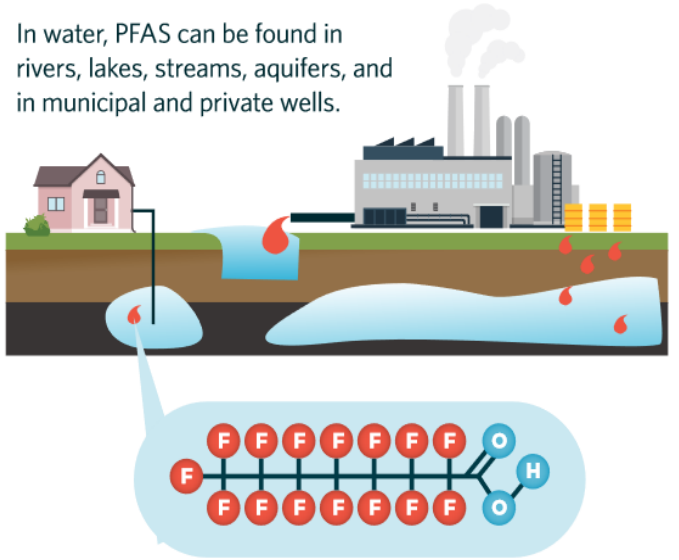
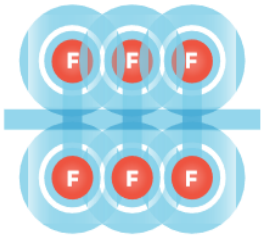
- Over 9,000 synthetic compounds used to make products resistant to stain, heat, oil, grease, & water
- In use since the 1940s (Teflon)
- USS Forrestal fire (1967) was triggering event for creation of PFAS firefighting foams; Navy revamped fire fighting practices
- Carbon-fluorine bond is one of the strongest in chemistry... very stable compounds and **Hard to Treat!**



The chemical bond of PFAS is so strong that it takes decades or longer to break down.



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Sources of PFAS

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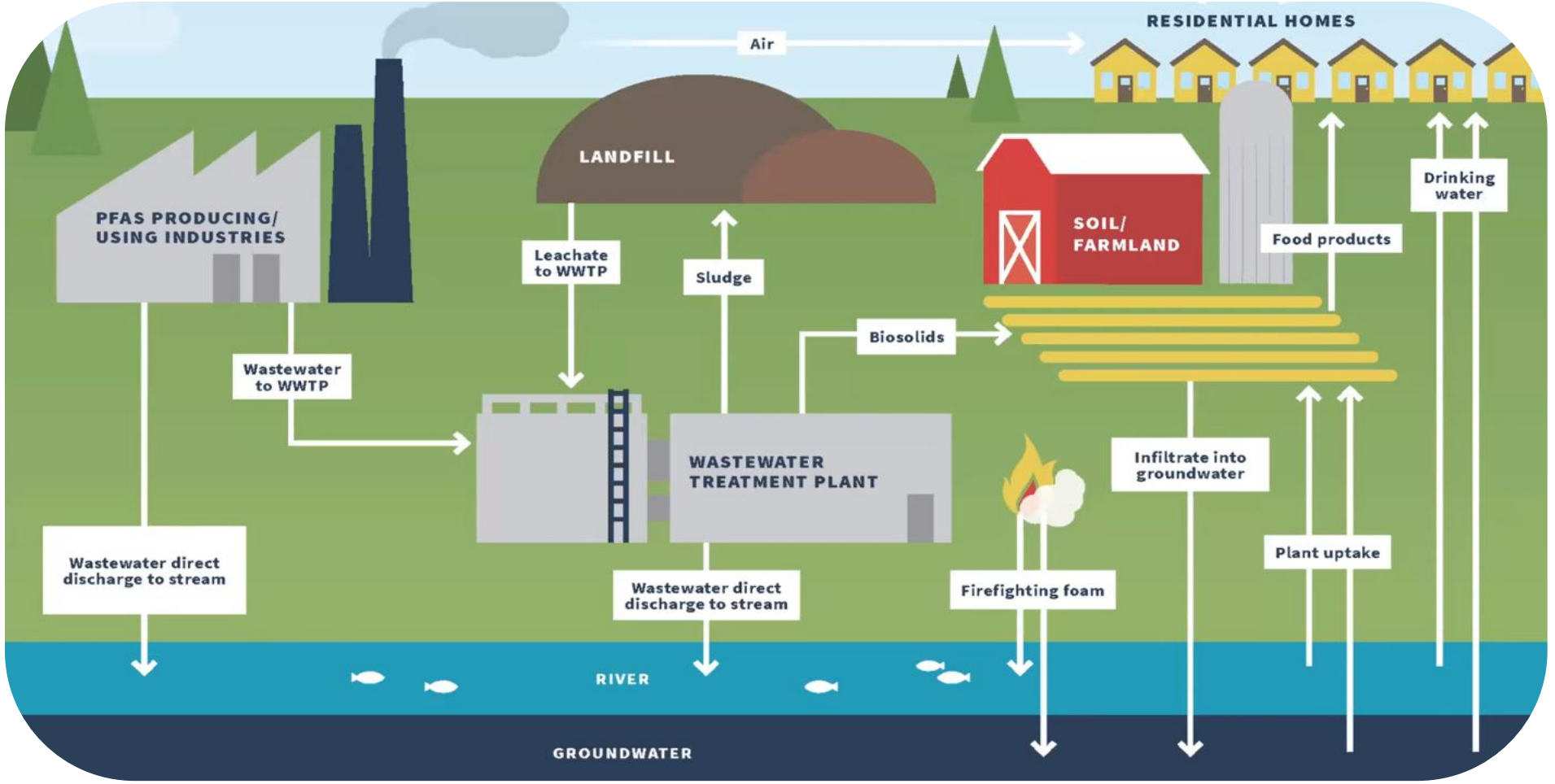

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Two Major Regulations Finalized in April 2024

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National Primary Drinking Water Regulation

- **MCLs** set **for six PFAS**
- Monitoring by 2027; compliance with MCLs by 2029
- **GAC, IX, RO/NF "Best Available Technologies"** for PFAS

CERCLA Hazardous Substance Designation for PFOA & PFOS

- Established **liability** for polluters, enables access to federal superfunds for **environmental remediation**
- EPA enforcement targets polluters, but tech providers, utilities, etc.… may be open to public lawsuits

Pending Global Regulatory Initiatives

- EU (2026), CA , UK, AU have pending PFAS drinking water regulations
- US EPA will regulate landfills, metals plating, organic chemicals industries through NPDES & studying many others, such as MicroE

PFAS	MCL	HBWC	Hazard Index
PFOA	4 ppt	N/A	
PFOS	4 ppt	N/A	
PFNA	10 ppt		If ≥ two present, divide level by HBWC and add. Total <1
PFHxS	10 ppt		
Gen-x	10 ppt		
PFBS	N/A	2000 ppt	

EPA estimates:

- **By 2027, 66,000 public drinking water utilities** must measure PFAS
- **By 2029, 4,000-6,500 utilities serving 100M people will need to reduce PFAS levels**

April 2024 final PFAS rule published, April 2027 initial monitoring deadline, April 2029 final compliance deadline

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PFAS Contamination in the U.S.

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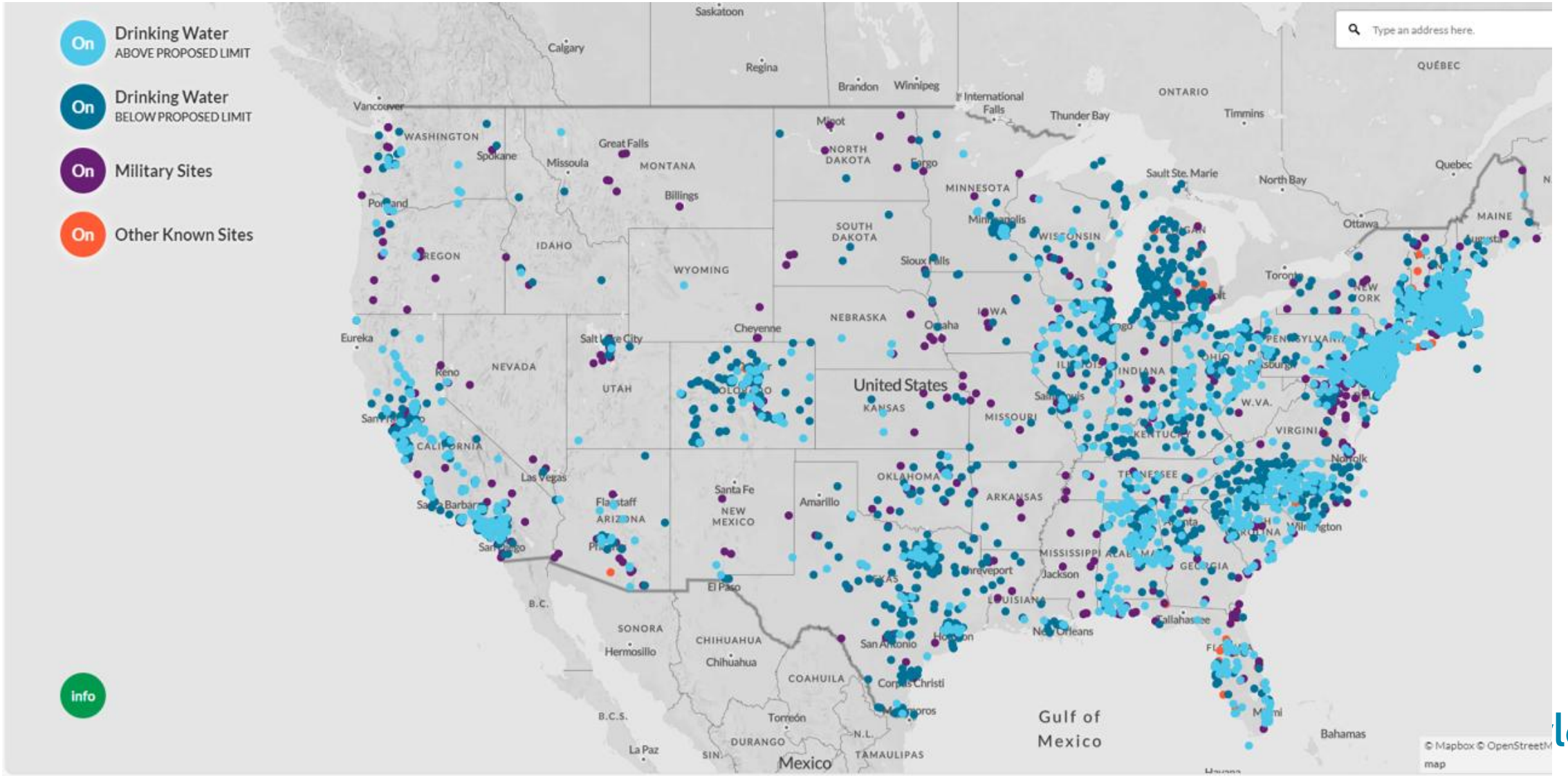

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State of Detection & Measurement

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- Current EPA analytical standards involve liquid chromatography and tandem mass spectroscopy; accurate for up to 40 PFAS compounds.
- They can detect concentrations in the low parts per trillion (ppt).
- They do not account for most of the over 9,000+ identified PFAS compounds.
- To compensate, the industry typically uses the Total Oxidizable Precursors Assay (TOPA).
- Precursor concentrations are estimated by evaluating amounts before and after.

EPA United States Environmental Protection Agency

Method 533: Determination of per- and polyfluoroalkyl substances in drinking water by **isotope dilution** anion exchange solid phase extraction and liquid chromatography/tandem mass spectrometry.

Method 537.1: Determination of selected per- and polyfluorinated alkyl substances in drinking water by **solid phase extraction** and liquid chromatography/tandem mass spectrometry (LC/MS/MS).

Method 1633: Analysis of per- and polyfluoroalkyl substances (PFAS) in **aqueous, solid, biosolids, and tissue** samples by LC-MS/MS.

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Infrastructure Investment and Jobs Act / Bipartisan Infrastructure Law

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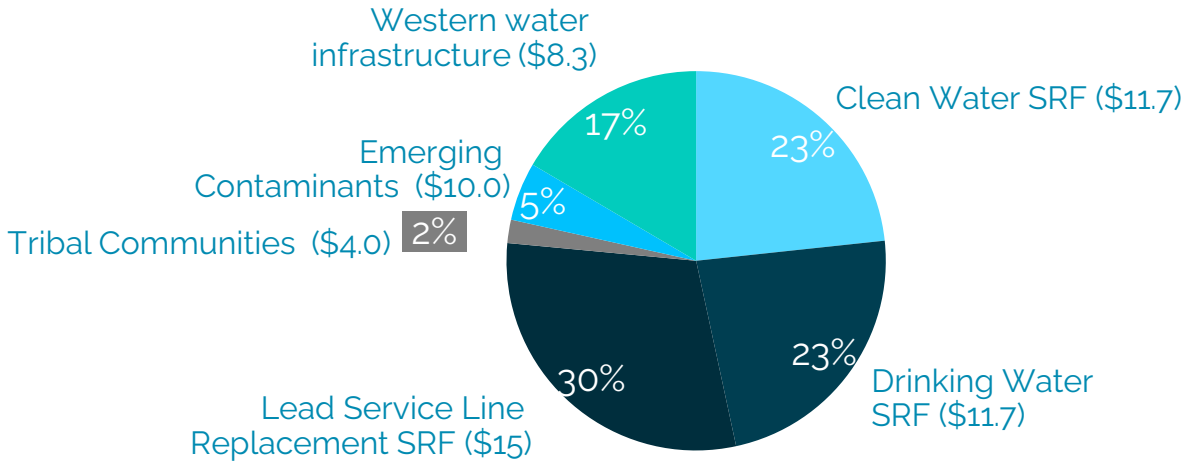
- **$66B** for clean drinking water, generally dispersed over 5 years.
- Of this $66B, **$10B proposed for PFAS**/emerging contaminants funding:
  - $1B to address emerging contaminants in wastewater through the Clean Water State Revolving Fund
  - $4B to address PFAS in drinking water through the Drinking Water State Revolving Fund
  - $5B for small and disadvantaged communities to address emerging contaminants



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EPA issued first-ever national, legally enforceable PFAS drinking water standard

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EPA Key Facts

- EPA's first national drinking water standard for a contaminant since 1996
- Established maximum contaminant levels for five individual PFAS chemicals
- ~$1B in new funding to help communities address PFAS contamination
- Utilities have 3 years for monitoring compliance, 5 years to install technology

$10B allocated in Infrastructure Bill to PFAS remediation efforts

Xylem PFAS Treatment Capabilities

Granular Activated Carbon:
Selectively adsorb thousands of organic, certain inorganic materials

Ion Exchange Resins:
Remove or concentrate impurities across variety of applications

Membrane Systems Integrator:
Expertise in developing comprehensive filtration systems

Xylem has current installations with 80 utilities

Opportunities for Xylem

Services:
Utilities will require expertise for managing complex solutions

Equipment:
Utilities will need to upgrade infrastructure (e.g., membranes)

Innovation:
Exploring monitoring and destruction technologies

By 2029, ~6,000 utilities will need treatment and ~2,000 will need service[(a)]

Xylem capabilities (e.g., carbon, ion exchange) positioned to benefit from PFAS rules

Notes: (a) EPA estimates

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Technology Landscape

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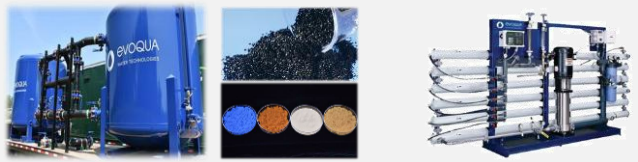
	Separation / Concentration	Destruction / Sequestration	Detection / Monitoring
			
Considerations:	*PFAS are generally found in dilute concentrations. Volume reduction is key to **cost-effective** treatment.*	*Viable destruction technologies exist. **Regulations** on byproducts, maturity, and cost drive selection.*	*Low concentrations of regulated PFAS approach detection limits of existing **technologies**.*
Currently Accepted:	**Sorbents / Membranes:** • Granular Activated Carbon (GAC) • Ion Exchange Resins (IX) • Nanofiltration (NF) • Reverse Osmosis (RO)	**Thermal:** • Incineration • Reactivation **Sequestration:** • Deep Well Injection (DWI) • Landfilling	**Analytical**: • Liquid Chromatography / Tandem Mass Spectrometry (LC/MS/MS)
Gaining Acceptance:	**Sorbents:** • Novel Sorbents • Regenerable Media	**Destruction:** • Electrochemical Oxidation (EOX) • Plasma • Supercritical Water Oxidation (SCWO)	**Analytical**: • Combustion Ion Chromatography (CIC) • Nuclear Magnetic Resonance (NMR)
Viability Uncertain:	**Other Separations:** • Foam Fractionation (FF) • Electrodialysis (ED) • Catalytic media • Others	**Destruction:** • Advanced Reductive Processes • Biological Processes **Sequestration:** • Encapsulation	**Real-time Sensing**: • Molecularly Imprinted Polymers (MIP) • Metal Organic Frameworks (MOF) • Enzyme Linked Immunosorbent Assays (ELISA)

The above encompasses the critical technology landscape as understood today.

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Xylem Treatment Solutions & Services

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- Xylem is a global, stable company with world class PFAS experts and almost a decade of PFAS experience
- 80+ real world installations
- We offer all EPA Best Available Technology & supporting services to remove PFAS from drinking water
- We are continually investing in internal R&D & establishing innovation partnerships for emerging PFAS technologies to address the full PFAS lifecycle and lower cost/liability for customers
- Dedicated PFAS team collaborating across the company to drive the growth of our drinking water business to benefit our customers

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Questions?

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Thank You

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