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# The PFAS Challenge: How Water Systems Can Stay Ahead

## Regulatory updates, compliance strategies and a proactive approach

In the kNOW Webinar

May 22, 2025

# Agenda

- Drinking Water Regulatory Updates and Considerations – Katie Walker
- Biosolids Considerations – Todd Williams
- Translating Modeling and Piloting Efforts to Full-Scale Compliance – Roger Scharf
- American Water Case Study – Nicole Wiley
- Q&A

# Poll Question

# Drinking Water Regulatory Updates and Considerations

# EPA PFAS Final National Primary Drinking Water Regulation (NPDWR) – April 2024

- Issued maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) for five PFAS

| Compound | MCL (enforceable) | MCLG |
|---|---|---|
| PFOA | 4.0 ppt | Zero |
| PFOS | 4.0 ppt | Zero |
| PFHxS | 10 ppt | 10 ppt |
| PFNA | 10 ppt | 10 ppt |
| HFPO-DA (GenX) | 10 ppt | 10 ppt |

- Issued Hazard Index (HI) that covers four PFAS

$$HI\ MCL = \left(\frac{[HFPO\text{−}DA_{water}]}{[10\ ppt]}\right) + \left(\frac{[PFBS_{water}]}{[2000\ ppt]}\right) + \left(\frac{[PFNA_{water}]}{[10\ ppt]}\right) + \left(\frac{[PFHxS_{water}]}{[10\ ppt]}\right) = 1$$

# EPA PFAS Final NPDWR Schedule – April 2024

**Before 2027**

- Conduct initial monitoring
- Or obtain approval to use previous monitoring data

**Starting 2027**

- Commence compliance monitoring
- Includes compliance monitoring results in CCR
- Issue public notification of violations

**Starting 2029**

- Comply with MCLs
- Running annual average may require treatment starting in 2028

# Example Compliance Scenarios – Running Annual Average

- MCLs (and current HI) are based on running annual average (RAA)
- Results below the practical quantitation limit (PQL) are considered zero in the RAA calculation

| Compound | PQL (ppt) |
|---|---|
| PFOA | 4.0 |
| PFOS | 4.0 |
| PFHxS | 3.0 |
| PFNA | 4.0 |
| HFPO-DA (GenX) | 5.0 |
| PFBS | 3.0 |

# Example Compliance Scenarios – RAA

- Assumes treatment results in levels below the PQL
- If finished water levels are slightly above MCL
  - Example: PFOS is around 4.4 ng/L
  - To achieve compliance, likely need one sample collected with active treatment

$$RAA = \frac{4.4\frac{ng}{L} + 4.4\frac{ng}{L} + 4.4\frac{ng}{L} + 0\frac{ng}{L}}{4} = 3.3\ ng/L$$

- If finished water levels are well above MCL
  - Example: PFOS is around 10 ng/L
  - To achieve compliance, likely need three samples collected with active treatment

$$RAA = \frac{10\frac{ng}{L} + 0\frac{ng}{L} + 0\frac{ng}{L} + 0\frac{ng}{L}}{4} = 2.5\ ng/L$$

# EPA Announces Intent to Modify Regulations on May 14, 2025

## EPA Announces It Will Keep Maximum Contaminant Levels for PFOA, PFOS

EPA intends to provide regulatory flexibility and holistically address these contaminants in drinking water

May 14, 2025

**Contact Information**
EPA Press Office (press@epa.gov)

**WASHINGTON** – U.S. Environmental Protection Agency (EPA) Administrator Lee Zeldin announced the agency will keep the current National Primary Drinking Water Regulations (NPDWR) for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS), which set nationwide limits for these "forever chemicals" in drinking water. The agency is committed to addressing Per- and Polyfluoroalkyl substances (PFAS) in drinking water while following the law and ensuring that regulatory compliance is achievable for drinking water systems.

*"The work to protect Americans from PFAS in drinking water started under the first Trump Administration and will continue under my leadership,"* ***said EPA Administrator Zeldin****. "We are on a path to uphold the agency's nationwide standards to protect Americans from PFOA and PFOS in their water. At the same time, we will work to provide common-sense flexibility in the form of additional time for compliance. This will support water systems across the country, including small systems in rural communities, as they work to address these contaminants. EPA will also continue to use its regulatory and enforcement tools to hold polluters accountable."*

- Maintain focus on PFOS/PFOA removal
- Modify compliance deadline
- Launch new outreach
- Establish federal exemption framework
- "Hold polluters accountable"

# New Rulemaking Process for PFAS NPDWRs

- Keep current NPDWRs for PFOA and PFOS but “rescind and reconsider” for PFHxS, PFNA, HFPO-DA (GenX) and the Hazard Index

| Compound | April 2024 EPA PFAS Limits (all with 2029 deadline) | May 2025 EPA Announcement |
|---|---|---|
| **PFOA** | 4.0 parts per trillion (ppt) | Keep as is (propose 2031 deadline) |
| **PFOS** | 4.0 ppt | Keep as is (propose 2031 deadline) |
| **PFHxS** | 10 ppt | Rescind and Reconsider |
| **PFNA** | 10 ppt | Rescind and Reconsider |
| **HFPO-DA (commonly known as GenX Chemicals)** | 10 ppt | Rescind and Reconsider |
| **Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS** | 1 (unitless)<br><br>Hazard Index | Rescind and Reconsider |

- Extend compliance deadline for treatment from 2029 to 2031
- Issue Proposed Rule in Fall 2025 with a Final Rule in Spring 2026

# EPA will launch the PFAS OUTreach (PFAS OUT) Initiative

Connect with utilities requiring treatment

Provide assistance

Support current funding and financing programs

# Additional EPA Actions in May 14, 2025 Announcement

## Federal Exemption Framework

- Intend to issue federal exemption framework

## "Hold Polluters Accountable"

- Intend to take action to reduce prevalence of PFAS
- Propose ELGs to reduce burden on drinking water
- No current regulations proposed

# Considerations for PFAS Compliance Moving Forward

- Initial reactions to the announcement
  - NRWA and ASDWA expressed support for the extended compliance deadline
  - Environmental and public health groups argue the revisions will weaken the drinking water protections and have signaled intent to fight in court
- 2024 PFAS NPDWR will remain until EPA finalizes a rule changing it
  - Most treatment already driven by PFOA and PFOS levels
  - Understand how the RAA impacts your compliance requirements
  - Extending compliance deadline may assist with supply chain challenges anticipated with PFAS equipment
- Expect continued litigation
  - Unclear how the “anti-backsliding” provision in the SDWA will be applied
  - Environmental and public health groups: desire for stricter regulations
  - Professional and industrial organizations: desire higher PFOA and PFOS limits

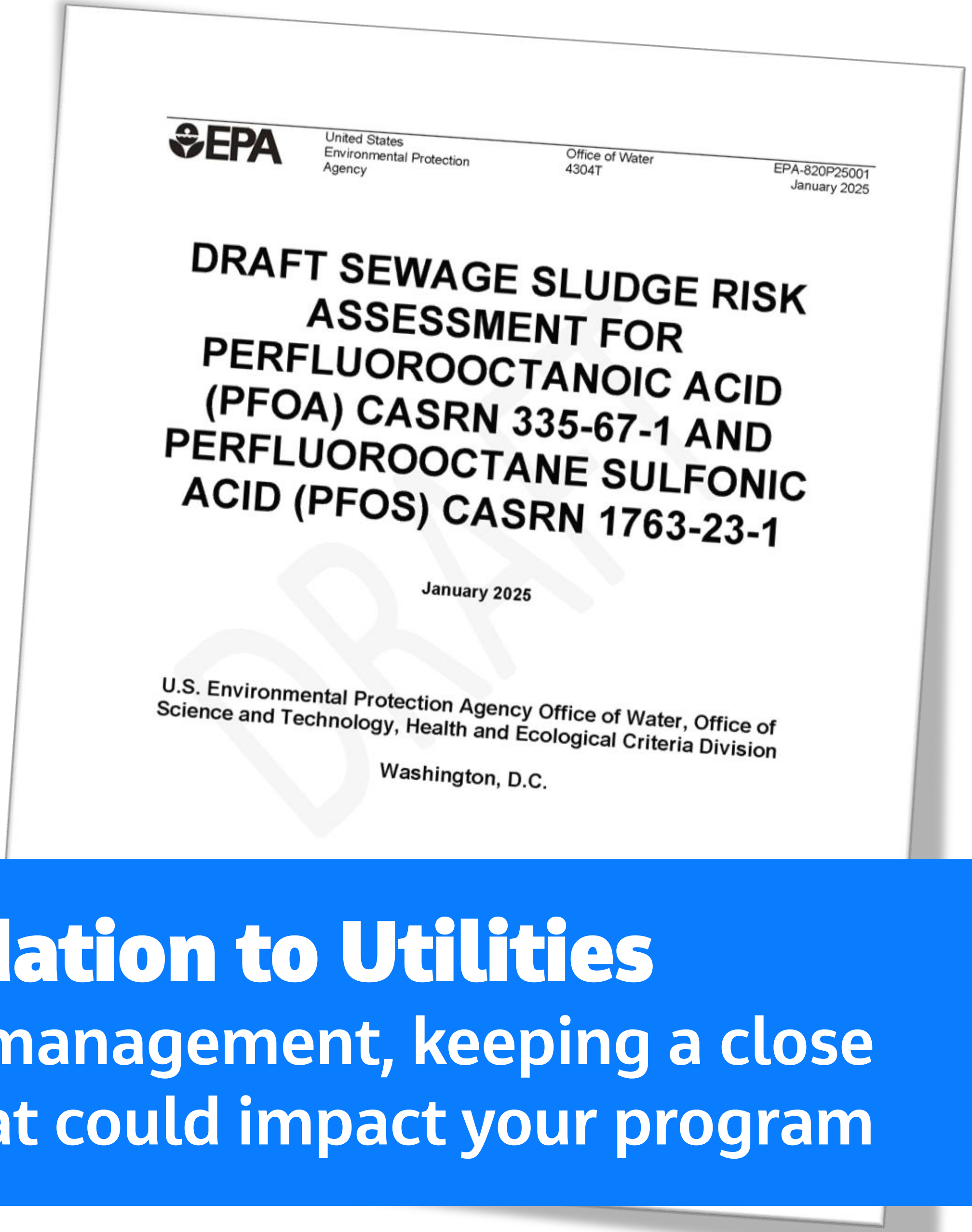
# Biosolids Regulatory Updates and Considerations

# What are the main concerns of biosolids managers in 2025?

- **Regulatory uncertainty**
  - **PFAS,** microplastics, statewide bans
- Cost of hauling drastically increasing
- **Cost of alternative disposal options drastically increasing**
  - Metro Atlanta cost up from $40/ton to > $120/ton in just 2 years
  - New England cost up to >$220/ton due to bans in Maine, Connecticut
- **Need for added storage** (especially in wintertime)
- **Desire to produce higher quality (Class A) products** (less odor, more outlets)
- **Energy, digester optimization**
- **Improved dewatering**
- **Diversification of products/potential outlets**

# Recent EPA DRAFT Biosolids PFOA and PFOS Risk Assessment highlights need for informed, flexible strategies to navigate changing regulatory landscape

- DRAFT – Comment period extended to August 14
- Not a regulation, not EPA guidance
- Focused on very specific farm family and surface impoundment risk scenarios
- Did not model risk to the general public


EPA United States Environmental Protection Agency Office of Water 4304T EPA-820P25001 January 2025

DRAFT SEWAGE SLUDGE RISK ASSESSMENT FOR PERFLUOROOCTANOIC ACID (PFOA) CASRN 335-67-1 AND PERFLUOROOCTANE SULFONIC ACID (PFOS) CASRN 1763-23-1

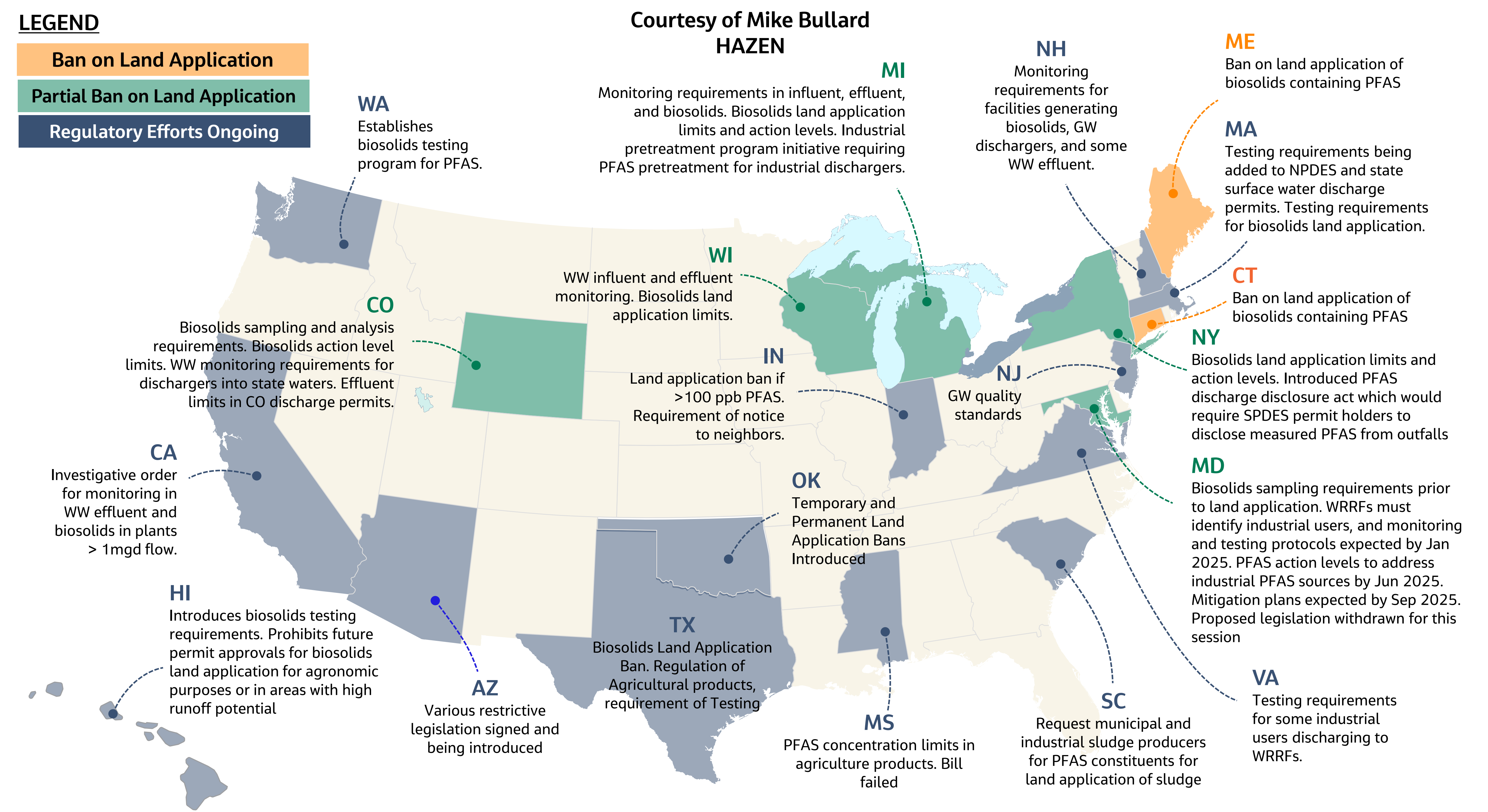
January 2025

U.S. Environmental Protection Agency Office of Water, Office of Science and Technology, Health and Ecological Criteria Division

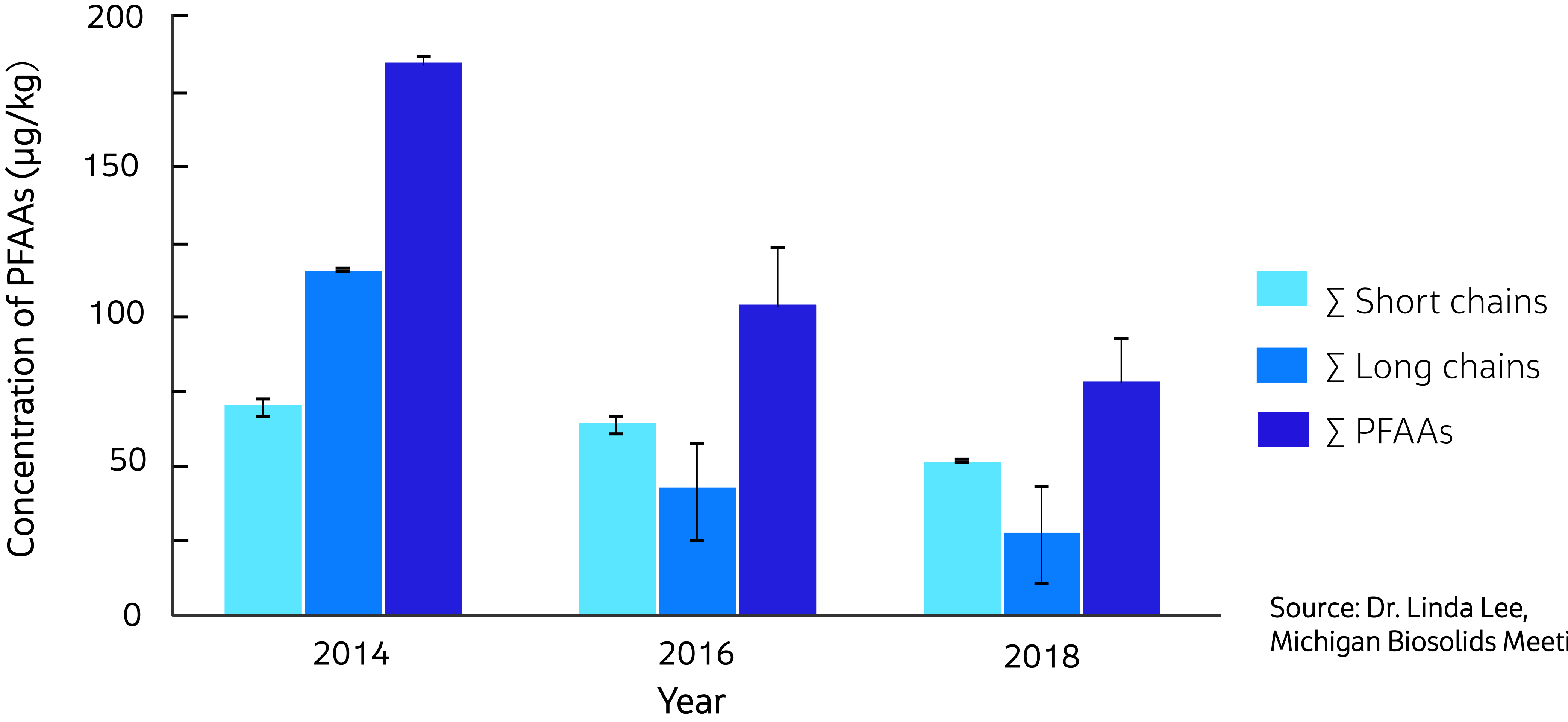
Washington, D.C.

## Our Overarching Recommendation to Utilities

**Develop an adaptable approach to biosolids management, keeping a close eye/ear on public and state level activities that could impact your program**


Courtesy of Mike Bullard
HAZEN
LEGEND
Ban on Land Application
Partial Ban on Land Application
Regulatory Efforts Ongoing
WA
Establishes biosolids testing program for PFAS.
MI
Monitoring requirements in influent, effluent, and biosolids. Biosolids land application limits and action levels. Industrial pretreatment program initiative requiring PFAS pretreatment for industrial dischargers.
NH
Monitoring requirements for facilities generating biosolids, GW dischargers, and some WW effluent.
ME
Ban on land application of biosolids containing PFAS
MA
Testing requirements being added to NPDES and state surface water discharge permits. Testing requirements for biosolids land application.
CT
Ban on land application of biosolids containing PFAS
WI
WW influent and effluent monitoring. Biosolids land application limits.
CO
Biosolids sampling and analysis requirements. Biosolids action level limits. WW monitoring requirements for dischargers into state waters. Effluent limits in CO discharge permits.
IN
Land application ban if >100 ppb PFAS. Requirement of notice to neighbors.
NJ
GW quality standards
NY
Biosolids land application limits and action levels. Introduced PFAS discharge disclosure act which would require SPDES permit holders to disclose measured PFAS from outfalls
CA
Investigative order for monitoring in WW effluent and biosolids in plants > 1mgd flow.
OK
Temporary and Permanent Land Application Bans Introduced
MD
Biosolids sampling requirements prior to land application. WRRFs must identify industrial users, and monitoring and testing protocols expected by Jan 2025. PFAS action levels to address industrial PFAS sources by Jun 2025. Mitigation plans expected by Sep 2025. Proposed legislation withdrawn for this session
HI
Introduces biosolids testing requirements. Prohibits future permit approvals for biosolids land application for agronomic purposes or in areas with high runoff potential
TX
Biosolids Land Application Ban. Regulation of Agricultural products, requirement of Testing
AZ
Various restrictive legislation signed and being introduced
MS
PFAS concentration limits in agriculture products. Bill failed
SC
Request municipal and industrial sludge producers for PFAS constituents for land application of sludge
VA
Testing requirements for some industrial users discharging to WRRFs.

# PFAA concentrations in biosolids have dropped as PFOS and PFOA were phased out of production in the US (2002 and 2015 respectively) Based on (one dried biosolids case study)




Source: Dr. Linda Lee,
Michigan Biosolids Meeting, 2019

# What's the Impact of Biosolids Technologies on PFAS?

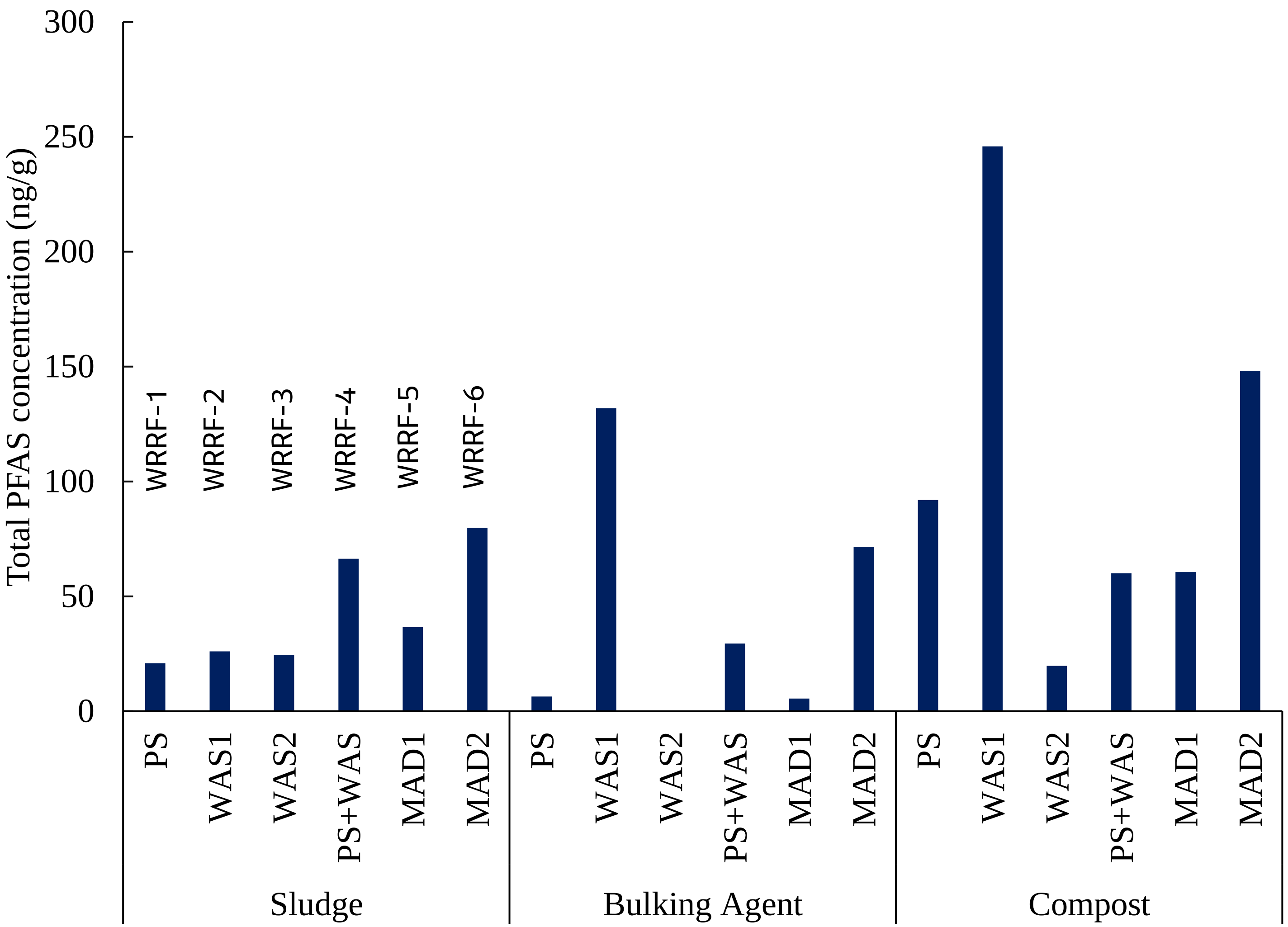
- Digestion
- Composting
- Thermal Drying
- Pyrolysis/Gasification

# Impact of Anaerobic Digestion (AD) on PFAS

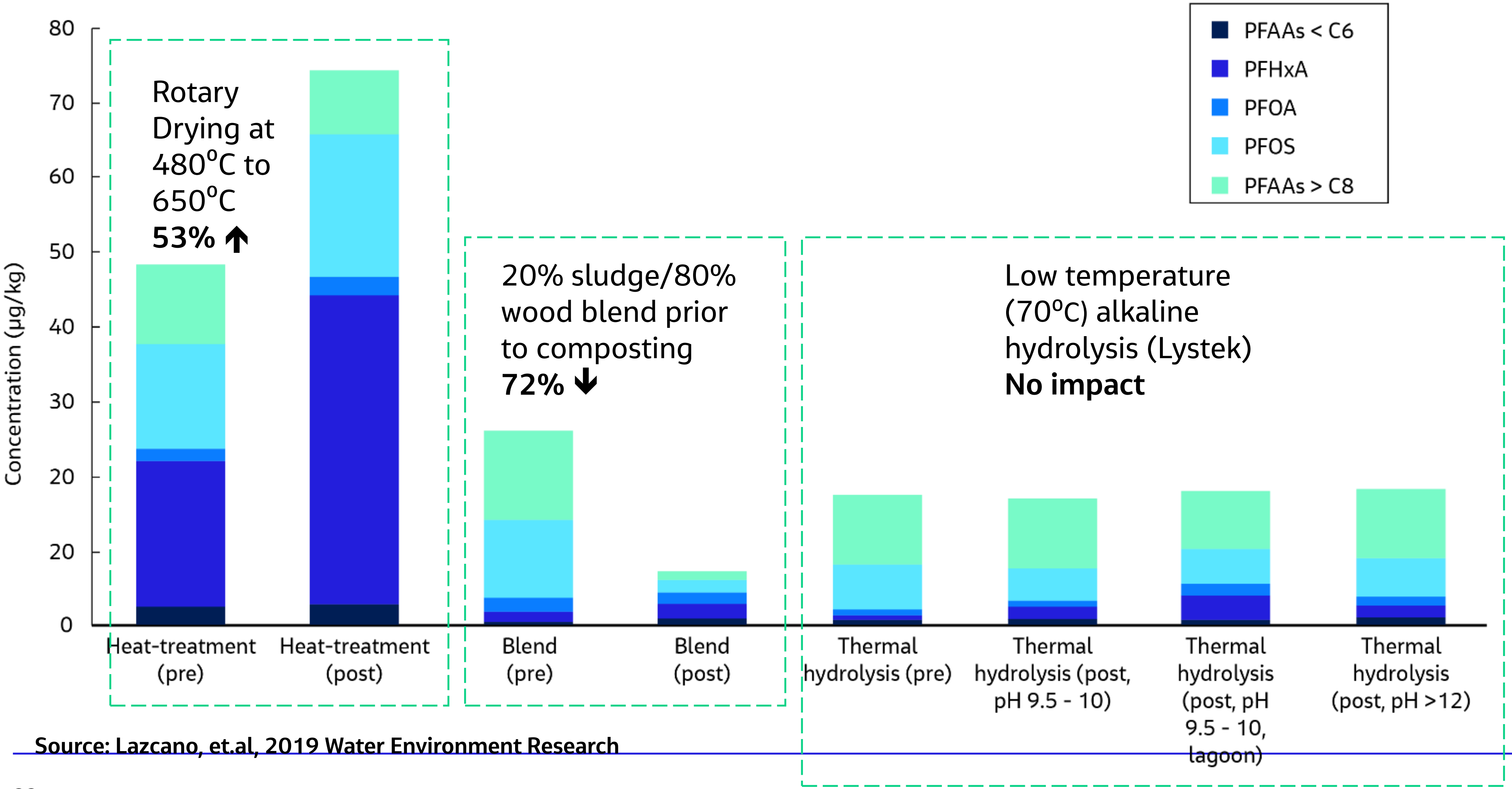
- PFAS concentration tends to increase through AD
- Researchers suggest three possible factors that cause this increase:
  - Precursor transformation
  - Reduction in volatile solids causing accumulation of recalcitrant
  - AD process enhances sorption capacity of PFAA's in solids
- Increase in SRT above 15 days has no impact
- Pretreatment has little impact on overall PFAS content

# Total PFAS in Biosolids Composts & Impact on PFAS Concentrations

- PFOS is the most commonly found in composting
- Primary sludge (WRRF-1) not treated aerobically first
  - More susceptible to precursor transformation into multiple PFAS terminal compounds through composting
- Type of bulking agents
- Recycle of bulking agents may increase PFAS in composting products (WRRF-2, WRRF-6)
- Aerobically processed sludges and anaerobically digested sludges may result in less precursor transformation during composting (WRRF-3, WRRF-4, WRRF-5)

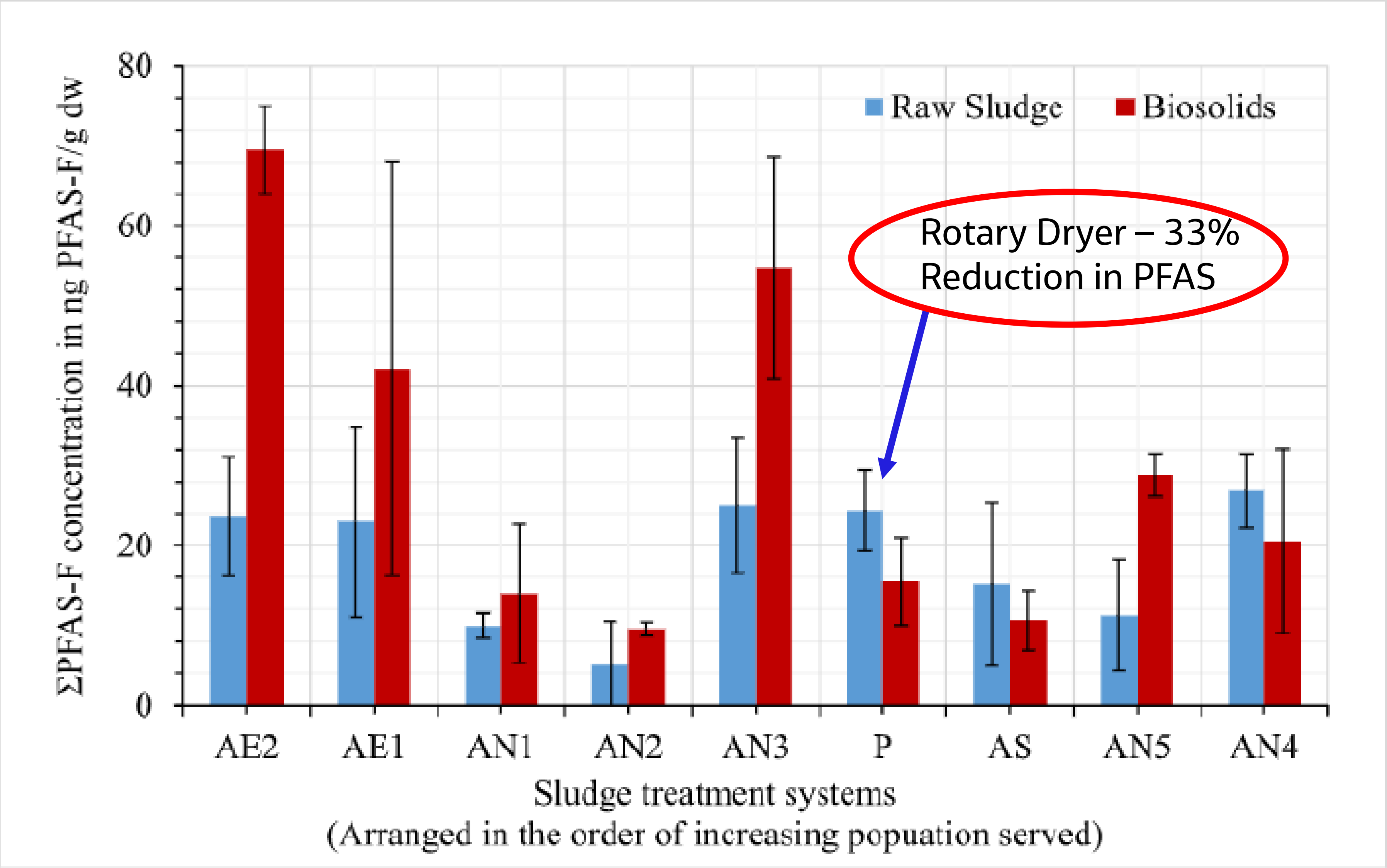


# Impact of thermal drying, blending with bulking agent, and chemical/thermal hydrolysis treatment (not THP)




Source: Lazcano, et.al, 2019 Water Environment Research

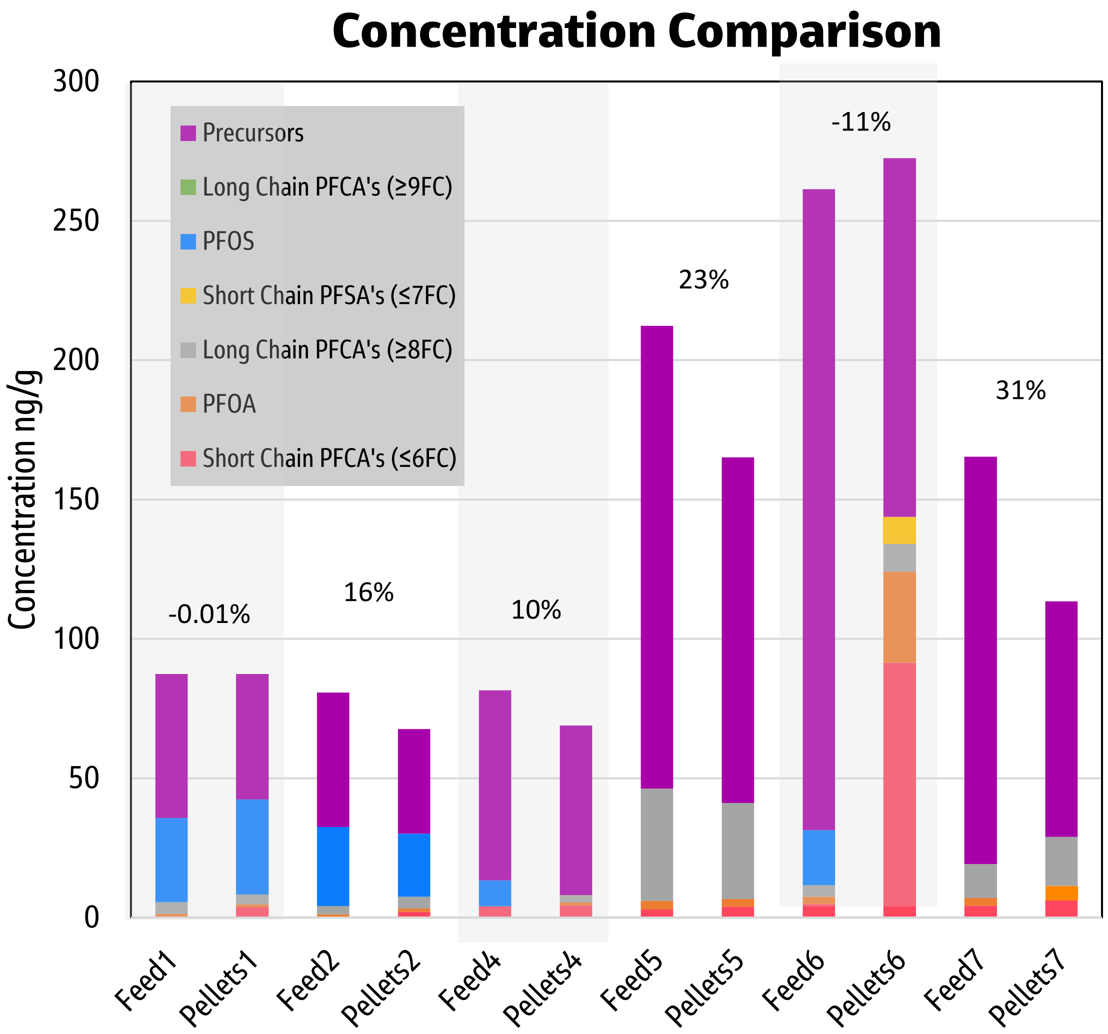
# Canadian Sludge Treatment Systems Impact on PFAS



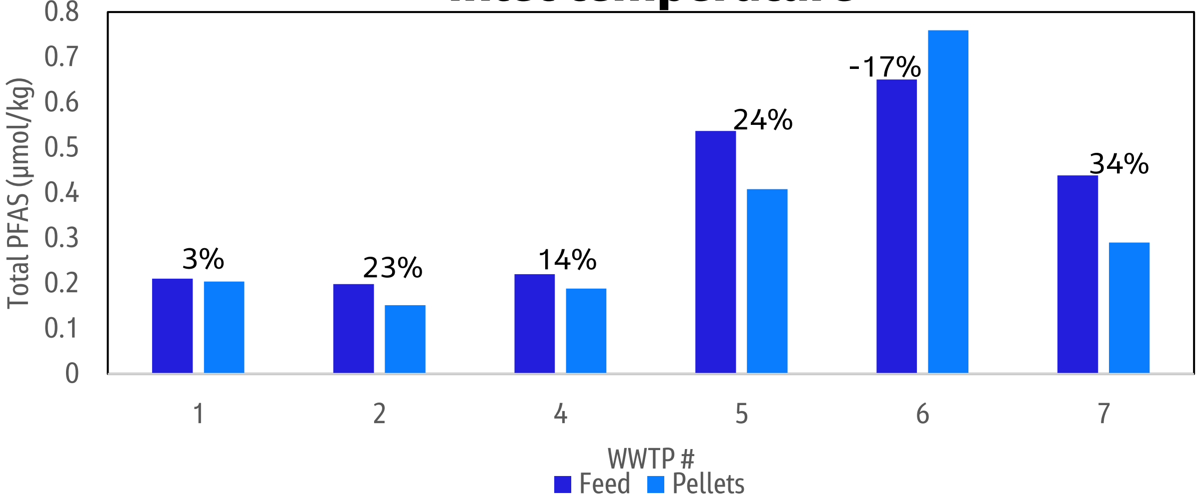


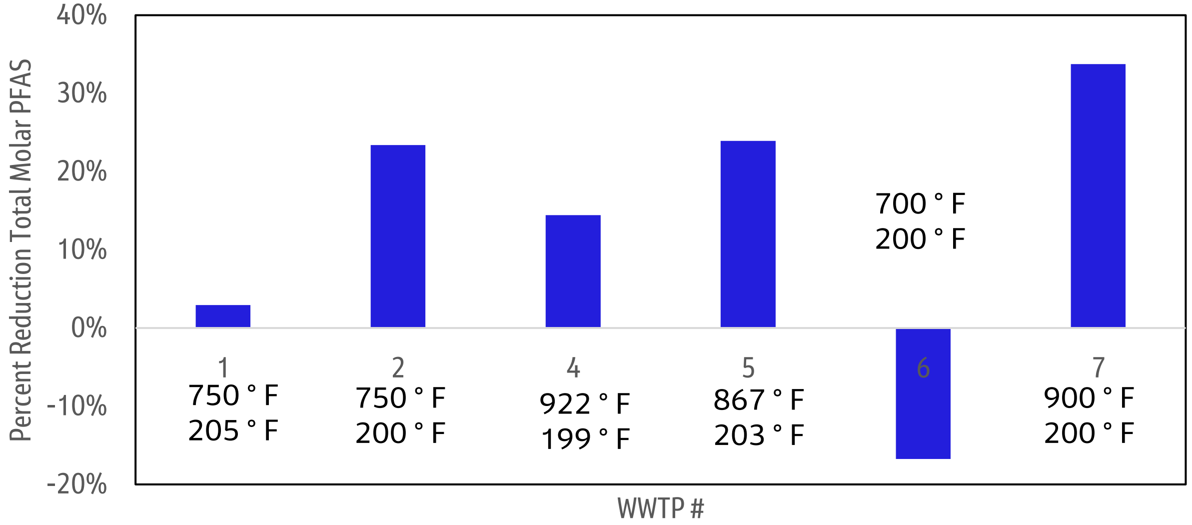

**Source: Lakshminarasimman, et.al, 2021 Science of the Total Environment**

# Thermal drying generally reduces molar concentration of PFAS




## Molar PFAS concentrations increase at lowest inlet temperature

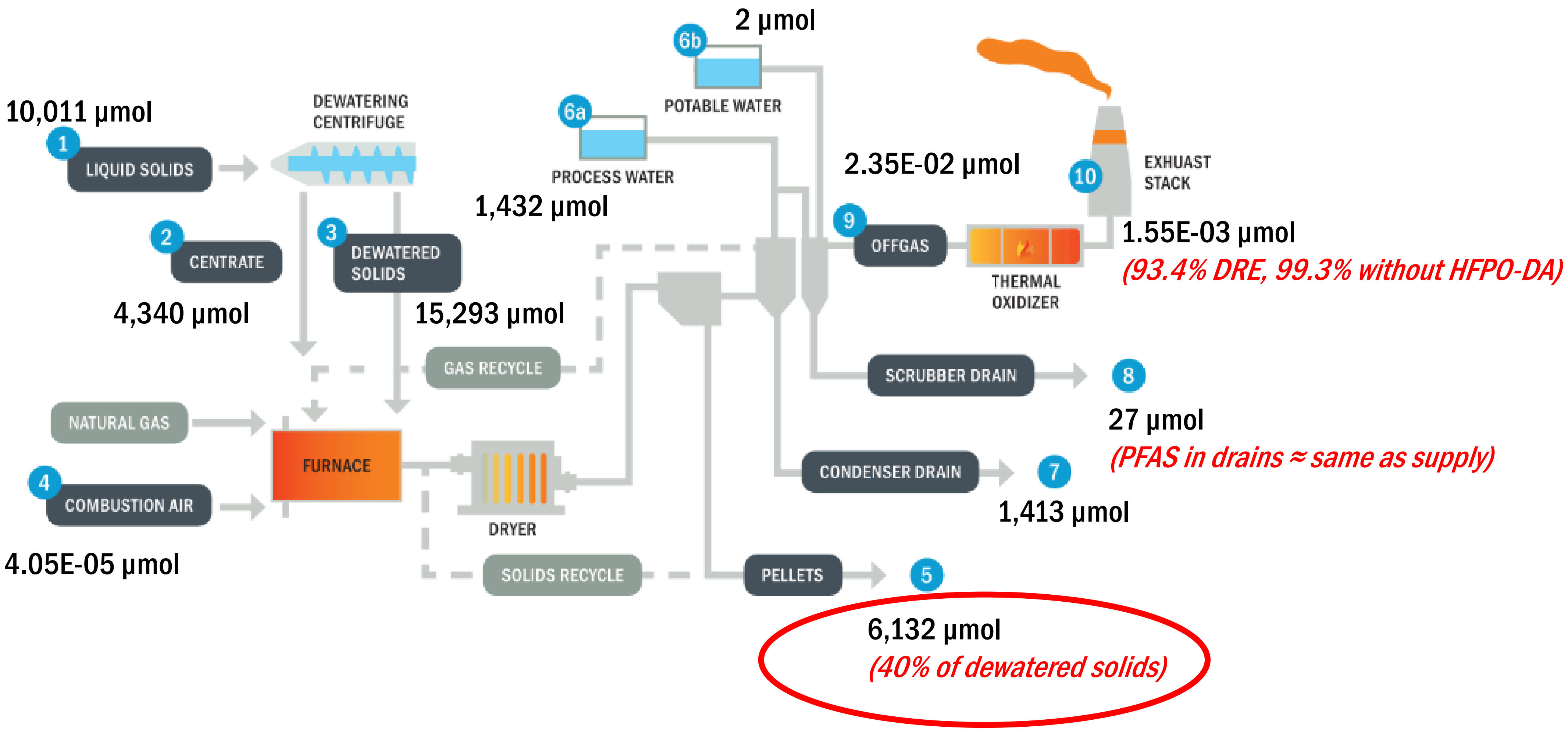



*Source: Jacobs 2023*

# Thermal Drying PFAS Testing Results from a Full-Scale Facility in 2023

Courtesy of
John Ross
B&C



# What if PFAS Standards for Biosolids are Developed?
# Pyrolysis after Drying will Eliminate <u>Measurable</u> PFAS in Char

- One set of samples 2019, confirmed in 2020
- Jacobs independent test confirmed in 2020
- Pyrolysis at 1100°F (600°C)
- Peer-reviewed literature supports PFOA and PFS destruction >1000 °C


| Compound Name | Dry Biosolids (ng/g) | Biochar (ng/g) |
|---|---|---|
| PFBA | 7.03 | Not Detected |
| 3:3 FTCA | ND | Not Detected |
| PFPeA | 5.94 | Not Detected |
| PFBS | 2.3 | Not Detected |
| 4:2 FTS | ND | Not Detected |
| PFHxA | 33.7 | Not Detected |
| PFPeS | ND | Not Detected |
| HFPO-DA | ND | Not Detected |
| 5:3 [illegible] | [illegible] | [illegible] |
| PF[illegible] | [illegible] | [illegible] |
| AD[illegible] | [illegible] | [illegible] |
| PF[illegible] | [illegible] | [illegible] |
| 6:[illegible] | [illegible] | [illegible] |
| PFOA | 89.1 | Not Detected |
| PFHpS | ND | Not Detected |
| 7:3 FTCA | 40 | Not Detected |
| PFNA | 5.3 | Not Detected |
| PFOSA | ND | Not Detected |
| PFOS | 26.3 | Not Detected |
| 9Cl-PF3ONS | ND | Not Detected |
| PFDA | 11.3 | Not Detected |
| 8:2 FTS | 5.68 | Not Detected |
| PFNS | ND | Not Detected |
| MeFOSAA | 23.5 | Not Detected |
| EtFOSAA | 19.6 | Not Detected |
| PFUnA | 3.39 | Not Detected |
| PFDS | ND | Not Detected |
| 11Cl-PF3OUdS | ND | Not Detected |
| 10:2 FTS | ND | Not Detected |
| PFDoA | 5.85 | Not Detected |
| MeFOSA | ND | Not Detected |
| PFTrDA | ND | Not Detected |
| PFTeDA | 2.44 | Not Detected |
| EtFOSA | ND | Not Detected |
| PFHxDA | ND | Not Detected |
| PFODA | ND | Not Detected |
| MeFOSE | 17.1 | Not Detected |
| EtFOSE | ND | Not Detected |

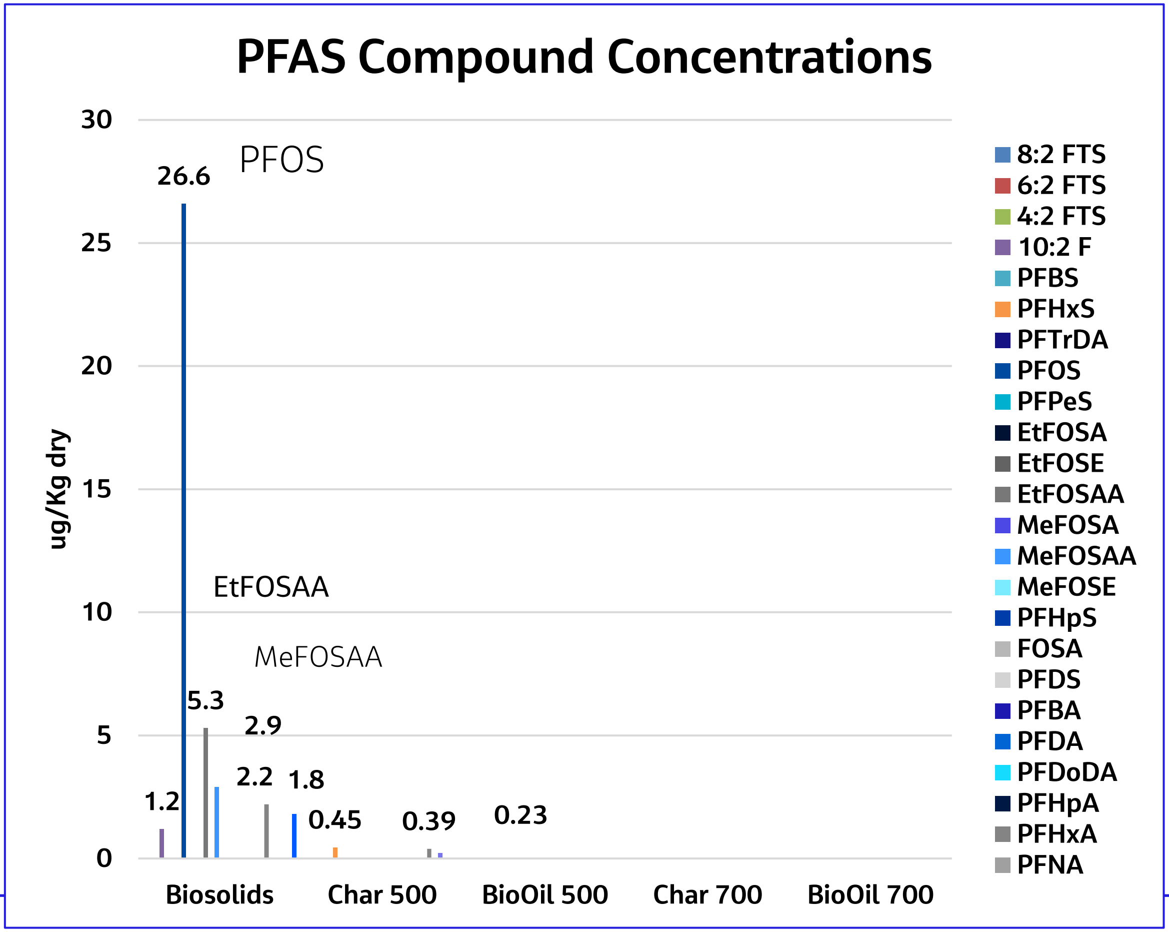
PFOA =89.1 &
PFOS = 26.3

All ND
@ 2ppb

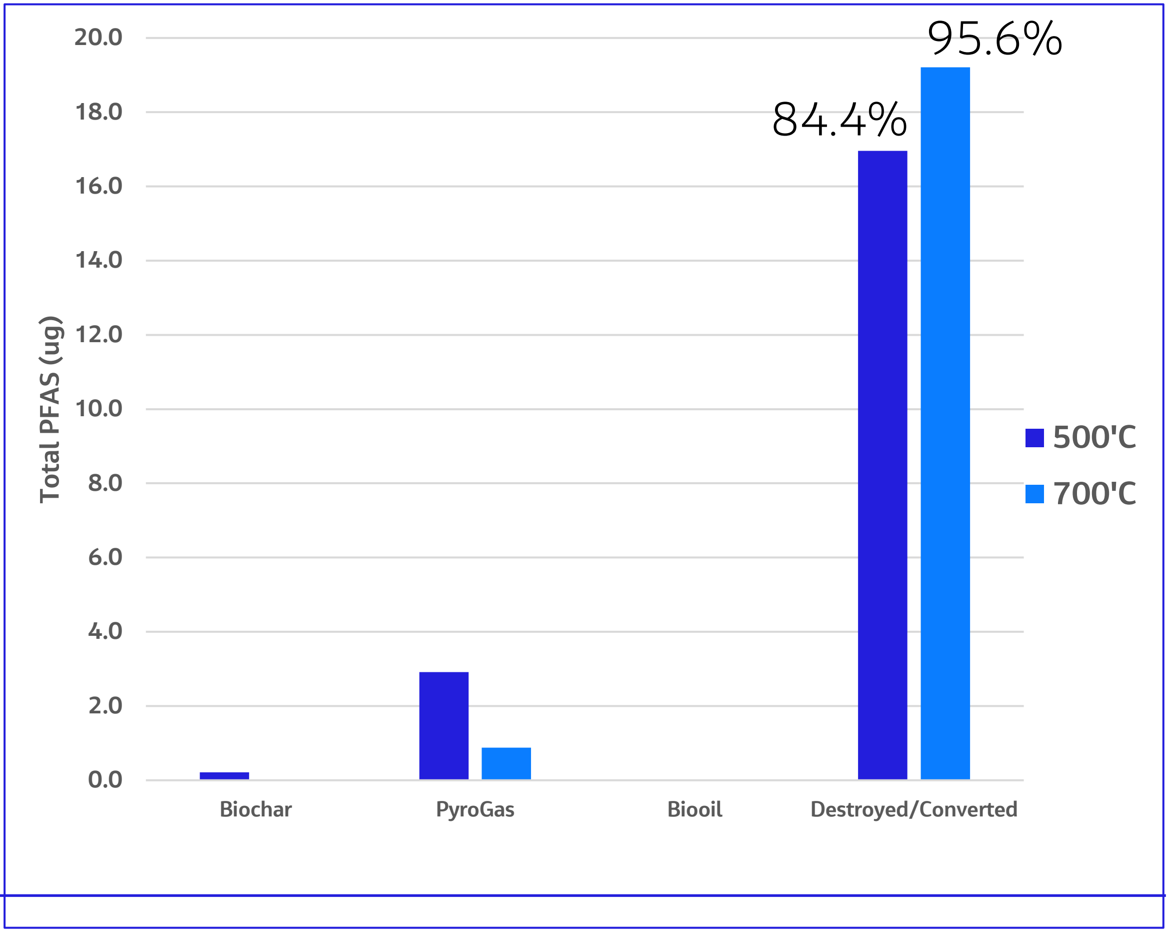


Source: BioForceTech, 2019, retested and confirmed 2020

# Pyrolysis Results Before and After Pyrolysis (Char, Gas and Oil)
# Undigested Dried Biosolids

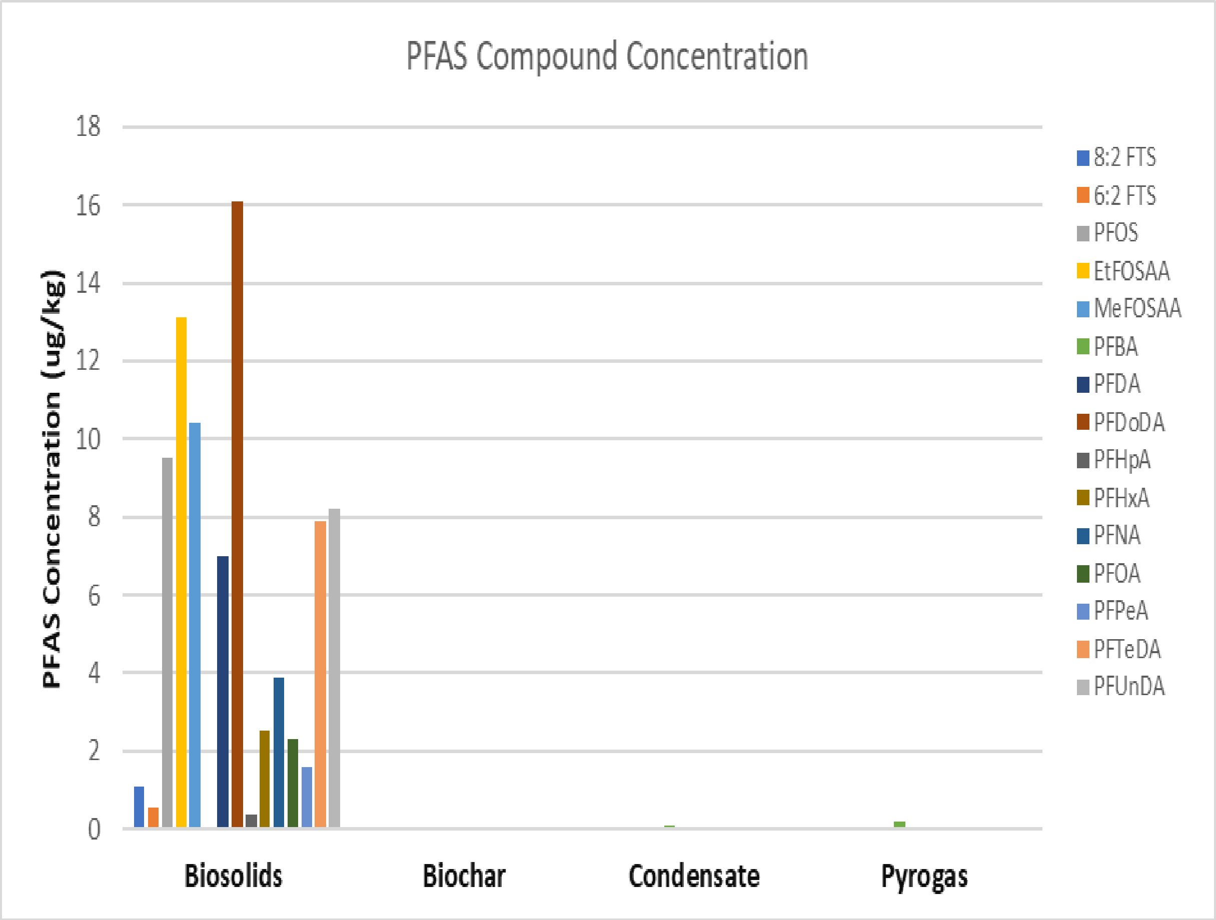


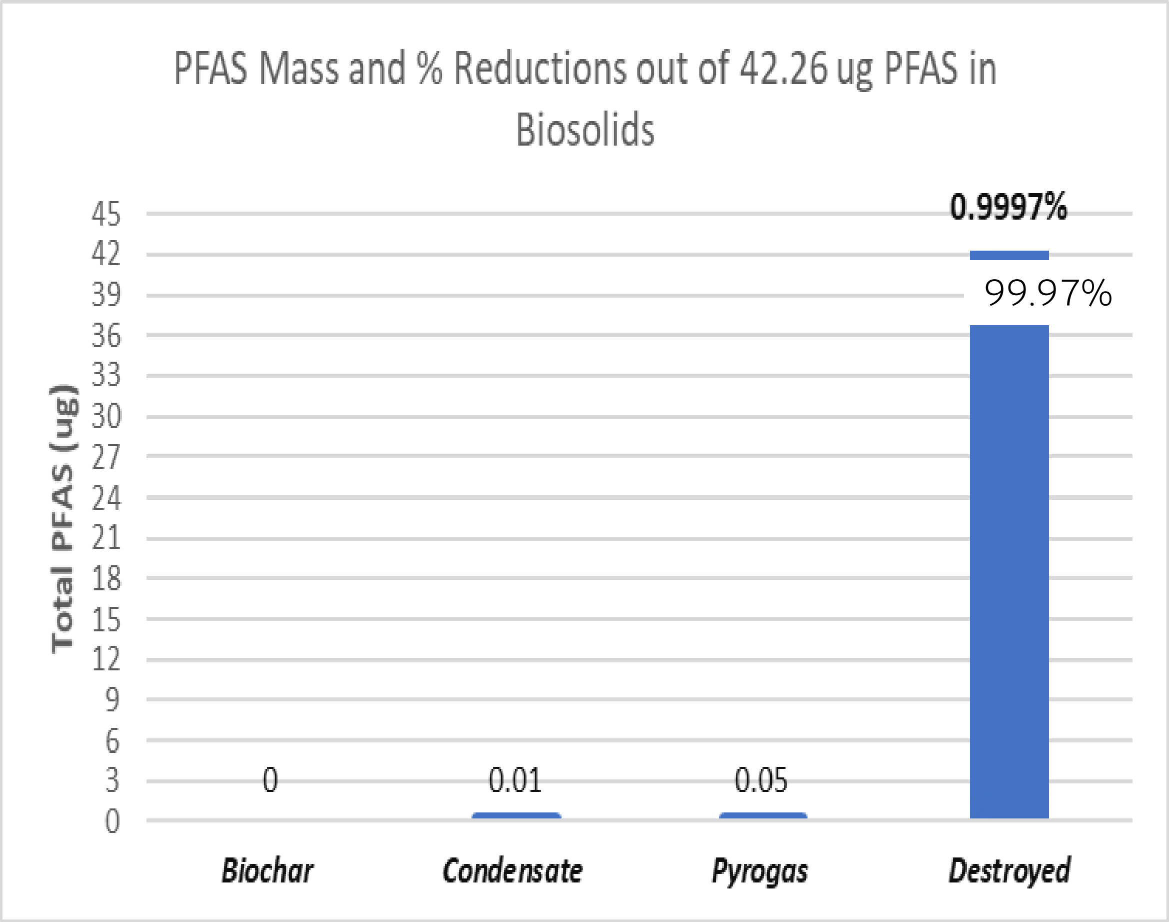

PFAS Mass and % Reductions out of 20 ug total measured PFAS in biosolids




Source: Jacobs, WEF RBC 2021

# Pyrolysis Results Before and After Pyrolysis (Char, Gas and Oil)
# Digested Dried Biosolids

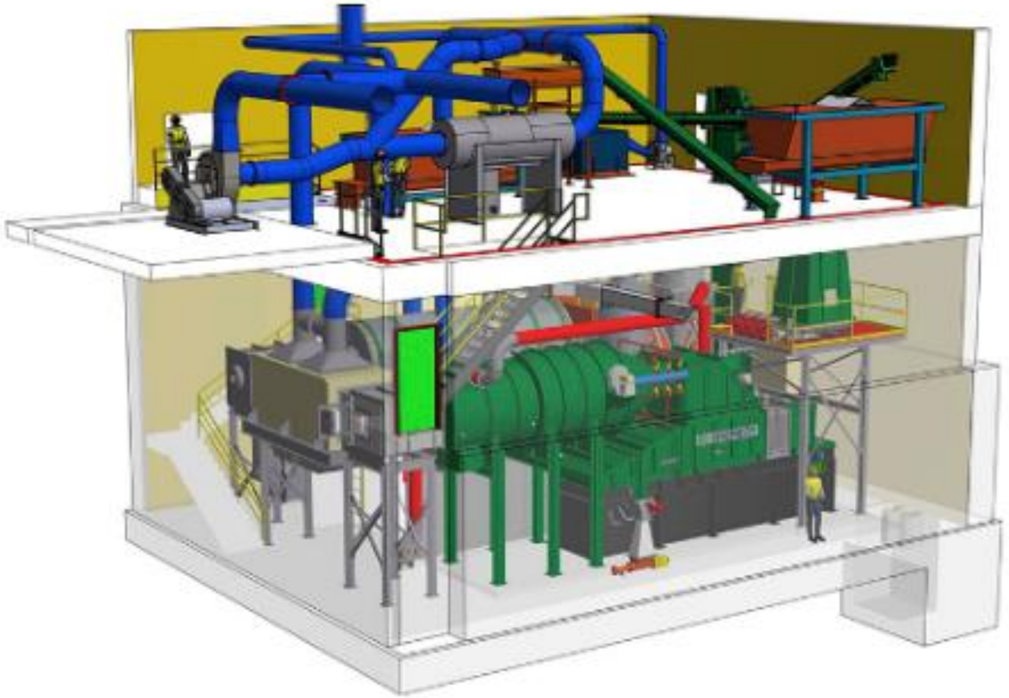



Source: Jacobs, 2022

# Status of pyrolysis and gasification technology development in US

- Bioforcetech – pairs with biodryers
- Ecoremedy – pairs with rotary dryer
- Earthcare - pairs with rotary dryer
- Aries – pairs with rotary dryer
- Others in early development
- More PFAS testing is being done and will be reported this year




# Publications on PFAS in biosolids and other resources will continue to be released in 2025


Journal of Water Process Engineering 72 (2025) 107508

ELSEVIER

Contents lists available at ScienceDirect

Journal of Water Process Engineering

journal homepage: www.elsevier.com/locate/jwpe

## Understanding dynamics of PFAS in biosolids processed through composting, thermal drying and high temperature pyrolysis☆

Arifur Rahman [a,*], Scott Grieco [b], Bani Bahman [c], Andrew Friedenthal [d], Andrew White [e], Todd Williams [f]

Environmental Science Water Research & Technology

ROYAL SOCIETY OF CHEMISTRY

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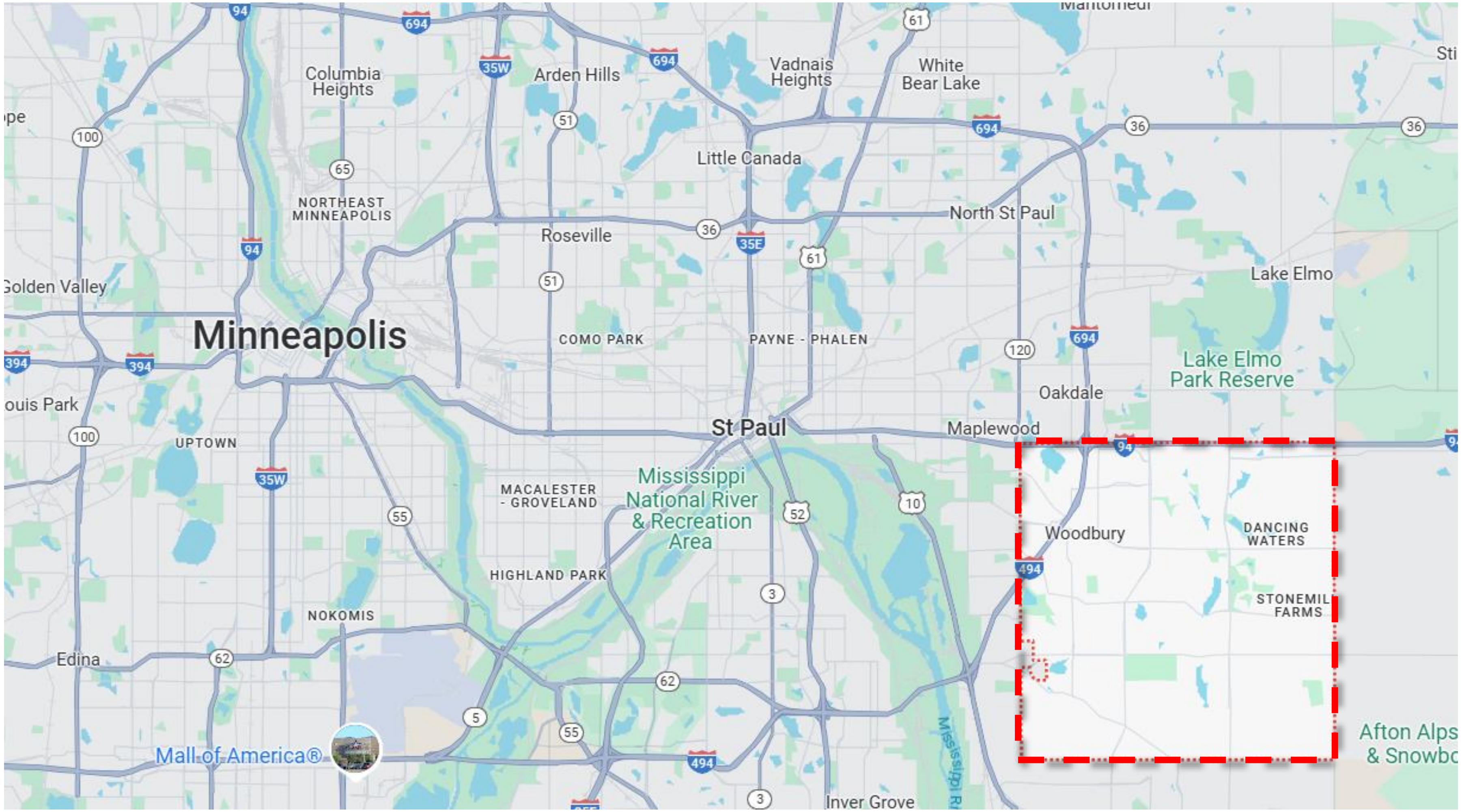
Cite this: DOI: 10.1039/d4ew00890a

## Drying reduces the total PFAS concentration in biosolids and alters the PFAS profile†

Patrick J. McNamara, [*ab] Jessica Calteux, [b] Eric Redman, [c] Taryn McKnight, [c] Lynne Moss, [a] Webster Hoener, [a] Scott Carr [a] and Zhongzhe Liu [d]

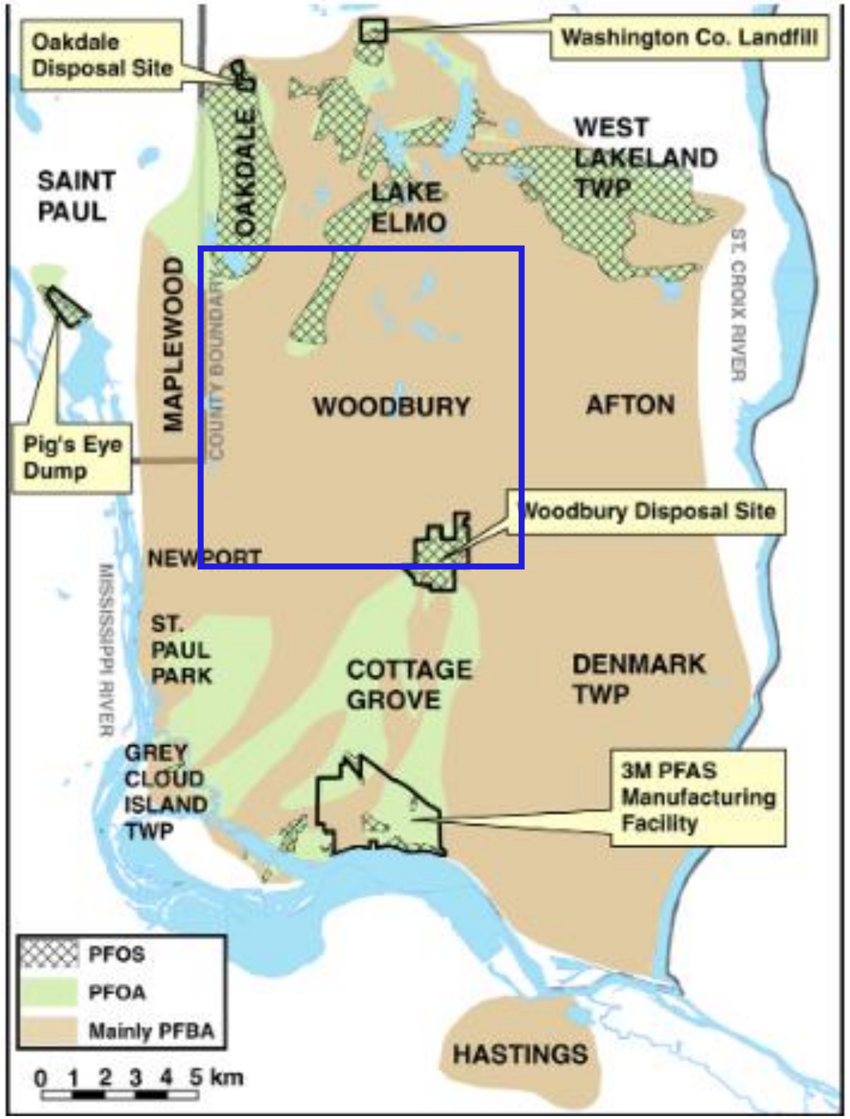
# Translating Modeling and Pilot Efforts to Full-Scale Compliance

# Where in the world is Woodbury?

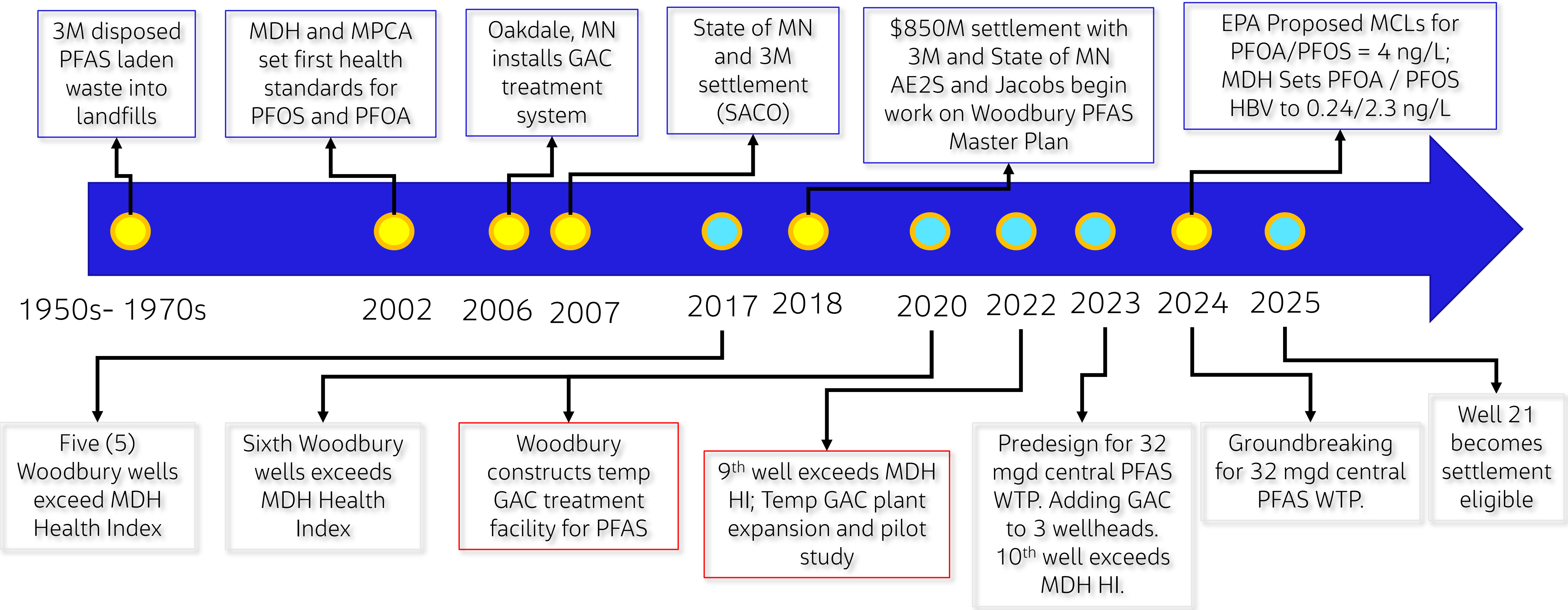



# Woodbury Water Supply System

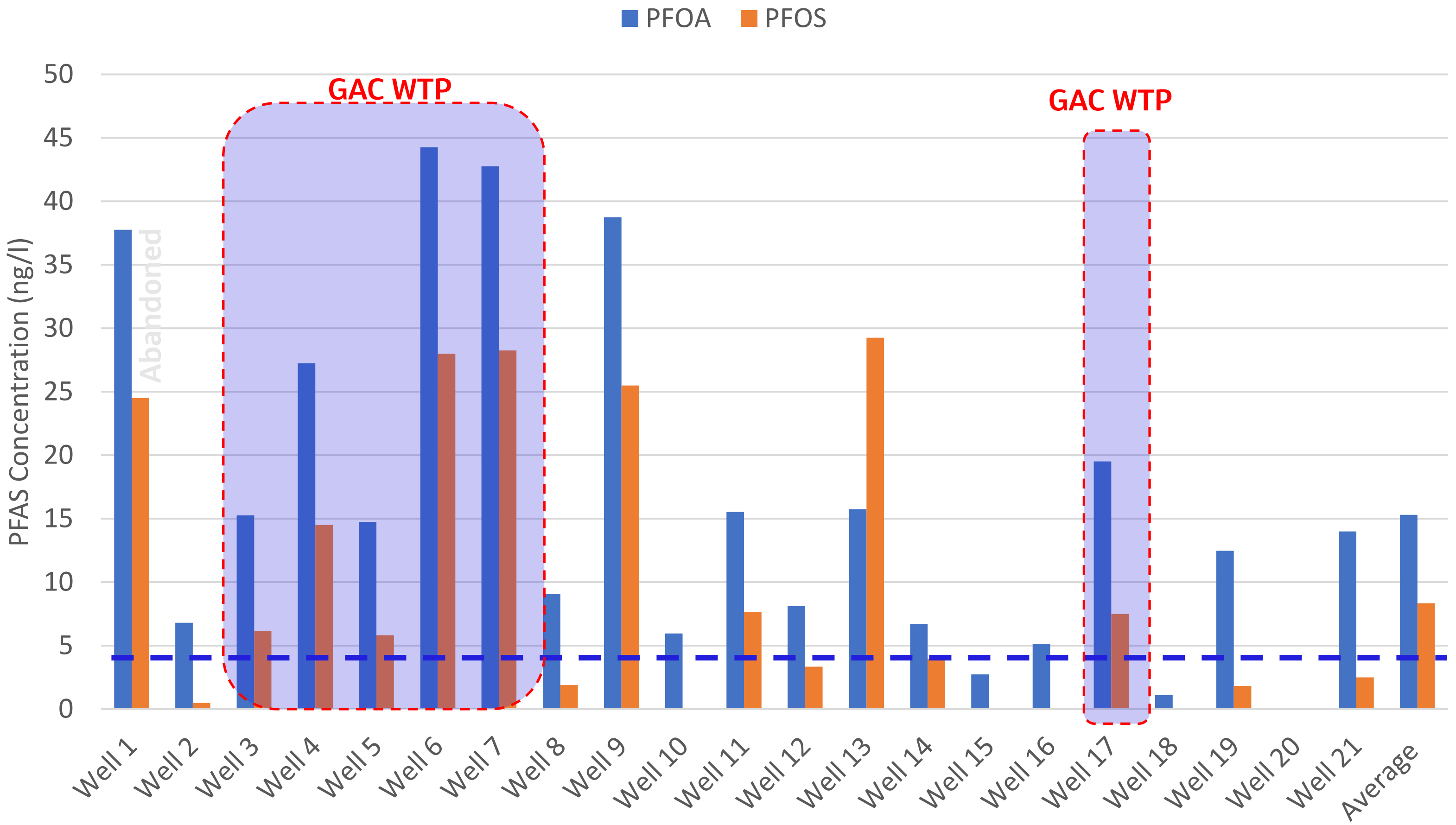
- Population ~82,000+; high growth area
- Jordan aquifer - 20 wells total (21 future)
- Peak demand >20 mgd (75.7 ML/d)
- Contamination traced to four 3M legacy disposal sites from PFAS production
  - Plume 150 sq miles (388 sq km), 140,000 residents impacted
  - Potential negative health impacts to East Metro residents



# Woodbury PFAS Issues Timeline



# Woodbury PFOS and PFOA Concentration by Well




- PFOA: 4-45 ng/L
- PFOS: 2-29 ng/L
- PFHxS: 2-70 ng/L
- PFHxA: <16 ng/L
- PFBS: <20 ng/L
- PFBA: <500 ng/L

- TOC: < 1 mg/L
- Hardness: 250-350 mg/L as $CaCO3$
- Fe and Mn near SMCLs

# Pilot Testing Overview

**Goal:** Guide City's Decision Making for Short and Long Term PFAS Treatment Needs and Operations

## 3 Phases of Pilot Testing

- **Phase 1: Bench Testing**
  - Isotherms for sorption capacity estimates
  - RSSCTs for media screening
- **Phase 2: Rapid IX Fouling Pilot Testing on IX Media**
  - Evaluate Rapid Fouling Impacts on IX Media Performance
  - Short Loaded Columns (~4-6 months Test Duration)
- **Phase 3: Long Term Pilot Testing**
  - Evaluate Long-Term Fouling Impacts
  - Standard Loaded Columns (18 months Test Duration)


# Types of testing

**Experimental Isotherms:**

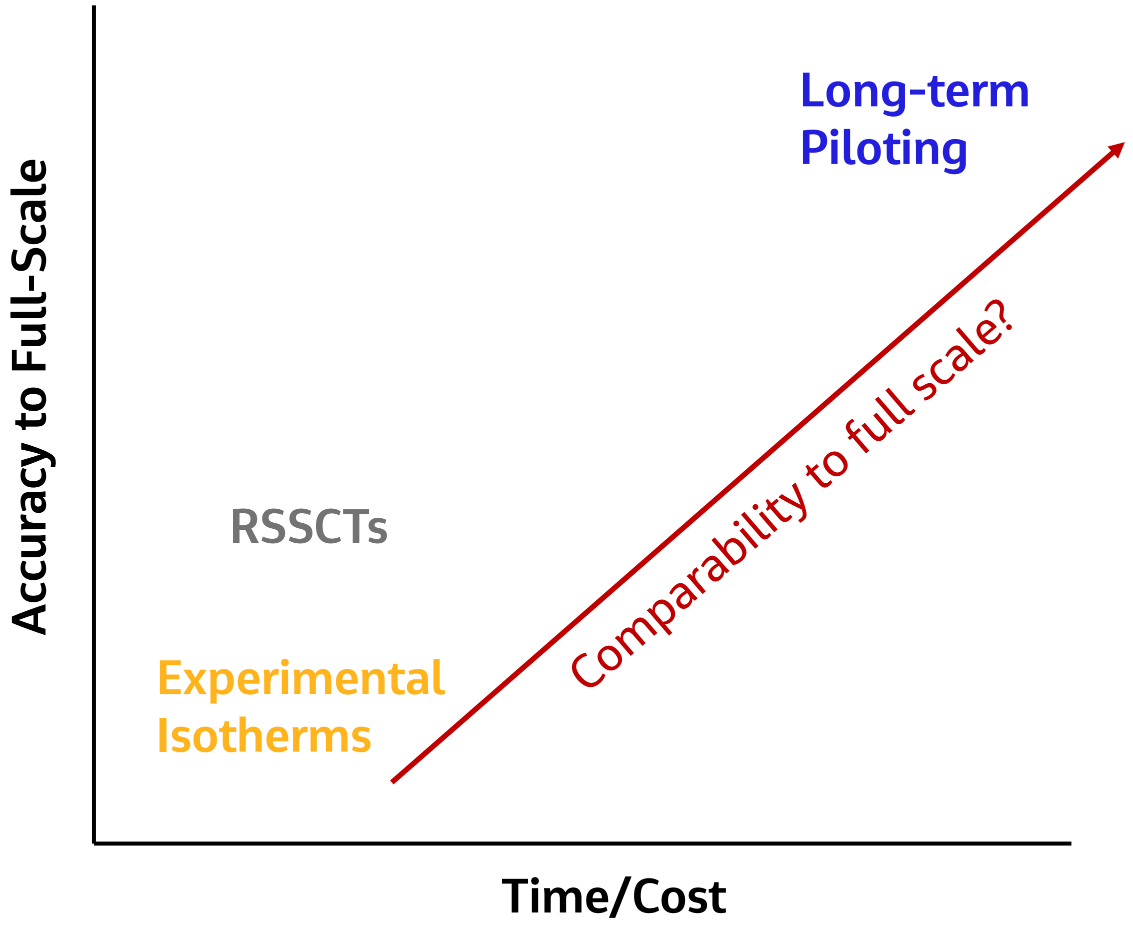
- 2–4-day batch experiments
- Low sampling frequency

**Rapid small-scale column testing (RSSCT):**

- 5–15-day lab experiments
- Increased sampling frequency

**Long-term piloting:**

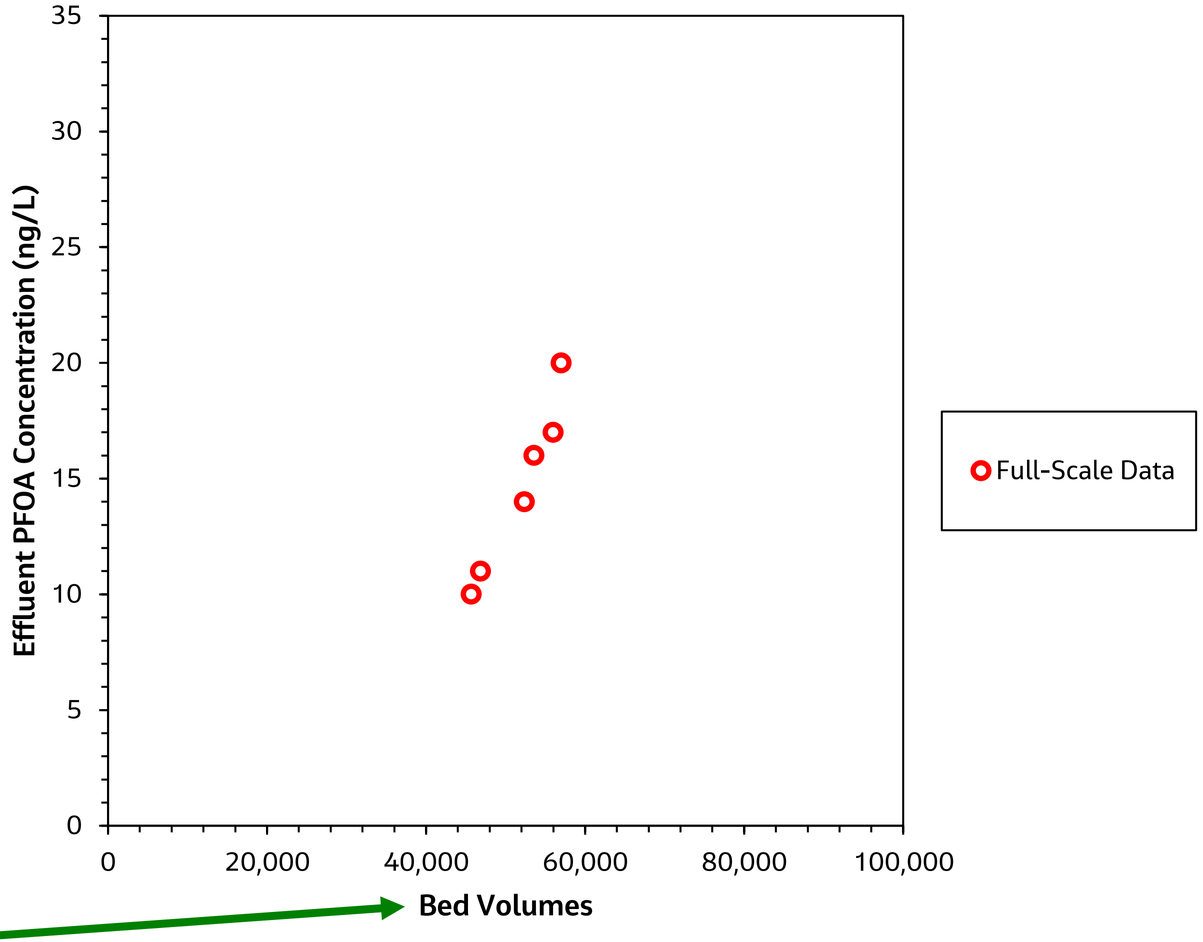
- 9–24-month experiments
- Greatest number of samples



# Comparison of testing to full-scale data

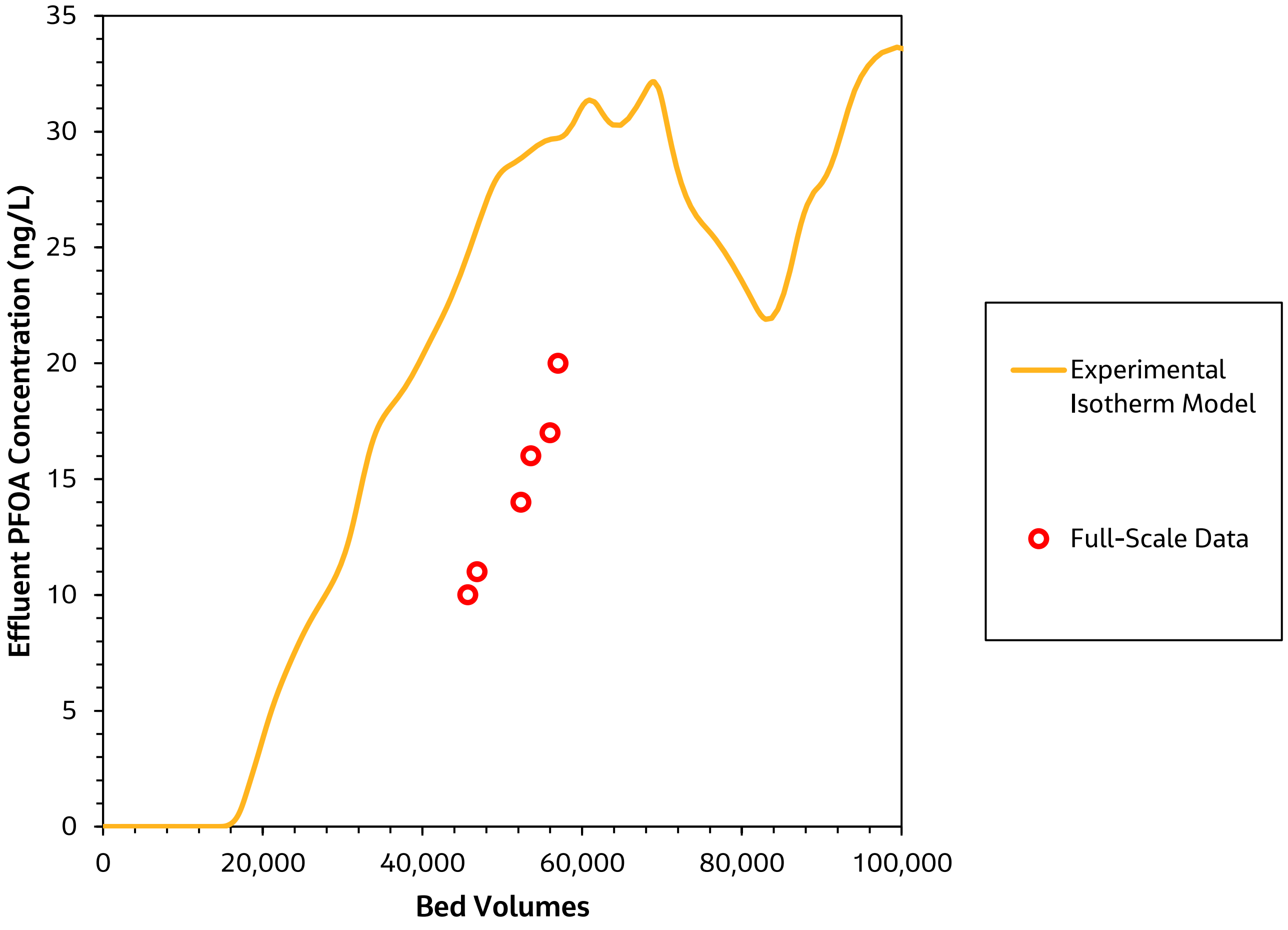
PFAS concentration leaving the lead GAC vessel

Water volume treated (in terms of media volume)



# Comparison of testing to full-scale data

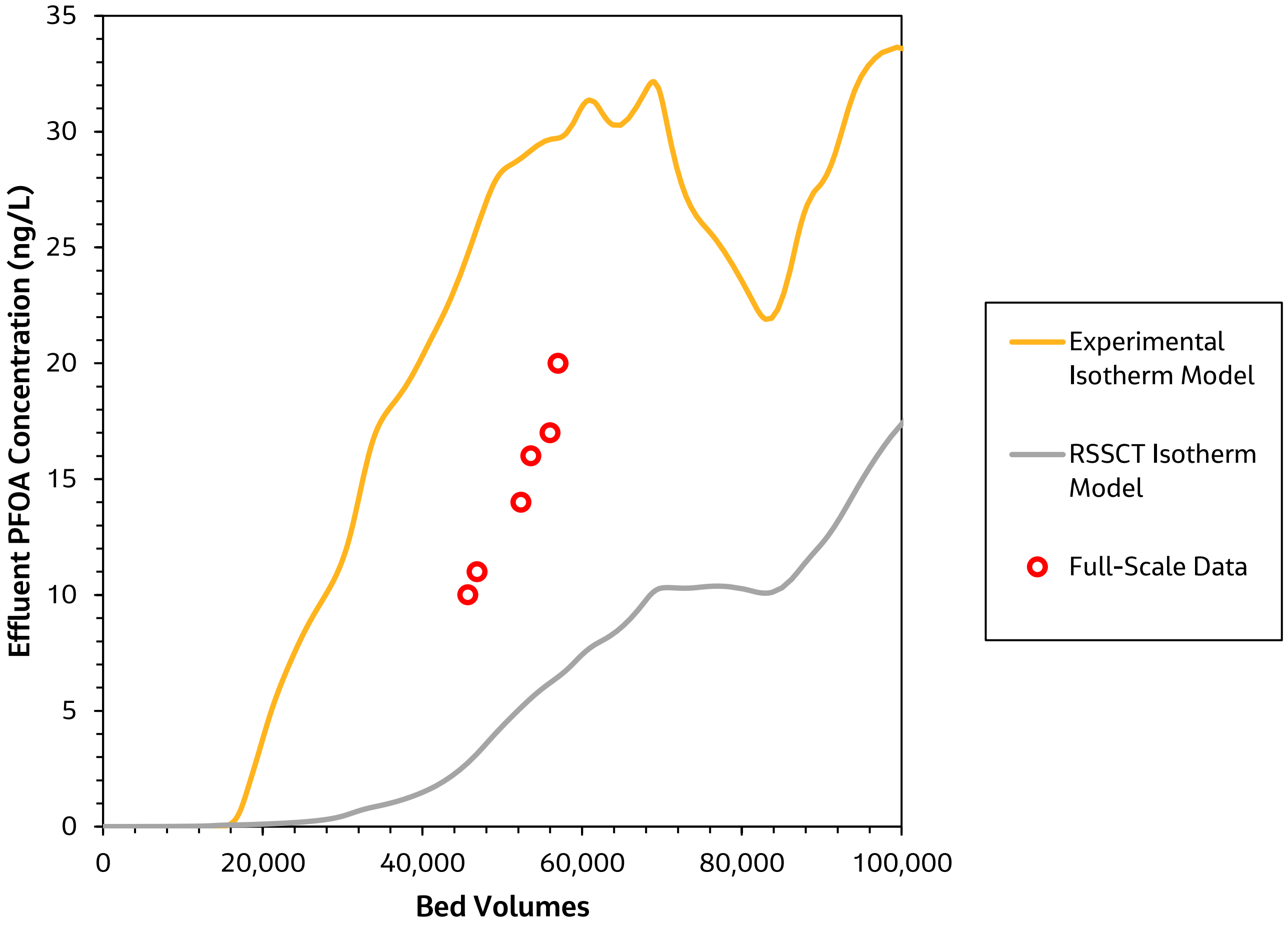
- **Isotherms** estimate sorption capacity of media



# Comparison of testing to full-scale data

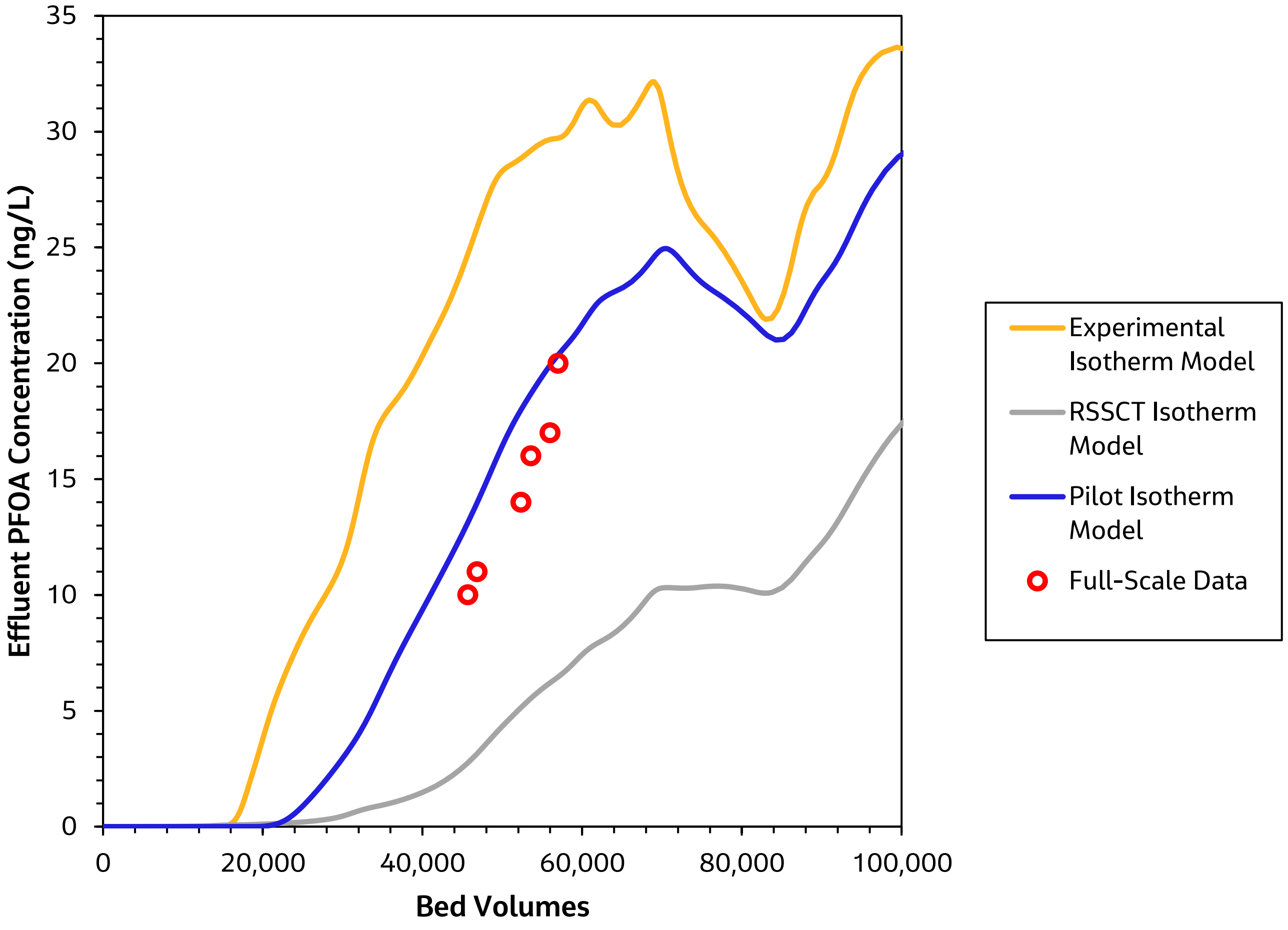
- Isotherms estimate sorption capacity of media

- **RSSCTs** quickly capture significant breakthrough

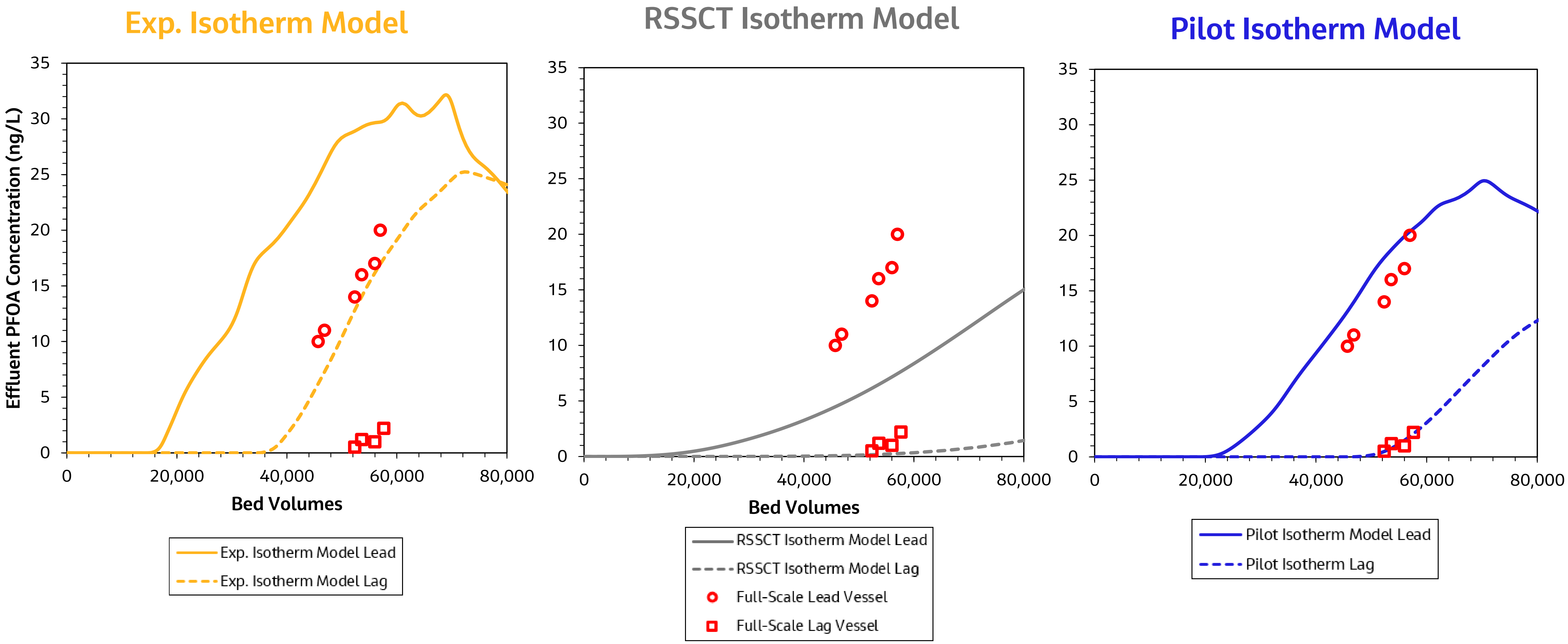


# Comparison of testing to full-scale data

- Isotherms estimate sorption capacity of media
- RSSCTs quickly capture significant breakthrough
- **Piloting** yields operational information similar to full scale

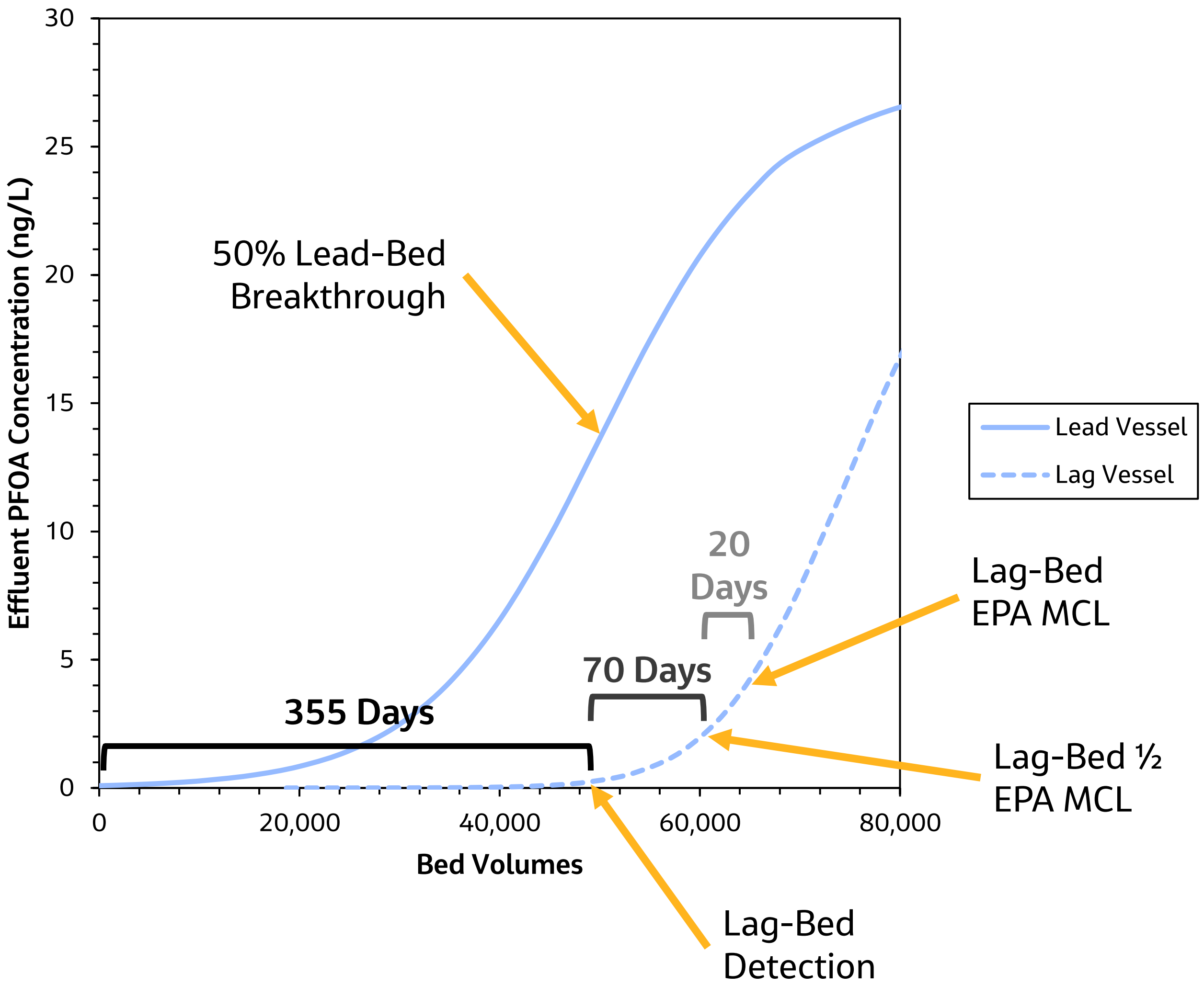


# Comparison of testing to full-scale lead-lag operations



# Comparison of changeout target for length of operation

- High confidence in full-scale breakthrough projections allow us to comfortably get the most out of the media
- There are several indicators we can utilize to initiate a media changeout



# Poll Question

# Case Study – American Water


American Water

# Addressing PFAS – Utility Perspective

**May 22, 2025**

# About American Water

*Largest regulated water and wastewater company in the United States*

- Founded in 1886, American Water (NYSE: AWK) has **served customers and communities for more than 135 years**.
- We serve a broad national footprint and **a strong local presence**.
- We treat and deliver more than **one billion gallons of water daily**.
- We provide services to more than **14 million people with regulated operations in 14 states and on 18 military installations**.
- We **employ 6,700 talented professionals** who leverage their significant expertise and the company's national size and scale to achieve excellent outcomes for the benefit of customers, employees, investors and other stakeholders.


***American Water corporate headquarters located in Camden, N.J.***

# American Water Operations

## Regulated Operations

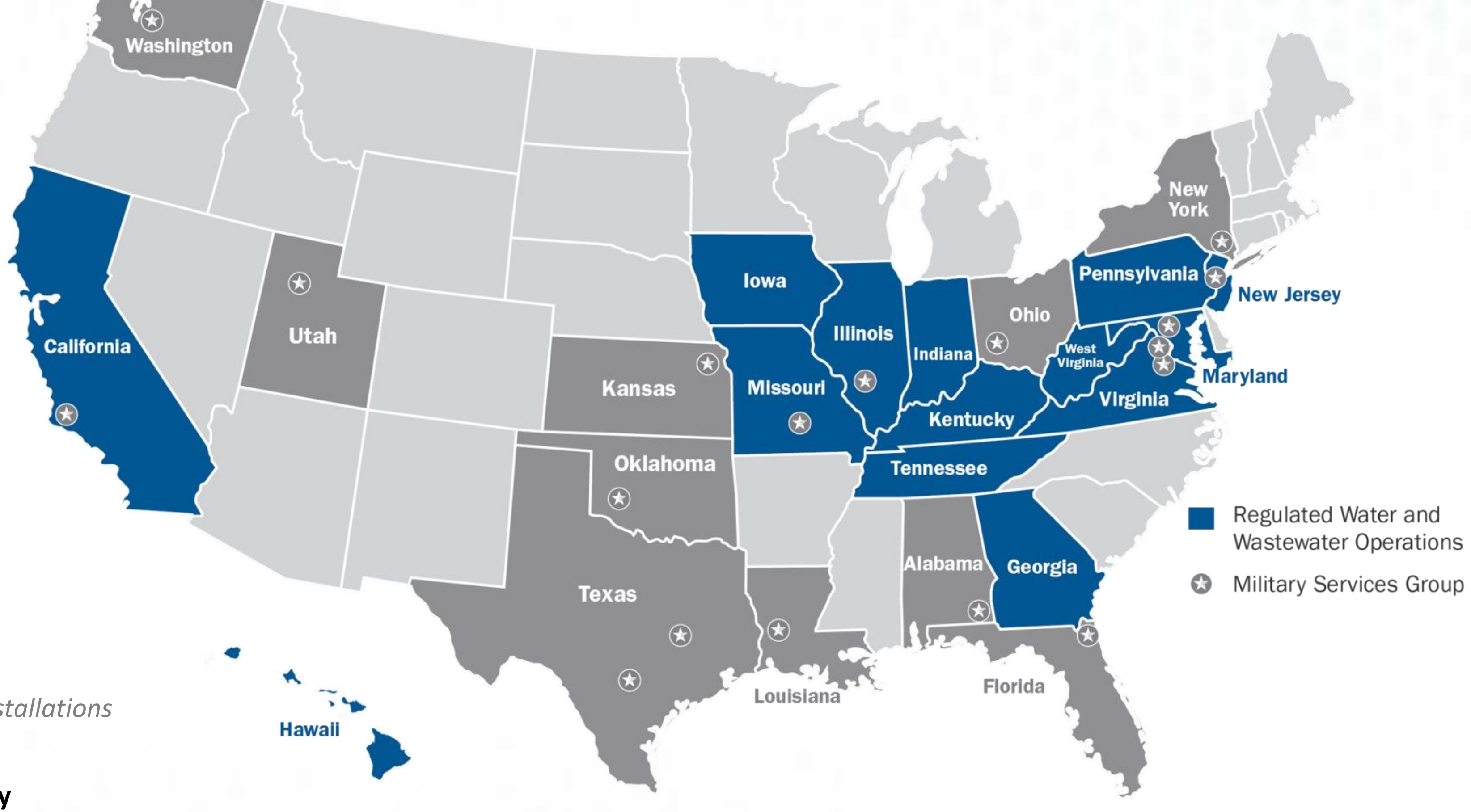
- **80** surface water treatment plants
- **520** groundwater treatment plants
- **190** wastewater treatment plants
- **54,500** miles of transmission, distribution and collection mains and pipes
- **1,200** groundwater wells
- **1,800** water and wastewater pumping stations
- **1,100** treated water storage facilities
- **75** dams

## Military Services Group

*Regulated-like operations at 18 military installations*

- **12 Army**
- **5 Air Force**
- **1 Navy**

### Our National Footprint

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# USEPA Published Federal PFAS Regulations in April 2024

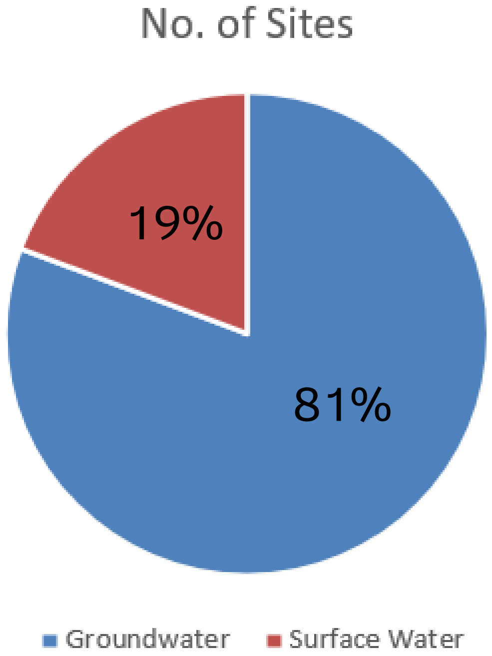
| CHEMICAL | MCLG (NON-ENFORCEABLE GOALS) | MCL (ENFORCEABLE LIMITS) |
|---|---|---|
| PFOA | 0 | 4.0 ppt |
| PFOS | 0 | 4.0 ppt |
| PFNA | 10 ppt | 10 ppt |
| PFHxS | 10 ppt | 10 ppt |
| HFPO-DA (GenX Chemicals) | 10 ppt | 10 ppt |
| Mixture of two or more: PFNA, PFHxS, HFPO-DA, and PFBS | Hazard Index of 1 | Hazard Index of 1 |

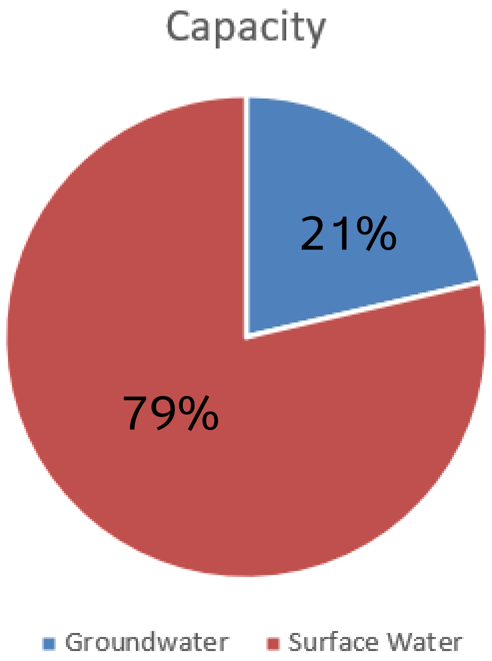
# American Water Approach

# Impact of PFAS Regulations on American Water

Monitor

| Category | | SOS | WTPs | SW WTPs |
|---|---|---|---|---|
| Non-Detect or More | 1 | 777 | 443 | 46 |
| Average <3, Max <4 | 2 | 82 | 61 | 12 |
| Average 3.0-3.2, Max <4 | 3 | 6 | 3 | 0 |
| Average 3.0-3.2, Max >4 | 4 | 1 | 1 | 0 |
| Average 3.2-4, Max <4 | 5 | 21 | 9 | 1 |
| Average 3.2-4, Max >4 | 6 | 9 | 9 | 6 |
| Average >4 | 7 | 191 | 99 | 10 |




**Proposed PFAS Sampling Strategy**

**Surface Water**

1. At least 1 raw water data set for each quarter.
2. If average raw water PFOA or PFOS values exceeds 2.0 ppt ***or*** if the maximum raw water PFOA or PFOS exceeds 4.0 ppt complete monthly raw water sampling for at least 12 consecutive months

**Ground Water**

1. For SOSs with only 1 recent (post 2019) data point, collect a 2nd raw sample.
2. For SOSs that have any PFOA or PFOS detect above 2 ppt between 4 and 6 additional samples may be required

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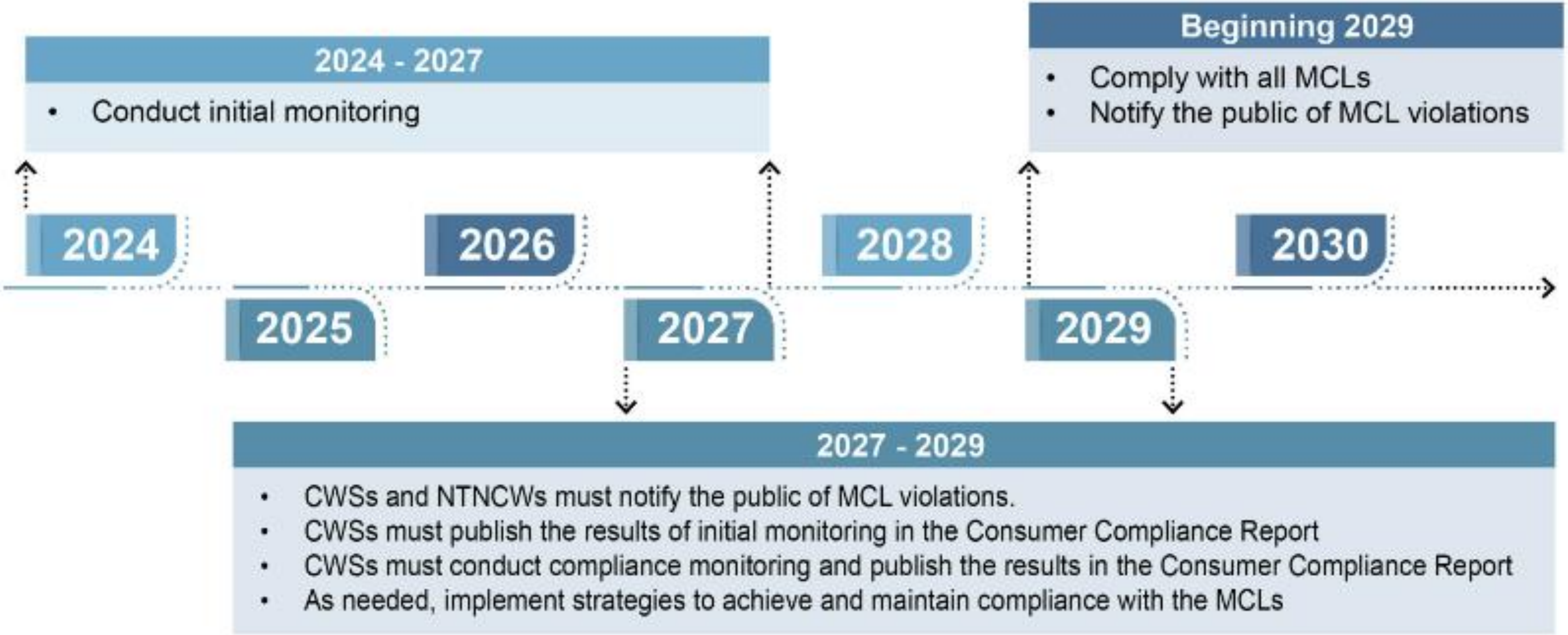
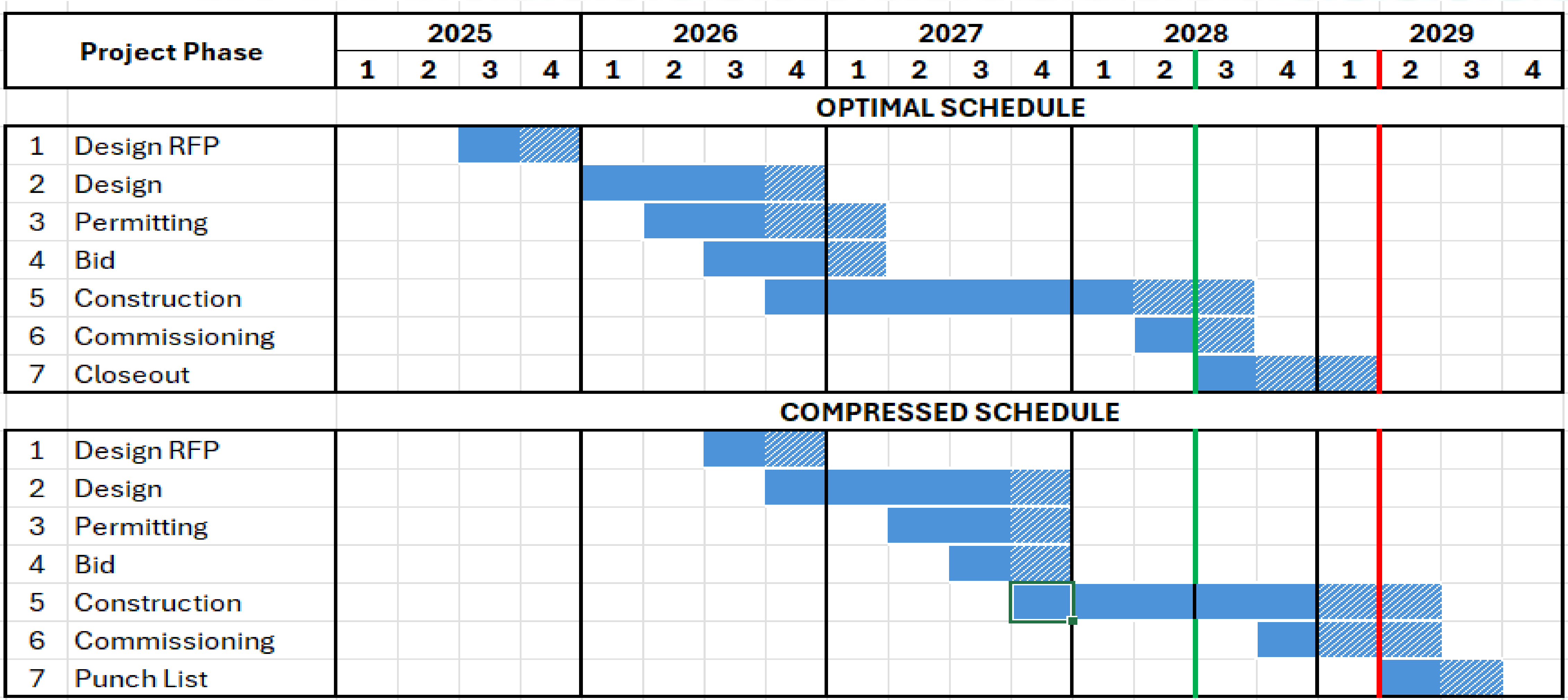
# EPA Original Schedule For Compliance



# Sample Project Schedules for Smaller (GW) Projects

Assess & Plan

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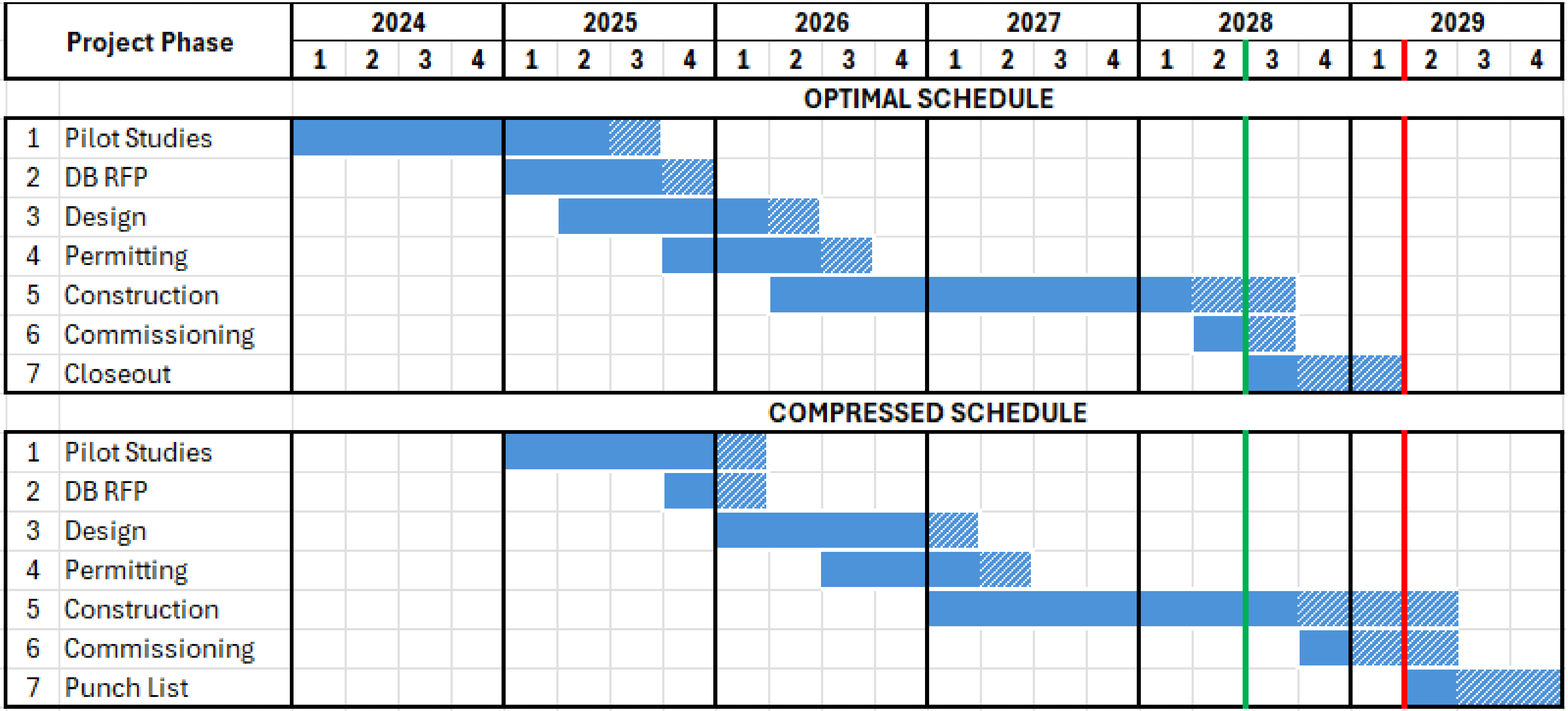
# Sample Project Schedules for Large Projects

Assess & Plan

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Research & Pilot

# PFAS Treatment Summary

| TECH | ADVANTAGES | DISADVANTAGES |
| --- | --- | --- |
| Granular Activated Carbon (GAC) | • Easy to use<br>• Able to remove other contaminants<br>• Reactivation offers destruction of PFAS<br>• Compatible in gravity absorbers/contactors | • Less effective for short chain PFAS<br>• Larger footprint than IX<br>• Iron and manganese removal sometimes required upstream of GAC<br>• (Generally) higher capital than IX<br>• More frequent replacement of GAC than IX |
| Ion Exchange (IX/AIX) | • Easy to use<br>• Smaller footprint than GAC<br>• Resin can be specialized for specific PFAS compounds | • Less effective for short chain PFAS<br>• Pre-filtration (Fe/Mn) sometimes required<br>• Disposal requires incineration for destruction of PFAS<br>• Not practical in gravity absorbers |
| Reverse Osmosis (RO) | • Likely effective for broadest range of PFAS | • Disposal options limited for high waste volume with elevated PFAS<br>• High Capital and Operating Expenses<br>• High complexity |

# Pilot-Scale Testing

Research & Pilot

- Large facilities and surface water treatment plants
- Where required by State regulators

12 SW pilots complete or almost complete with 2 more SW pilots starting in near future

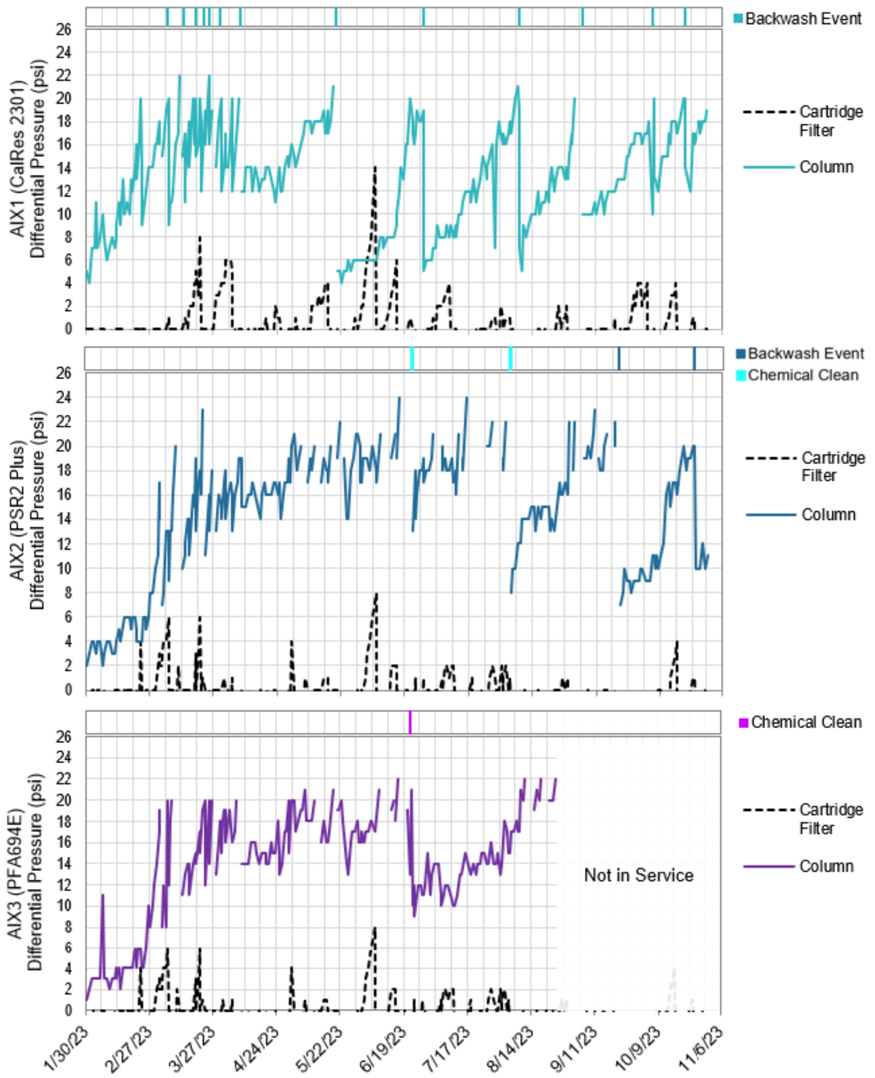
6 GW pilots starting in near future (does not include NJ pilots previously completed to meet State regulations)

# Preliminary Observations from Surface Water Pilots

Research & Pilot

1. **GAC**
   a) Headloss is an issue that will require weekly to monthly BW depending on performance of upstream treatment
   b) TOC and DBP precursor removal sustained throughout bed life – even downstream of existing GAC filter caps
2. **IX**
   a) Significant headloss accumulation has occurred in all (>10) surface water pilot studies
   b) Backwashing IX resin difficult and not recommended
   c) Biological fouling may be occurring as evidenced by ATP analysis and upward trends in clean bed HL
3. **Selective Sorbents**
   a) Inconsistent PFAS performance early in bed life seen in some pilots, but stabilizes in time
   b) Headloss accumulation also a challenge, and evidence of significant PFAS in BWWW (bound to fines?)

Figure 3.3: AIX Columns Differential Pressures

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# Design – GAC vs AIX vs Selective Sorbent

Design Solutions

| Criteria | GAC | AIX | Selective Adsorbent |
|---|---|---|---|
| EBCT/Stage (min) | 8.5 – 10 | 2.5 – 3 | 3.5 – 4 |
| SLR (gpm/sf) | 5 – 9 | 8 – 12 | 7 – 9 |
| Bed Life Capacity (cf/cf) | 25,000 – 40,000 | 100,000 – 250,000 | 150,000 – 250,000 |
| 1.5 MGD System | | | |
| No. of Vessels | 4 | 2 | 2 |
| Diameter (ft) | 10 | 10 | 12 |
| Media Volume (lbs/Vessel) | 20,000 | 17,250 | 27,000 |
| Vol. Treated (MG/Vessel) | 125 – 200 | 300 – 750 | 600 – 1000 |
| 5 MGD System | | | |
| No. of Vessels | 8 | 6 | 8 |
| Diameter (ft) | 12 | 12 | 12 |
| Media Volume (lbs/Vessel) | 40,000 | 20,000 | 22,700 |
| Vol. Treated (MG/Vessel) | 250 – 400 | 350 – 870 | 500 – 850 |

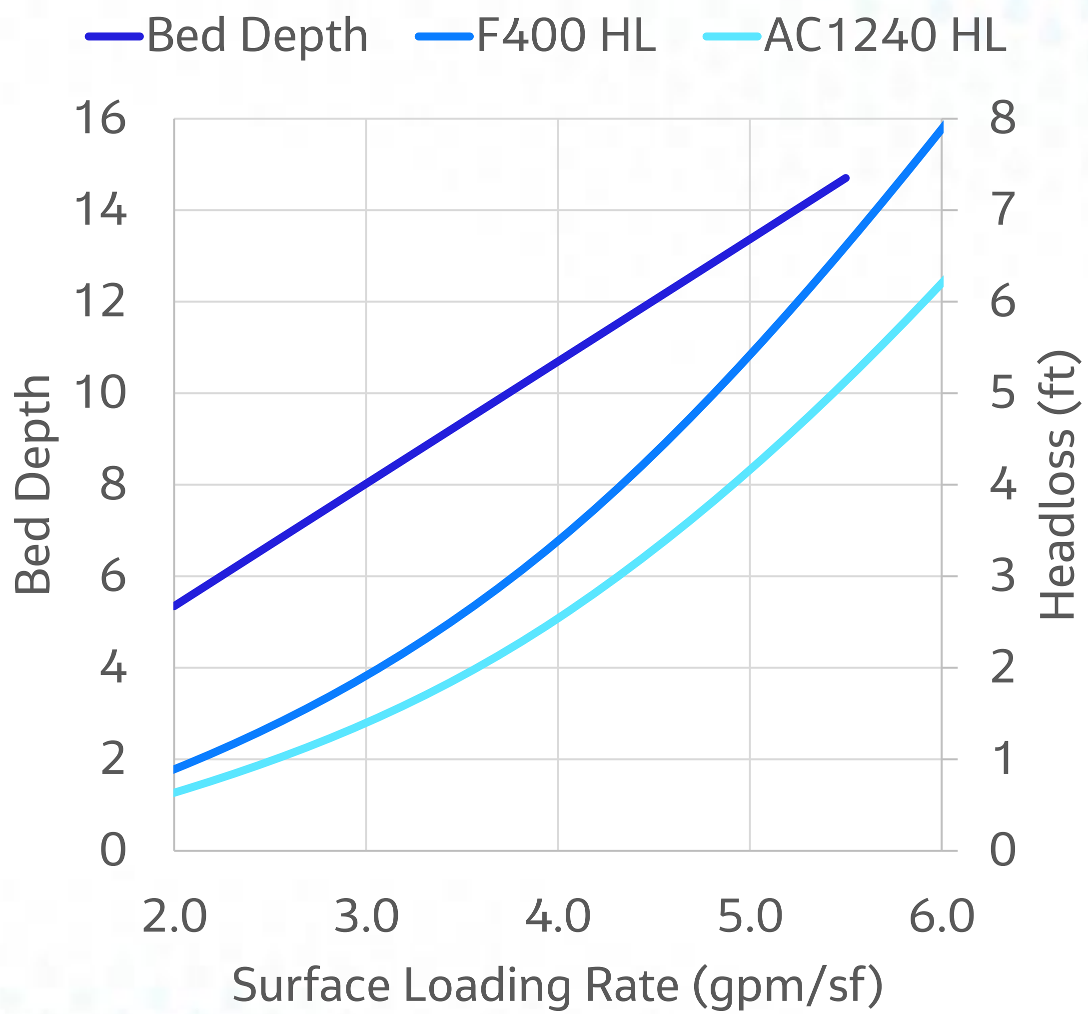
# Gravity GAC Absorber Design Criteria

Design Solutions

- **Gravity when > 10 - 20 MGD**
- **Standard GAC delivery: 20,000 lbs**
- **Multiple parallel single-stage units w/ staggered breakthrough**
- **Min EBCT ≈ 20 min at plant design flow w/ "N" units OOS**
- **Max SLR ≈ 4.5 gpm/sf**
- **Max Bed Depth ≈ 12 ft**
  - **Similar to gravity filters but much deeper (25' vs 16' box depth)**
- **Intermediate lift pumping typically req'd**

# Gravity GAC Filter Absorber Design Considerations

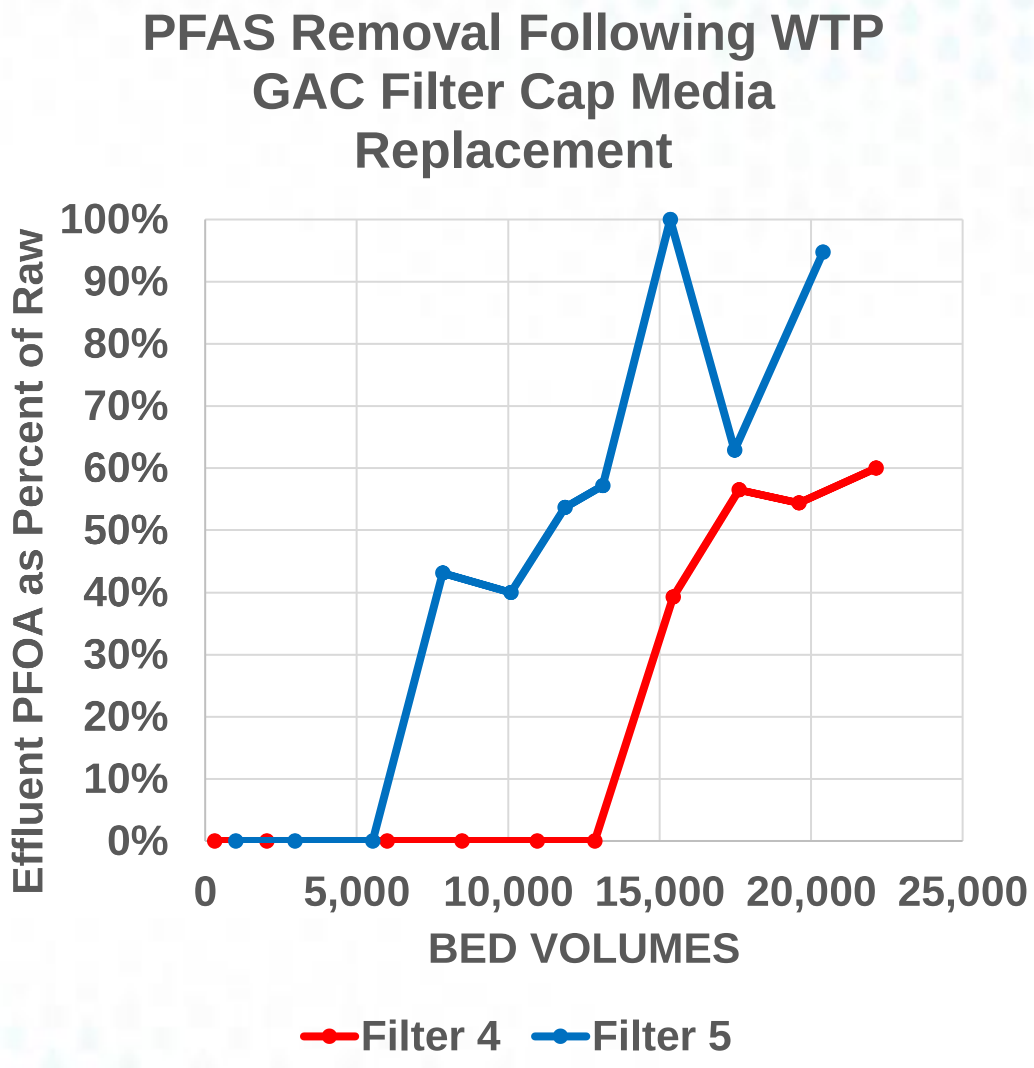
- **Filter Dimensions**
  - **GAC Volume/filter: 160 – 500K lbs**
  - **Bed Area: 500 – 1,500 SF**
- **Designing for media changeout**
  - **N+1 if <8 filters**
  - **N+2 if 8-16 filters**
  - **N+3 if >16 filters**
- **Robust underdrain needed for frequent and complete media replacements**
- **Effective Media Size: F400 vs AC1240**
  - **Bed life capacity/TOC impact**
  - **Media Headloss important factor**



# Considerations for Implementation

Implement

1. **Plants with raw water PFAS just at or near the MCL:**
   a) **Powdered Activated Carbon**
   b) **More frequent replacement of GAC filter media**
2. **Developing SOPs around startup and media changeout at large facilities**

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# Thank you!

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# Key Takeaways

- Continue progress towards complying with PFOA and PFOS MCLs
- Leverage industrial pretreatment programs to reduce PFAS discharges at the source
- Continue to test biosolids for PFAS to understand future solutions
- Bench- and pilot-scale data can be useful in understanding long-term compliance strategies

# Resources

# Resources

- Jacobs – [PFAS and Emerging Contaminants Website]
- American Water – [PFAS and Your Water]
- EPA
  - [PFAS Monitoring and Reporting Fact Sheet]
  - [May 14 Announcement]
  - [Small Drinking Water Systems Webinar Series]
- American Water Works Association - [PFAS Website]

## PFAS and Emerging Contaminants in Water

Navigating PFAS and emerging contaminants to enhance health and safety, ensure regulatory compliance and maintain business continuity.

Jacobs

Challenging today. Reinventing tomorrow.

### Introduction

A global leader in PFAS and emerging contaminants research, assessment and treatment across the water, environmental and advanced manufacturing sectors, Jacobs delivers comprehensive solutions this growing challenge. Our extensive expertise includes assessing PFAS and emerging contaminants sources and contamination pathways and evaluating, designing and implementing multi-media treatment techniques. With over 15,000 technical experts worldwide serving the water, environmental and advanced manufacturing sectors, we have a deep understanding of current science and regulations and lead innovation and research and development (R&D) to develop next-generation PFAS and Emerging Contaminants solutions.

### What We Do

Jacobs is a leader in providing comprehensive, customized PFAS and emerging contaminants solutions, with expertise across the full contaminant lifecycle, from identification and assessment to treatment and mitigation. We help clients mitigate risks, ensure compliance and achieve sustainability goals. Our ability to shape emerging contaminants solutions is drawn from comprehensive environmental, water, wastewater, solid waste and infrastructure expertise around the world.

### The PFAS and Emergi

PFAS and emerging contaminants h

### Why Jacobs?

- End-to-End PFAS Solutions. From initial characterization and risk assessment to treatment, strategic planning, waste disposal, program management and full operations management, we offer comprehensive support for our clients' PFAS and emerging contaminants challenges.
- Innovative Technology and Expertise: Leveraging award-winning advanced screening and prediction methods, data visualization, and AI/ML-driven risk assessment, we provide cutting-edge solutions that enhance decision-making and optimize PFAS and emerging contaminants management. We optimize our approach with real-world data and operations at the 200+ facilities operated by Jacobs.
- Proven Client-Centric Delivery. Building on decades of successful PFAS and emerging contaminants projects, we are your trusted pair of hands underpinned by our industry reputation in water solutions.
- Strategic Planning & Advisory: Our strategic advisory support includes funding analysis, regulatory compliance and ESG planning, ensuring risk-informed decisions and compliant PFAS and emerging contaminants management practices.
- Global Leadership and Innovation: Our award-winning global team of experts in water, PFAS and emerging contaminants treatment and R&D positions us to seamlessly integrate different specializations and disciplines to ensure the latest, most effective technology approach.

## PFAS Research and Development at Jacobs

Developing solutions for per- and polyfluoroalkyl substances (PFAS) is a core competency of Jacobs and central to our sustainability ethos. Working ahead of regulatory requirements, our Emerging Contaminants team at Jacobs has partnered with clients, academic partners, and remediation vendors to develop and test solutions related to

- Characterization and environmental transport
- Risk assessment
- Drinking water and groundwater treatment
- Soil treatment
- Wastewater, biosolids, and landfill leachate,

Jacobs encourages this collaborative and innovative environment to create an in-house knowledge base to provide our clients with novel and cost-effective solutions.

# Thank You

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