

Barr Engineering Co.

Emerging contaminants:

Considerations for per- and polyfluoroalkyl substances (PFAS) in the watershed district

www.barr.com

Office: Minneapolis, MN



*To view the presentation as given at the
board meeting, click please click the link
below:*

<https://youtu.be/zdQw09N1Dv8?t=3679>.

What are PFAS?

PFAS impacts to human health and the environment

Best management practices and treatment technologies

Evaluation and strategies for watershed district managers

Two decades of PFAS experience



2002

- Assessed air, water, waste output for industry users
- Developed stack sampling and analytical methods for PFOA

2004

- Developed solute-transport models for MN Pollution Control Agency and MN Dept of Health to evaluate PFAS, still sought by clients to date

2015

- Investigated and addressed contaminants at multiple sites in Eastern U.S. for active or former manufacturing facilities

2021

- Designed / installed full-scale water treatment system addressing PFAS for public sector client
- Conducted PFAS stack test sampling using OTM-45

2000

2005

2010

2015

2020

2004-2015

- Worked on various PFAS projects for manufacturing and municipal clients

2016

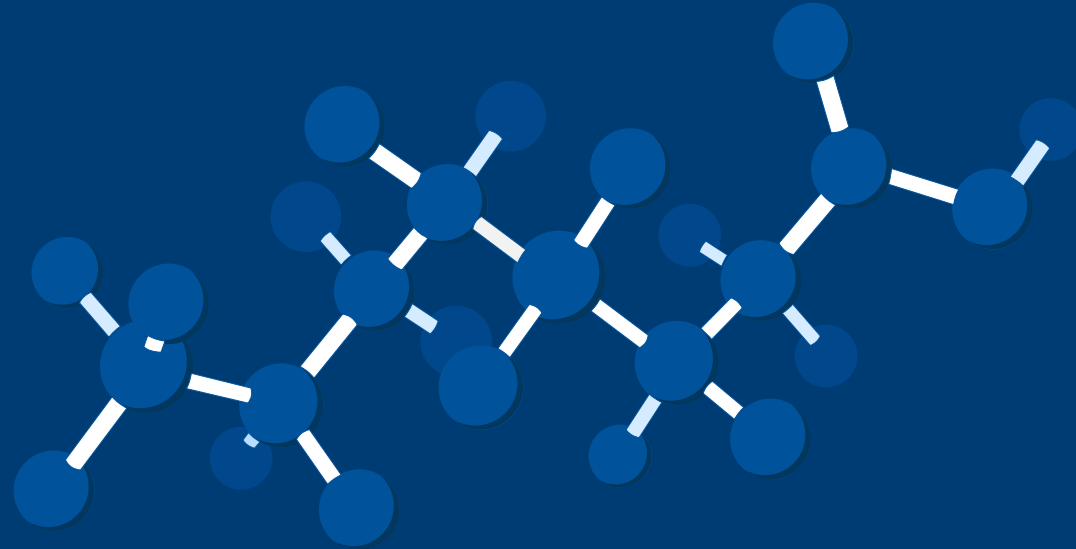
- Developed best practices for sample collection to reduce or eliminate water-sample-and-blank cross contamination

2017

- Worked with multiple laboratories to help reduce or eliminate method blank cross contamination

2018

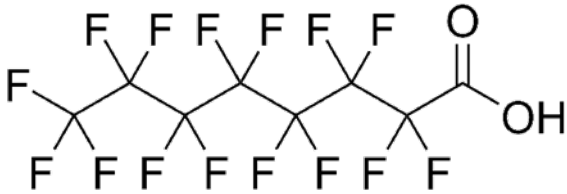
- Responded to industrial emergency event designed / installed rapid PFAS treatment system



What are PFAS?

What are PFAS?

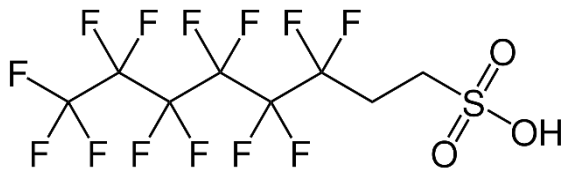
PFOA



PFOS



6:2 FTS

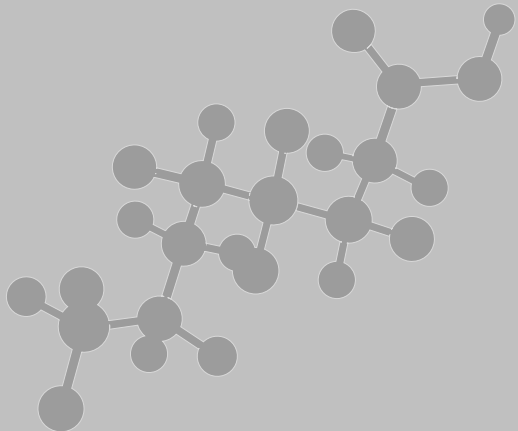


- Man made chemicals
- Approx. 4,000-6,000 compounds
- Per vs. Poly fluorinated
 - **P**- per
 - **F** – fluorinated
 - **X** – length of carbon chain
 - **A** or **S** – definition of functional group

● What are PFAS?

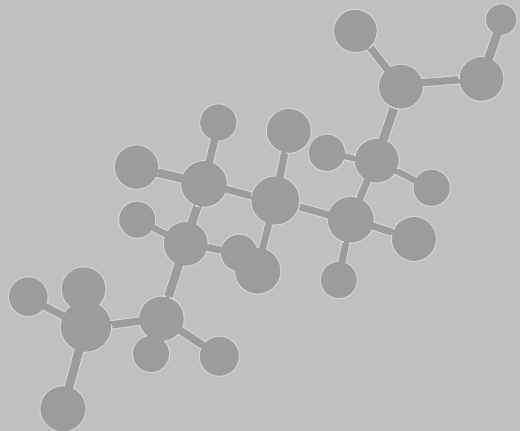
PFAS properties

- Heat, oil, stain, and water resistant
- Resistant to biodegradation
- Destroyed at high temperatures
- Semi-volatile
- Miscible in water
- Some affinity for organic carbon



What are PFAS?

PFAS properties

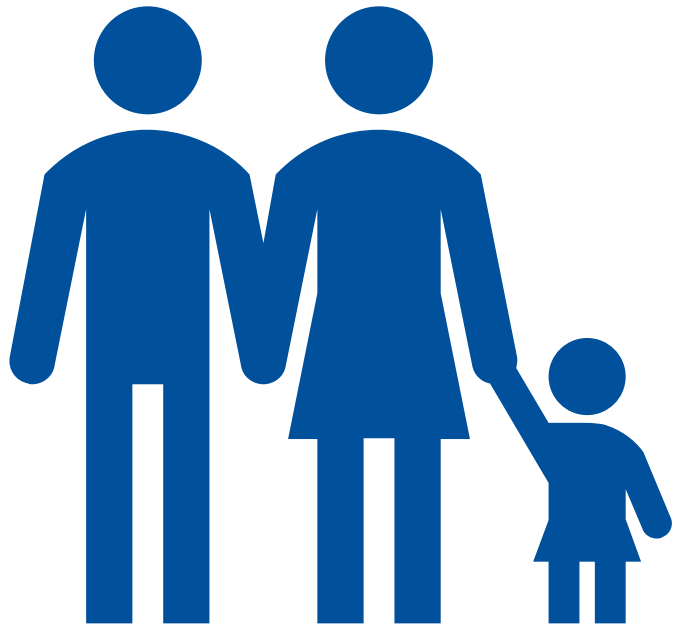


Uses and history

- Used in coating and waterproofing processes, fire suppression and to reduce surface tension
 - Products include ski wax, non-stick cookware, clothing/waterproofing, automotive, cosmetics
- Production of PFOA and PFOS phased out
 - Current products have different chemical makeup
- Historical chemicals were found to be persistent
- Historical production created PFAS mixture

Human health and the environment

Human health and the environment



- PFAS do not break down in the environment
- Half-life of PFOA in humans is ~4 years, half-life of PFOS is about ~5 years
- Human health risks may include cancer, liver damage, thyroid disease
- Bioaccumulate (build-up) in fish and wildlife

Research on the health effects of PFAS is evolving

2016

EPA released health advisory levels for PFOA/PFOS of 70 parts per trillion levels

2018

Agency for Toxic Substances and Disease Registry (ATSDR) draft report on PFAS listed potential health effects for some additional PFAS compounds

2021

EPA releases draft scientific documents addressing drinking water health risks for PFOA and PFOS

2022

EPA releases interim updated drinking water health advisories for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS)

2016

2017

2018

2019

2020

2021

2022

Federal and state regulatory action

EPA PFAS Strategic Roadmap

PFAS Strategic Roadmap: EPA's Commitments to Action 2021–2024



https://www.epa.gov/system/files/documents/2021-10/pfas-roadmap_final-508.pdf

- Sources in focus
- Buildout of regulatory framework
- Multi-media focus
- Lifecycle analysis
- Disadvantaged Community protection

Recent Minnesota actions - PFAS



<https://www.pca.state.mn.us/sites/default/files/p-gen1-22.pdf>

- Emphasis on:
 - Sampling
 - Addressing historical contamination
 - Certain industries
- Key aspects of plan:
 - **Prevent** PFAS pollution wherever possible
 - **Manage** PFAS pollution when prevention is not feasible or pollution has already occurred
 - **Clean up** PFAS pollution at contaminated sites

Potential sources of PFAS in and around RWMWD

Recent Minnesota actions – PFAS Monitoring Plan

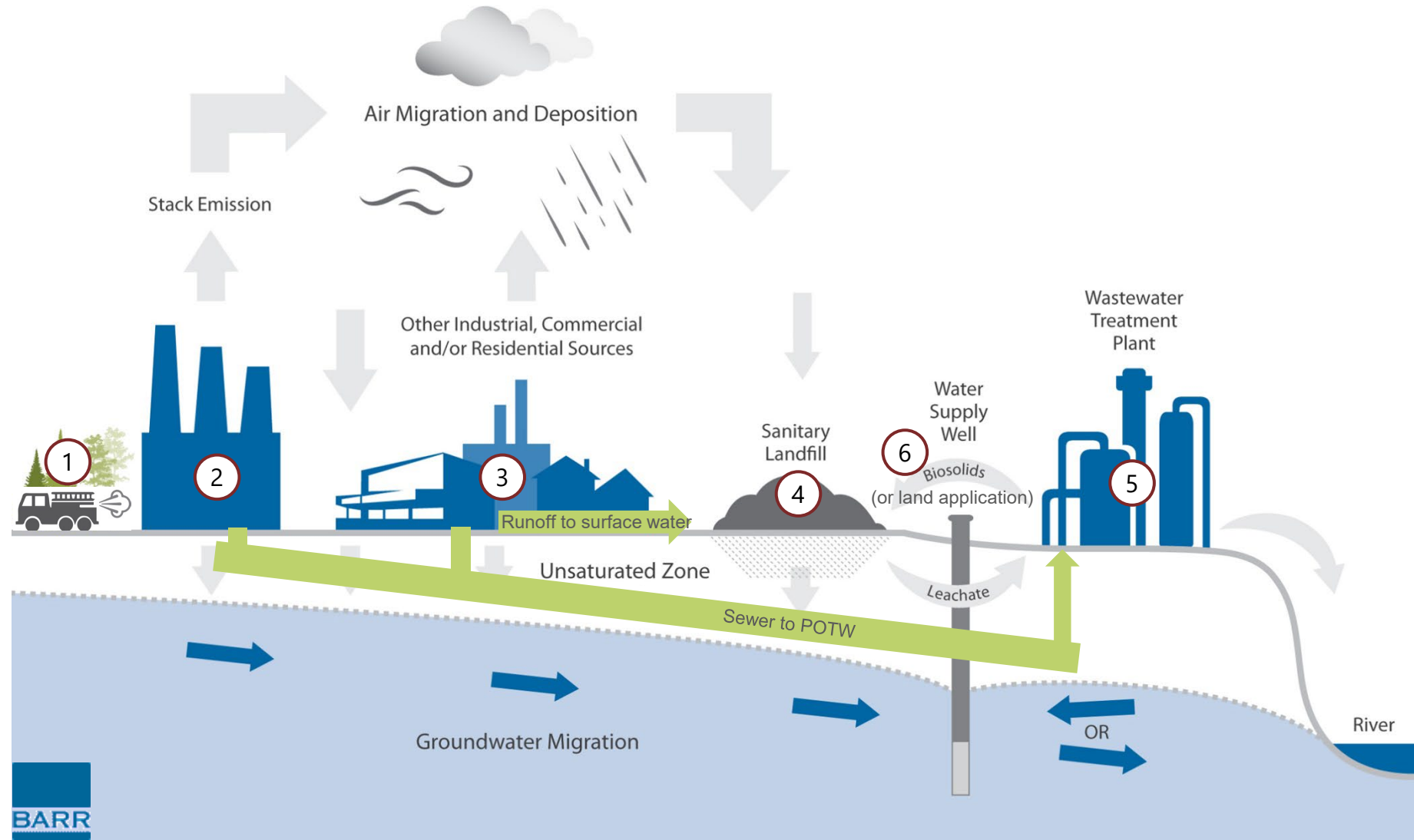


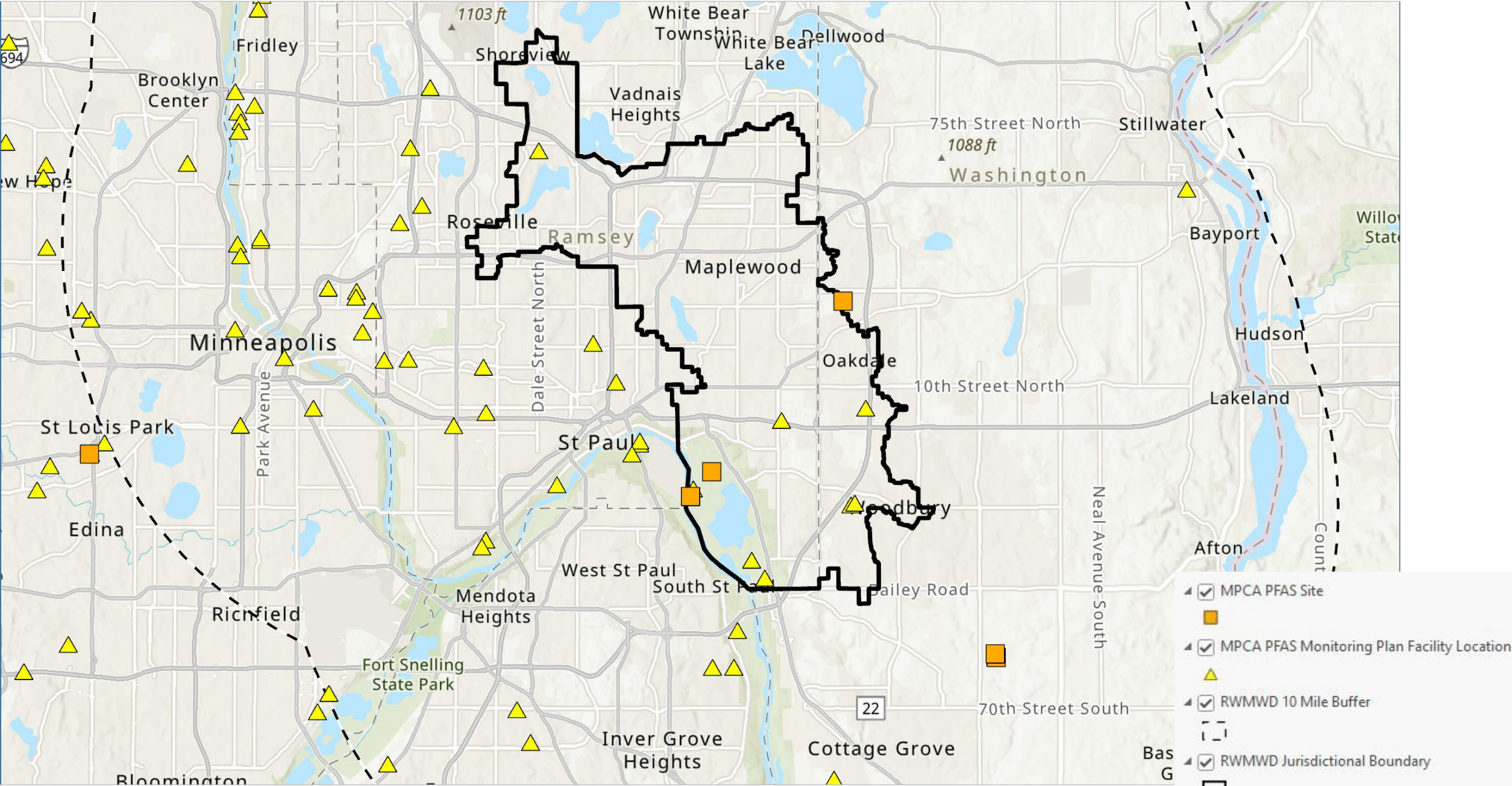
- > 100 named facilities
- Air, Wastewater, Waste Management, Stormwater, Remediation
- Implementation 2022-2023 and beyond

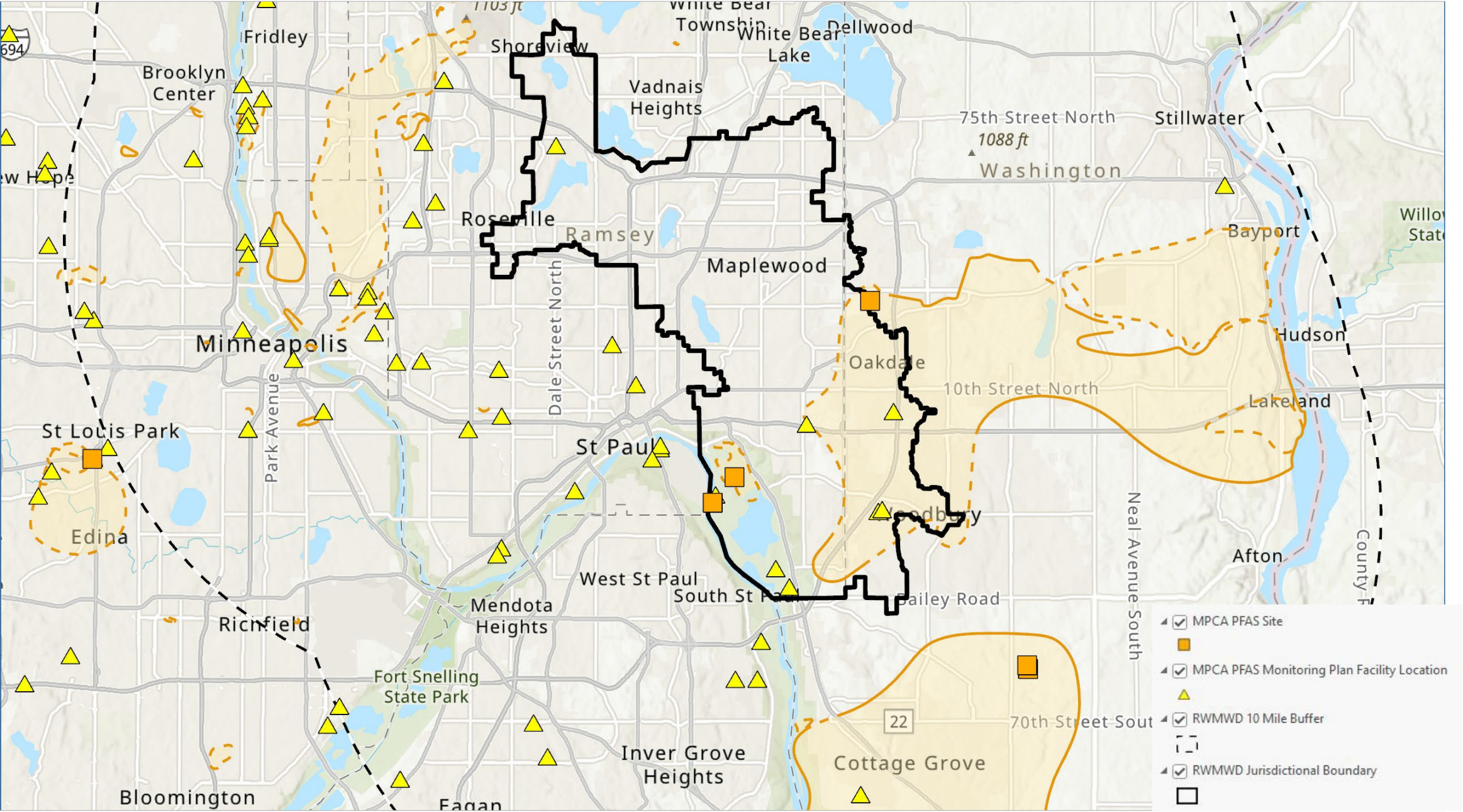
<https://www.pca.state.mn.us/air-water-land-climate/monitoring-pfas>

PFAS Sources and Transport

- 1 Aqueous Film-Forming Foam (AFFF)
- 2 Primary Manufacturers
- 3 Secondary Manufacturers and Consumers/Users
- 4 Landfills
- 5 Publically Owned Treatment Works (POTW)
- 6 Biosolids







PFAS fate and transport



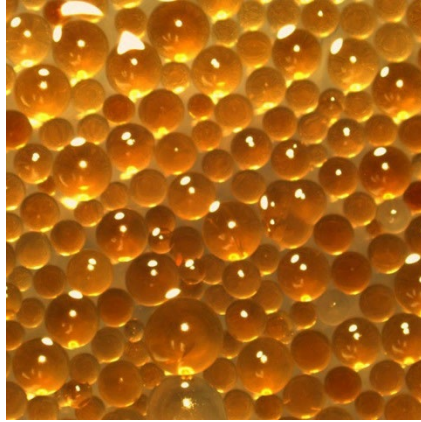
- Still learning about PFAS and surface water interaction
 - Dissolved versus particulate
 - Contact time and transport
 - Runoff events and sediment transport

Considerations for PFAS in surface and groundwater

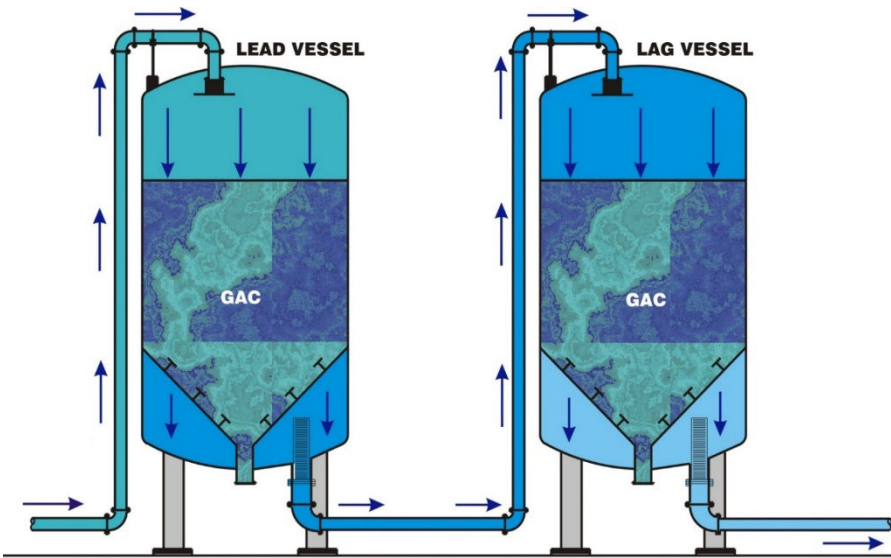
- Source reduction or elimination primary mechanism to remove PFAS in the environment
- Emerging technologies to treat PFAS
- Ongoing testing and monitoring to understand extent of PFAS in the environment
 - Testing is complex and expensive

Remediation and treatment technologies

Remediation and treatment technologies



- Focus on drinking water and wastewater technologies
 - Primary technologies granular activated carbon (GAC) and ion exchange (IX)
- Pre-treatment important to address PFAS



Mature Technologies

Emerging and Alternative Technologies

- Incineration
- Cement Kilns

Destructive Technologies

Adsorption Technologies

- Granular Activated Carbon (GAC), paired with media incineration or reactivation
- Anion Exchange (AIX) Resin, paired with media incineration or **regeneration**

Separation Technologies

- Nanofiltration (NF)
- Reverse Osmosis (RO)

PFAS Treatment Options

Source Reduction

Destructive Technologies

Adsorption Technologies

- Biochar
- Powder Activated Carbon (PAC) with membrane filtration
- Modified and novel adsorbents
- Polymeric additives
- Synthetic Gel Polymers
- Metal-Organic Frameworks (MOF)

Separation Options

- Foam Fractionation
- Ozone Fractionation

- Electrochemical Oxidation
- Plasma Reactors
- Supercritical Water Oxidation (SCWO)
- Advanced Reduction Processes (ARP)
- Sonolysis/Sonochemical oxidation
- Other Advanced Oxidation Processes (AOP)
- Biological Treatment (fungi, Feammox)

Emerging surface water solutions



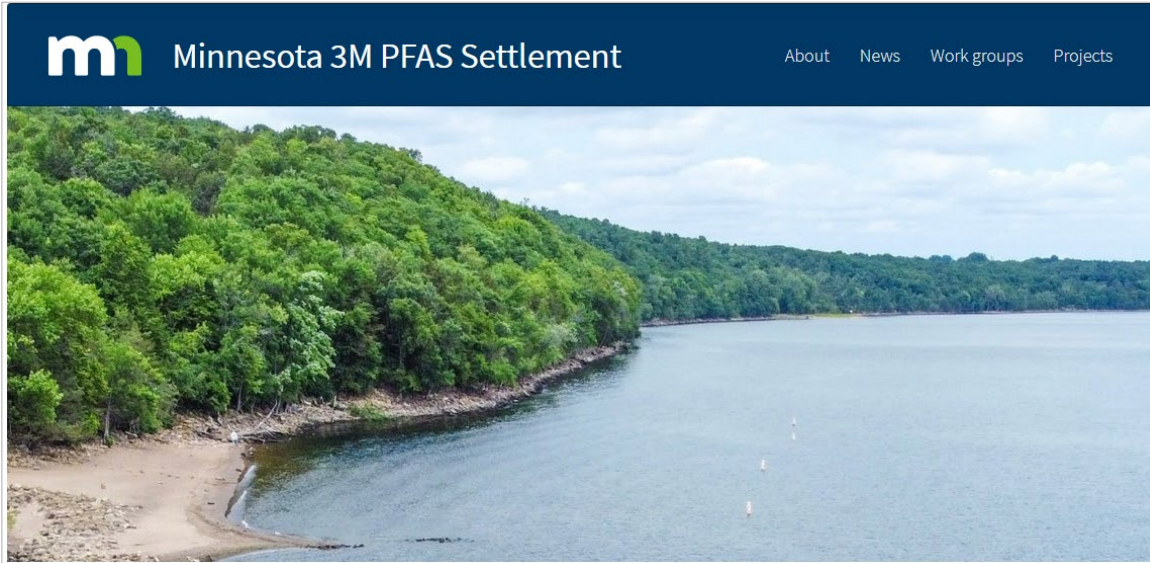
- Surface water treatment still emerging
 - Foam fractionation
 - Capture and divert stormwater
 - Storage and treatment

Planning and funding

Who is responsible to address PFAS?

- U.S. EPA setting national maximum contamination limits (MCLs) and federal regulatory framework
 - Clean Drinking Water Act
 - Surface Water Act
 - Clean Air Act
- MPCA taking action to understand full extent of PFAS in Minnesota and can set state regulatory framework
- Minnesota Department of Health (MDH) sets drinking water standards

3M Settlement – Priority 2 workgroups and grants



- \$20 million in grant money
 - “to compensate for losses to recreational and ecological resources”
 - DNR and MPCA will convene two work groups to provide input on Priority 2 planning

3M Settlement – Priority 2 workgroups and grants



- Priority 2 Resident Work group
 - Provide feedback on Priority 2 goals and planning processes to the DNR and MPCA
 - Work Group membership open to residents from Ramsey, Washington, and Dakota counties
 - Application deadline February 21, 2023
- Priority 2 Subgroup: Ecosystem Services and Recreation

Potential funding sources



- Infrastructure Investment and Jobs Act (IIJA)
- Potential state funding
- Grants

Key takeaways



Questions?

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Thank You