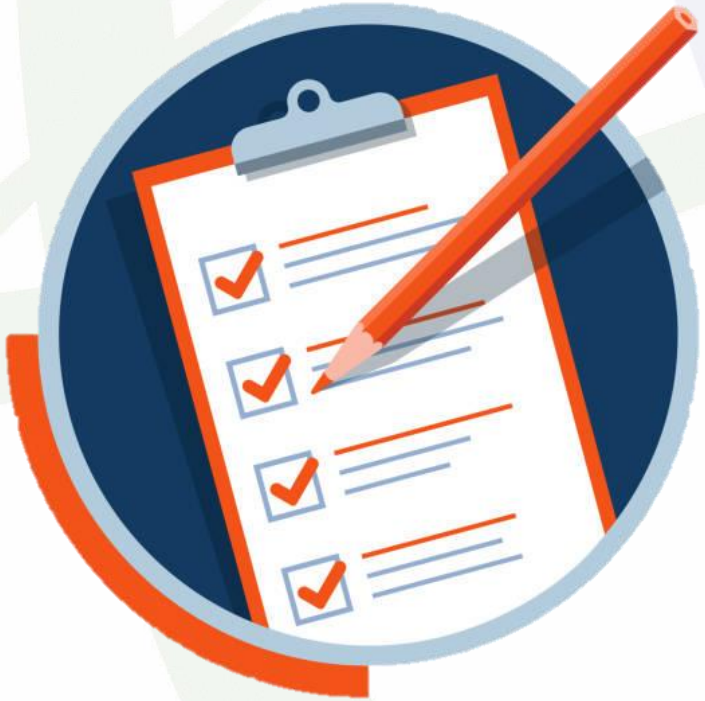
PFAS Today, Tomorrow, and Forever

Will Shaffer, PE

November 14, 2023

Agenda

- Introduction
- Regulations
- Characterization, Sampling and Analysis
- Treatment
- Funding Options



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Introduction

Introduction

EEC Environmental

- National environmental engineering consultant
- Chemists, engineers, geologists, hydrogeologists, regulatory and compliance specialists
- PFAS treatment experts

PFAS Services

- Site assessment and remediation
- PFAS characterization and planning
- Treatment system design
- Owner's representative consultant

Will Shaffer, PE
Project Engineer

What is Your Level of PFAS Knowledge?

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1. I have already begun PFAS planning or have installed PFAS treatment systems
2. I am learning about PFAS, but no actions yet
3. I am brand new to PFAS

What is Your Role?

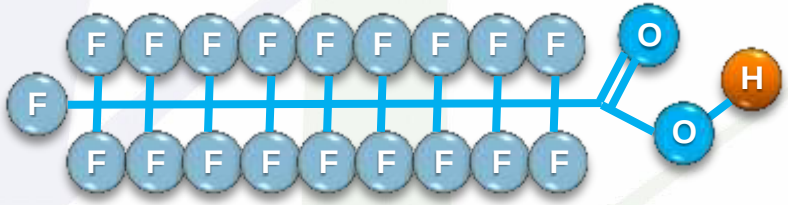
1) Regulator
2) Water/wastewater system owner
3) Water/wastewater system operator
4) Engineer or consultant
5) Other

What is Your Greatest Concern?

PFAS in…

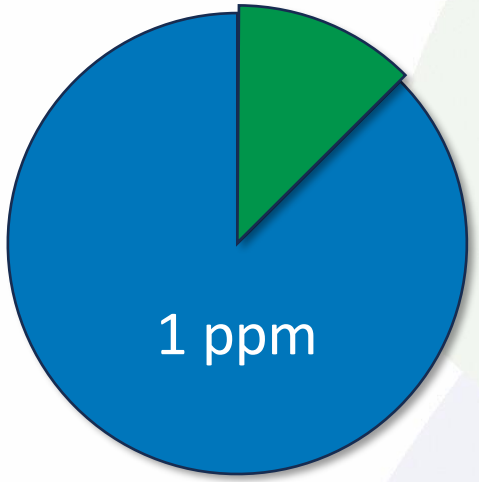
1) Drinking Water
2) Wastewater/Biosolids
3) Recycled Water
4) Stormwater
5) Impacted Sites
6) Air Quality
7) Other

PFAS 101



- Broad class of manufactured chemicals used to make products that resist heat, oils, grease, stains, & water
- Teflon™ coated cookware, carpets, clothing, paper packaging for food, fire retardants, AFFF
- First developed in 1940s
- Over 5,000 PFAS compounds (terminal and precursors)
- Extremely stable in environment and can be found in soil, air, surface water, groundwater, wastewater plant effluent, sewage sludge and landfills **"Forever Chemicals"**

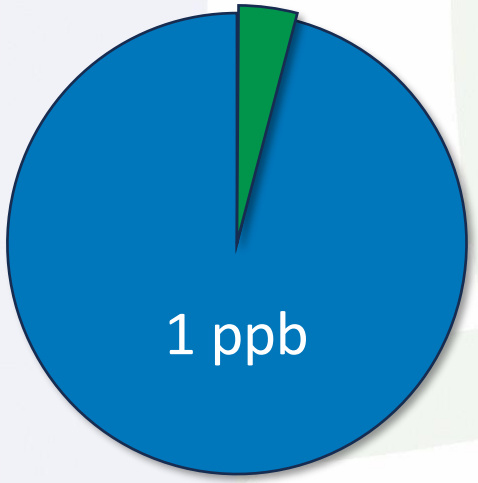
PFAS Concentration Units: ppt



1 ppm (part per million)

1 milligram per liter, mg/L

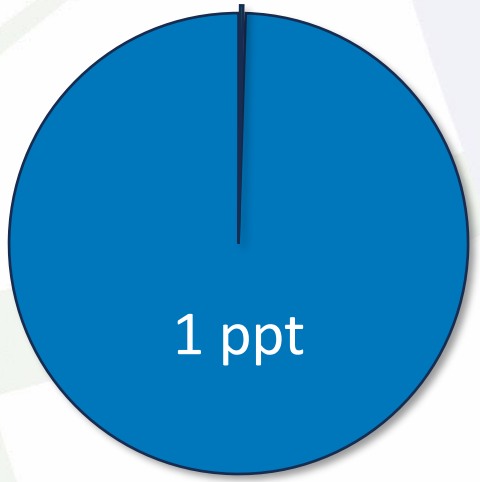
1 second in 11.5 days



1 ppm (part per billion)

1 microgram per liter, µg/L

1 second in 31.7 years



1 ppt (part per trillion)

1 nanogram per liter, ng/L

1 second in 31,700 years

1 drop in 20 Olympic pools

½ tsp in SoFi Stadium

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Regulations

EPA PFAS Strategic Roadmap
Key Actions

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Research — **Restrict** — **Remediate**

Fall 2021
- Nationwide monitoring (UCMR5)

Spring 2022
- Enhance PFAS reporting under Toxics Release Inventory

Winter 2022
- Leverage NPDES permitting to reduce PFAS discharges to waterways

Summer 2023
- **Finalize PFOS and PFOA (at a minimum) as hazardous substances (CERCLA) [1]**

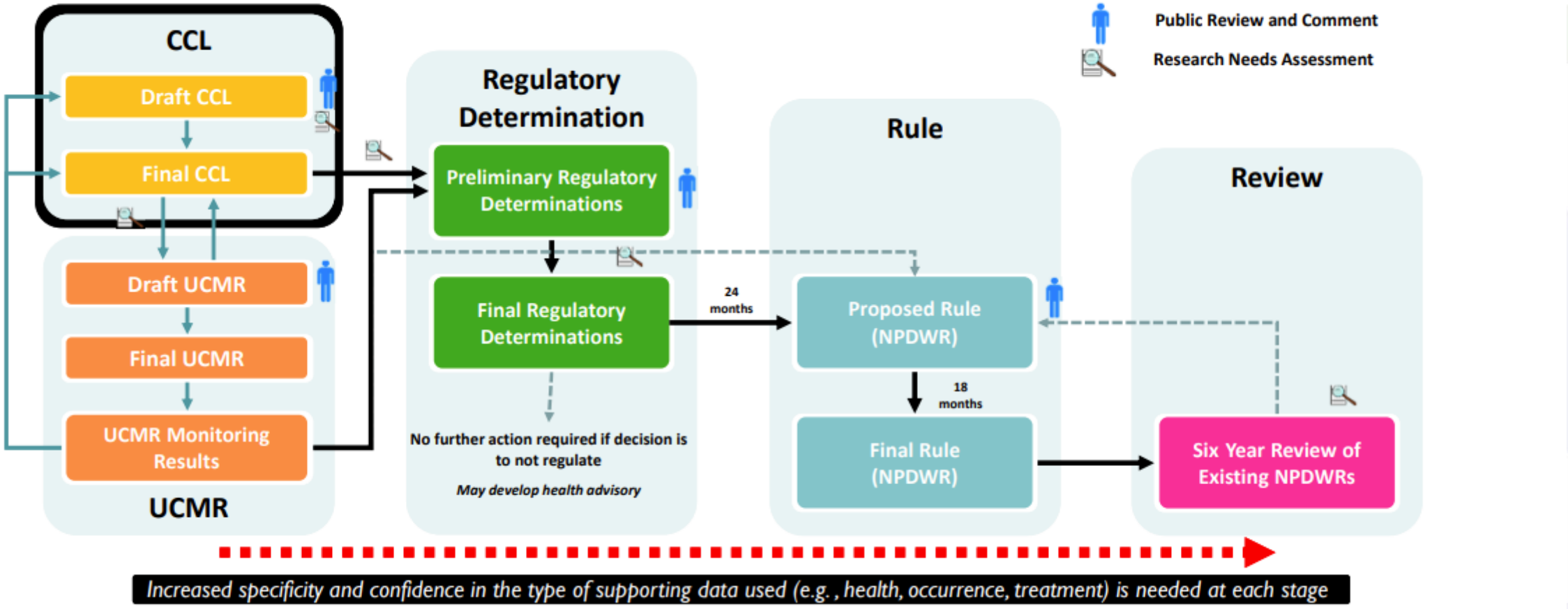
Fall 2023
- **Finalize PFOA/PFOS MCLs [2]**

Summer 2024
- Adopt Effluent Limitation Guidelines (ELGs) for nine industrial categories and landfills.
- Includes OCPSF, metal finishing, electroplating

Winter 2024
- **Finalize risk assessment for PFOA and PFOS in biosolids to determine whether regulation is appropriate**

[1] PFOA, PFOS, PFBS, PFHxS, PFNA, GenX, PFBA, PFHxA, PFDA & precursors (proposed Fall 2022)
[2] PFOA, PFOS, PFNA, PFHxA, PFBS, GenX (proposed Spring 2023)

Flow of SDWA Regulatory Processes



Source: USEPA

Drinking Water with PFAS > Proposed MCLs

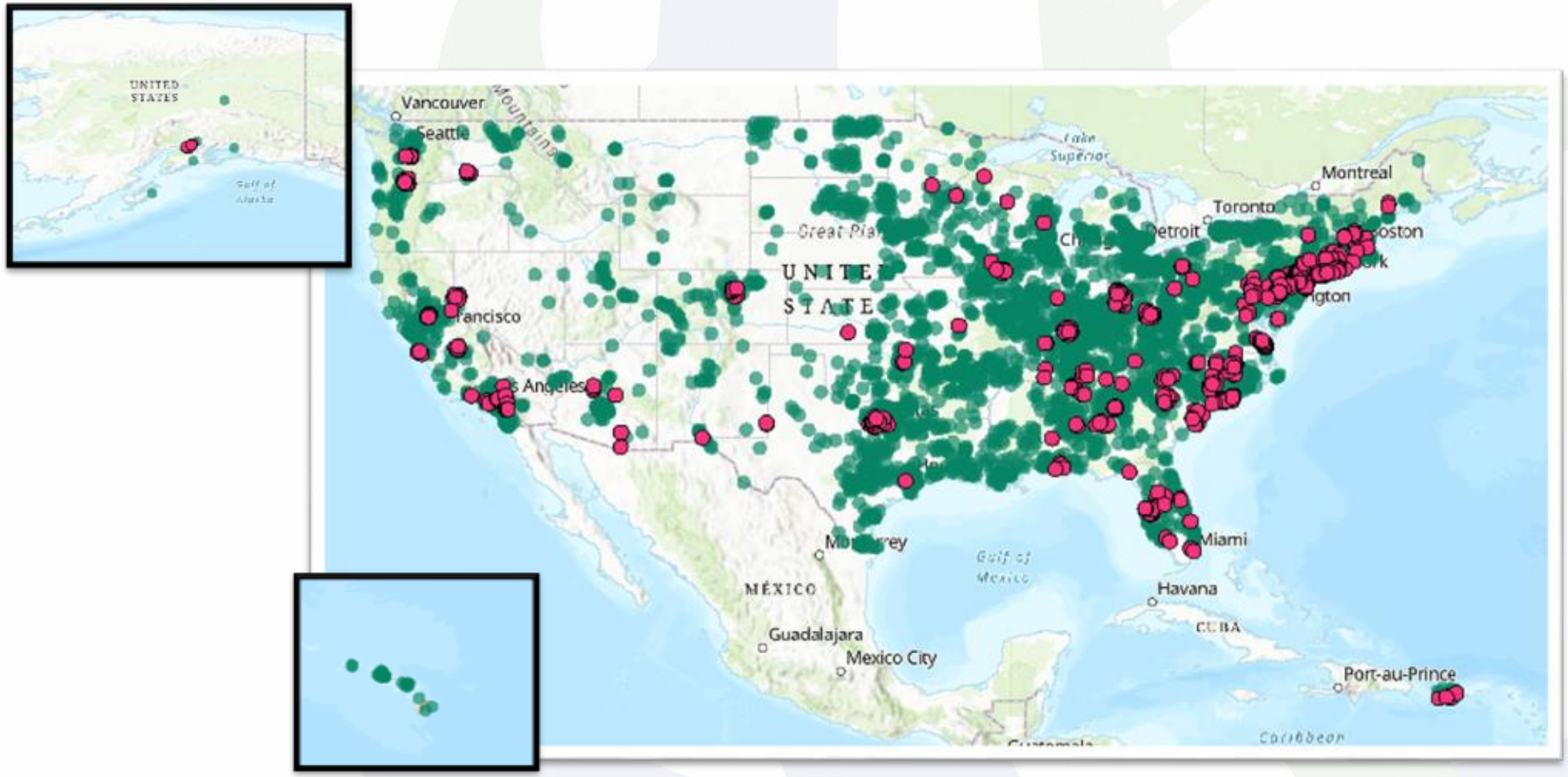
As of October 2023

	0-10,000 customers Small PWS	10,000+ customers Large PWS
Number of PWS Sampled	1,883	1,189
PFOA > Proposed MCLs	132 (7.0%)	161 (13.5%)
PFOS > Proposed MCLs	164 (8.7%)	166 (14.0%)
GenX > Proposed MCLs	0	1
PFBS > Proposed MCLs	0	0
Exceedance Percentage	**10.8%**	**18.2%**

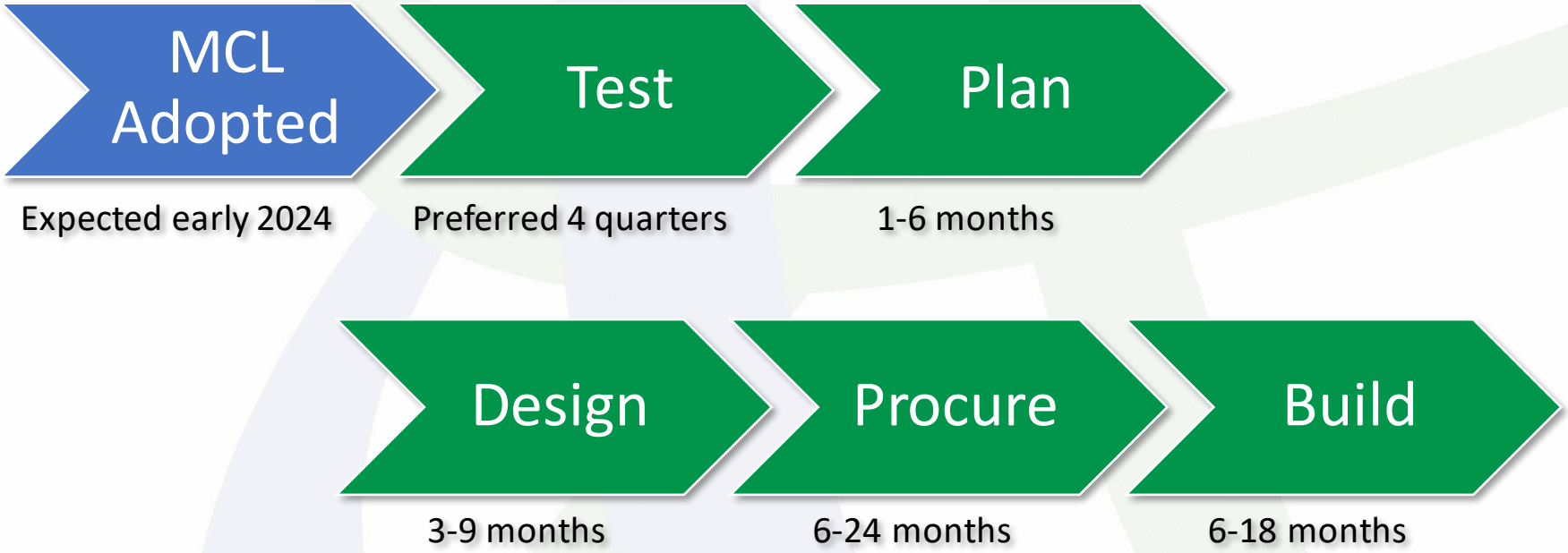
https://www.epa.gov/dwucmr/fifth-unregulated-contaminant-monitoring-rule-data-finder

Drinking Water with PFAS > Proposed MCLs

As of August 2023



Timeline to Comply



- 3 years to comply with MCL, additional 2 years possible
- Equipment lead time up to 24 months (vessels, electrical)

Drinking Water Standards in the US

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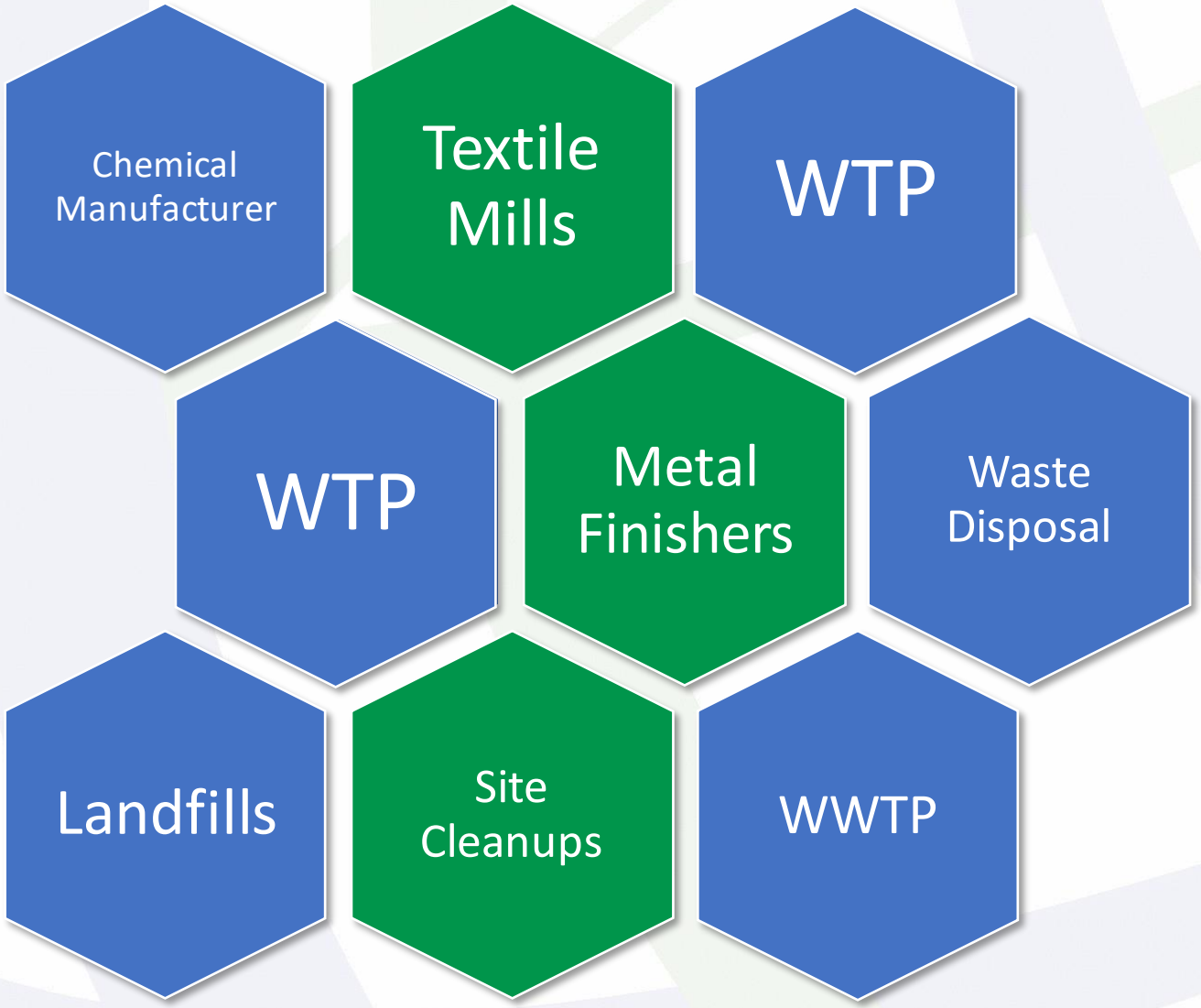
State	PFOS	PFOA	PFNA	PFHxS	PFBS	HFPO-DA (GenX)	PFHpA	PFHxA	PFDA
Massachusetts (MCL)	20	20	20	20			20		20
Michigan (MCL)	16	8	6	51	420	370		400,000	
New Hampshire (MCL)	15	12	11	18					
New Jersey (MCL)	13	14	13						
New York (MCL)	10	10							
Pennsylvania (MCL)	18	14							
Vermont (MCL)	20	20	20	20			20		
Wisconsin (MCL)	70	70							
USEPA (Proposed MCL)	**4**	**4**	**10 ***	**9 ***	**2,000 ***	**10 ***			

Values in parts per trillion (ppt) or ng/L

*Hazard Index Values: Sum of fractions must not exceed 1.0

CERCLA Designation

- Cradle to grave responsibility
- High cost of disposal
- Unknown presence of COCs



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Drinking Water MCLs	Impact	Unknown
3 years to comply	10-20% of PWS nationally	Regulations still pending Cost impacts unknown

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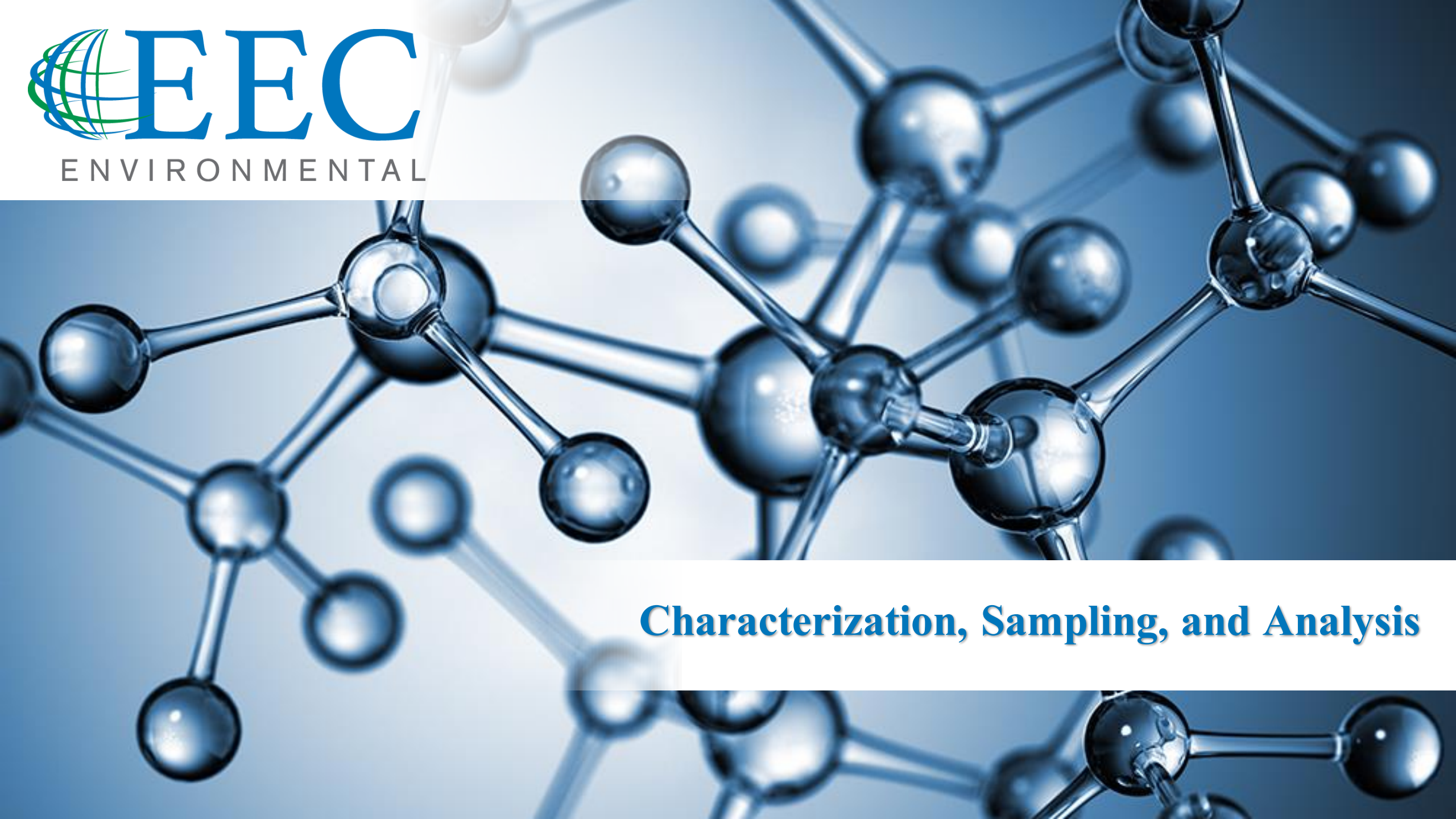
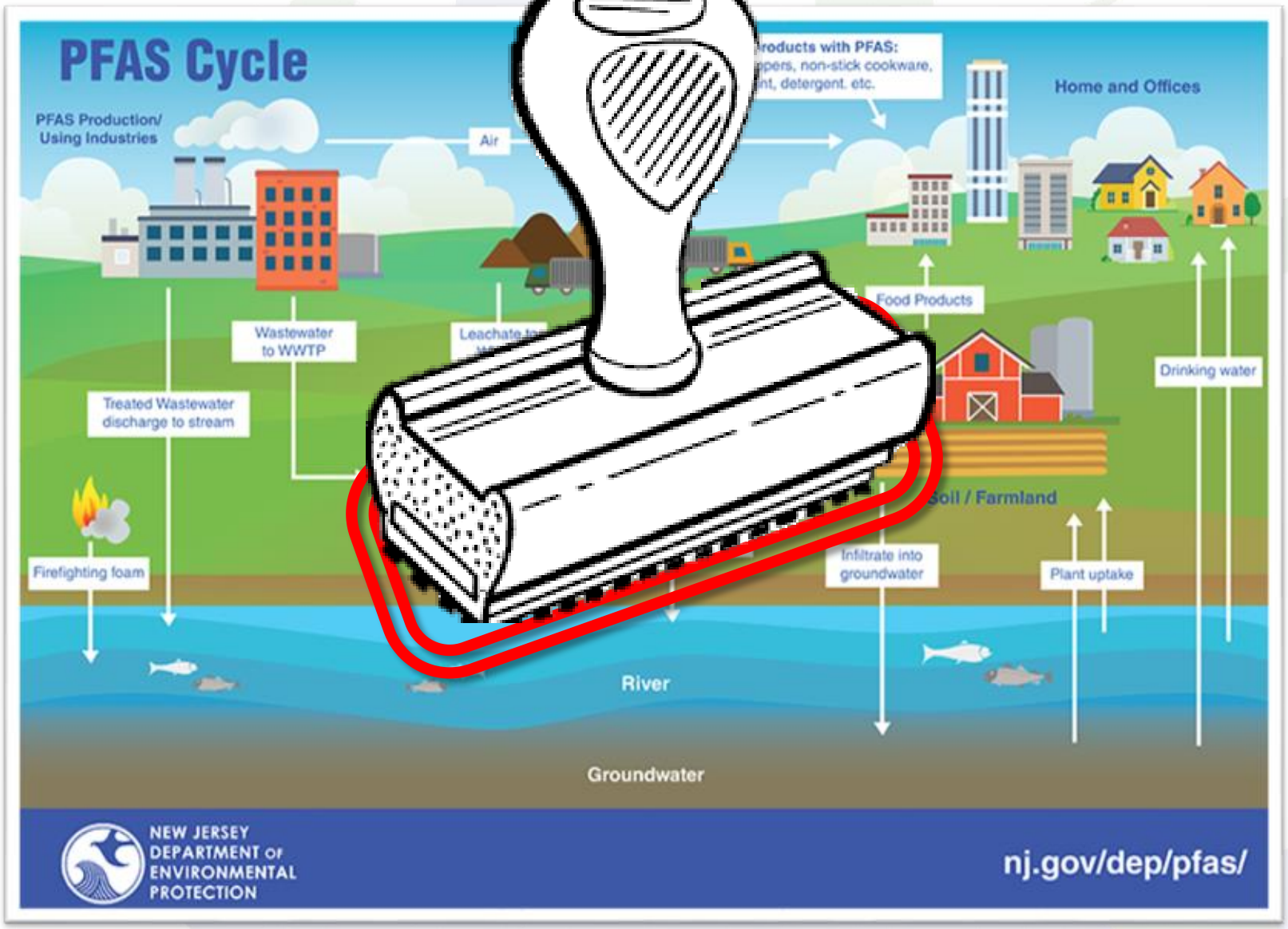


Characterization, Sampling, and Analysis

PFAS Environmental Cycle



Michigan PFOS Source Study 2020

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Industry / Category / Type	% Confirmed Sources	Range Effluent PFOS Screening Level of 12 ppt
Landfills	88%	13 - 5,000
Metal Finishing	15%	20 - 240,000
Contaminated Sites	50%	14 - 34,000
Centralized Waste Treaters (CWTs)	75%	13 - 8,400
Paper Manufacturing, Packaging	64%	16 – 410
Commercial Laundries	42%	24 – 69
Chemical Manufacturers	24%	18 - 4,600,000
AFFF-contaminated Sewers	100%	240 - 45,000

Source: Michigan EGLE

Drinking Water Analytical Methods

EPA Method 537.1

- 18 PFAS Compounds
- Preservative Trisma

EPA Method 533

- 25 PFAS Compounds
- Preservative ammonium acetate

Wastewater Analytical Methods

EPA Draft Method 1633

- Groundwater, surface water, wastewater, sediment, soil, tissue, biosolids
- Not yet promulgated, but widely used
- 40 PFAS compounds (terminal and precursor PFAS)

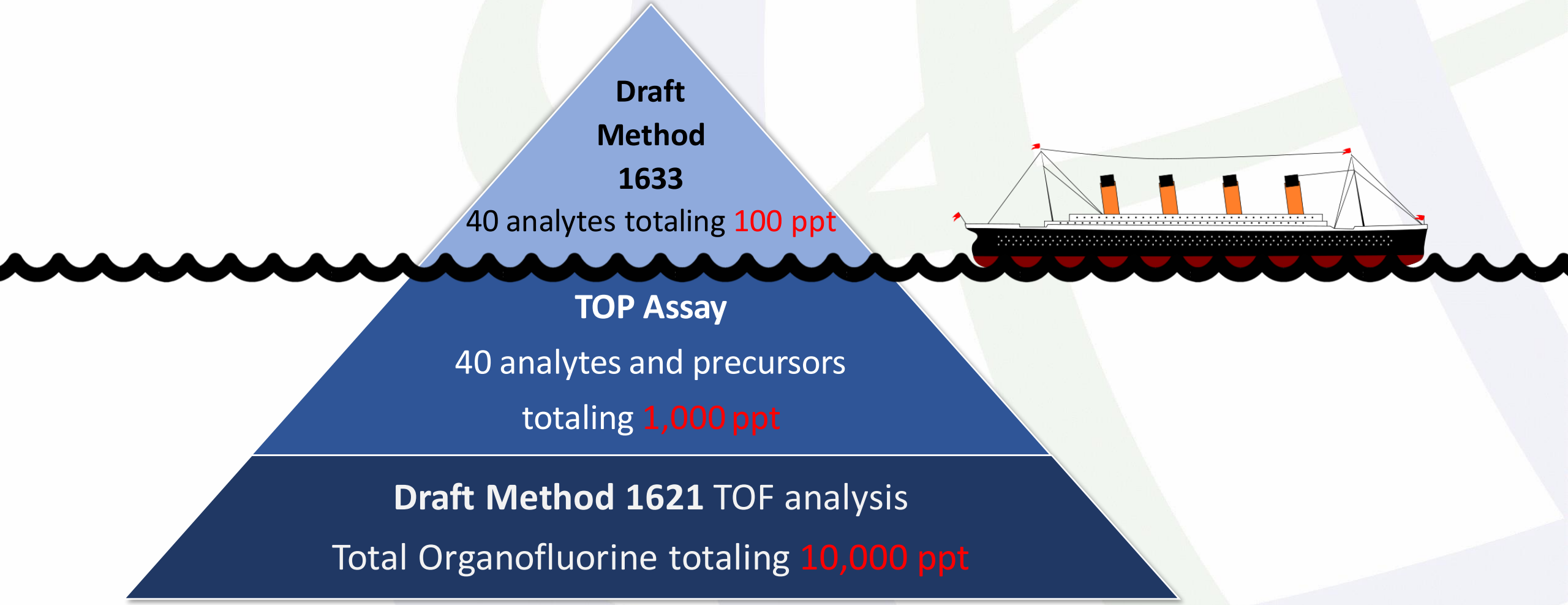
Total Oxidizable Precursors (TOP) Assay

- Non-targeted analysis
- Indirect measurement of precursors that may transform into terminal PFAS compounds

EPA Draft Method 1621 – Total Organofluorine (TOF) Assay

- Screening method to estimate the adsorbable organic fluorine concentration
- An indicator of total PFAS concentration

Wastewater Analytical Methods



Hypothetical WWTP influent sample

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Sources	Sampling	Ubiquitous
Source identification is crucial	Analytical may only show some of the picture	“Toolbox” approach may be necessary

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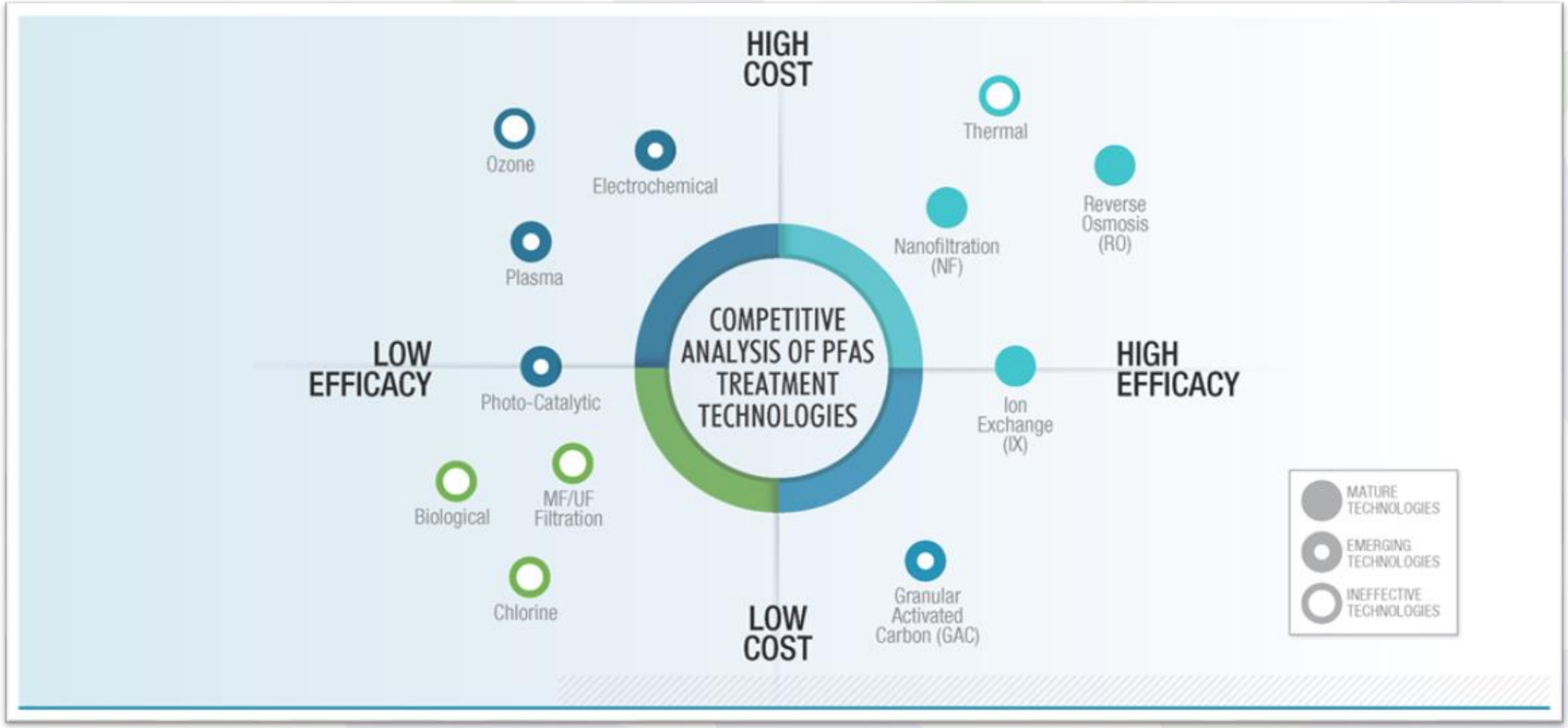
Treatment

Best Available Treatment Technologies



Source: Carollo

Best Available Treatment Technologies

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Technology	Removal Efficiency	Pros	Cons
Granular Activated Carbon (GAC)	• Effective for long-chain PFAS and strongly adsorbing compounds	• Well understood technology • Simple operation	• High OPEX due to frequent reactivation • Large footprint • Disposal/Reactivation of large volumes of carbon
Ion Exchange Resin (IX)	• Excellent removal of certain PFAS (anions)	• Efficient single-step technology • Small footprint • Low to medium OPEX	• Non-regenerable in most cases • Waste management (resin and brine) can be time consuming
Membrane Processes	• Effective for PFAS removal, both long- and short chain • Removes other CECs	• Efficient process if properly operated and maintained • Low to medium OPEX	• High CAPEX • Complex operation • Concentrate treatment/disposal

Adsorption Technologies (GAC/IX/Novel)

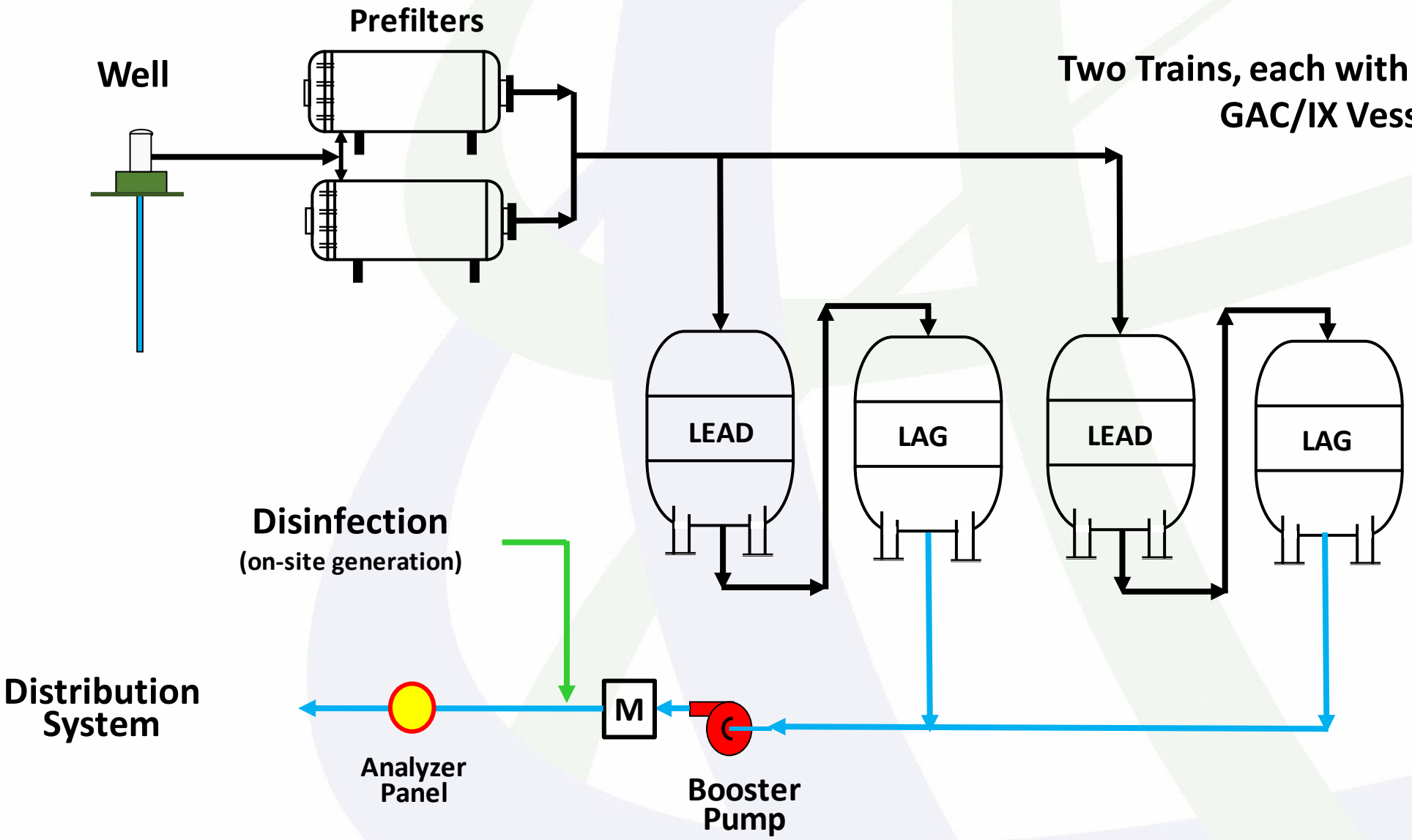
Granulated Activated Carbon (GAC)

Ion Exchange (IX) Resin

Novel Adsorbent

Adsorption Technologies (GAC/IX/Novel)

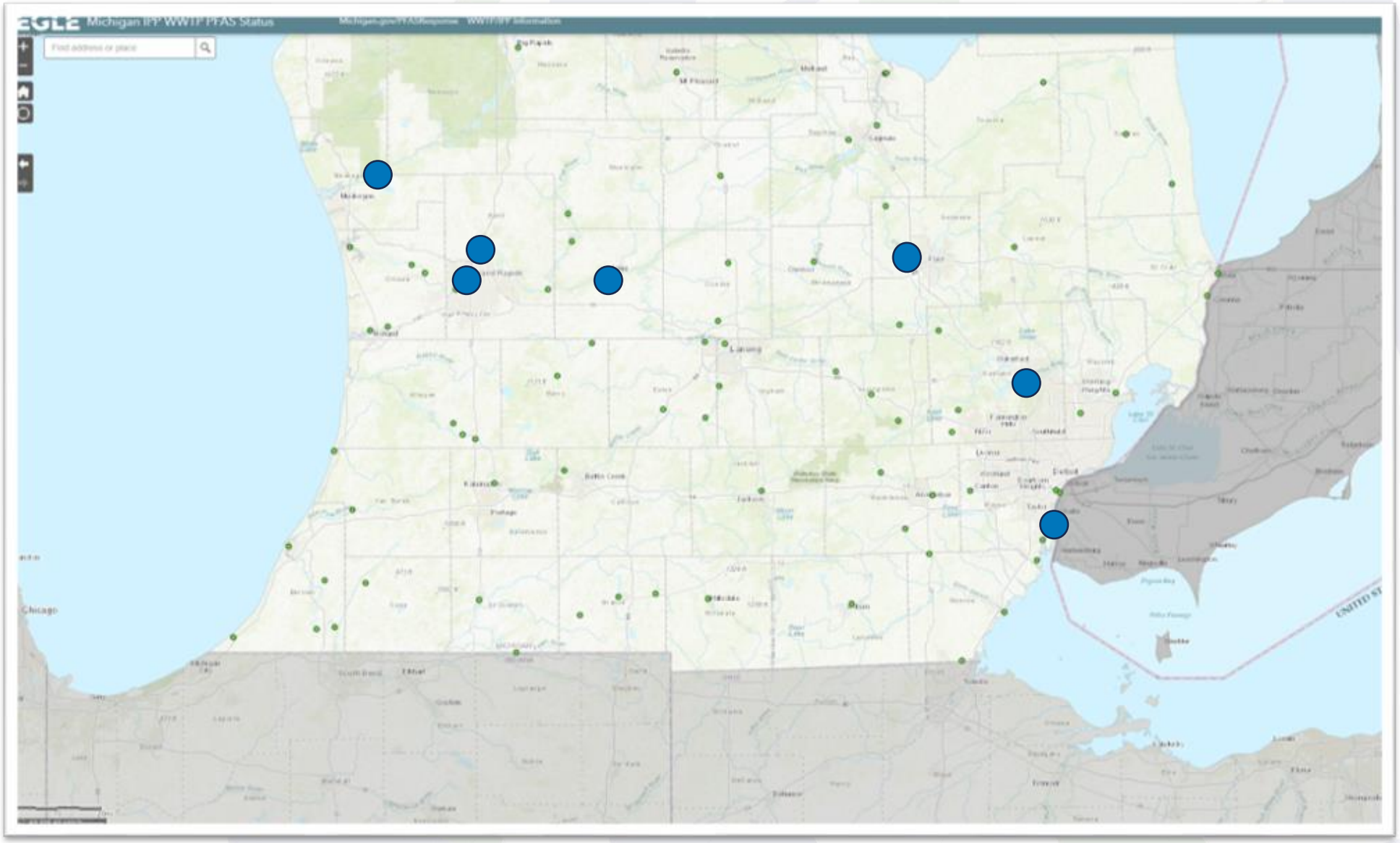
Typical Pressure Vessel Treatment System



PFAS at WWTPs

- Driven by NPDES limit
- PFAS transformation at the POTW
- Controllable (industrial) vs. uncontrollable (domestic, stormwater) contributions important
  - IPP programs, source investigations
- Biosolids a big concern (land application)
- Recycled water programs in jeopardy
- Treatment options largely unknown

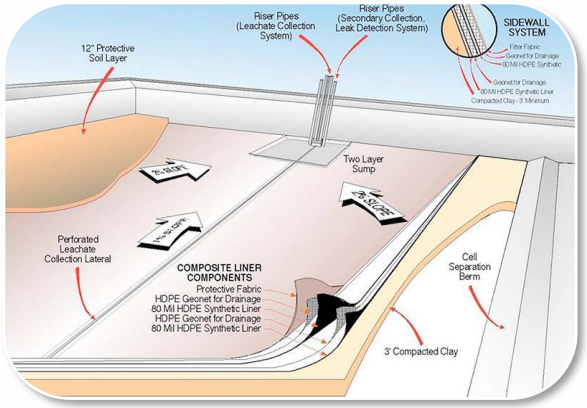
Image source: City of Milpitas



POTWs exceeding Water Quality Standard (WQS)

Source: Michigan EGLE

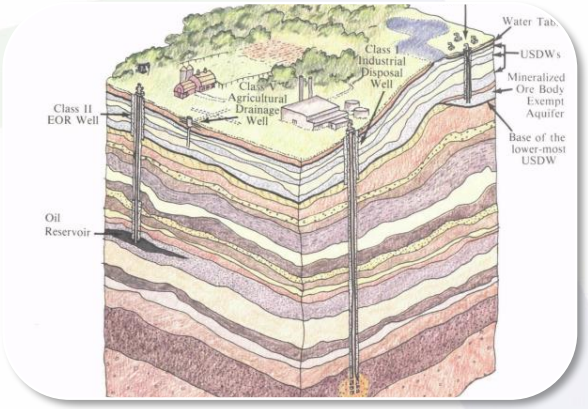
PFAS Waste Disposal Options



Landfill (haz)

Incineration

Destruction



Deep well injection

Sources:
1 US Ecology
2 Center for Land Use Interpretation/Creative Commons
3 Duke University
4 Geoengineer.org

PFAS Destruction

Treatment (separation/concentration) requires waste disposal or destruction

Illinois and Department of Defense (DoD) have banned incineration of PFAS-laden waste (April/June 2022)

- EPA Office of Research and Development (ORD) with DoD studying fate of PFAS during incineration
- Incineration could result in Products of Incomplete Combustion (PIC)

DoD temporary incineration ban (April 2022) modified with issuance of destruction guidance (July 2023)

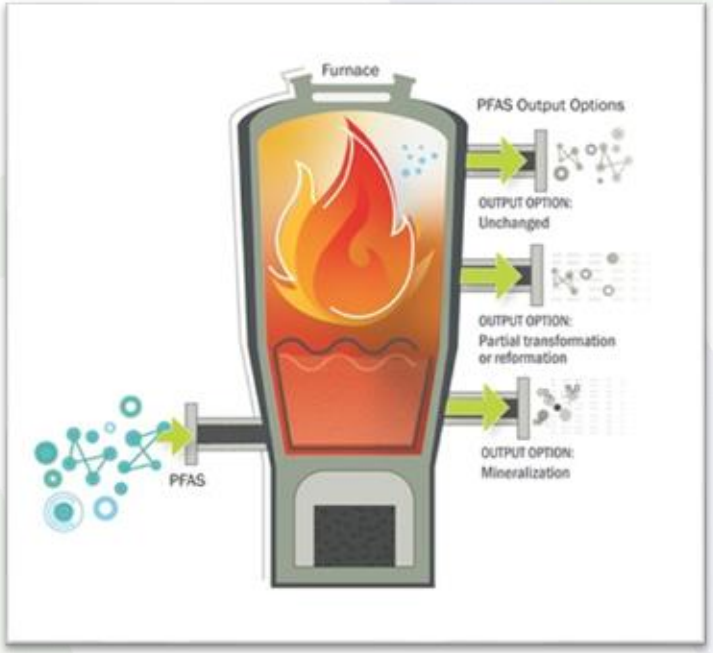


Image source: Brown and Caldwell

PFAS Destruction

Supercritical Water Oxidation (SCWO)

Hydrothermal Alkaline Treatment (HALT)

Electrochemical Oxidation

Laboratory or pilot scale

Low flow, high concentration

Emerging technologies

Sources:
1 Duke University
2 Aquagga
3 Axine Water Technologies

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BAT	Water v Wastewater	Disposal/ Destruction
Best available technologies (BATs) are mature	Drinking water is simpler Wastewater is complicated	Disposal and destruction can be complicated

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Funding Options

Funding Options

Bipartisan Infrastructure Law ($billions)

Grants and low interest funding

- Disadvantage community subsidies may be available

Clean Water State Revolving Fund (CWSRF)

Litigation and cost recovery

Environmental Finance Center Network

https://efcnetwork.org/resources/funding-tables/

EMERGING CONTAMINANTS IN SMALL OR DISADVANTAGED COMMUNITIES GRANT

Under the Bipartisan Infrastructure Law (BIL), enacted and funded in 2021, the Safe Drinking Water Act (SDWA) section 1459A added a new grant focus: Emerging Contaminants in Small or Disadvantaged Communities (EC-SDC) Grant Program. The grant is administered under § 300j-19a., the Assistance for small and disadvantaged communities section of the statute amending subsections (a) through (j) of SDWA section 1459A. This is the same statute under which the Water Infrastructure Improvements for the Nation (WIIN) Act prioritizes compliance and water accessibility via drinking water infrastructure through the *Small, Underserved, and Disadvantaged Communities* (SUDC) Grant Program. The new grant program specifically addresses emerging contaminants across small or disadvantaged communities and focuses on projects that address perfluoroalkyl and polyfluoroalkyl substances (PFAS) and/or any contaminant listed in EPA's Contaminant Candidate Lists.

GRANT INFORMATION

Non-competitive[1] | SDWA 1459A(a)-(j) | EC-SDC Grant

[1]Decisions will be made by the state or territory based on available funding.

FUNDING AMOUNT

$1B annually (FY22-FY26) will be allocated to states, territories, and tribes based on several factors that determine need

OBJECTIVE: TACKLING FOREVER CHEMICALS

This grant funds for eligible projects or activities addressing emerging contaminants, with a focus on PFAS. The grant program is anticipated to systematically support the reduction of exposure by the general public to PFAS and other contaminants through their drinking water.

States will prioritize the grants to assist public water systems in small or disadvantaged communities that are unable to finance activities needed to address emerging contaminants in drinking water.

FUNDING DETAILS

There is no match or cost-share requirement

FOCUS

Small or disadvantaged communities

WHO RECEIVES FUNDING

STATES AND TERRITORIES will receive allotments of funding annually

*Funds to support tribal water systems will be administered by EPA Regional Offices.

APPROACH

It is anticipated that the states will expand their Intended Use Plan (IUP) project listings to communities that are eligible for grant funding but may not qualify for State Revolving Fund funding. This list can be the first, but not the only, source of eligible projects to fund in order to meet the objectives of the grant program.

TIMING

- An allotment memorandum has been released in February 2023
- The implementation document has been made available on EPA's **EC-SDC Grant website**
- Funding is anticipated to be awarded to participating states and territories as early as FY2023
- States and territories will have through the end of each fiscal year to submit applications for project awards

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Act Now!	Assess	Treat	EFCN
We are just getting started. Don’t wait!	Characterize Identify sources	Treatment options are available	Leverage your local EFCN chapter

Questions?

Speaker Contact Information

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Thank you!

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