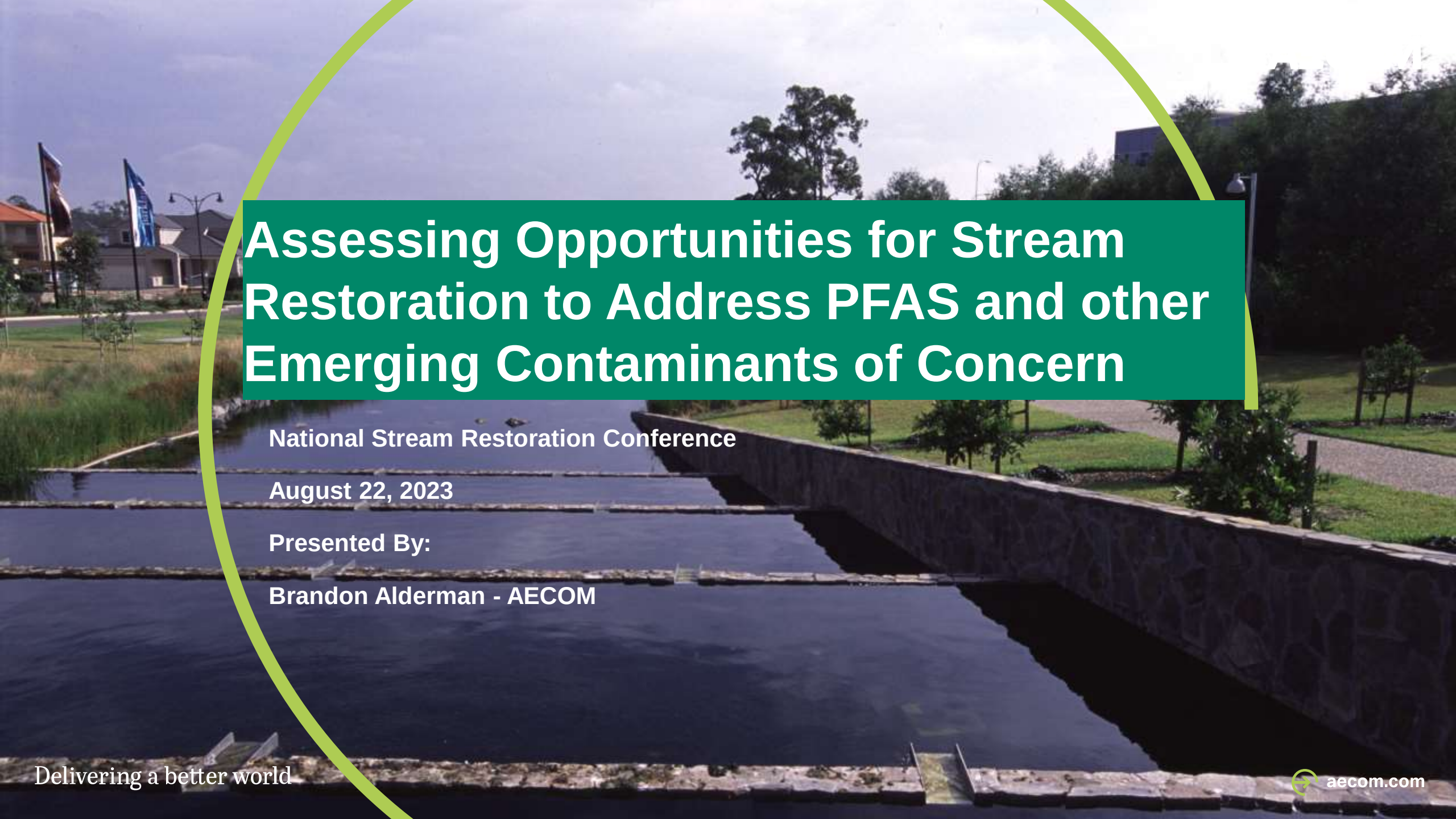


Assessing Opportunities for Stream Restoration to Address PFAS and other Emerging Contaminants of Concern

National Stream Restoration Conference

August 22, 2023

Presented By:

Brandon Alderman - AECOM

Presentation Roadmap

1. How is stream restoration currently being used to address water quality concerns?
2. What is PFAS, where does it come from and why is it an issue?
3. What are we currently doing to address PFAS contamination?
4. Can we use stream restoration to address PFAS?

Stream Restoration Today

- Addresses flooding and erosion
- Reconnects floodplains and improves aquatic life habitat
- Addresses water quality concerns due to TSS, TN, and TP

Hanalei Stream Restoration

	TN	TP	TSS
Reduction	0.075	0.068	248

Default Stream Restoration Removal Rates (lb/ft/yr)

Now, we are concerned with PFAS as well!

PFAS Characteristics

What are PFAS?

- Per- and polyfluoroalkyl substances
- Class of >4,000 synthetic compounds
- Resist thermal, chemical, and biological degradation
- Many act as surfactants
- Toxic to humans at low concentrations

Why are PFAS so difficult to mitigate?

- Carbon-Fluorine one of the strongest chemical bonds
- Widely distributed due to extreme mobility
- Toxicity drives clean up to very low concentrations
- Chemical stability makes destruction challenging

Why is there urgency around PFAS solutions?

- PFAS appear in drinking water of millions of people
- Public sentiment has driven many responses
- Evolving regulations at federal and state levels are increasingly stringent
- Liability is incurred in absence of destructive solution

Toxic

Mobile

Regulated

Researched

Consumed

Costly

What is a PFAS source? Where might PFAS occur?

Aqueous Film Forming Foam (AFFF)

- Federal sites
- Airports
- Fire stations
- Power plants
- Fuel bulk storage & refineries

AFFF

Manufactured goods (stain-, grease-, waterproofing)

- Landfills
- Pulp and paper
- Water/ stain proofing operations

Landfills and Leachate

Industrial processes

- PFAS manufacturing
- Metals plating/finishing
- Hi-tech industry
- Fire retardant manufacturing
- Poultry farms
- Uranium enrichment

Metals Plating

Contaminated waters

- Potable water plants
- Wastewater treatment plants
- Groundwater and Surface Water

Wastewater Treatment Plants

One Water Perspective

Manufacturing

Wastewater Treatment

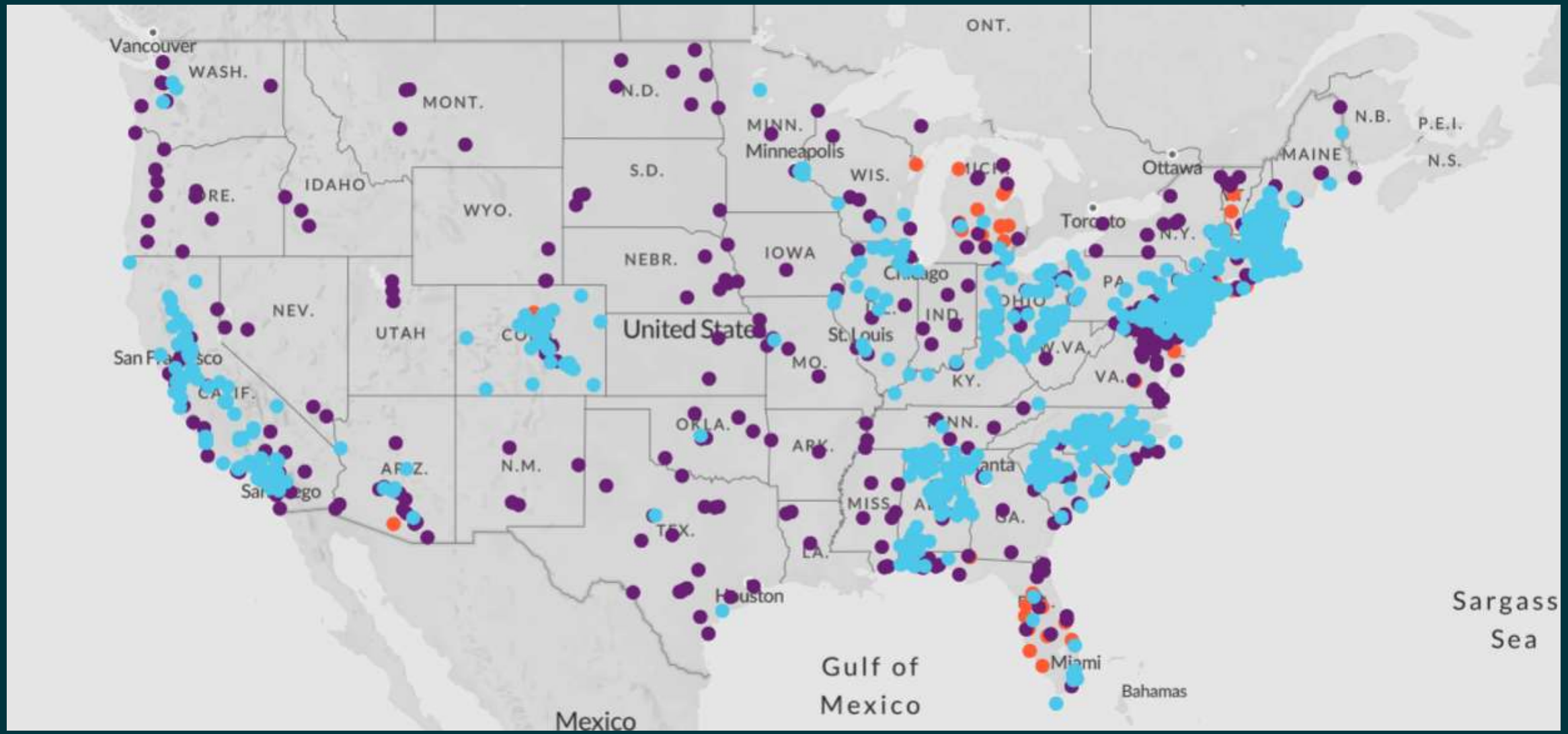
Domestic Use

Consumer Products

PFAS Sources

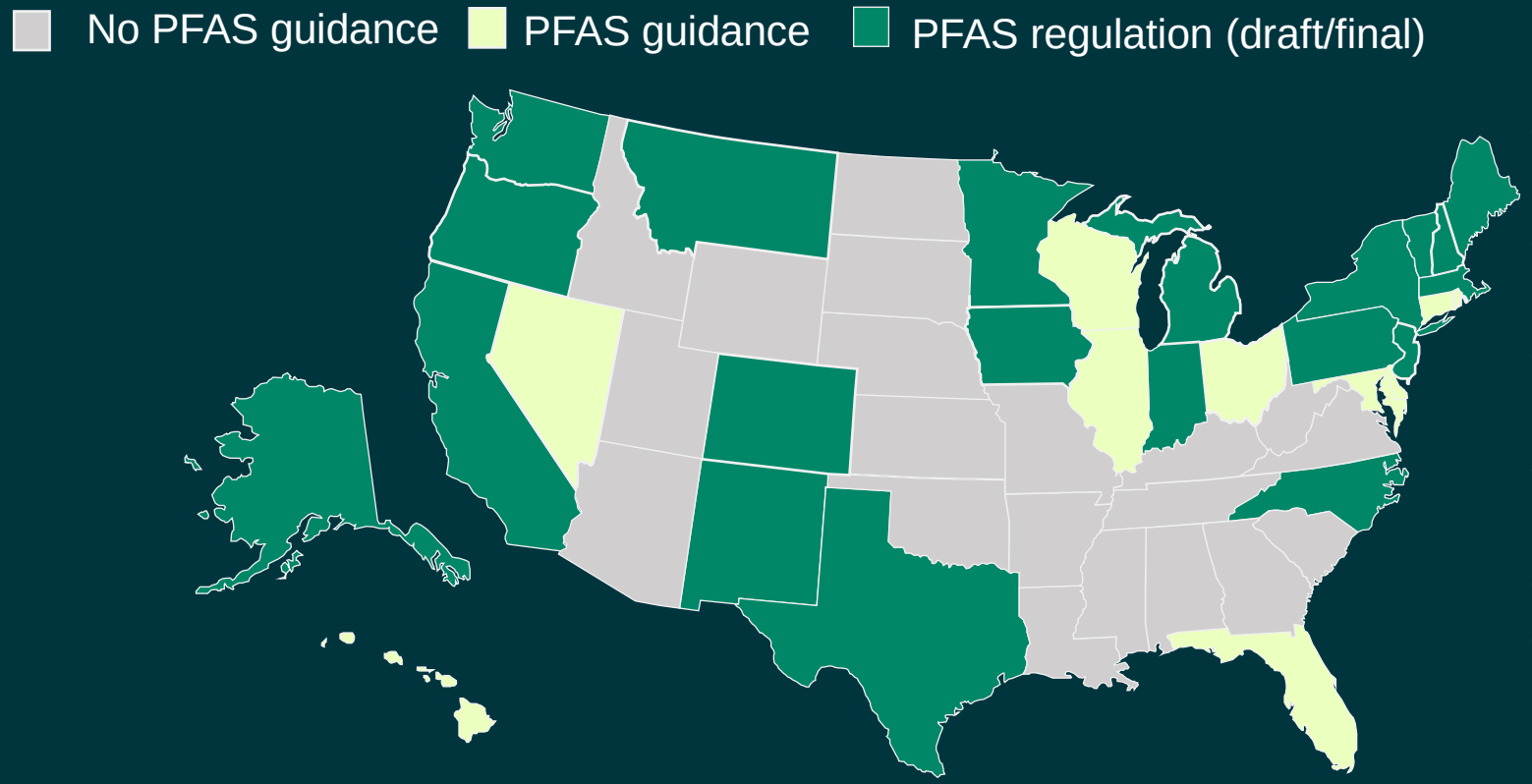
PFAS Impacts

PFAS Overview



US PFAS Drinking Water Regulations: States All Over the Map

State PFAS Drinking Water Regulations (2023)



- 20 states have fully promulgated drinking water criteria
- Concentration limits vary by state/compound
- Many states manage more than 2 PFAS
- New York and Massachusetts manage 6 PFAS
- Texas regulates 16 PFAS
- California notification levels for PFOA (5.1 ppt), PFOS (6.4 ppt) and PFHxS (3 ppt) are the current lowest state standards

Source: https://pfas-1.itrcweb.org/ Jan2023

(Library of up-to-date regulatory values in US)

Current PFAS Treatment Technologies

Ex-Situ		In-Situ
• **Granular activated carbon*** • **Ion exchange resin*** • **Reverse osmosis, nanofiltration*** • Foam Fractionation • Chemical precipitation, flocculation and coagulation • Electrocoagulation • Novel and regenerable sorbents	**Separation**	• Colloidal GAC • Phytoremediation
• **Incineration*** • Advanced oxidation • Electrochemical oxidation • Sonolysis • Plasma • UV Photolysis	**Destruction**	• Chemical oxidation • Chemical reduction • Enzyme catalyzed oxidation • Microbial degradation

***Commercially available**

AECOM PFAS Treatment Project – GAC System

Future Uses – Restoration as PFAS Treatment

Kingman Island Wetland Restoration

- Existing PFAS treatments are highly effective, but there is certainly room for improvement to identify passive restoration opportunities. Stream and wetland restoration is aesthetically attractive and could be cheaper as a long-term solution.
- Potential exists to pair stream restoration and wetland restoration and use phytoremediation to target contaminated soil and water.

Plant Uptake of PFAS

- Chemical properties of PFAS such as its solubility, ionization, and non-volatility promote bioaccumulation in plants
- Plant Uptake would allow for in-situ remediation, which is sometimes difficult with PFAS
- Some research containing typha sp., juncus sp., and phragmites has been completed across the globe.

Floating wetland in Australia for PFAS removal

Moving Forward – Questions and Concerns

- Need for future research
- Most research is related to crop vegetation
- Phytoremediation may be better suited to soil removal, not removal from surface water
- Risk for aquatic life or other wildlife to consume contaminated plants
- Would regular removal and replacement of plants and soil be necessary?
- Stream restoration is a slow process and may not be suitable for locations with immediate need for PFAS mitigation

PFAS

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