The Influence of PFAS Regulations on Waste Disposal

Presented by

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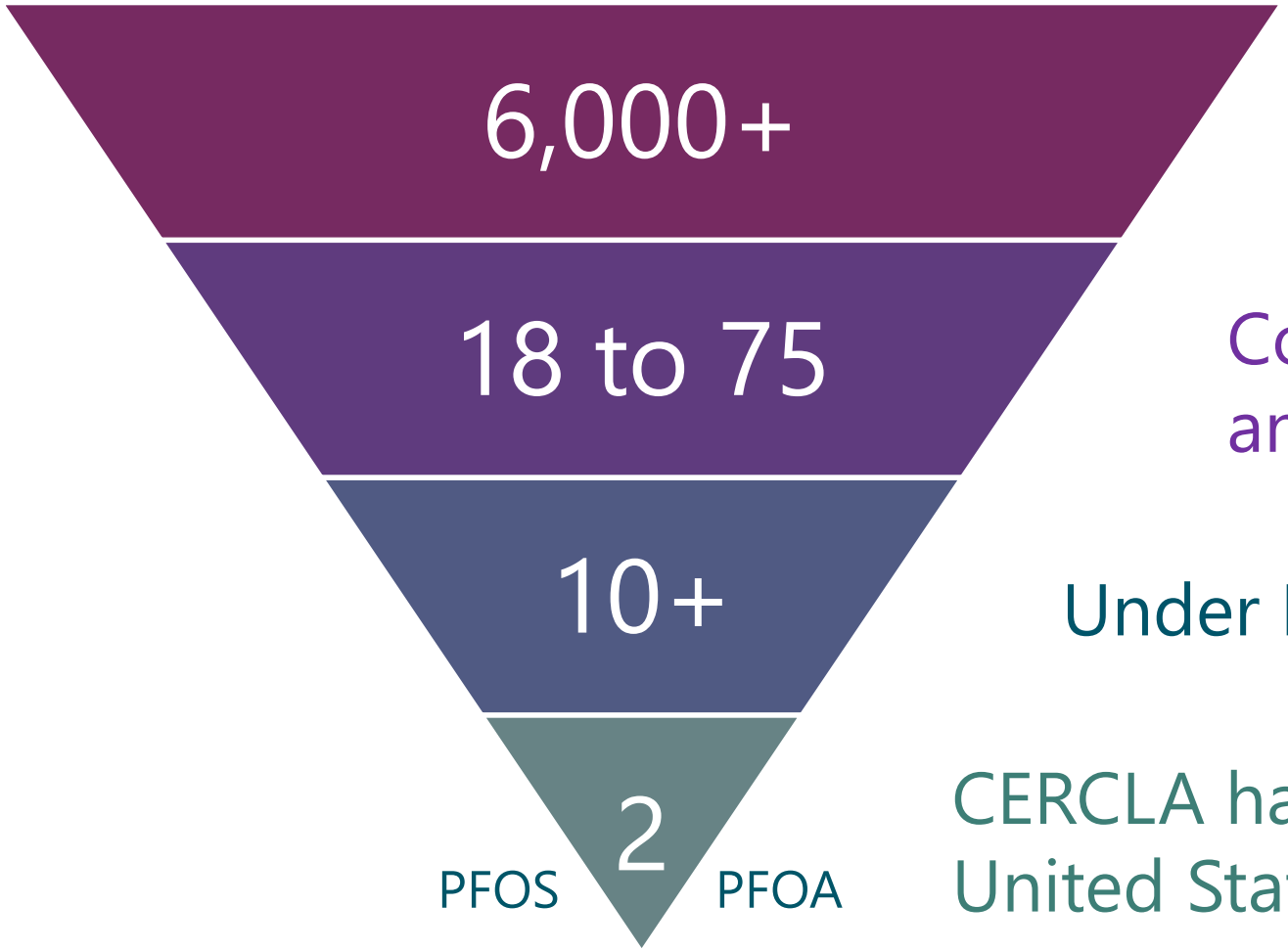
Per- and Polyfluoroalkyl Substances (PFAS)



PFAS compounds

Compounds on laboratory analyte lists

Under EPA regulatory attention

CERCLA hazardous substance in the United States

Completed Federal Regulatory Activities PFAS Strategic Roadmap*

- Established national PFAS testing strategy
- Set Regional Screening Levels and Maximum Contaminant Levels (MCLs) for Drinking Water
- CERCLA designation of PFOS and PFOA
- Considering CERCLA designation of at least seven additional PFAS
- Final Ambient Water Quality Criteria for certain PFAS

*List is not exhaustive

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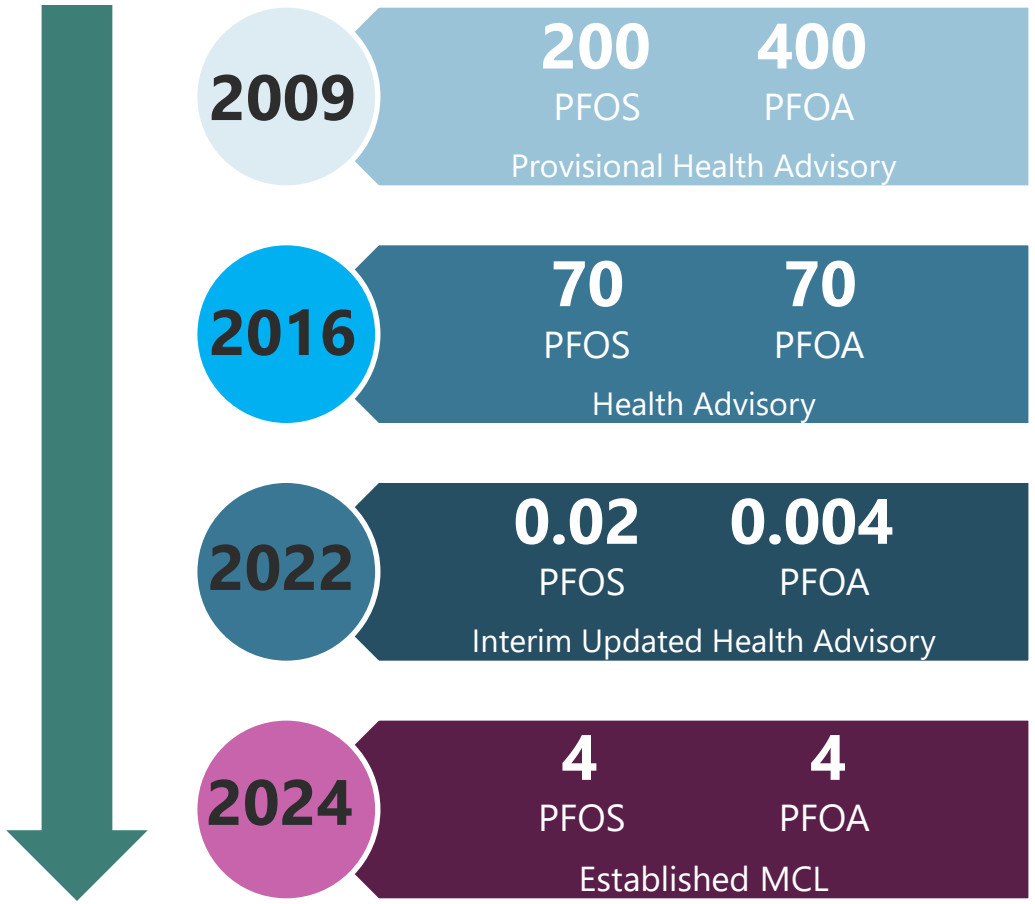
Federal Regulatory Activity: Drinking Water

- First subject of EPA attention was drinking water
- Health Advisory (HA) levels have been revised downward
- HAs are not enforceable
  - Jurisdictions are using HAs as cleanup levels in the absence of other guidelines
- Maximum contaminant level (MCL) finalized in April 2024



Units are ng/L (ppt)

EPA Final Recommended Aquatic Life Water Quality Criteria

Published October 7, 2024

PFAS Freshwater	Acute Water Column (mg/L)	Chronic Water Column (mg/L)	Invertebrate Whole-Body (mg/kg)	Fish Whole-Body (mg/kg)
PFOA	3.1	0.1	1.18	6.49
PFOS	0.071	0.00025	0.028	0.201

Status of PFAS Screening Levels for Sediment

- No comprehensive federal sediment screening levels for the United States yet
- Some focused studies and sites have proposed screening levels

Entity	Receptor	PFOA (mg/kg)	PFOS (mg/kg)
Texas (2020)	Ecological (freshwater)	7.28	0.115
New Hampshire (2019)	Human Health (recreational/child)	0.186	0.091

- Significant uncertainty and minimal research have limited the development of screening levels for sediment
  - 2021 study done at Argonne National Laboratory indicated it was “premature” to develop sediment screening levels due to uncertainties and data gaps for PFAS behavior in sediments

CERCLA (Superfund) Regulation of PFAS

Comprehensive Environmental Response, Compensation, and Liability Act

LISTED:
PFOS
PFOA

POTENTIAL:
7+ additional PFAS

Details Unclear

CERCLA chemicals = hazardous substances

More PFAS sites added to the Superfund National Priorities List

Current Superfund sites tested for PFAS

Dredged material characterized for PFAS

Cleanup and special disposal levels set

Appropriate special disposal required

Gaps in Federal CERCLA Guidance

01

No testing requirements for dredged material

02

No concentration criteria that triggers special disposal

03

Very little guidance on disposal options for PFAS-containing material

"EPA recommends Subtitle C landfills when PFAS levels of the waste are relatively high and landfill disposal is the selected option"

- Interim Guidance on the Destruction and Disposal of PFAS and Materials Containing PFAS (issued March 2024)

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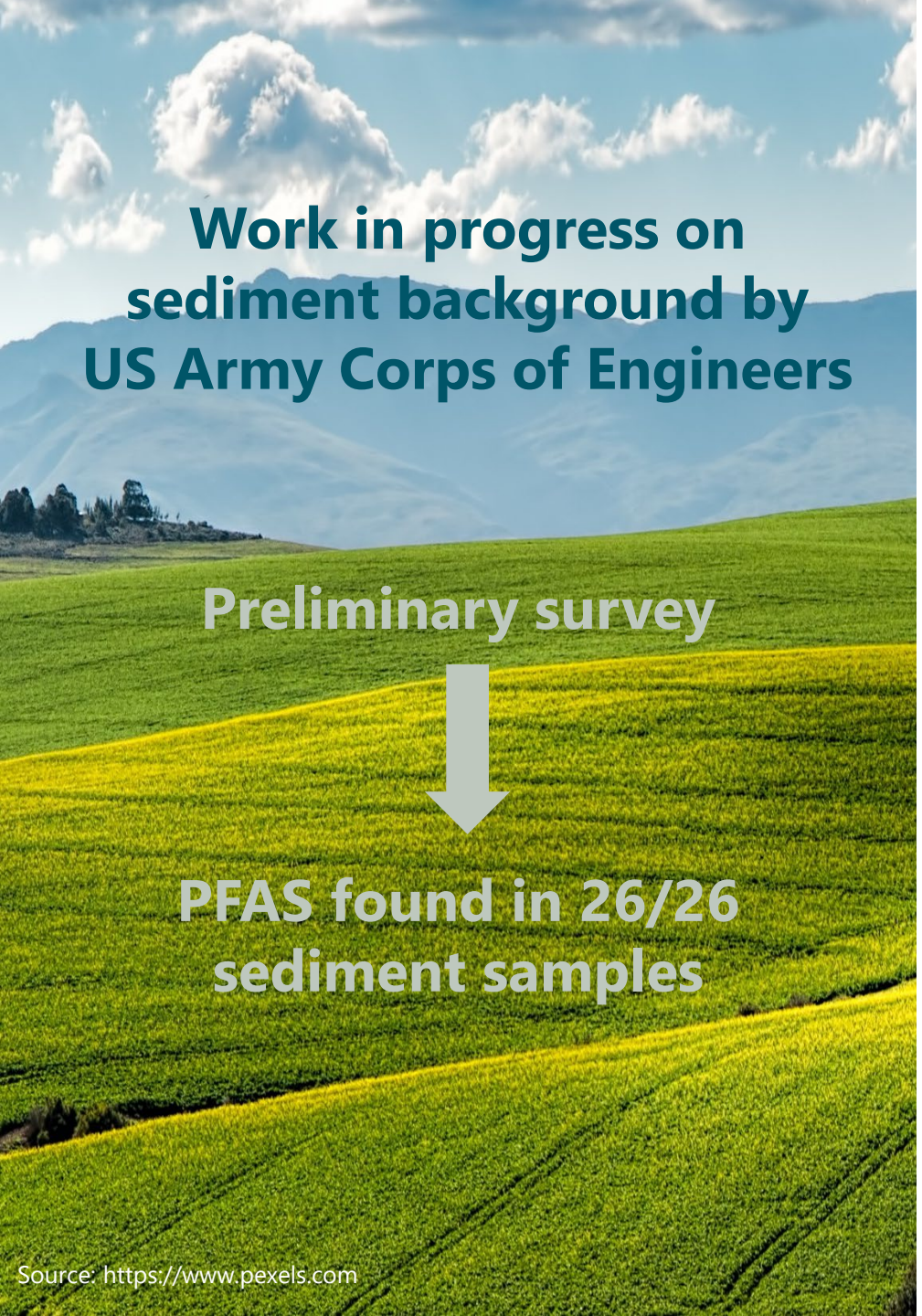

PFAS Soil Background Occurrence

PFOA (ng/g)	Vermont	New Hampshire	Maine
Maximum	4.9	4.1	5.29
Median	0.4	0.8	Not Reported
Percent Detect	91%	96%	65%

PFOS (ng/g)	Vermont	New Hampshire	Maine
Maximum	9.7	5.4	4.35 (Urban) 5.32 (Non-Urban)
Median	0.7	1.0	Not Reported
Percent Detect	100%	100%	81% (Urban) 63% (Non-Urban)

Sediment studies by Guilherme Lotufo
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Example Dredge Management Approach

Mississippi River Lower Pool 2

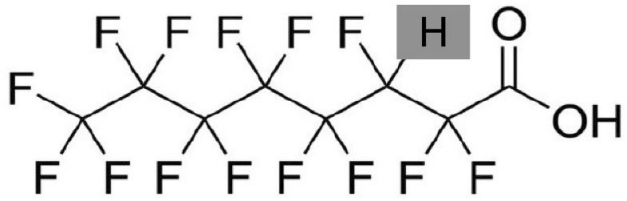
USACE DMMP 2020

- PFAS in sediment: <1 to 3 ng/g
  - Minnesota Soil Reference Values for PFAS = 330 to 63,000 ng/g
    - Revised since date of study to 41 ng/g on the low-end
- No special PFAS measures suggested for the sediment
- Tentatively selected plan: placement of dredged sediment into former mining pit
- Some material to be made available for beneficial use

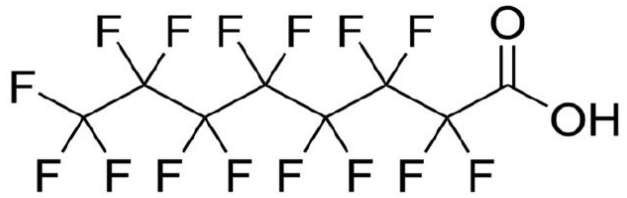
Figure: U.S. Army Corps of Engineers, 2020. *Pool 2 Dredged Material Management Plan*.

Current Analytical Tools for Identification of PFAS

- LC/MS/MS, including EPA 537 series of methods and EPA 1633
  - These are targeted analysis methods
- Very low detection limits capable of seeing concentrations below 1 ng/L
- The tradeoff is that these methods are **very selective** in what they are looking for and sort out other compounds

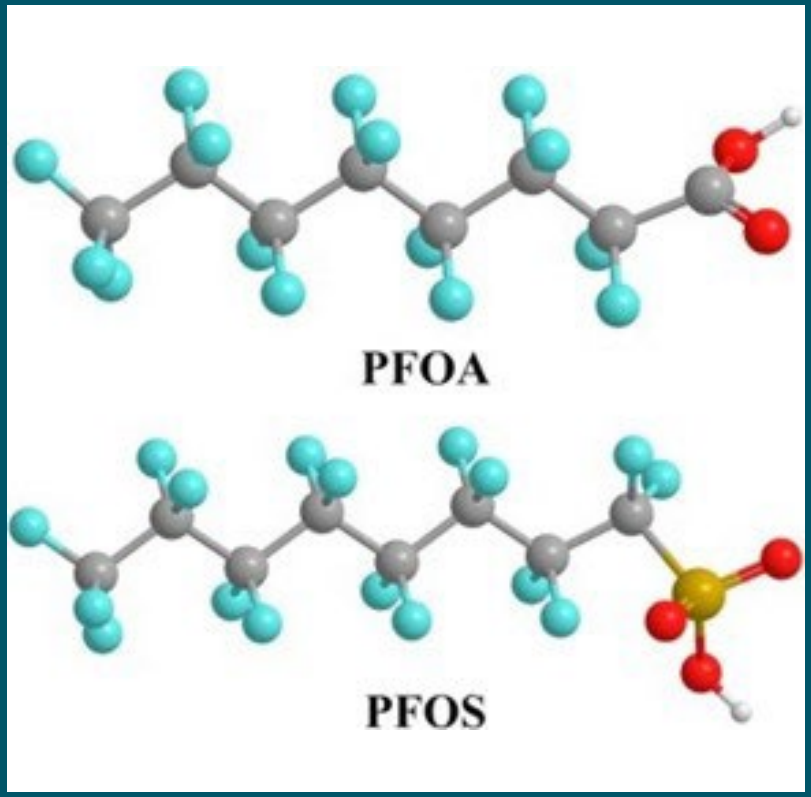


- A small change in the chemical structure would make the compound invisible because the current methods being employed commercially are so targeted and selective
- Of the more than **5,000** compounds that fit the current definition of PFAS, there are approximately **70** with commercially available standards
- There are no TIC (tentatively identified compound) reports in these methods



Destruction Technologies

- Strong bond, high energy
- Always consider transformation and liberation
- Analytical techniques are not designed to detect variations of PFAS without the functional head
  - Want to be sure the carbon-fluorine bond has been broken, not just the functional head



Destruction Technologies

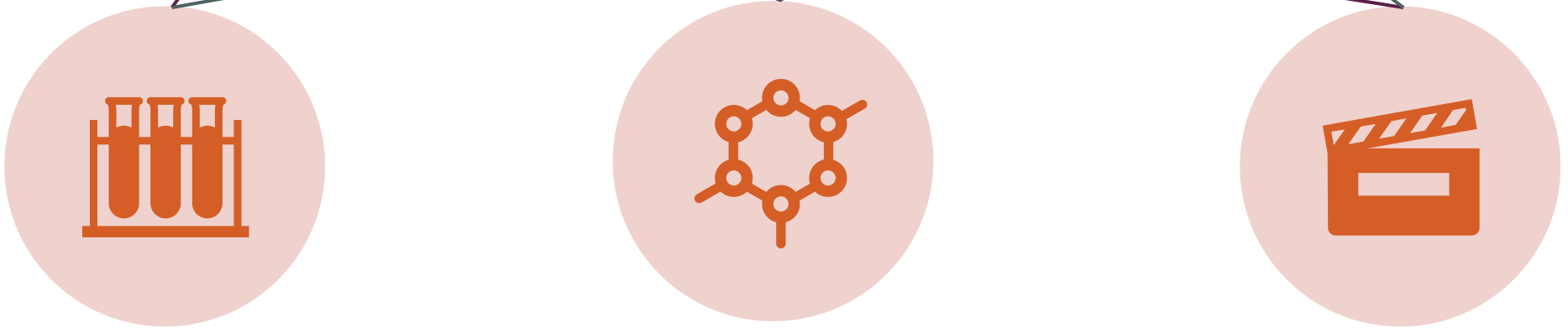
Type	Approach
Incineration	Currently, the only **viable, large-scale destruction technology**; high temperatures required (>1,000°C); **proper scrubbers critical**; research into using plasma or sorption improves the process
Hydrothermal Liquefaction	Moderate success, but some studies show **incomplete destruction**; field-scale studies continue; **PFOS destruction was limited**
Thermal Hydrolysis	**Results have been mixed**; more studies are needed
Pyrolysis	Creates biochar; **PFAS destruction is unclear**; more research and robust testing is needed
Electrochemical	Still in development; may result in the **creation of potentially dangerous by-products**
Molecular destruction	Various technologies; complete mineralization not known; **none at field scale, yet**

Sources:
Garg et al. "Treatment technologies for removal of per- and polyfluoroalkyl substances (PFAS) in biosolids" Chemical Engineering Journal 453 (2023).
PFAS in the Water and Wastewater Sectors: Fundamentals, Management, and Treatment, Chapter 11, WEF Publications.

Considerations for Dredged Material Handling

Internal Discussion

Regulatory Agency Discussion



Should We Test for PFAS?

Which Compounds Should We Test for?

Which Levels Will Trigger Special Disposal?

Conclusions

- PFAS regulations are evolving rapidly
- Guidance and practical implementation lag behind
- PFAS-containing material disposal guidance is lacking
- Background levels suggest PFAS is widespread
- Most destruction technologies still developing (apply with care)
- Proactive strategies are needed for handling regulatory uncertainties