PFAS in the Waste Sector

IWWSG Meeting - January 2025

Reworld™

Reworld™ Sustainable Waste Solutions

4,500 employees

90+ facilities nationwide

12,000+ volunteer hours in our communities

Reworld™ is a leader in sustainable waste solutions.

We are building a smarter, more sustainable world by helping businesses and communities reimagine what their waste can do.

Here are some of the many ways we're doing that every year!

REDUCE CLIMATE RISKS

41 Million
METRIC TONS OF GHGs AVOIDED

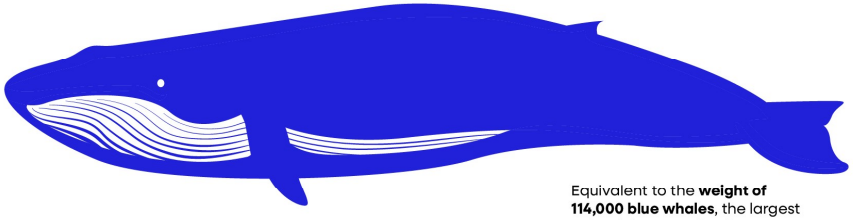
Equivalent to the amount of CO2 sequestered by **48 million acres of forest**, an area fully covering 8 US states,

or removing **9.8 million gasoline powered passenger vehicles from the road for a full year.**

The kind of impact we have is equal to **half of the entire U.S. utility scale solar installations.**

RENEW RESOURCE VALUE

20 Million
TONS MANAGED SUSTAINABLY



Equivalent to the **weight of 114,000 blue whales**, the largest animal that ever lived!

500,000
TONS OF METALS RECOVERED

Enough to build **5 Golden Gate bridges**

280 Million
GALLONS OF WASTEWATER RECYCLED OR REUSED

Equal to **570 Olympic-sized** swimming pools

10 Million
MWHe OF ENERGY GENERATED FROM WASTE

Enough to power nearly **1 million homes** annually

REINVEST IN COMMUNITIES

36,000
MEALS PROVIDED TO UNDERSERVED COMMUNITIES

2,000+
COMMUNITY ENGAGEMENT EVENTS

33,000
AMERICAN FLAGS HONORABLY RETIRED

300+
FACILITY TOURS

updated 05.02.24

Our Focused Service Lines

This zero waste-to-landfill solution diverts waste from landfills, reduces environmental liabilities and drives resource synergy through a single, streamlined service.

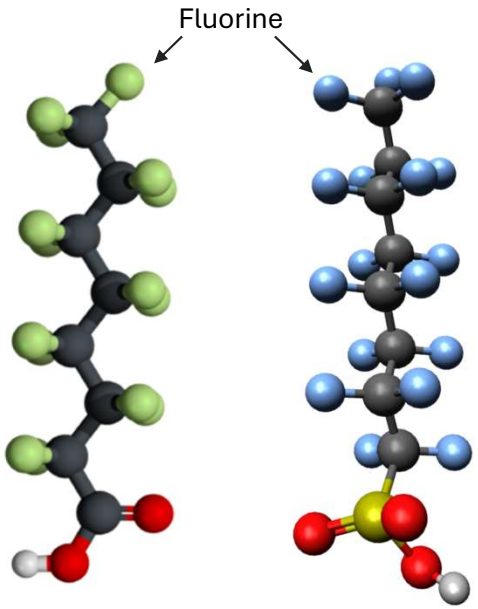
This alternative engineered fuel solution transforms post-recycled materials into customized, low-carbon fuels for the cement and lime industry.

This wastewater solution treats and separate water from its contaminants for comprehensive and cost-effective reuse, recycling, or energy recovery.

This waste logistics solution handles all aspects of the removal, transport and disposal of waste materials, including its intuitive tracking and reporting.

This carbon offset solution helps businesses meet their emission goals through renewable energy credits derived from our sustainable operations.

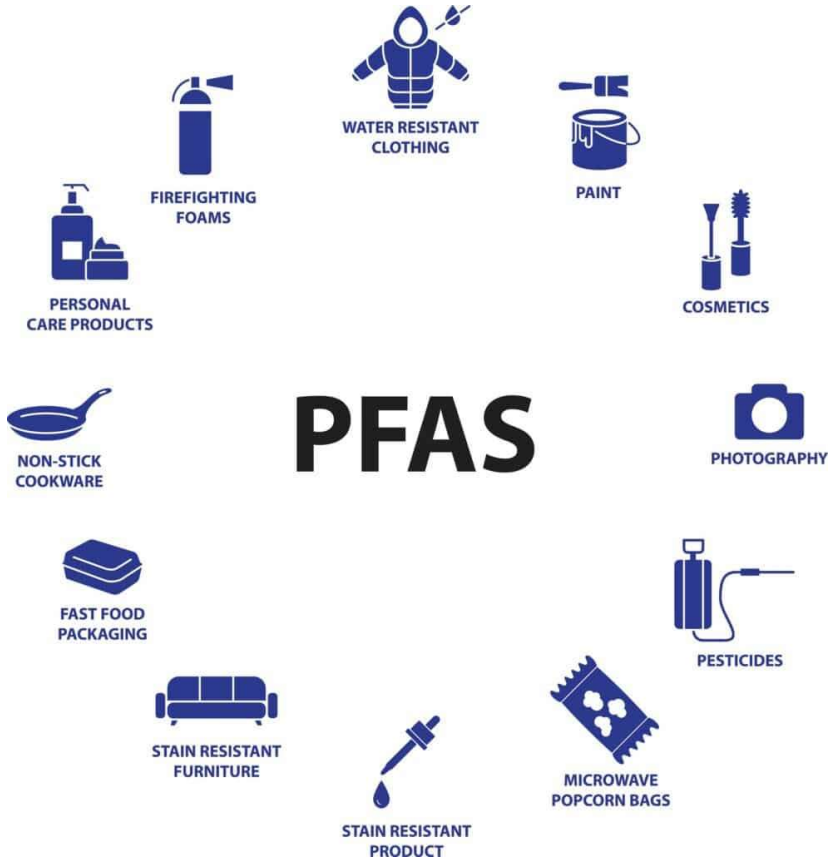
What is PFAS?



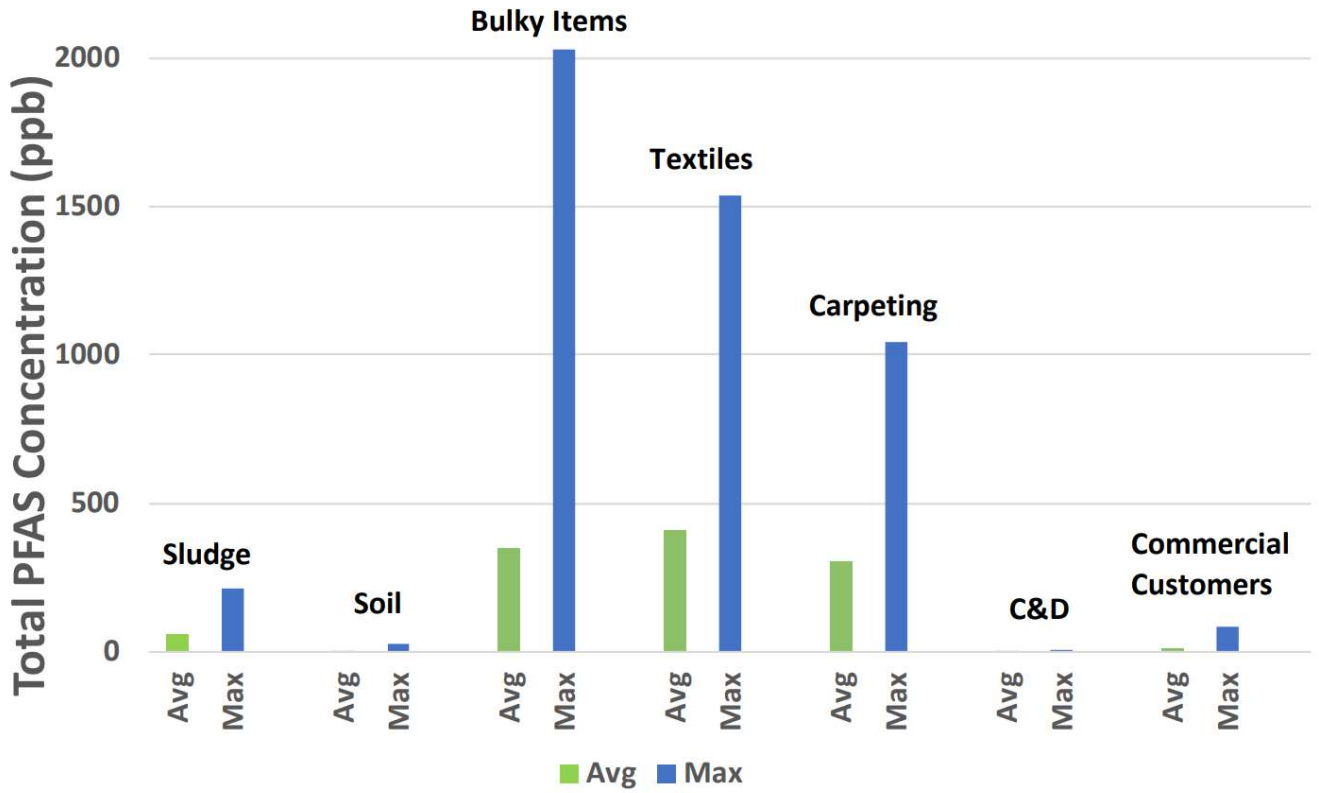
- **A class of man-made chemicals, known as Per- & Polyfluoroalkyl Substances (PFAS)**
  - **Chains** of carbon (C) atoms surrounded by fluorine (F) atoms, with different functional groups at the terminus
  - **Complicated chemistry** – thousands of different variations exist in commerce
  - **Widely used** in industrial processes and in consumer products since the 1940s
  - **Some** PFAS are known to be **PBT**:
    - **Persistent** in the environment
    - **Bioaccumulative** in organisms
    - **Toxic** at relatively low (ppt) levels
- Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS), for example, are two of the most widely used and studied chemicals in the PFAS group. PFOA and PFOS have been replaced in the United States with other PFAS in recent years.

What are sources?

- **Drinking water** – in public drinking water systems and private drinking water wells.
- **Soil and water at or near waste sites** - at landfills, disposal sites, and hazardous waste sites such as those that fall under the federal Superfund and Resource Conservation and Recovery Act programs.
- **Fire extinguishing foam** - in aqueous film-forming foams (or AFFFs) used to extinguish flammable liquid-based fires.
- **Manufacturing or chemical production facilities that produce or use PFAS** – for example at chrome plating, electronics, and certain textile and paper manufacturers.
- **Food** – for example in fish caught from water contaminated by PFAS and dairy products from livestock exposed to PFAS.
- **Food packaging** – for example in grease-resistant paper, fast food containers/wrappers, microwave popcorn bags, pizza boxes, and candy wrappers.
- **Household products and dust** – for example in stain and water-repellent used on carpets, upholstery, clothing, and other fabrics; cleaning products; non-stick cookware; paints, varnishes, and sealants.
- **Personal care products** – for example in certain shampoo, dental floss, and cosmetics.
- **Biosolids** – for example fertilizer from wastewater treatment plants that is used on agricultural lands can affect ground and surface water and animals that graze on the land.

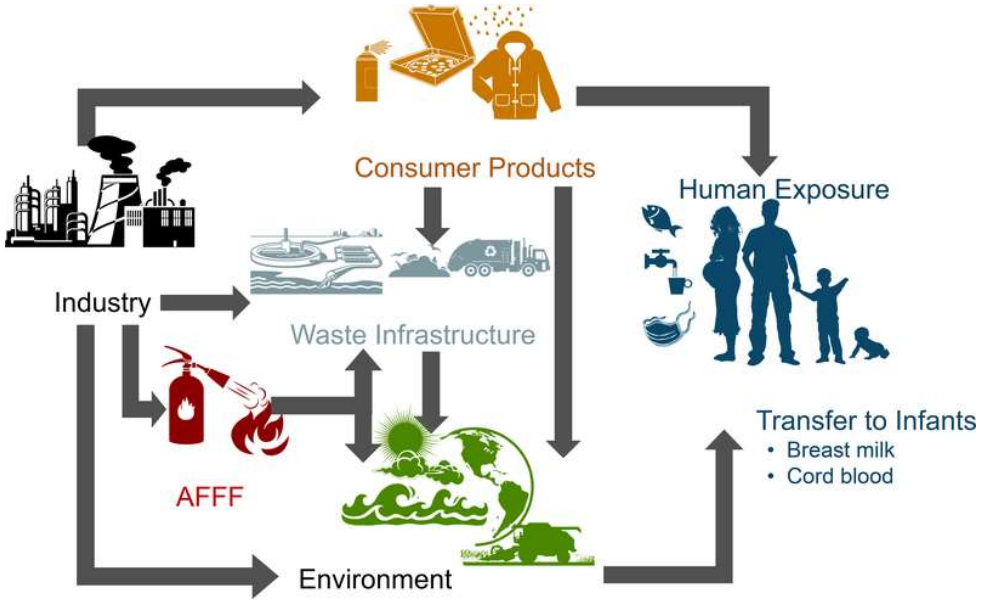


Comparison of PFAS Levels in Wastes

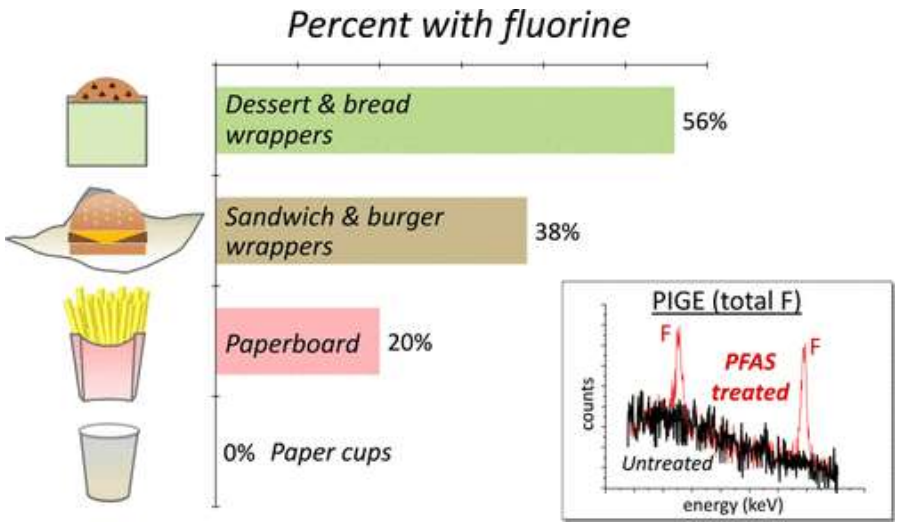


Sanborn Head (2019) *PFAS Waste Source Testing Report*

PFAS Exposure Pathways



Source: Sunderland *et al* (2018) *J Expo Sci Environ Epidemiol*. 2019 Mar;29(2):131-147.



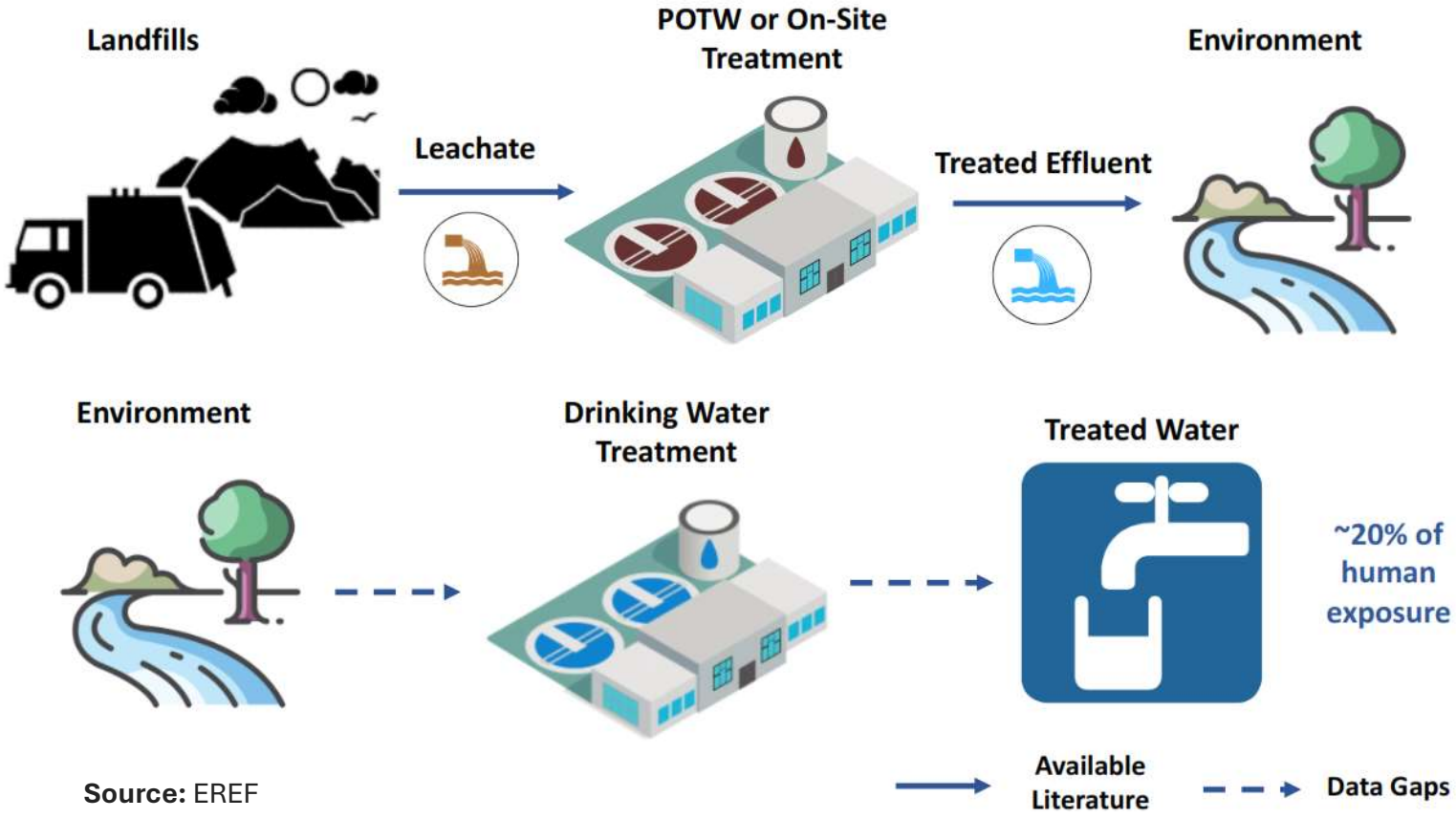
Source: Schaider *et al.* (2017) *Environ. Sci. Technol. Lett.* 2017, **4**, 3, 105–111

PFAS Exposure Pathways – Which are most important?

PFAS	Diet	Dust	Tap water	Food Pkg.	Inhalation	Dermal	Other
PFOA	16	11		56	14		2[a]
PFOA	85	6	1	3[b]			4[c]
PFOA	77	8	11		4		
PFOA	66	9	24		<1	<1	
PFOA	41		37				22[d]
PFOA	99		<1				
PFOS	66	10	7		2		16[d]
PFOS	72	6	22		<1	<1	
PFOS	96	1	1		2		
PFOS	81	15					4[a]
PFOS	93		4				3[d]

Source: Sunderland *et al* (2018) *J Expo Sci Environ Epidemiol*. 2019 Mar;29(2):131-147.

What is Waste Management's Role?



Source: EREF

What are the health effects?

- Most people have been exposed to PFAS. Some PFAS chemicals can accumulate and can stay in the human body for long periods of time
- There is evidence that exposure to certain PFAS may lead to adverse health effects
- Most data is only for a limited set of PFAS compounds

Source:
Agency for Toxic Substances and Disease Registry
https://www.atsdr.cdc.gov/pfas/hcp/clinical-overview/health-effects.html

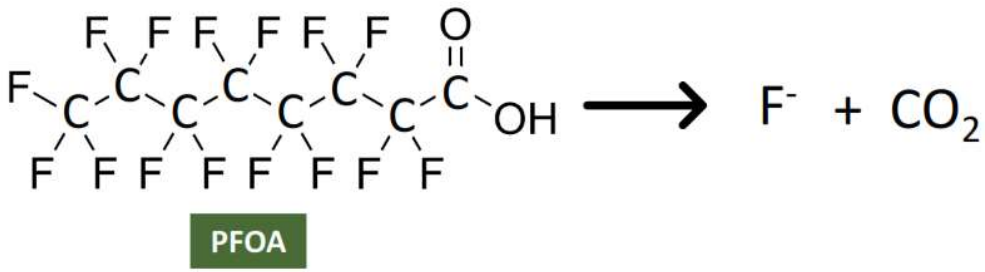
Health Effect		ATSDR Review of Associations (PFAS Associated with Health Effects)*	NASEM Category of Association†
NASEM and ATSDR Health Effects			
	Increases in cholesterol levels	Evidence of an association (PFOA, PFOS, PFNA, PFDA)	Sufficient evidence of an association
	Small decreases in birth weight (<0.7-ounce decrease per 1 ng/mL blood PFOA/PFOS increase)	Evidence of an association (PFOA, PFOS)	Sufficient evidence of an association
	Lower antibody response to vaccines in children	Evidence of an association (PFOA, PFOS, PFHxS, PFDA)	Sufficient evidence of an association
	Kidney and testicular cancer	Evidence of an association (PFOA)	Sufficient evidence for kidney cancer / Limited or suggestive evidence for testicular cancer
	Pregnancy-induced hypertension or preeclampsia	Evidence of an association (PFOA, PFOS)	Limited or suggestive evidence of an association
	Changes in liver enzymes	Evidence of an association (PFOA, PFOS, PFHxS)	Limited or suggestive evidence of an association
Additional Health Effects Considered			
	Thyroid disease and dysfunction	No consistent evidence of an association	Limited or suggestive evidence of an association
	Breast cancer	No consistent evidence of an association	Limited or suggestive evidence of an association
	Ulcerative colitis	No consistent evidence of an association	Limited or suggestive evidence of an association

Health Effects Associated with PFAS

What Are the Options?

Destruction

Haz Waste Incineration, Municipal Waste Combustion, Flares, ICE,
Emerging: Plasma, Supercritical Water Oxidation

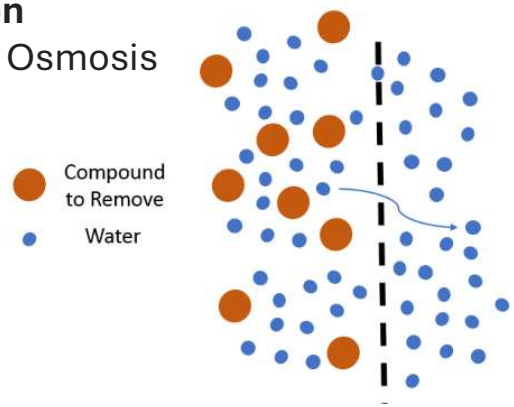


Adsorption

Activated Carbon

Filtration

Reverse Osmosis



Storage

Landfills, Deep Well Injection

Current EPA Guidance (2024)

The following technologies are currently viewed as "more protective"

Underground Injection	• The limited number of wells currently receiving off-site PFAS and waste transportation logistics may significantly limit the type and quantity of PFAS-containing fluids appropriate for underground injection.
Haz Waste Landfills	• EPA recommends Subtitle C landfills when PFAS levels of the waste are relatively high and landfill disposal is the selected option. • For all landfill types, new information demonstrates landfilling could have higher PFAS releases to the environment than previously thought in 2020.
Thermal Treatment – Haz Waste Incinerators	• Research suggests that the use of higher temperatures, well mixed combustion environments, and longer residence times may be more conducive to destroying PFAS and controlling related products of incomplete combustion. • EPA encourages additional testing with EPA-approved or EPA evaluated methods by waste managers of thermal treatment operations, including for products of incomplete combustion and the presence of PFAS in all associated waste streams.

Source: U.S. EPA (2024) Interim Guidance on the Destruction and Disposal of PFAS and Materials Containing PFAS

Current policy initiatives on PFAS

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Initiative	Description
Drinking water standards	EPA has set a national drinking water limit of 4 ppt for both PFOA and PFOS, 10 ppt for PFNA, PFAHxS and GENEX chemicals; and established a hazard index limit for combinations of these chemicals.
Effluent limitation guidelines (ELGs)	ELGs establish national technology-based regulatory limits on the level of specified pollutants in wastewater discharged into surface waters and into municipal sewage treatment facilities.
Toxic release inventory (TRI)	TRI is a national reporting program for "releases" of a variety of chemicals to air, land and water. PFAS compounds are being added.
CERCLA hazardous substance listing	The addition of two PFAS substances as hazardous substances means that the EPA can bring sites into the Superfund program specifically for PFAS. It also means that companies that contribute PFAS to the potential Superfund site could face liability for cleanup.
Regulate PFAS as a hazardous air pollutant (HAP) under the Clean Air Act (CAA)	While PFAS are not currently listed as HAPs under the Clean Air Act, EPA is building the technical foundation on PFAS air emissions to inform future decisions.
TSCA reporting of PFAS manufacturing & importing	Manufacturers & importers must report on each PFAS to the extent the information is "known or reasonably ascertainable."
Passive Receivers	Legislative efforts to exempt "passive receivers" from CERCLA & other liability

Thank you

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