



# Per- & Polyfluoroalkyl Substances (PFAS)

Iowa Strategic Goals Program  
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# What are PFAS and Why are We Concerned?

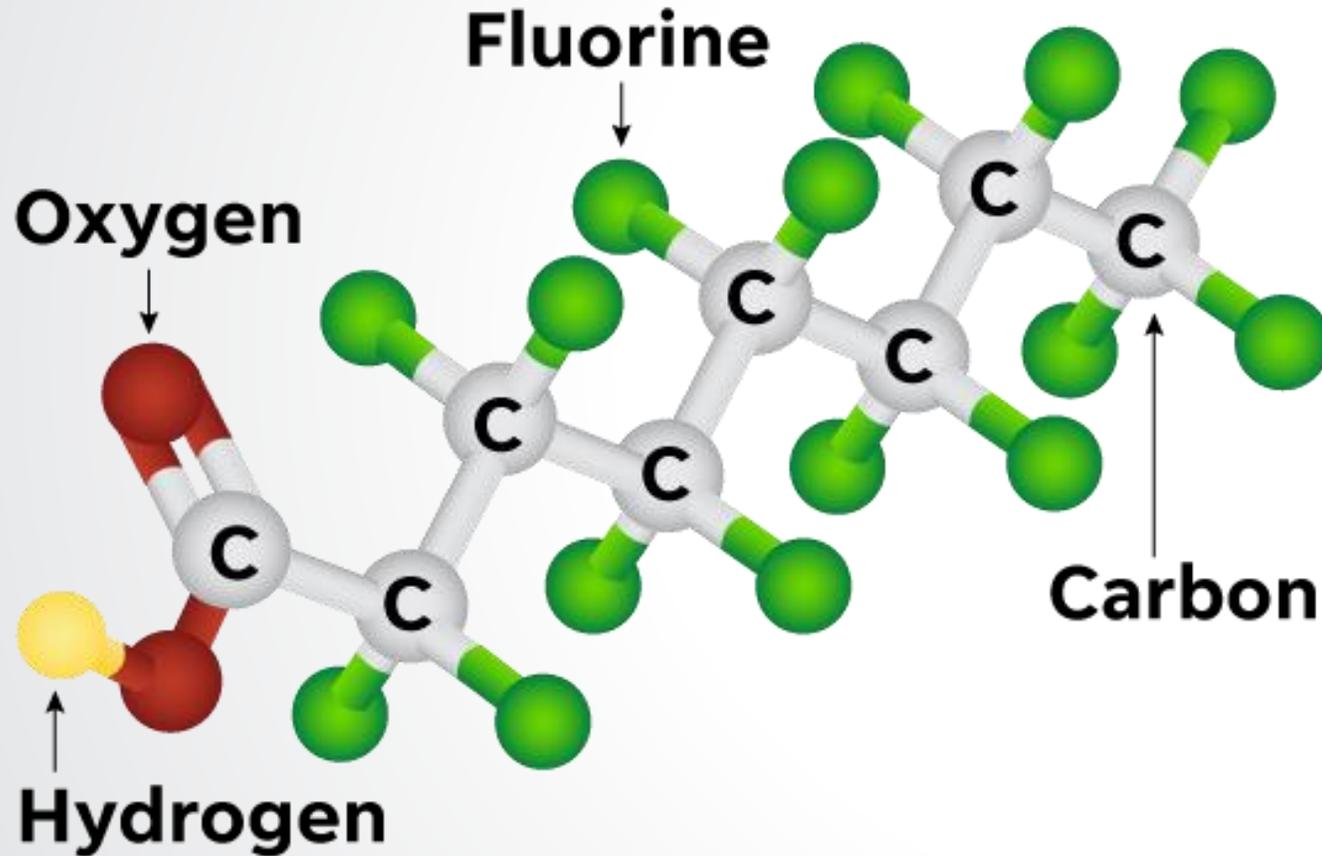


Image: NIEHS

- **Chains** of carbon (C) atoms bonded with fluorine (F) atoms, with a **functional group** on one end
- **Per-** or **Poly**fluoroalkyl: fully or mostly fluorinated carbon chain
- NOT fluorinated aromatics (carbon rings) or chlorofluorocarbons

- C-F bond is one of the **strongest single bonds** in organic chemistry
- Durable when exposed to high heat or chemicals, which is useful in industry/consumer products
- But also **resists degradation** by typical environmental processes

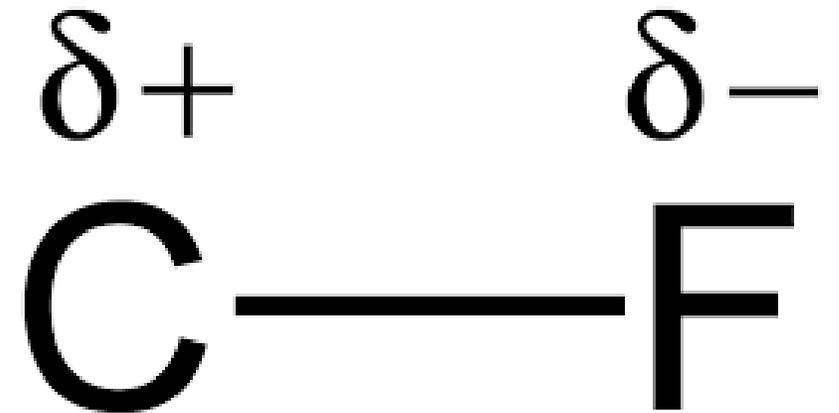


Image: Wikipedia

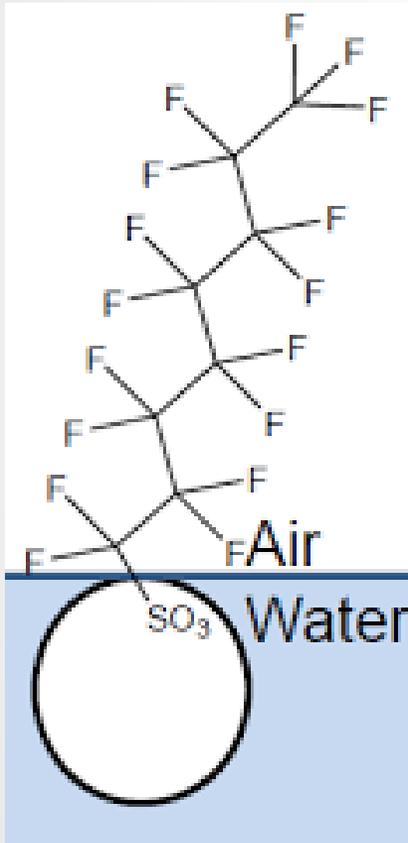
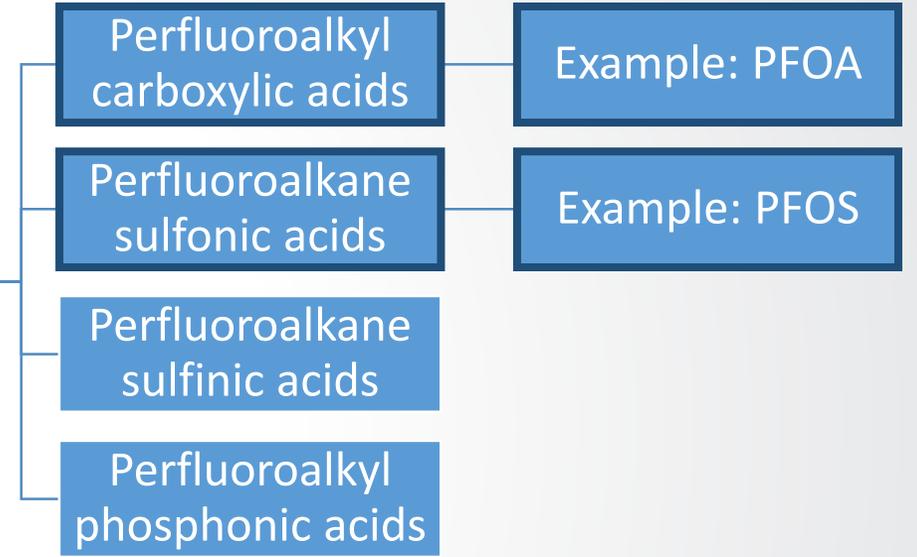
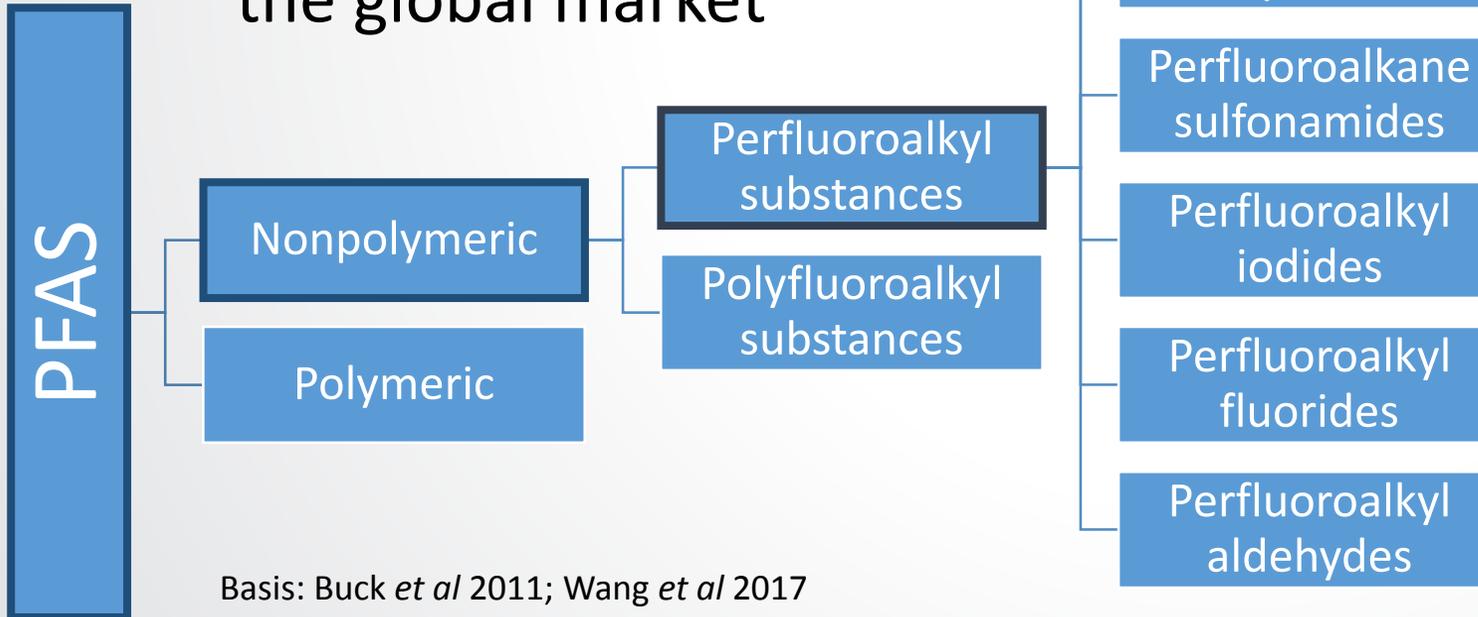


Image: TRC

- PFAS “tail” (C-F chain) is **hydrophobic and lipophobic** and “head” (functional group) is **polar and hydrophilic**
- Useful in industry and consumer products: surfactant, water/stain/oil resistance
- Competing head/tail tendencies also promote **broad distribution** in the environment

- PFAS include **more than 3,000 custom-made** chemical compounds in the global market



- Research and regulation have struggled to keep up,** focusing on PFOA/PFOS; lack of information about other PFAS is a concern

Basis: Buck *et al* 2011; Wang *et al* 2017

- Consumer products with PFAS are **prevalent**. Examples include:

Nonstick cookware

Cardboard pizza boxes

Paperboard to-go boxes

Grease-resistant papers

Microwave popcorn bags

Candy wrappers

Weatherproof notebooks

Teflon tape

Medical supplies

Carpets/rugs

Upholstery

Stain-resistant textiles

Water-resistant textiles

Cosmetics/sunscreens

Conditioners

Waxes/polishes/sealants

Cleaning products

Varnishes/paints



# PFAS Background: Often Released



Image: <https://images.app.goo.gl/W92SgJw2M1i9vjqx7>

- In the US, **hundreds of releases** have been identified where PFAS was used or managed:
  - Industrial manufacturing/processing
  - Aqueous film-forming foam use
  - Landfills and wastewater treatment plants
- PFAS are used in many diverse industries

- Some PFAS 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**
- Comprehensive assessment of risk will **require more toxicity data and analytical methods** for more PFAS compounds

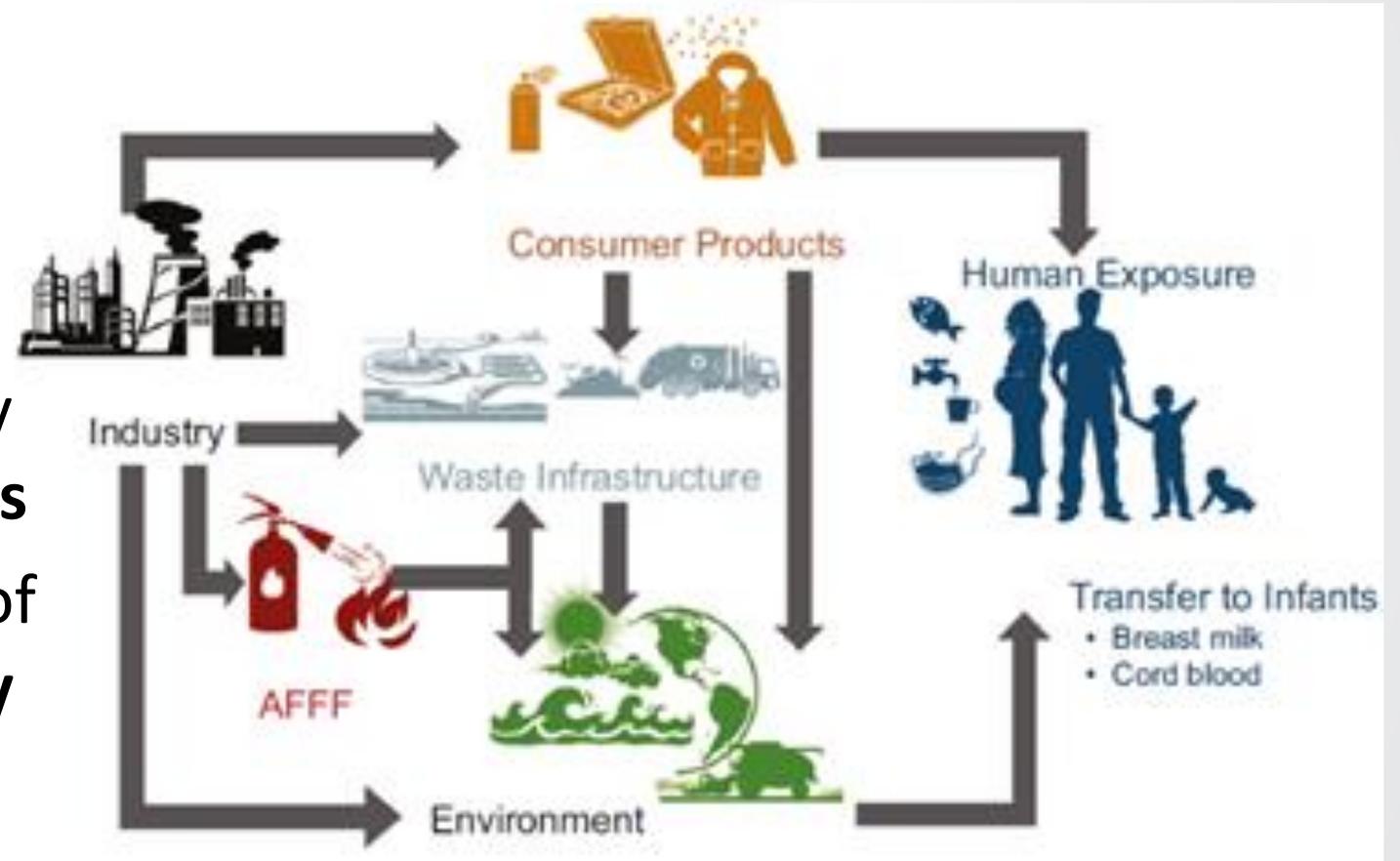
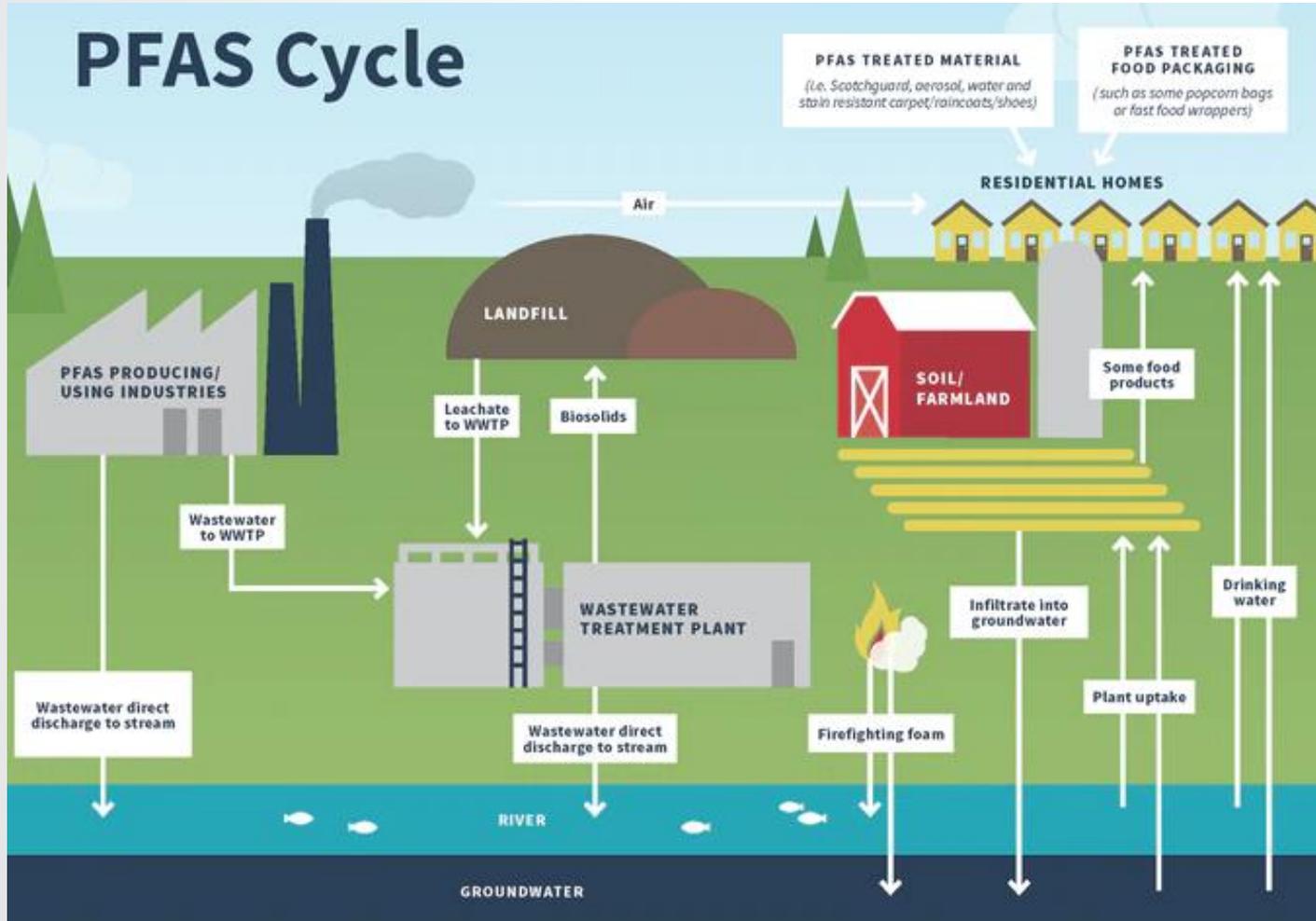


Image: CA State Water Resources Control Board



- Characterizing PFAS **fate and transport** along a multi-media exposure pathway is complicated:
  - Partitioning
  - Transport
  - Transformation from “precursor” PolyFAS to “terminal” PerFAS



# PFAS Background: Challenging to Remedy

- Remediation/treatment requires a thorough knowledge of the **target PFAS** contaminants and **technologies available**
- Disposal of spent filters, excavated soil, and other PFAS-impacted materials may be **challenging/costly**



Image: [www.michiganradio.org](http://www.michiganradio.org)



- Past examples:
  - PFOS use in electroplating was replaced with a polyfluorinated fluorotelomer, a precursor
  - PFOA was replaced with a GenX processing aid technology using HFPO dimer acid and its ammonium salt; the toxicology assessment was only recently drafted
  - DOD committed to move from AFFF to F3 foams, but took multiple F3 generations to achieve comparable AFFF functionality without aquatic toxicity issues

- A lot of questions
- Additional data collection, research, development, and policy decisions are needed to answer them
- Many agencies and organizations are responding simultaneously



Image: [www.mlive.com](http://www.mlive.com)



## Additional Information

EPA Basic Information on PFAS: <https://www.epa.gov/pfas/basic-information-pfas>

ITRC PFAS Fact Sheets: <https://pfas-1.itrcweb.org/fact-sheets/>

Buck, R.C., Franklin, U. Berger, J.M. Conder, I.T. Cousins, P. Voogt, A.A. Jensen, K. Kannan, S.A. Mabury, and S.P. Leeuwen. 2011. "Perfluoroalkyl and Polyfluoroalkyl Substances in the Environment: Terminology, Classification, and Origins." *Integrated Environmental Assessment and Management*, 7(4): 513-541.

<https://setac.onlinelibrary.wiley.com/doi/epdf/10.1002/ieam.258>

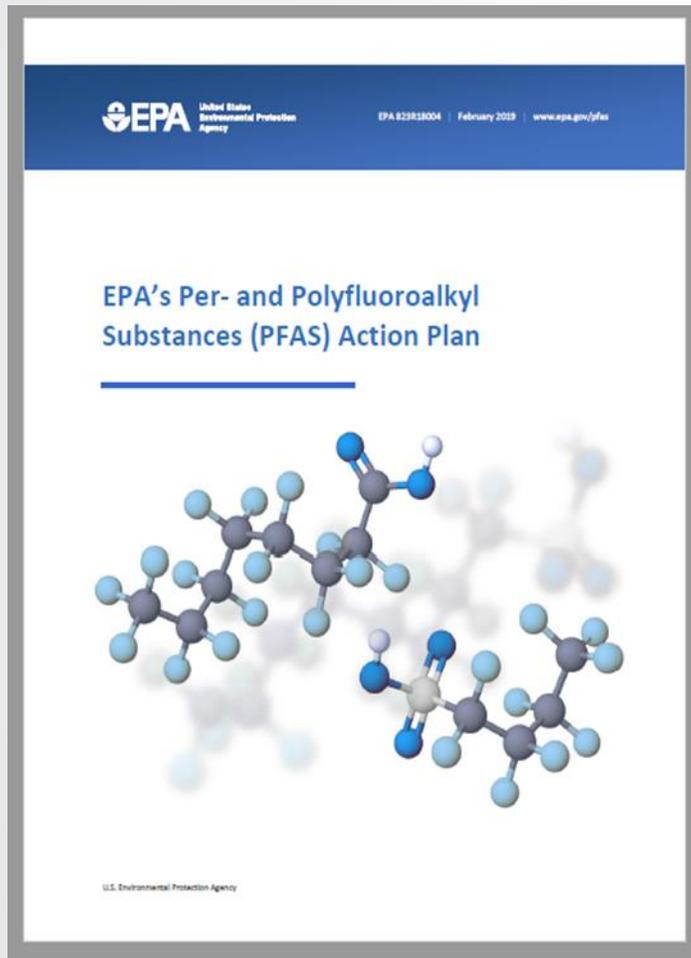
Wang, Z., J.C. DeWitt, C.P. Higgins, and I.T. Cousins. 2017. "A Never-Ending Story of Per- and Polyfluoroalkyl Substances (PFASs)?" *Environmental Science & Technology*, 51(5): 2508-2518. As corrected.

<https://pubs.acs.org/doi/abs/10.1021/acs.est.6b04806>



# What is EPA Doing to Address PFAS-Related Challenges?

# EPA's PFAS Action Plan: Overview



- The first multi-media, multi-program, national research, management and risk communication plan to address a challenge like PFAS
- Builds on prior Agency work to address PFAS since it was identified as a public health concern
- Based on feedback from community engagement and ~120,000 public docket comments
- Developed to provide tools to assist states, tribes, and communities in addressing PFAS

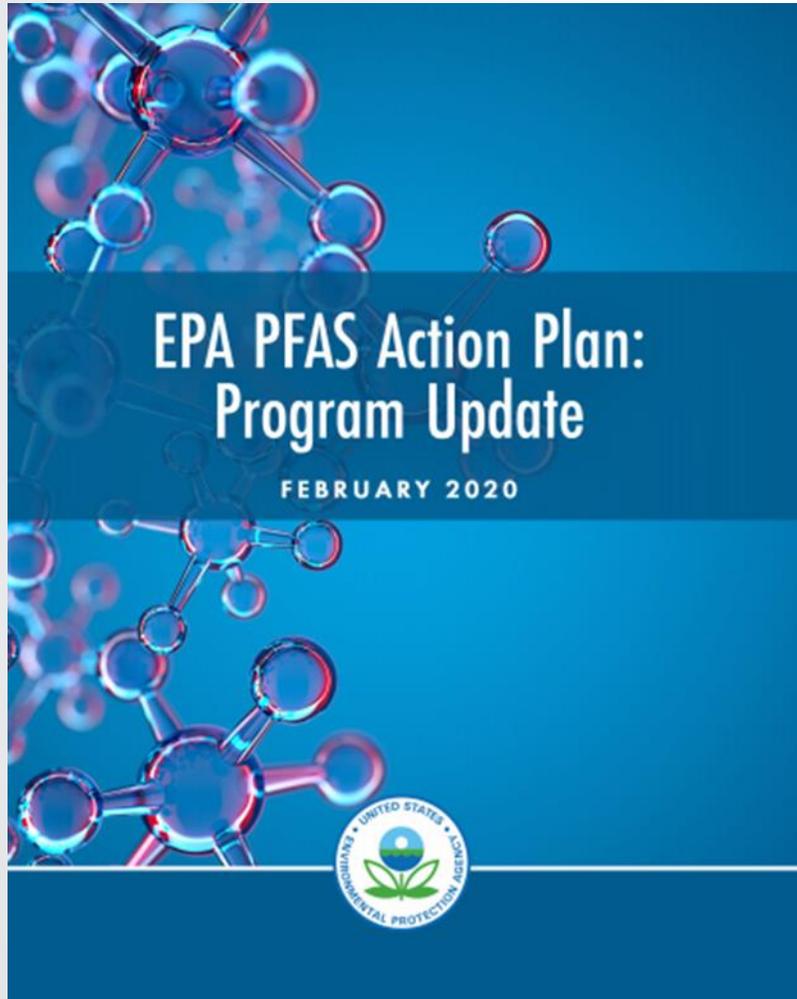
- Key Stakeholder Concerns
  - Cost burden for communities/utilities
  - Lack of hazardous substance listing
  - Lack of enforceable numeric standards
  - Different agencies, different health values
  - Limited information on PFAS human health toxicity, ecosystem impacts
  - Lack of multi-media sampling/analytical methods
  - Information gaps on how to safely handle PFAS waste





# EPA's PFAS Action Plan: Key Actions

- Key EPA actions identified in the Plan:
  - Use legal tools, such as in TSCA, to **prevent** future PFAS contamination
  - Address PFAS in **drinking water** using regulatory and other tools
  - Expand **toxicity** information for PFAS
  - Develop new tools to **characterize** PFAS in the environment
  - Evaluate approaches and develop guidance to facilitate **cleanup** of contaminated groundwater
  - Use **enforcement** tools to address PFAS exposure in the environment and **assist** states in enforcement activities
  - Develop new tools and materials to **communicate** about PFAS

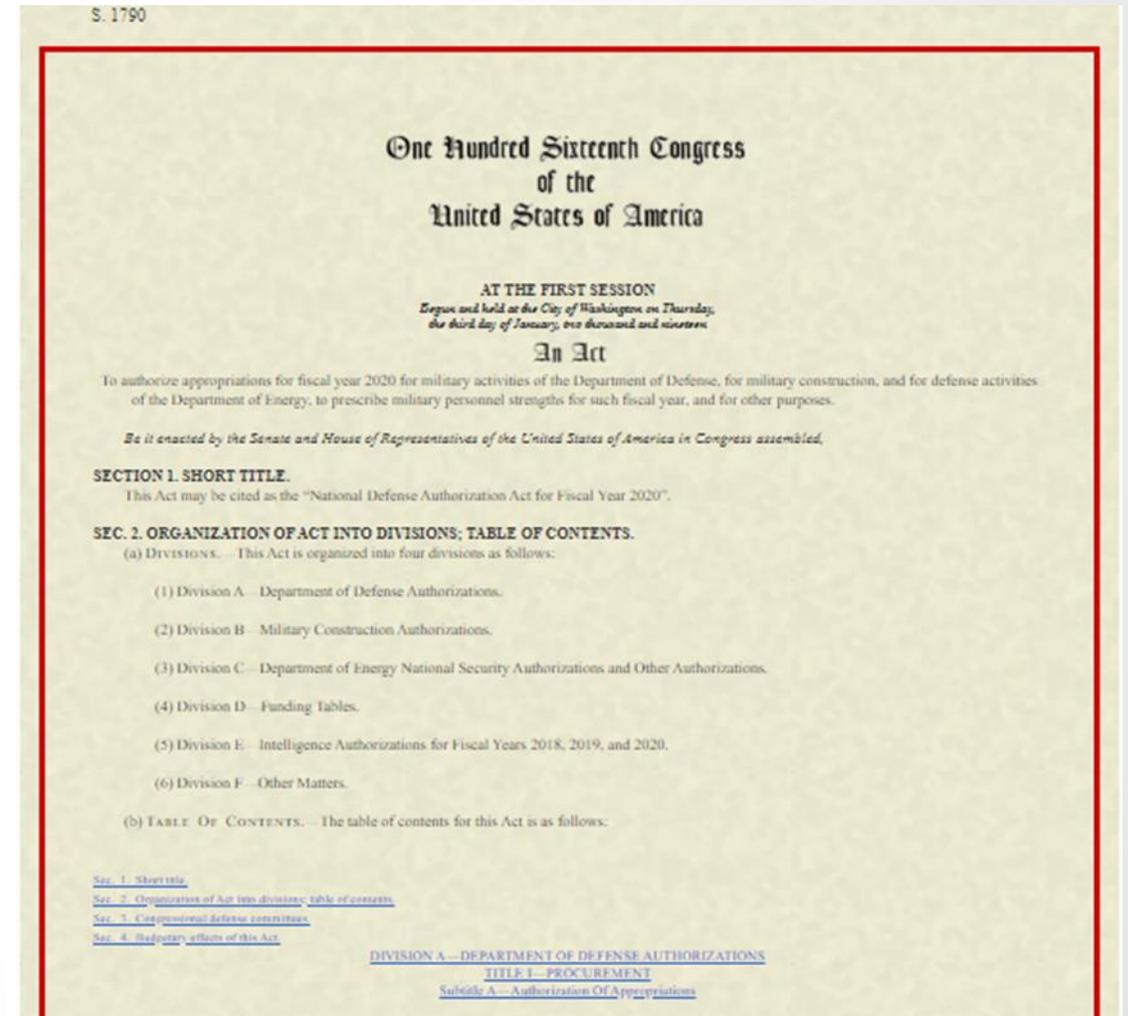


- Progress from the first year of implementing EPA's PFAS Action Plan is documented in a February 2020 Update report and on line
- The Agency has worked aggressively to make progress in all Plan program areas
- This has been accomplished in close coordination with other federal agencies, states, tribes, local governments, utilities, industry, the public



# National Defense Authorization Act, FY2020

- Continued EPA action on PFAS will also consider EPA requirements under the National Defense Authorization Act for Fiscal Year 2020
- Senate Bill 1790 became Public Law No. 116-92 on December 20, 2019





## Additional Information

EPA's PFAS Community Engagement, Summer 2018:

<https://www.epa.gov/pfas/pfas-community-engagement>

EPA's PFAS Action Plan, February 2019:

<https://www.epa.gov/pfas/epas-pfas-action-plan>

EPA's PFAS Action Plan: Program Update, February 2020:

[https://www.epa.gov/sites/production/files/2020-01/documents/pfas\\_action\\_plan\\_feb2020.pdf](https://www.epa.gov/sites/production/files/2020-01/documents/pfas_action_plan_feb2020.pdf)

National Defense Authorization Act for Fiscal Year 2020, Senate Bill 1790, Public Law No. 116-92, December 2019:

<https://www.congress.gov/bill/116th-congress/senate-bill/1790/text>



## Actions under the **Toxic Substances Control Act:**

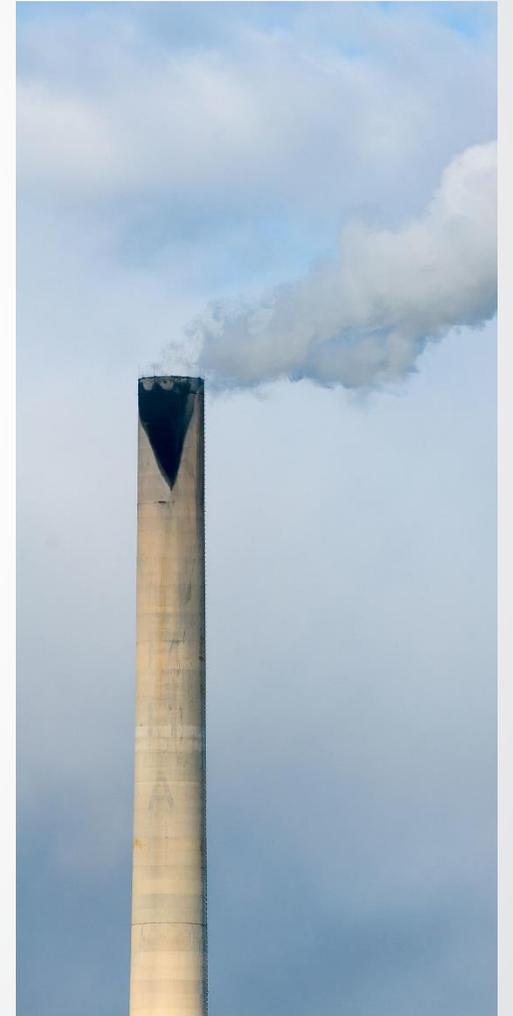
- 2006: PFOA Stewardship Program commits industry leaders to 95% reduction by 2010, elimination by 2015
- 2002, 2007, 2013, 2015: Significant New Use Rules limit future manufacture or importation of certain PFAS
- February 2020: EPA issues a supplemental proposal to ensure that new uses of certain persistent long-chain PFAS chemicals in surface coatings cannot be manufactured or imported into the United States without notification and review under TSCA

## Actions under the **Toxics Release Inventory**:

- On February 20, 2020, EPA released an updated list of 172 PFAS chemicals subject to Toxics Release Inventory reporting as required by the National Defense Authorization Act for Fiscal Year 2020.

## Planned Data Call:

- Also under the NDAA, EPA must require (by rule, by January 2023) reporting by anyone who manufactured a PFAS since January 1, 2011





# Additional Information

Risk Management for PFAS under TSCA (multiple tabs):

<https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-management-and-polyfluoroalkyl-substances-pfas>

Implementing Statutory Addition of Certain PFAS to the TRI Chemical List:

<https://www.epa.gov/toxics-release-inventory-tri-program/implementing-statutory-addition-certain-and-polyfluoroalkyl>

List of PFAS Added to the TRI by the NDAA:

<https://www.epa.gov/toxics-release-inventory-tri-program/list-pfas-added-tri-ndaa>

TRI Reporting and New Requirements for PFAS Chemicals (presentation):

<https://www.epa.gov/toxics-release-inventory-tri-program/tri-reporting-and-new-requirements-pfas-chemicals>



# Addressing PFAS in Drinking Water



## Early Actions:

- Safe Drinking Water Act Contaminant Candidate List
  - 2009: PFOA/PFOS placed on CCL 3 for evaluation.
  - 2016: Carried to CCL 4 to further evaluate health effects, establish occurrence, develop analytics.
- Health Advisories
  - 2009: Provisional health advisories for PFOA (0.4  $\mu\text{g}/\text{L}$ ) and PFOS (0.2  $\mu\text{g}/\text{L}$ ); best available science
  - 2016: Drinking water lifetime health advisories for PFOA and PFOS of 70 ppt individually or combined.



# Addressing PFAS in Drinking Water

Early Actions – Unregulated Contaminant Monitoring Rule:

- UCMR 3 (2012, 2013-2015): Sampled 6 PFAS in 4,920 public water systems

PFAS	MRL (ppt)	HAL (ppt)	≥ MRL (#)	≥ HAL (#)
PFOS	40	70	95	46 (0.9%)
PFOA	20	70	117	13 (0.3%)
PFNA	20	--	14	--
PFHxS	30	--	55	--
PFHpA	10	--	86	--
PFBS	90	--	8	--

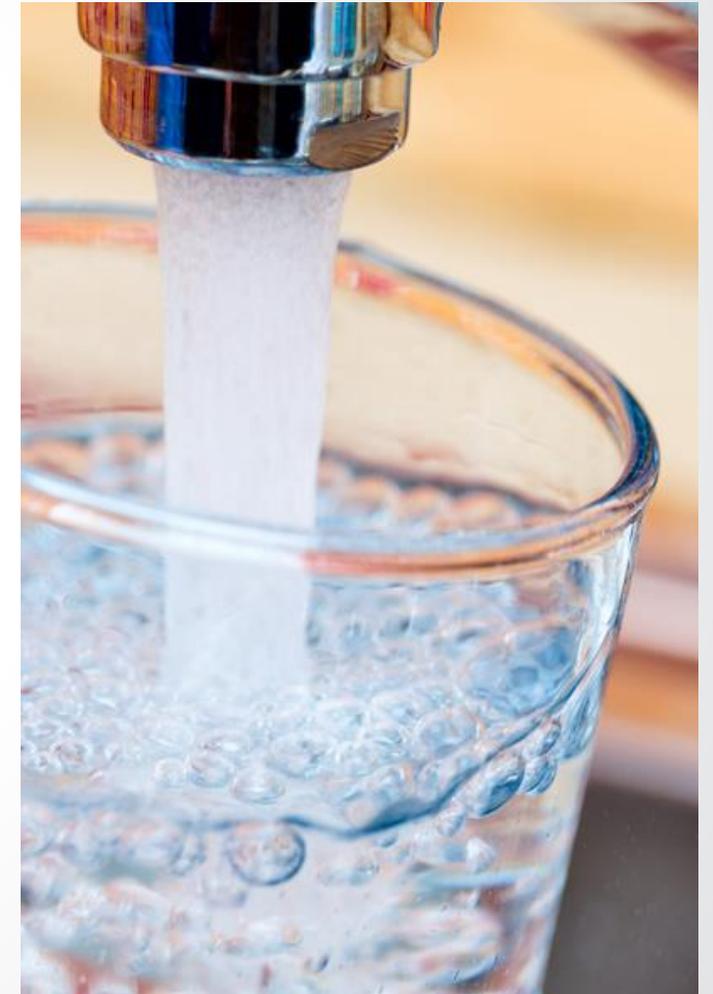
- UCMR 5 (2022, 2023-2025): Any unregulated PFAS with a validated method



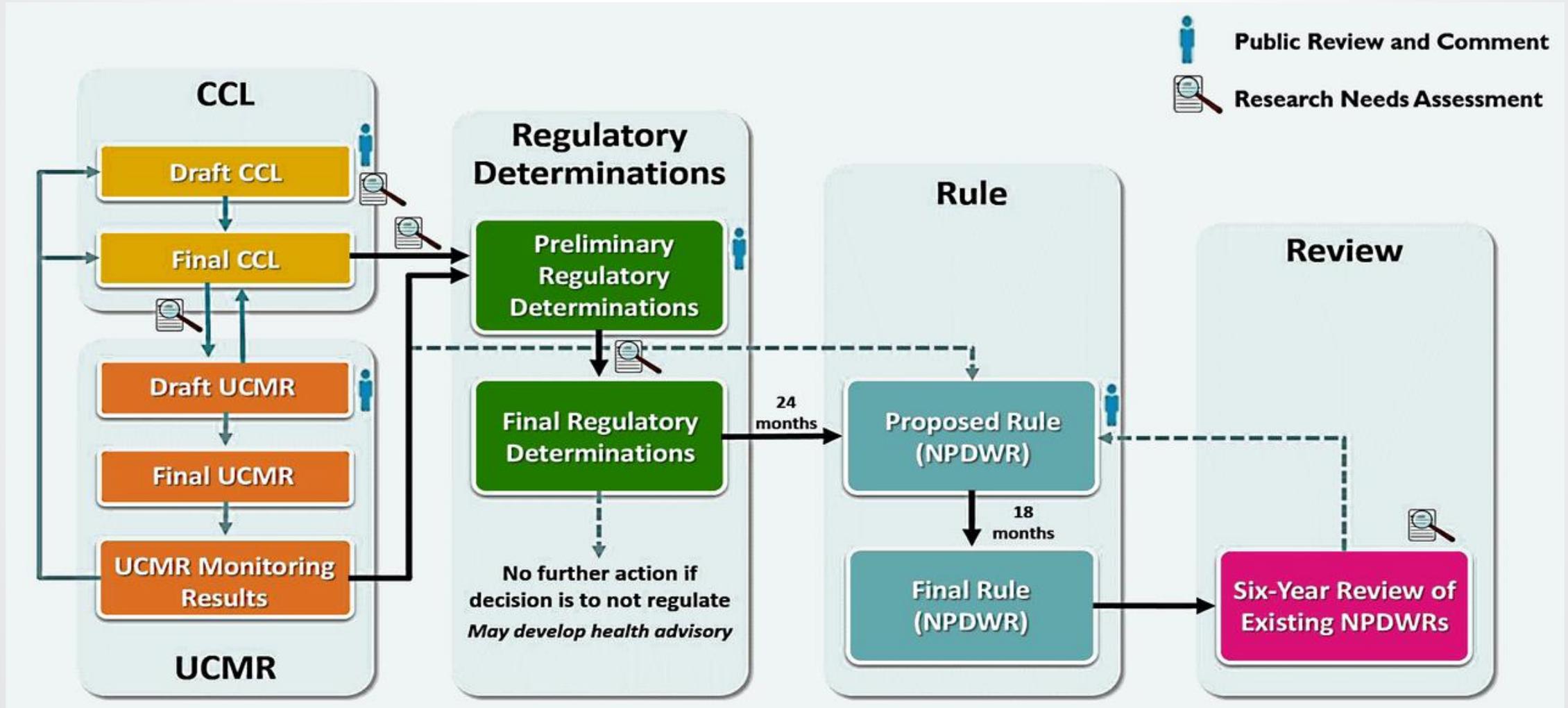
# Addressing PFAS in Drinking Water

## Recent Actions:

- February 2020: EPA announced and requested public comment on a preliminary regulatory determination to **regulate PFOA and PFOS in drinking water**, an important step in implementing the Agency's PFAS Action Plan
- EPA also requests input on other PFAS, monitoring requirements, and regulatory approaches
- Federal Register (<https://www.regulations.gov>)  
Docket ID No. EPA-HQ-OW-2019-0583



# Addressing PFAS in Drinking Water





# Addressing PFAS in Drinking Water



- December 2019: EPA published validated **EPA Method 533** for 11 “short chain” PFAS (C4 to C12) in drinking water, complementing updated EPA Method 537.1
- Ongoing Actions:
  - Researching cost and performance of drinking water **treatment technologies**, including point-of-entry systems
  - Updating the Drinking Water Treatability Database (22 PFAS just added) and linking Unit Cost Models



# Additional Information

EPA Data Summary for UCMR 3:

<https://www.epa.gov/dwucmr/data-summary-third-unregulated-contaminant-monitoring-rule>

EPA PFOA & PFOS Drinking Water Health Advisories, Fact Sheet:

[https://www.epa.gov/sites/production/files/2016-06/documents/drinkingwaterhealthadvisories\\_pfoa\\_pfos\\_updated\\_5.31.16.pdf](https://www.epa.gov/sites/production/files/2016-06/documents/drinkingwaterhealthadvisories_pfoa_pfos_updated_5.31.16.pdf)

EPA Prelim. Regulatory Determination: <https://www.epa.gov/ccl/regulatory-determination-4>

EPA Method 537.1:

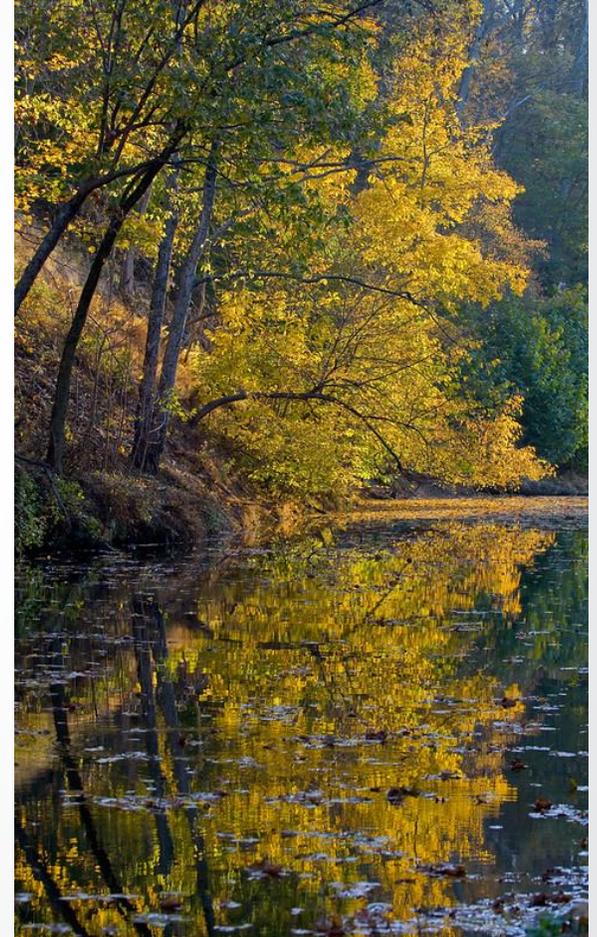
[https://cfpub.epa.gov/si/si\\_public\\_record\\_Report.cfm?dirEntryId=343042&Lab=NERL](https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=343042&Lab=NERL)

EPA Method 533:

<https://www.epa.gov/dwanalyticalmethods/method-533-determination-and-polyfluoroalkyl-substances-drinking-water-isotope>

Drinking Water Treatability Database: <https://oaspub.epa.gov/tdb/pages/general/home.do>

- Planned Action: EPA will develop national **Clean Water Act human health and aquatic life criteria** for PFAS, as data supports
- Ongoing Action: EPA is examining available data on industrial PFAS releases to surface waters to assess the need for additional study and/or regulation
- Planned Action: Under the NDAA, EPA will support performance standard development and data sharing for USGS nationwide sampling efforts





# Reducing PFAS Exposure through Cleanups



- December 2019: EPA issued *Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS*, guidance for federal cleanup programs (e.g., CERCLA, RCRA) that will also be helpful to states and tribes
- Planned Action: EPA will follow through on the regulatory development process for listing certain PFAS as **hazardous substances** under CERCLA



# Reducing PFAS Exposure through Cleanups

- EPA is developing test methods and conducting research to support site characterization/cleanup
- June 2019: EPA validated **SW-846 Method 8327** for analysis of 24 PFAS in non-potable water
- Ongoing in 2020:
  - Validation of SPE-ID Method for solid and non-potable aqueous matrices (DOD NAVSEA)
  - Evaluation of Total Organic Fluoride method
  - Development of stack emissions methods
  - Research on treatment and management





# Additional Information

Interim Recommendations for Addressing Groundwater Contaminated with PFOA/PFOS:

<https://www.epa.gov/pfas/interim-recommendations-addressing-groundwater-contaminated-pfoa-and-pfos>

40 CFR Hazardous substance determination: <https://www.law.cornell.edu/cfr/text/40/302.4>

EPA PFAS Analytical Methods Technical Brief:

[https://www.epa.gov/sites/production/files/2020-01/documents/pfas\\_methods-sampling\\_tech\\_brief\\_7jan2020-update.pdf](https://www.epa.gov/sites/production/files/2020-01/documents/pfas_methods-sampling_tech_brief_7jan2020-update.pdf)

SW-846 Method 8327:

<https://www.epa.gov/hw-sw846/validated-test-method-8327-and-polyfluoroalkyl-substances-pfas-using-external-standard>

Clean-up Information:

[https://clu-in.org/contaminantfocus/default.focus/sec/Per-and\\_Polyfluoroalkyl\\_Substances\\_\(PFASs\)/cat/Overview/](https://clu-in.org/contaminantfocus/default.focus/sec/Per-and_Polyfluoroalkyl_Substances_(PFASs)/cat/Overview/)

# Increasing Research to Reduce Risk



- EPA is conducting research to address the lack of **human toxicity** information for many PFAS of interest
- Early Action (2016): Issued peer-reviewed *Health Effects Support Documents* for PFOA and PFOS
- Ongoing Actions:
  - Toxicity assessments for GenX chemicals, PFBS (draft 2019, final anticipated 2020)
  - Initiated assessments for five additional PFAS: PFBA, PFHxS, PFHxA, PFNA, PFDA (public 2020)
  - In vitro, high throughput screening: bioactivity analysis of ~150 different PFAS (posted in 2020)

- EPA is conducting research to address the lack of **ecological toxicity** information for many PFAS, including a systematic literature review and research planning to identify sensitive taxa, bioaccumulation, benchmarks, and thresholds to support criteria
- EPA is conducting research to address the lack of **systematic knowledge** on sources, site-specific concentrations, fate and transport, bioaccumulation, and human and ecological exposure



# Increasing Research to Reduce Risk



- Additional recent and planned actions to support research and reduce risk include:
  - 2019: EPA established a PFAS library of 430 **technical-grade reference samples** of known composition and purity to enable consistent analysis
  - Planned Action: EPA will develop risk assessments for PFOA and PFOS in **biosolids** to understand any potential health impacts

- EPA is **funding multiple grants** to supplement the Agency's research projects:
  - \$6M to Research Potential Environmental Impacts of PFAS Substances in Waste Streams
  - \$3.9M to Research Human Health and Ecological Exposure to PFAS
  - \$1.7M to Small Businesses, plus Grants to 21 Student Teams, for Innovative Technologies
  - \$4.8M to Research PFAS Impacts on Rural America and the Agricultural Operations





# Additional Information

EPA Research on PFAS:

<https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas#1>

Computational Toxicity Dashboard and EPA PFAS Research Compound List:

[https://comptox.epa.gov/dashboard/chemical\\_lists/EPAPFASRESEARCH](https://comptox.epa.gov/dashboard/chemical_lists/EPAPFASRESEARCH)

ECOTOX Knowledgebase:

<https://cfpub.epa.gov/ecotox/help.cfm?sub=so-site-info>

GenX and PFBS Draft Toxicity Assessments:

<https://www.epa.gov/pfas/genx-and-pfbs-draft-toxicity-assessments>

IRIS Assessments in Development:

[https://cfpub.epa.gov/ncea/iris\\_drafts/atoz.cfm?list\\_type=erd](https://cfpub.epa.gov/ncea/iris_drafts/atoz.cfm?list_type=erd)



- EPA is working collaboratively to develop a risk communication toolbox that includes multi-media materials and messaging for federal, state, tribal, and local partners to use with the public

## PFAS WHAT YOU NEED TO KNOW

### WHAT ARE PFAS CHEMICALS?

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that includes PFOA, PFOS and GenX chemicals. Since the 1940s, PFAS have been manufactured and used in a variety of industries around the globe, including in the United States. PFOA and PFOS have been the most extensively produced and studied of these chemicals. Both are very persistent in the environment and in the human body. Exposure to certain PFAS can lead to adverse human health effects.

**PFOA & PFOS**  
U.S. manufacturers voluntarily phased out PFOA and PFOS, two specific PFAS chemicals.

**GenX Chemicals**  
GenX chemicals are a replacement for PFOA.

### WHAT EPA IS DOING

Some of the agency's work includes: development of additional toxicity values, analytical methods for additional PFAS and non-drinking water media as well as treatment options for PFAS in drinking water. EPA is also hosting a National Leadership Summit on PFAS in May 2018.

Established methods to measure 14 PFAS compounds in drinking water

Identified five treatment processes for PFOA and PFOS

Identified all PFAS chemicals that are legally available for production and use

Provided national monitoring data for 6 PFAS in drinking water

Issued drinking water health advisories (70 parts per trillion) for PFOA and PFOS in 2016

Provided support for 10 states with site-specific PFAS challenges and problems:  
NC (Cape Fear River), MI, DE, WY, CO, NY (Hoosick Falls), OH, NH, VT and NJ

Updated website to include tools and information so that states, tribes and local communities can understand, assess and address PFAS incidents and emergencies

### HOW ARE WE EXPOSED TO PFAS?

PFAS include a large number of important chemicals that can be used in some food packaging and can make things grease- and stain-resistant. They are also used in firefighting foams and in a wide range of manufacturing practices. Unfortunately, some of these substances don't break down over time. That means they build up in the environment and in our bodies.

Drinking water can be a source of exposure in communities where these chemicals have contaminated water supplies. Such contamination is typically localized and associated with a specific facility, for example,

- an industrial facility where PFAS were produced or used to manufacture other products, or
- locations where firefighting foam was used such as oil refineries, airfields or other training facilities for firefighters

If you are concerned about the possibility of PFAS in your drinking water, contact your local water supplier and ask for more information about PFAS.

STAIN/GREASE REPELLENT

FIREFIGHTING FOAMS

INDUSTRIAL USES

### HEALTH EFFECTS

There is evidence that exposure to PFAS can lead to adverse health outcomes in humans. If humans or animals ingest PFAS (by eating or drinking food or water that contain PFAS), the PFAS are absorbed and can accumulate in the body. PFAS stay in the human body for long periods of time. In some cases, the level of PFAS in the body can increase to the point where people can suffer from adverse health effects.

Studies indicate that high concentrations of PFOA and PFOS can cause reproductive and developmental, liver and kidney, and immunological effects in laboratory animals. Both chemicals have caused tumors in animal studies. The most consistent findings from human studies are increased cholesterol levels among exposed populations, with more limited findings related to:

- infant birth weights
- adverse effects on the immune system
- cancer (for PFOA)
- thyroid hormone effects (for PFOS)

WWW.EPA.GOV/PFAS SOURCE: U.S.EPA

- EPA is collaborating with many federal and state partners to take action:
  - Environmental Council of the States (ECOS) to ensure state priorities are addressed
  - US Department of Agriculture (USDA) and US Food and Drug Administration (FDA) to examine the impacts of PFAS on agriculture, rural communities, and food supplies.
  - National Institute of Environmental Health Sciences' (NIEHS) National Toxicology Program on assessing PFAS toxicity
  - Department of Defense on analytical methods and approaches for PFAS cleanup



# Thank You

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## Questions?