United States Environmental Protection Agency

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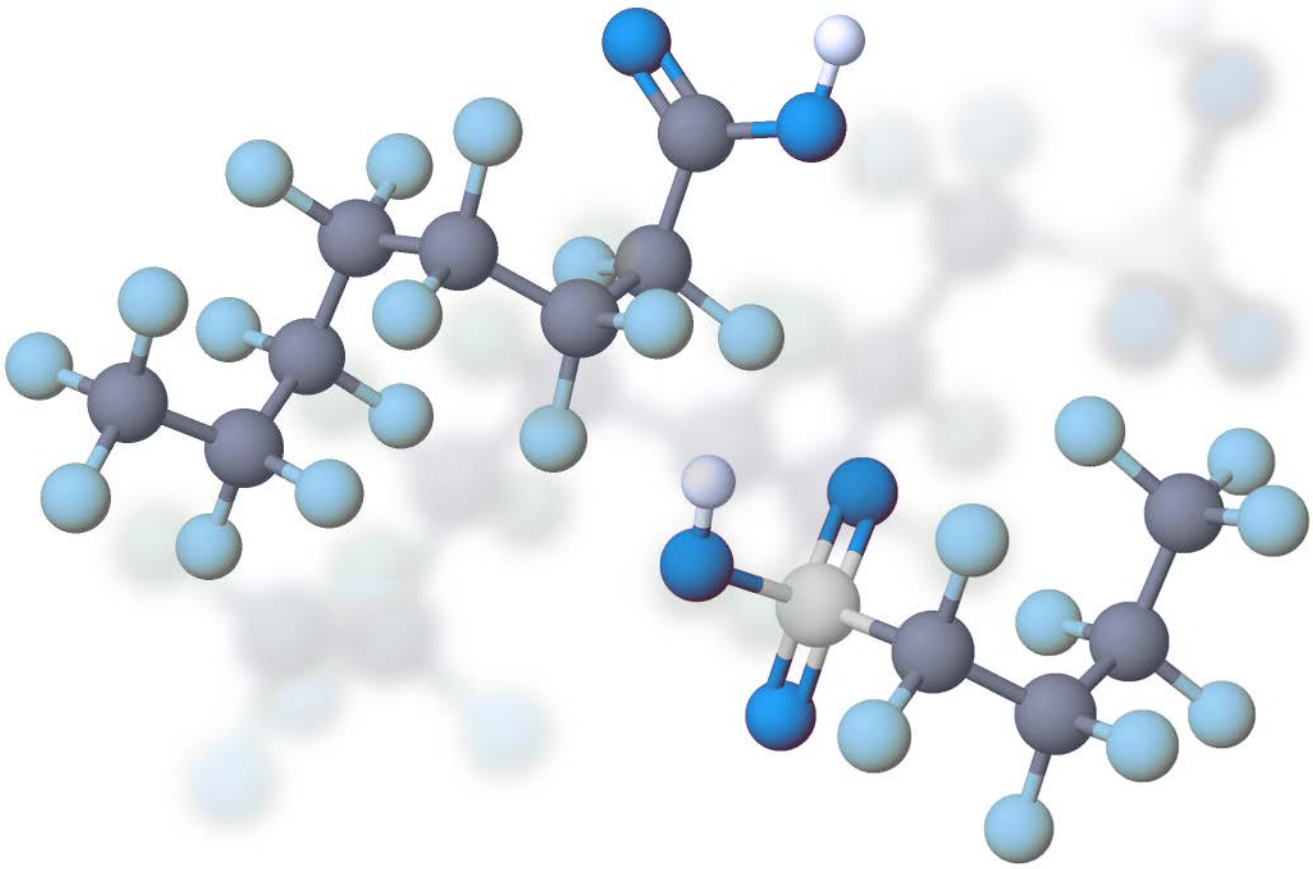
EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan



U.S. Environmental Protection Agency

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List of Acronyms

ACRONYM	FULL PHRASE
ASDWA	Association of State Drinking Water Administrators
ASTHO	Association of State and Territorial Health Officials
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
ATSDR	Agency for Toxic Substances and Disease Registry
CAA	Clean Air Act
CCL	Contaminant Candidate List
CDC	Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
CWS	Community Water System
DoD	Department of Defense
DWSRF	Drinking Water State Revolving Fund
ECOS	Environmental Council of States
ELGs	Effluent Limitations Guidelines
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
GenX	Gen X Chemicals (i.e., HFPO dimer acid and its ammonium salt), also known as (2,3,3,3-tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)propanoic acid (CASRN 13252-13-6) or hexafluoropropylene oxide (HFPO) dimer acid and 2,3,3,3-tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)propanoate (CASRN 62037-80-3) or HFPO dimer acid ammonium salt)
HA	Health Advisory
HERO	Health and Environmental Research Online
HFPO	Hexafluoropropylene Oxide
HTT	High Throughput Toxicity Testing
HTTK	High Throughput Toxicokinetic
HUD	Department of Housing and Urban Development
ITRC	Interstate Technology and Regulatory Council
KDHE	Kansas Department of Health and Environment
LCPFAC	Long-Chain Perfluoroalkyl Carboxylate
LGAC	Local Government Advisory Committee
MCL	Maximum Contaminant Level
MDEQ	Michigan Department of Environmental Quality
NIST	National Institute of Technology

NPDES	National Pollutant Discharge Elimination System
NTP	National Toxicology Program
OECD	Organization for Economic Cooperation and Development
PFCA	Perfluoroalkyl Carboxylic Acid
PFAS	Per- and Polyfluoroalkyl Substances
PFBS	Perfluorobutane Sulfonic Acid
PFBA	Perfluorobutanoic Acid
PFHpA	Perfluoroheptanoic Acid
PFHxS	Perfluorohexane Sulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PMN	Premanufacture notice
ppt	Parts per Trillion
PWSs	Public Water Systems
RCRA	Resource Conservation and Recovery Act
SDWA	Safe Drinking Water Act
SNUN	Significant New Use Notice
SNURs	Significant New Use Rules
TSCA	Toxic Substances Control Act
UCMR	Unregulated Contaminant Monitoring Rule
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WCIT	Water Contaminant Information Tool

I. Executive Summary

Per- and polyfluoroalkyl substances (PFAS) are a group of synthetic chemicals that have been in use since the 1940s. PFAS are found in a wide array of consumer and industrial products. PFAS manufacturing and processing facilities, facilities using PFAS in production of other products, airports, and military installations are some of the contributors of PFAS releases into the air, soil, and water. Due to their widespread use and persistence in the environment, most people in the United States have been exposed to PFAS. There is evidence that continued exposure above specific levels to certain PFAS may lead to adverse health effects (USEPA 2016a, 2016b, ATSDR 2018a).

The EPA will continue to partner with other federal agencies, states, tribes, and local communities to protect human health and, where necessary and appropriate, to limit human exposure to potentially harmful levels of PFAS in the environment. The EPA is leading the national effort to understand PFAS and reduce PFAS risks to the public through implementation of this Action Plan and through active engagement and partnership with other federal agencies, states, tribes, industry groups, associations, local communities, and the public.

Key EPA Actions Addressing PFAS-Related Challenges

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

Throughout recent engagements, the EPA heard clearly the public's desire for immediate action to address potential human health and economic impacts from PFAS in the environment.

This Action Plan describes the EPA's approach to identifying and understanding PFAS, approaches to addressing current PFAS contamination, preventing future contamination, and effectively communicating with the public about PFAS. The Action Plan describes the broad actions the EPA has underway to address challenges with PFAS in the environment, including next steps on the four PFAS management actions the EPA announced at the May 2018 National Leadership Summit. The four actions announced at the Summit were:

- Initiating steps to evaluate the need for a maximum contaminant level (MCL) for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS);
- Beginning the necessary steps to propose designating PFOA and PFOS as "hazardous substances" through one of the available federal statutory mechanisms[1];
- Developing groundwater cleanup recommendations for PFOA and PFOS at contaminated sites;
- Developing toxicity values or oral reference doses (RfDs)[2] for GenX chemicals[3] and perfluorobutane sulfonic acid (PFBS).

In addition to these significant actions, the EPA's PFAS Action Plan identifies more short-term and long-term actions that are currently being implemented to understand and address PFAS. Short-term actions include:

- Developing new analytical methods and tools for understanding and managing PFAS risk;
- Promulgating Significant New Use Rules (SNURs) that require EPA notification before chemicals are used in new ways that may create human health and ecological concerns; and
- Using enforcement actions to help manage PFAS risk, where appropriate.

Short-term actions are generally taking place or expected to be completed within two years. The Action Plan also sets out long-term regulatory and research approaches the EPA will pursue to reduce exposures and to understand the potential human health and environmental risks associated with PFAS. Actions classified as long-term, such as multi-step research initiatives or regulatory actions, are generally expected to take more than two years. Some long-term actions may result in intermediate steps and products that can help to reduce PFAS exposures and protect public health.

Ecological risks are of great concern to many stakeholders due to the widespread distribution and persistence of PFAS in the environment and the wide variety of PFAS chemicals for which environmental fate and transport is currently uncharacterized. While this Action Plan focuses mainly on human health, characterizing potential ecological impacts and risks are important areas of work for the EPA.

Table 1 below summarizes the key actions the EPA is taking to assist states, tribes, and communities in addressing PFAS. These activities are intended to address challenges identified though stakeholder input

[1] There are multiple statutory mechanisms available to designate PFAS as CERCLA hazardous substances, including CERCLA, RCRA, TSCA, CWA, and CAA.
[2] A reference dose is an estimate of the amount of a chemical a person can ingest daily over a lifetime (chronic RfD) or less (subchronic RfD) that is unlikely to lead to adverse health effects.
[3] hexafluoropropylene oxide (HFPO) dimer acid and its ammonium salt

during the PFAS National Leadership Summit, multiple community engagements, and through the public docket (see Appendices B and C for summaries of stakeholder input).

In addition to the highlighted action items in Table 1, the EPA continues to make progress on developing tools and expanding the body of scientific knowledge needed to understand and effectively manage risk from PFAS, including developing PFAS analytical methods, evaluating treatment and remediation techniques for PFAS, understanding the exposure from various environmental media, and evaluating human health impacts of additional PFAS. These activities are described in more detail in Appendix A.

Table 1. Key PFAS-Related Challenges and Planned and Ongoing EPA Actions

Stakeholder Concern or Challenge	EPA Action(s)	Purpose	Anticipated Timeframe
EPA Priority Actions			
Regulatory uncertainty (e.g., MCL) for PFAS in drinking water	Propose a national drinking water regulatory determination for PFOA and PFOS, highlighting key information gathered by the Agency and our partners to date and additional data needs.	Provide the opportunity for the public to comment on and contribute to the information the EPA may consider related to the regulation of PFAS in drinking water.	2019
Hold responsible parties accountable for PFAS releases into the environment	The EPA has initiated the regulatory development process for listing PFOA and PFOS as CERCLA hazardous substances.	Listing PFOA and PFOS as CERCLA hazardous substances would provide additional authority to address PFOA and PFOS, including the ability to require responsible parties to carry out and/or pay for response actions.	Ongoing Started 2018
Provide guidance for groundwater cleanup actions at contaminated sites	Develop interim cleanup recommendations to address groundwater contaminated with PFOA and PFOS.	Recommendations will provide a starting point for making site-specific cleanup decisions. These recommendations may be considered for federal facility and private-party cleanup under CERCLA, RCRA corrective action programs, and state cleanup programs, where appropriate.	Anticipated 2019
Increase understanding about potential human health impacts of additional PFAS	Finalize draft toxicity assessments for GenX chemicals and PFBS; develop additional PFAS toxicity values for PFBA, PFHxA, PFHxS, PFNA, and PFDA.	Finalized toxicity assessments can be combined with specific exposure information by government and private entities to help characterize potential public health risks associated with exposure to these chemicals.	Final toxicity assessments for PFBS and GenX chemicals in 2019; Draft toxicity assessments for five additional PFAS in 2020

Stakeholder Concern or Challenge	EPA Action(s)	Purpose	Anticipated Timeframe
Expand knowledge about whether new PFAS chemicals entering commerce are safe	Use new statutory requirements added by the Frank R. Lautenberg Chemical Safety for the 21st Century Act to review new PFAS and issue supplemental proposed Significant New Use Rules (SNUR on PFAS).	New chemical reviews under TSCA ensure that unreasonable risks are addressed prior to commercialization. The issuance of SNURs for existing PFAS chemicals prohibits new uses for these chemicals until the EPA determines whether the significant new use presents an unreasonable risk and takes appropriate actions as required by TSCA to address any unreasonable risk.	Ongoing Started in 2016
Short-Term Actions			
Understanding and Addressing PFAS Toxicity and Occurrence			
Establish and curate a clearinghouse of chemical information for PFAS	The EPA's CompTox Chemistry Dashboard has been updated to include several curated lists of PFAS chemicals with links to known chemical, physical, and other properties.	Provide simple access to a comprehensive array of up-to-date information for PFAS of interest.	Ongoing
Expand analytical methods to accurately test for additional PFAS in drinking water	Expand the current drinking water Method 537 to include GenX chemicals and additional PFAS; develop a new drinking water method for additional short-chain PFAS not measured by Method 537.	Improved and/or additional methods would help stakeholders and the EPA accurately test, analyze, and quantify a broader suite of PFAS in their drinking water, including GenX chemicals and other short-chain PFAS.	Method 537.1 completed November 2018; additional methods in 2019
Test for PFAS and PFAS precursors in media other than drinking water	Develop and validate methods for other water matrices (wastewater, surface waters, groundwater), solids (soil, sediment, biosolids, fish tissue), and air (ambient, stack emission, off-gases).	Provide additional methods for stakeholders and the EPA to identify the presence of PFAS in concentrations of concern for media other than drinking water.	2019 – 2021
Coordination across federal agencies with common interests in PFAS toxicity	Participate in a cross-federal-agency working group on PFAS information gathering and sharing.	Better leverage federal investments and reduce redundancies. Provide states, tribes, and communities with consistent cross-federal information for making decisions.	2019

Stakeholder Concern or Challenge	EPA Action(s)	Purpose	Anticipated Timeframe
Identifying and Addressing PFAS Exposures			
Additional robust treatment and remediation technologies for PFAS in the environment	Conduct additional research to identify performance and costs associated with treatment and remediation approaches to address PFAS in the environment, along with any potential unintended consequences associated with specific technologies.	Identify new/additional treatment and remediation options that can be used to address PFAS contamination.	2019
Information about drinking water treatment effectiveness and costs for different PFAS	Incorporate the latest research results for additional PFAS into the EPA's online drinking water treatability database.	Support stakeholders in selecting the most effective drinking water treatment approaches to address concerns with PFAS in the environment.	Ongoing
Hold responsible parties accountable for PFAS releases into the environment	Employ an enforcement strategy that relies first on state and local authorities and utilizes federal authorities as appropriate where, for example, state and local authorities are not available or responsible parties do not address PFAS voluntarily.	Support communities that have PFAS releases by using federal enforcement authorities, where relevant and appropriate.	Ongoing
Understand sources and concentrations of PFAS in the environment	Partner with ECOS to build an interactive map to provide users with easy access to publicly available data on potential PFAS sources and occurrence.	Enable states, tribes, and communities to use the best available data to guide PFAS management decisions.	2019
Risk Communication and Engagement			
Coordinated messaging on PFAS across the federal government	Participate in and coordinate with an interagency PFAS risk communication workgroup to develop consistent communication materials that can be used across the federal government and are informed by the best available science.	Ensure coordinated messaging from the federal government is provided to the states, tribes, and local communities.	Ongoing Start 2019
Communication materials that can be used to inform the public of concerns related to PFAS	Work with other federal agencies, states, and tribes to develop a risk communication toolbox that includes materials and messaging for federal, state, tribal, and local partners to use with the public.	Provide states, tribes, local officials, and utilities with communication tools that convey clear and consistent messages to the public.	2019

Stakeholder Concern or Challenge	EPA Action(s)	Purpose	Anticipated Timeframe
Long-Term Actions			
Increase knowledge about PFAS releases	Explore data availability for listing PFAS chemicals to the Toxics Release Inventory (Section 313 of the Emergency Planning and Community Right-to-Know Act).	Make information about PFAS releases reported by industrial and federal facilities available. This information may be helpful to inform decision-making by communities, government agencies, companies and others.	Start 2019
Reduce PFAS releases into ambient waters and sources of drinking water	Determine if available data and research support the development of Clean Water Act Section 304(a) ambient water quality criteria for human health for PFAS.	When adopted by states and tribes as water quality standards, criteria can be used to set permit limits on discharges to a waterbody and to determine if a waterbody requires cleanup to protect human health and aquatic life.	2021
Hold responsible parties accountable for PFAS releases into the environment	Examine available information and beginning in 2019 seek additional information from industry to explore identification of industrial sources that may warrant potential regulation through national ELGs to be described in preliminary ELG plan 14 (2019).	ELGs require that a technology-based, minimum level of control be applied to any NPDES permit for direct discharge to waters or be directly applicable for indirect dischargers.	Start 2019
Characterize potential health impacts from a broader set of PFAS	Generate PFAS toxicology data through new approaches such as high throughput screening, computational toxicology tools, and chemical informatics for chemical prioritization, screening, and risk assessment.	Inform a more complete understanding of PFAS toxicity for the large set of PFAS chemicals without conventional toxicity data and allow prioritization of actions to potentially address groups of PFAS.	Ongoing
Develop more drinking water occurrence data for a broader group of PFAS	The EPA will propose nationwide drinking water monitoring for PFAS under the next UCMR monitoring cycle utilizing newer methods available to detect more PFAS chemicals and at lower minimum reporting levels (MRLs) than previously possible in earlier monitoring.	Monitoring results will improve understanding of the frequency and concentration of PFAS occurrence in finished U.S. drinking water.	Anticipated 2020
Develop a PFAS data inventory and best practices for contributing data	Develop a data standards best practice that allows sharing of soil, air, water, fish tissue, and other PFAS monitoring data.	Provide a way to share PFAS testing results for media other than drinking water that facilitates integration and easy access and use of PFAS data.	Start 2019

Stakeholder Concern or Challenge	EPA Action(s)	Purpose	Anticipated Timeframe
Access ecological risk information to protect ecosystems	Identify sensitive and susceptible species; synthesize information on bioaccumulation in organisms and food chains; where appropriate develop benchmarks and thresholds for ecological toxicity.	Enable action to protect aquatic ecosystems; establish cleanup levels for contaminated sites; protect recreational and cultural values, such as hunting and fishing.	2022
Understand potential for atmospheric transport of PFAS	Incorporate PFAS information into the EPA atmospheric models to understand the potential for atmospheric fate and transport of PFAS.	Enable risk managers to understand the full range of potential PFAS exposure pathways so that they can prioritize appropriate action.	2022

II. Introduction

Many Americans are concerned about potential health impacts from exposure to per- and polyfluoroalkyl substances (PFAS) in the environment. Over the last decade, there has been a move to the manufacture and use of PFAS that may be less bioaccumulative and may be less likely to cause adverse health effects in humans and the environment. However, contamination from legacy PFAS and uncertainty regarding the safety of newer, alternative, PFAS compounds in the environment are a continuing concern for the federal government, states, tribes, and local communities. The EPA is leading efforts with our federal, state, tribal, and community partners to better characterize and mitigate risks related to the presence of PFAS in the environment. The Agency will work with partners to accomplish these goals through pollution prevention, characterization and remediation of contamination in the environment, evaluation of human health and ecological risks, reducing exposures, development of treatment and remediation technologies, dissemination of risk communication materials, identification of safer alternatives, and use of enforcement authorities and regulatory approaches as appropriate.

This PFAS Action Plan identifies EPA-led short-term actions, longer-term research, and potential regulatory approaches designed to reduce the risks associated with PFAS in the environment. In carrying out this Action Plan, the EPA intends to work closely with its federal partners, states, tribes, and local communities. The challenges associated with PFAS cross multiple environmental media and many potential sources. Effective collaboration among all stakeholders is key to successful characterization, communication, and mitigation of concerns associated with PFAS in the environment. The EPA has heard the concerns expressed by the public through a recent series of EPA-sponsored community engagement meetings and through public comments submitted to the EPA through an open docket. The EPA will work with states, tribes, communities, and other federal agencies to take appropriate steps to protect human health and limit risks from PFAS in the environment. Through implementation of this Action Plan and active engagement with other federal agencies, international organizations, states, tribes, industry groups, associations, local governments, communities, and the public, the EPA will lead the national effort to understand and reduce PFAS risks to the American people. As the EPA learns more about PFAS and the risks they may pose, the Agency may update this Action Plan to reflect that new information.

III. PFAS Identification and Actions Previously Taken by the EPA

The term PFAS refers to per- and polyfluoroalkyl substances. PFAS are a very large group of synthetic chemicals that includes PFOA, PFOS, PFBS, perfluorononanoic acid (PFNA), hexafluoropropylene oxide (HFPO) dimer acid and its ammonium salt (referred to as GenX chemicals), and thousands of other compounds (USEPA 2018a). Due to their strong carbon-fluorine bonds, many PFAS can be very persistent in the environment with degradation periods of years, decades, or longer under natural conditions (Beškoski et al. 2018, Kallenborn 2004, Luo et al. 2015, Parsons et al. 2008, Frömel and Knepper 2010). Differences associated with chain length, chemical structure, and chemical functional groups incorporated into individual PFAS have important implications for mobility, fate, and degradation within the environment, as well as uptake, metabolism, clearance, and toxicity in humans, plants, and other animals. There is evidence that exposure to certain PFAS in the environment can lead to adverse human health effects (ATSDR 2018a, USEPA 2016a, USEPA 2016b). PFOA and PFOS, two of the most widely studied PFAS, have been detected in the blood serum of up to 99% of samples collected between 1999 and 2012 in a population that is representative for the U.S. More recent studies suggest blood levels of PFOA and PFOS have been decreasing since some U.S. manufacturers voluntarily phased out production beginning in 2000[4](ATSDR 2018a, USEPA 2016a, USEPA 2016b, CDC 2018). Measured body concentrations of other PFAS, including replacement PFAS, are showing different patterns (Kato et al. 2011, Olsen et al. 2008, USEPA 2018b). For example, PFNA in women of child-bearing age increased between 1999-2000 and 2007-2008, while perfluorohexane sulfonic acid (PFHxS) was relatively constant (USEPA 2013). However, because these results are based on a broad national survey, they do not depict the exposure distribution for those who live near PFAS-contaminated sites or people who work in

[4] The PFOA Stewardship Program began in 2006. PFOS was phased out by 3M between 2000 and 2002.

occupations that use PFAS. There are many PFAS in wide use for which more information regarding their presence, toxicity and mobility in a variety of environmental media is needed.

Stakeholder Concerns

At the PFAS National Leadership Summit, at community engagement events across the country, and through comments submitted to the docket, the EPA has heard about the many challenges communities are facing with PFAS. The EPA heard that effective collaboration is needed at the federal and state levels to compile and reconcile different information sources, better understand exposure impacts, enhance monitoring approaches, and to develop additional information on PFAS. Stakeholders and decision makers have emphasized the need to accelerate the understanding of PFAS toxicity and the impacts of PFAS to ecosystems as well as the need to expand the availability of analytical methods to detect and characterize exposures of concern.

At these events, the EPA also heard many challenges associated with addressing PFAS including:

- Cost burden and affordability concerns for PFAS-impacted communities and utilities, especially for the cost and operating requirements associated with treatment and remediation technologies;
- Lack of hazardous substance listings, precluding the use of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) cleanup orders and cost recovery for PFAS;
- Lack of enforceable numeric standards;
- Lack of multi-media sampling methods;
- Confusion about different health values from various authorities; and
- Information gaps on how to safely handle PFAS-containing waste byproducts, biosolids, treatment plant residuals, and materials containing PFAS.

Overarching Challenges for PFAS Management

Understanding the scope of PFAS exposure including sources, pathways, populations exposed, and levels of exposure is critical to effectively characterizing the potential human health and environmental risks associated with these compounds. Other unknown and undiscovered PFAS likely exist within the environment as impurities or byproducts of chemical production or as a result of environmental degradation and transformation processes. Health and occurrence data and validated analytical methods are available for certain PFAS (e.g., PFOA and PFOS). However, for most PFAS there is limited or no toxicity information. While validated EPA drinking water measurement methods are available for 18 PFAS today, including PFOA and PFOS, and more are in development, we lack validated analytical methods for national environmental measurements and assessment of exposure for hundreds of other PFAS. Additional challenges to remediation and cleanup include PFAS occurrence as mixtures with other contaminants. There are continuing research needs related to the development of PFAS destruction technologies. Additional tools and information would improve risk characterization, cleanup options, and management decisions. Knowledge of PFAS impacts on human health and the environment is advancing, and the EPA and other organizations are collaborating to generate research and consider new scientific information as it becomes available. To effectively manage PFAS-related exposures and

human health risks when they have been identified, decision makers must consider the potential sources, available technology and if necessary, the regulatory authorities and enforcement tools that may allow federal agencies, states, tribes, and local governments to address PFAS exposure in the environment.

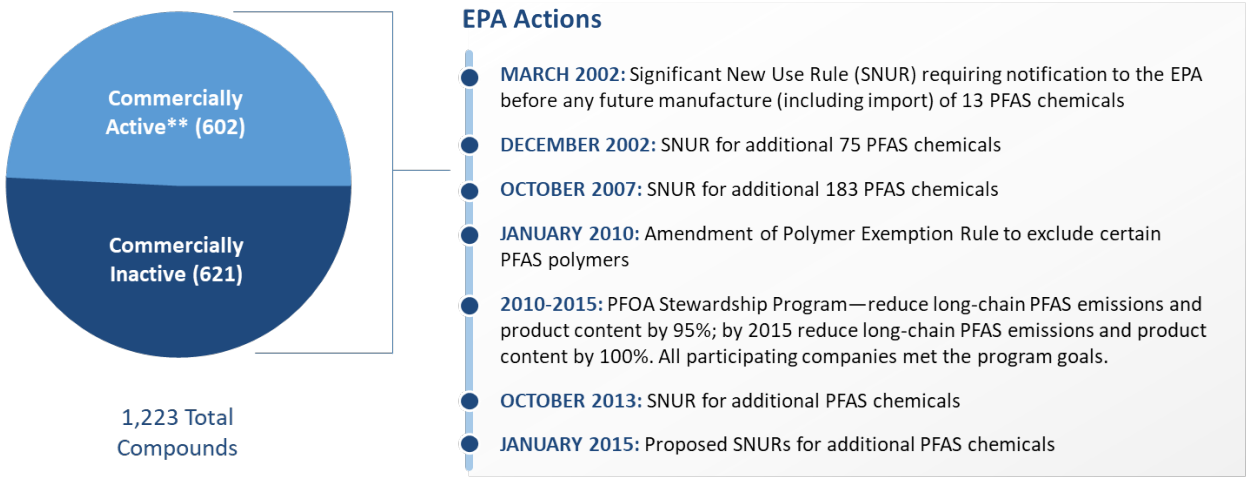
Federal, state, tribal, and local government, communities, and public and private entities will need to partner on developing and implementing management approaches, policies, and solutions to efficiently use limited resources to address PFAS-related risks. While better understanding and reducing the risks posed by PFAS is an important EPA priority, it is not the only public health or environmental challenge faced by our communities. Leveraging resources and partnering is important to ensure the availability of resources to address other priority environmental and public health issues.

While the EPA is evaluating options for development of the most appropriate regulatory programs and tools to address PFAS risks, the EPA also plans to actively lead and support PFAS management efforts using nonregulatory means and enforcement, where appropriate, in partnership with many stakeholders, to protect public health and the environment.

PFAS Use

Over 4,000 PFAS may have been manufactured and used in a variety of industries worldwide since the 1940s (OECD 2018, Guelfo et al. 2018). The EPA's Toxic Substances Control Act (TSCA) Chemical Substance Inventory lists over one thousand PFAS, of which approximately half are known to be commercially active within the last decade. Many PFAS are chemically and thermally stable and demonstrate resistance to heat, water, and oil (Rahman et al. 2014). These properties have made PFAS useful in a variety of consumer products and industrial processes, including firefighting foams, chemical processing, building/construction, aerospace, electronics, semiconductor and automotive industries, stain- and water-resistant coatings (e.g., carpets and rain repellent clothing), food packaging, and in waxes and cleaners (USEPA 2009). Due to their desirable chemical properties for consumer goods, PFAS are widely used in commercial products and can be found in almost every U.S. home and business. All eight companies participating in the EPA's PFOA Stewardship Program voluntarily phased out long-chain PFAS in favor of shorter-chain replacements, which are generally less bioaccumulative and potentially less toxic (Ritter 2010). Previously produced items and imported items may still contain longer-chain PFAS such as PFOA or PFOS (USEPA 2018b). Some replacement PFAS are capable of degrading to PFOA or other long-chain PFAS. Recent research suggests that additional factors aside from chain length may affect the bioaccumulation potential and toxicity of individual PFAS (ITRC 2018a, Ng et al. 2014).

PFAS on the TSCA Inventory*



* The TSCA Inventory is a list of chemical substances approved for U.S. commerce. The original Inventory was compiled from substances reported under the 1978 TSCA Inventory Reporting Rule, and substances have been added since via a commenced Premanufacture Notice.

** Substances on the TSCA Inventory currently designated as commercially active are those reported under the retrospective reporting requirements of the TSCA Inventory Notification (Active/Inactive) rule. These substances were in U.S. commerce at some point between June 2006 and June 2016.

Routes of Exposure

People are exposed to PFAS through the use of consumer products, through occupational exposure, and/or through consuming contaminated food or contaminated drinking water (Fromme et al. 2009). Potential pathways of significant human PFAS exposure include (USEPA 2018a, ATSDR 2018b, Fromme et al. 2009, Ghisi et al. 2018, McGoldrick and Murphy 2016, Stahl et al. 2014, Franko et al. 2012):

- Drinking water from public water and private water systems, typically localized and associated with a release from a specific facility (e.g., manufacturer, processor, landfill, wastewater treatment, or facilities using PFAS-containing firefighting foams);
- Consumption of plants and meat from animals, including fish that have accumulated PFAS;
- Consumption of food that came into contact with PFAS-containing products (e.g., some microwaveable popcorn bags and grease-resistant papers);
- Use of, living with, or otherwise being exposed to commercial household products and indoor dust containing PFAS, including stain- and water-repellent textiles (including carpet, clothing and footwear), nonstick products (e.g., cookware), polishes, waxes, paints, and cleaning products;
- Employment in a workplace that produces or uses PFAS, including chemical production facilities or utilizing industries (e.g., chromium electroplating, electronics manufacturing, or oil recovery); and
- In utero fetal exposure and early childhood exposure via breastmilk from mothers exposed to PFAS.

Potential Human Health Impacts

The majority of research on the potential human health risks of PFAS are associated with oral (ingestion) exposure. Limited data exist on health effects associated with inhalation or dermal exposure to PFAS. Most available toxicity data are based on laboratory animal studies. There are also several human epidemiological studies of PFOA and PFOS. Exposure to some PFAS above certain levels may increase risk of adverse health effects. While many of the same effects are observed for the family of PFAS chemicals, it appears that different adverse effects may be dominant in different PFAS. Depending on the PFAS, increased risks observed in some animal studies include developmental effects to fetuses during pregnancy and infants (e.g., low birth weight, altered puberty, skeletal variations), cancer (e.g., testicular, kidney), liver effects (e.g., tissue damage), immune effects (e.g., changes in antibody production and immunity), thyroid effects related to developmental outcomes, and other effects (e.g., cholesterol changes) (USEPA 2016a, USEPA 2016b). The EPA plans to continue evaluating toxicity information for PFAS; critical information may come from investigating whether exposure to structurally similar PFAS results in similar health effects. Currently, long-chain PFAS are generally thought to present greater toxicity in humans than shorter-chain PFAS (Ritter 2010, Eschauzier et al. 2012), though the toxicities of short-chain PFAS have generally been less thoroughly studied (Danish EPA 2015). Additionally, short-chain PFAS are as persistent in the environment as their longer-chain analogues and are highly mobile in soil and water (Bergström 2014). Due to increasing global production and use, environmental and human exposure to short-chain PFAS is expected to increase over time (Wang et al. 2013). Differences in mobility, fate and persistence in the environment, as well as treatability in environmental media across the complex family of PFAS are expected to contribute to differences in potential exposures and resulting health risks in humans.

History of the EPA's PFAS Actions

The EPA has been actively engaged in preventing risks associated with PFAS. Several statutes provide the EPA with the authority to address PFAS, including TSCA, the Safe Drinking Water Act (SDWA), and CERCLA. This section provides an overview of previous actions the EPA has taken to address PFAS.

Toxic Substances Control Act (TSCA)

Under TSCA, the EPA has broad authority to issue regulations designed to gather health/safety and exposure information on, require testing of, and control exposure to chemical substances and mixtures. TSCA gives the EPA authority to require reporting, record-keeping, and testing of chemical substances and mixtures, and protect against unreasonable risks to human health and the environment from existing chemicals. Among other things, section 5 of TSCA allows the EPA to issue SNURs that require notice to the Agency before chemical substances and mixtures are manufactured (including imported) or processed for significant new uses.

The EPA has used various strategies under TSCA to better understand and reduce exposures to PFAS. For example, in early 2000, the EPA worked with the 3M Company to support the company's voluntary phase-out and elimination of PFOS production and use. As a result of the EPA's 2010/2015 PFOA Stewardship Program, eight major chemical manufacturers and processors agreed to phase out the use

of PFOA and PFOA-related chemicals in their products and emissions from their facilities. All companies met the PFOA Stewardship Program goals by 2015. Through the EPA's work under TSCA, the Agency has also issued various SNURs to require manufacturers (including importers) and processors of certain PFAS chemicals to notify the EPA at least 90 days before starting or resuming significant new uses of these chemicals. This notification would require the EPA to review the significant new use, make a risk determination under section 5, and take appropriate regulatory action based on that risk determination. In 2015, the EPA proposed the most recent SNUR on PFAS to complement the long-chain PFAS phaseout under the 2010/2015 PFOA Stewardship Program by requiring manufacturers (including importers) of PFOA and certain PFOA-related chemicals, including as part of articles, and processors of these chemicals to notify the EPA at least 90 days before starting or resuming new uses of these chemicals. Upon receipt of the notice and prior to any "significant new use" activity commencing, TSCA mandates that the EPA review the potential health and environmental effects, make an affirmative determination on the risks, and take actions necessary to eliminate those risks, as appropriate. The EPA is considering the public comments received on the 2015 proposed SNUR as well as the new statutory requirements added by the Frank R. Lautenberg Chemical Safety for the 21st Century Act as it works to issue a supplemental proposed SNUR on PFAS for the manufacture (including import) of certain long-chain perfluoroalkyl carboxylate (LCPFAC) chemical substances, including as part of categories of certain articles, and the processing of these chemicals.

Safe Drinking Water Act (SDWA)

Section 1412 of the SDWA requires the EPA to publish a list of contaminants known or anticipated to occur in public water systems which may require regulation under the Safe Drinking Water Act (the Contaminant Candidate List). The EPA included PFOA and PFOS on the fourth Contaminant Candidate List (USEPA 2018c). The EPA worked with states and public water systems to characterize the occurrence of six PFAS in the nation's drinking water by including them in the third Unregulated Contaminant Monitoring Rule (UCMR), published in 2012 under the SDWA. The EPA uses the UCMR to collect data for contaminants that are suspected to be present in drinking water and do not have standards set under the SDWA. The EPA collected data for six PFAS in the UCMR: PFOA, PFOS, PFBS, PFNA, PFHxS, and perfluoroheptanoic acid (PFHpA). From 2013-2015, drinking water samples were collected and analyzed in nearly 5,000 public water systems across the nation, accounting for approximately 80% of the U.S. population served by public water systems (USEPA 2016c). The EPA plans to use these monitoring results and other information in the next step in the SDWA regulatory determination process as described below. In addition to the regulatory process, the SDWA provides authority for the Agency to publish drinking water Health Advisories (HAs) which are non-enforceable, health-based drinking water levels. In 2016, the EPA released lifetime Health Advisories for two PFAS (PFOA and PFOS). These Health Advisories provide the public, including the most sensitive populations, with a margin of protection from a lifetime of exposure to PFOA and PFOS from drinking water. Health Advisories are non-enforceable and non-regulatory and provide technical information to state agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination (USEPA 2016a, USEPA 2016b).

Furthermore, pursuant to section 1431(a) of the SDWA, the EPA has authority to take actions the Agency deems necessary to protect public health when a contaminant, whether regulated or not, is

present in or likely to enter a public water system or an underground source of drinking water, and "may present an imminent and substantial endangerment to the health of persons." This authority enables the EPA to respond to emergency conditions and conditions where contamination threatens public health. This section 1431 authority is distinct from the process to establish National Primary Drinking Water Regulations under section 1412 of the SDWA. The EPA has used its authority under section 1431 to issue orders that require persons who have caused or contributed to PFAS contamination to take actions as may be necessary to protect the health of persons, including actions that reduce or prevent exposures.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA, commonly known as Superfund, provides the federal government with authority to respond to releases and threatened releases of hazardous substances, and, if they may present an imminent and substantial endangerment, pollutants and contaminants. CERCLA section 104(e) also provides authority to investigate a site to determine whether hazardous substances, pollutants or contaminants have been or may be released. If there is a release of a hazardous substance, parties responsible for the release may be ordered to respond under CERCLA and/or may be liable under CERCLA for the costs of responding to those releases. PFOA and PFOS are considered CERCLA pollutants or contaminants, not hazardous substances. Thus, federal response/cleanup authority exists where the federal agency with CERCLA authority has made a determination that the PFOA or PFOS release may present an imminent and substantial danger to public health or welfare. In addition, the EPA has initiated the regulatory development process to designate PFOA and PFOS as CERCLA "hazardous substances", which would extend CERCLA order and cost recovery authorities to address communities affected by PFOA and PFOS contamination.

The EPA supports federal agencies, states, tribes, and local communities by coordinating with others to identify exposures, developing methods in order to measure PFAS in the environment, and supporting cleanup efforts where PFAS has been identified as a risk to human health, including working with other federal partners and using enforcement tools where necessary. Where the EPA finds that there may be an imminent and substantial endangerment to public health or welfare related to PFAS contamination, the Agency will consider using its response authority under CERCLA section 104 or utilizing its enforcement authorities such as the SDWA section 1431 or Resource Conservation and Recovery Act (RCRA) section 7003.

Consistent with CERCLA, the Agency for Toxic Substances and Disease Registry (ATSDR) recently released draft toxicological profiles for multiple PFAS, which included Minimal Risk Levels (MRLs). ATSDR's MRLs for four PFAS substances (i.e., PFOA, PFOS, PFHxS, and PFNA), when finalized, are intended to serve as screening tools to help public health professionals to determine areas and populations potentially at risk for exposure and can be used as a mechanism to identify hazardous waste sites that are not expected to cause adverse health effects (ATSDR 2018a). The EPA will continue to partner with ATSDR to better understand and communicate risks to human health from PFAS.

IV. Reducing PFAS Exposures: What the EPA Is Doing to Ensure the Problem Is Not Exacerbated

Understanding PFAS in Commerce

Risk Management for PFAS under TSCA

The EPA has the responsibility for reviewing new chemical substances before they enter commerce. The EPA's TSCA New Chemicals program functions as a "gatekeeper" to help manage the potential risk to human health and the environment from chemicals new to the marketplace. TSCA requires the EPA to make risk determinations on new industrial chemicals and provides the EPA with a range of regulatory options to address risks. The EPA has reviewed hundreds of new chemical substitutes for PFOA, PFOS, and other long-chain PFAS under TSCA since 2000. In many cases, the EPA has used its authority under TSCA to impose restrictions on these substances—as well as requiring companies to generate data on physical and chemical properties, environmental fate, toxicokinetics, acute toxicity, irritation and sensitization, repeated dose toxicity,

EPA Priority Action

ACTION: New SNUR on PFAS chemicals.

PURPOSE: In 2015 the EPA proposed the most recent SNUR on PFAS chemicals to complement the long-chain PFAS-phaseout under the 2010/2015 PFOA Stewardship Program.

NEXT STEPS: The EPA is considering the public comments received as well as the new statutory requirements added by the Frank R. Lautenberg Chemical Safety for the 21st Century Act as it works to issue a supplemental proposed SNUR on PFAS.

genotoxicity, reproductive/developmental toxicity, and cancer—as conditions for allowing the substances on the market.

Anyone who plans to manufacture or import a new PFAS chemical substance for a non-exempt[5] commercial purpose must first provide the EPA with notice, known as a premanufacture notice (PMN). The EPA must review and make an affirmative determination on the PMN. For purposes of TSCA, if a chemical is on the TSCA Inventory, the substance is considered an existing chemical substance in U.S. commerce. Any chemical that is not on the Inventory is considered a new chemical substance.

The EPA is required under TSCA to review PMNs in a 90-day period with the goal of identifying whether there are unreasonable risks and applying appropriate controls to mitigate risks where identified. The EPA uses an integrated approach that draws on knowledge and experience across disciplinary and organizational lines to identify releases and exposures and evaluate concerns regarding health and environmental effects. The EPA evaluation includes an assessment of occupational exposures and facility releases to land, water, and air. The EPA then evaluates the impacts of these releases on environmental receptors (primarily aquatic) as well as to the general population, including susceptible populations. The EPA also conducts, when relevant, an assessment of non-workplace exposures such as those experienced by persons using a specific commercial or consumer product containing a chemical (e.g., paints, cleaners). Product use scenarios used to assess risk may include, as appropriate, assessment of 'bystanders' (i.e., persons not actually using the product, but within the exposure vicinity) and subsequent impacts on environmental receptors. As required by TSCA, these evaluations are risk based and consider both hazard and exposure.

By the end of the review period, the EPA must make one of five determinations under TSCA:

1. Insufficient information to perform a reasoned evaluation;
2. Insufficient information and may present unreasonable risk;
3. Not likely to present an unreasonable risk;
4. Presents an unreasonable risk; or
5. Potential for substantial release/exposure.

More information on the EPA's review and decision-making processes is available on the EPA's website at: https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca.

The EPA can designate through rulemaking certain new uses of a chemical as significant new uses. Anyone who plans to manufacture or import a chemical substance for a use that has been designated by the EPA as a significant new use must first provide the EPA with notice, known as a significant new use notice (SNUN). The EPA must review and make an affirmative determination on the notice before that new use can commence, if at all. The EPA has already designated significant new uses for more than 400 PFAS chemicals, including for certain PFAS substances that have been through the new chemical review

[5] Certain manufacture of chemical substances is excluded or exempt from full PMN notification requirements, including small quantities of substances manufactured solely for research and development, substances manufactured for test marketing, substances manufactured in low-volumes, and substances manufactured with low releases or low exposures. Some of these exemptions (e.g., the Low Volume Exemption) require submission of an application to the EPA for review and potential action.

process but have not yet been commercialized, and for certain PFAS substances used in manufacturing (including importing) and processing of carpets or for treating carpet.

The Agency proposed in 2015 a Significant New Use Rulemaking for Long-Chain Perfluoroalkyl Carboxylate and Perfluoroalkyl Sulfonate Chemical Substances that would require manufacturers (including importers) of PFOA and certain PFOA-related chemicals, including as part of articles, and processors of these chemicals to notify the EPA at least 90 days before starting or resuming new uses of these chemicals in any products. The Agency plans to follow up on the 2015 SNUR.

Depending on the outcome of its review and determination, under TSCA the EPA may take actions on a new PFAS or significant new PFAS use, ranging from imposing restrictions or limitations (e.g., use restrictions, production volume cap, limitation on releases to water, etc.) to an outright prohibition on manufacture to ensure that the substance does not present an unreasonable risk. For example, if the EPA determines that there is insufficient information to perform a reasoned evaluation or that the chemical may present an unreasonable risk, the EPA may issue an order under TSCA that eliminates the potential for unreasonable risk. The EPA can also require the submitter to conduct testing to better understand whether or to what extent the chemical presents risks. Nearly all TSCA new chemicals orders issued by the EPA are consent orders negotiated with the submitter of the notice. Because these orders are binding only on the original PMN submitter for that substance, the EPA typically also issues a Significant New Use Rule that requires notice to the EPA by any manufacturer or processor who wishes to manufacture or process the chemical in a way other than described in the terms and conditions contained in the order.

Over the decades, and in particular since the beginning of the phase-out of long-chain PFAS in 2006 under the PFOA Stewardship Program, the EPA's new chemicals program has developed significant experience in reviewing PFAS substances before they enter the market. More than 300 PMN or SNUN submissions for PFAS substances have been reviewed by the EPA since the beginning of the PFOA Stewardship Program, of which about 200 were regulated by the EPA, typically under a section 5(e) Order. Similarly, more than 300 Low Volume Exemption Applications have been reviewed by the EPA during this period, most of which were granted based on restrictions/controls in the original or amended submissions.

With the restrictions the EPA has imposed on many of these chemicals, together with the data the EPA required to be generated, the TSCA new chemicals program is an important contributor to helping ensure the safe use of PFAS in commerce.

PFAS and the Toxics Release Inventory

Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) created the TRI Program. The TRI Program's mission is to provide the public with information about TRI chemicals, including releases, other waste management (e.g., recycling), and pollution prevention from TRI-reporting facilities. The TRI Program is another tool the EPA may use to understand the releases of PFAS by industrial and federal facilities. TRI tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. U.S. facilities in different industry sectors must report annually how much of each chemical is released to the environment and/or managed through recycling,

energy recovery and treatment. A "release" of a chemical means that it is emitted to the air or water or placed in some type of land disposal. The information submitted by facilities is compiled in the Toxics Release Inventory. TRI helps support informed decision-making by companies, government agencies, non-governmental organizations, and the public.

Currently, no PFAS chemicals are included on the list of chemicals required to report to TRI; however, the EPA is considering whether to add PFAS chemicals. In considering listing, the EPA must determine whether data and information are available to fulfill the listing criteria and the extent and utility of the data that would be gathered. For example, hazard data required for TRI listing may be readily available for certain PFAS chemicals, but not others. In addition, in considering if TRI will provide useful information to stakeholders, the EPA also will consider if those PFAS are still active in commerce. The process for listing includes notice and comment rulemaking to list PFAS chemicals for reporting prior to adding these chemicals to the TRI for annual reporting.

V. Understanding PFAS Toxicity to Develop Recommendations and Standards

The EPA is working to understand and address PFAS toxicity through development of human health toxicity assessments on long- and short-chain PFAS. This and other research using advanced toxicological methods will provide a better understanding of PFAS toxicity, including methods for assessing groups of PFAS with similar toxicities and exposures. Toxicity information can be used to provide health protective recommendations and standards for cleanup of environmental media.

The EPA's Actions to Develop Human Health Toxicity Information on PFAS

In 2016, the EPA issued a non-regulatory lifetime Health Advisory (HA) of 70 parts per trillion (ppt) for individual and combined PFOA and PFOS in drinking water. Additional information on the Health Advisories for PFOA and PFOS can be found at https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos. The EPA has made it a priority to produce a new toxicity assessment for GenX chemicals and an updated toxicity assessment for PFBS to facilitate hazard characterization and future risk management decisions. The EPA made

EPA Priority Action

ACTION: The EPA is developing toxicity values for GenX chemicals and PFBS.

PURPOSE: Industry has phased out the use of PFOS and PFOA in favor of shorter-chain PFAS such as GenX chemicals and PFBS. Toxicity values for these replacement chemicals will help inform risk management decisions of federal agencies, states, and tribes to protect human health.

NEXT STEPS: The EPA plans to release final toxicity values for GenX chemicals and PFBS in 2019. Toxicity values for five other PFAS are under development.

draft toxicity assessments for GenX chemicals and PFBS available for public comment in 2018 and expects to issue final toxicity assessments for these two compounds in 2019. Concurrently, the EPA plans to generate additional PFAS toxicity data through *in vitro* high throughput toxicity testing (HTT) and high throughput toxicokinetic (HTTK) assays to inform hazard effects characterization and promote prioritization of chemicals for further *in vivo* testing (Judson et al. 2009, Kavlock and Dix 2010). Generating HTT and HTTK data will improve our understanding of PFAS toxicity and potential human health effects for PFAS compounds for which there is currently limited health-related information and can help to inform Agency and stakeholder decision-making regarding human health risk and remediation levels across the broad landscape of PFAS compounds. In the near term, the EPA intends to also continue to use public peer-reviewed available toxicity information to work towards the development of additional PFAS toxicity assessments for perfluorobutanoic acid (PFBA), perfluorohexanoic acid (PFHxA), PFHxS, PFNA, and perfluorodecanoic acid (PFDA).

Groundwater Cleanup Recommendations for PFOA and PFOS

The EPA is developing Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS to support site-specific cleanup efforts. When finalized, the guidance will provide interim recommendations at sites being evaluated and remediated under the EPA's CERCLA federal cleanup program or at federal-led RCRA corrective action sites. The information and recommendations in this guidance may also be useful for other federal agencies, states, tribes, or other regulatory authorities (e.g., approved state RCRA corrective action programs).

Addressing PFAS in Drinking Water through Standards

The EPA is committed to following the Safe Drinking Water Act process for evaluating drinking water standards for PFAS, including an MCL for PFOA and PFOS. That process involves determining: (1) whether a contaminant may have adverse health effects; (2) whether a contaminant is found in public water systems with a frequency and at levels of concern; and (3) whether, in the sole judgment of the Administrator, there is a meaningful opportunity for health risk reduction through a national drinking water regulation. This process includes a formal rulemaking, engagement with the EPA's National Drinking Water Advisory Council, and extensive public participation. These requirements are expressly prescribed under the Safe Drinking Water Act to ensure scientific integrity and transparency for the regulation of contaminants in public water systems.

EPA Priority Action

ACTION: The EPA is developing interim recommendations for addressing groundwater contaminated by PFOA and PFOS.

PURPOSE: These recommendations will assist the EPA, other federal agencies, states, and tribes in developing and implementing cleanup goals for PFOA and PFOS under CERCLA.

NEXT STEPS: The groundwater cleanup recommendations will be released for public comments prior to finalization.

Certain PFAS have been shown to cause adverse health effects at sufficient exposures, and the EPA is continuing to gather and analyze data regarding the frequency and levels of occurrence of the sampled PFAS. Under the third Unregulated Contaminant Monitoring Rule (UCMR3) program the EPA collected data for six PFAS. From January 2013 through December 2015, samples were collected nationally by all public water systems (PWSs) serving more than 10,000 people, as well as from 800 representative PWSs serving 10,000 or fewer people. Additional information can be found at the EPA's UCMR3 website https://www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule (USEPA 2016c). The EPA found that 1.3 percent of the PWSs monitored under UCMR3 had measured concentrations of PFOA and PFOS that were greater than the EPA's lifetime HA (lifetime HA limit of 70 ppt or 0.07µg/L) (USEPA 2016a, USEPA 2016b).

Using the occurrence information from UCMR3 and other relevant information, the EPA will propose a regulatory determination for PFOA and PFOS in 2019 for public comment. A regulatory determination is the next step in the SDWA process for developing a national primary drinking water regulation. The Agency also recognizes that there is additional information that the EPA should evaluate regarding PFAS other than PFOA and PFOS, including new monitoring and occurrence data, recent health effects data, and additional information to be solicited from the public, which will inform the development of a national drinking water regulation for a broader class of PFAS in the future.

EPA Priority Action

ACTION: The EPA is committed to proposing a regulatory determination for PFOA and PFOS. In addition, the EPA is committed to proposing additional PFAS for the next round of unregulated contaminant monitoring.

PURPOSE: This is the next step in the SDWA process and will enable the EPA to obtain additional information on PFOA, PFOS, and other PFAS compounds to inform regulatory action.

NEXT STEPS: In 2019, propose a regulatory determination for PFOA and PFOS highlighting key information gathered by the Agency to date. The EPA will invite the public to comment on the Agency's efforts to date, including recommending additional information the Agency should consider in its regulatory determination.

The EPA also intends to propose nationwide drinking water monitoring for PFAS under the next UCMR monitoring cycle utilizing newer methods available to detect different PFAS and at lower minimum reporting levels (MRLs) than previously possible in earlier monitoring. As part of this process, the EPA intends to solicit pre-proposal stakeholder input in 2019 and issue a proposed drinking water monitoring rule (UCMR5) in 2020.

In addition to the available UCMR data, the EPA plans to evaluate the extensive occurrence information for PFAS in source and drinking waters recently collected by some states, and which other states intend to collect in the future. The Agency has also heard extensive concerns from the public about PFAS that were not monitored as a part of the UCMR3 effort. Within the proposed regulatory determination federal register notice for PFOA and PFOS, the EPA plans to highlight the information that is known by

the Agency and invite the public to provide additional information that the EPA can consider, including information from additional data sources related to sampling of additional water systems and for a broader suite of PFAS. Based on this and other information (including UCMR finished water data), the EPA will make a final determination for PFOA and PFOS, and as appropriate, other PFAS and take the appropriate next regulatory steps under the SDWA. In the interim, the Agency intends to prioritize prevention and remediation programs to support local communities currently facing PFAS challenges and will exercise its SDWA authorities where necessary and appropriate.

VI. Identifying PFAS and Addressing PFAS Exposures in Affected Communities

The EPA is focused on identifying and addressing PFAS exposures in order to protect people and communities from exposures to PFAS that present an adverse health risk, especially for the most vulnerable members of the exposed population. Additionally, the EPA is focused on providing tools and information to support federal agencies, states, tribes, and local communities to address PFAS in the environment. This work involves coordinating with others to identify exposures, developing methods in order to measure PFAS in the environment, and supporting cleanup efforts where PFAS has been identified as a risk to human health, including working with other federal partners and using enforcement tools where necessary. Where the EPA finds that there may be an imminent and substantial endangerment to public health related to PFAS contamination, the Agency will consider using its response authority under CERCLA section 104 or utilizing its enforcement authorities such as the SDWA section 1431 or RCRA section 7003.

Work with States, Tribes, and Local Governments on Identifying Exposures

Identifying PFAS is the first step in understanding if PFAS exposure may be of concern to a community. PFAS exposure in the general population occurs primarily through consumption of food that has been stored or cooked in materials containing PFAS, eating contaminated food grown in or collected from contaminated soil or water (Ghisi et al. 2018), eating contaminated meat from animals (e.g., fish), contact with household products contact through contaminated soil and dust (Shoeib et al. 2005), or drinking water that has been contaminated with PFAS. Drinking water contamination is typically localized and associated with a specific source of PFAS (for example, an industrial facility where these chemicals were produced or used to manufacture other products; or an airfield, military base, or petroleum or chemical facility at which PFAS containing foams were used for firefighting or training

(USEPA 2018a, Hu et al. 2016, Guelfo et al. 2018)). In addition to the monitoring conducted by the EPA and states as part of the UCMR program (monitored for six PFAS), some states have taken additional steps to understand the occurrence of PFAS contamination in communities with potential PFAS exposures from current or historical activities. In addition, some states have conducted sampling and monitoring more broadly to identify locations with PFAS contamination. These steps include sampling drinking water—either in large water systems that serve multiple communities, private potable wells potentially impacted by releases, or sites where PFAS-containing materials are known to have been used—to gather important baseline data on the presence of PFAS in the environment. A number of environmental monitoring activities are also ongoing to measure and assess trends of PFAS in air, water, fish, wildlife, and sediment. In addition, some states are conducting biomonitoring studies to measure the levels of PFAS in people (ASTHO 2018). States can also consider updating their source water assessments to account for potential PFAS risks based on monitoring results or known sources of contamination. The EPA is working with our partners to develop and disseminate sampling, measurement, and treatment tools to help stakeholders concerned about PFAS in their communities to implement actions to prevent and mitigate harmful human exposures to PFAS.

Many stakeholders have questioned the extent and magnitude of PFAS contamination across the United States. To help fill these information gaps, the EPA intends to compile baseline, publicly available, PFAS environmental data into a visual map. Mapping tools can be used to show known or potential PFAS contamination sources and related information. The EPA may also specify sites of interest to environmental monitoring, such as wildlife refuges and fisheries, as well as additional impacted environmental media (for example, air or soil). These efforts can be used to help assess environmental trends in PFAS concentrations and serve as one source of information for local and regional authorities.

The EPA is also exploring how to coordinate sampling, data sharing, and data evaluation across environmental media and biota to provide online tools that can provide information about PFAS detections for government and public users. The EPA plans to work with state partners to develop data sharing standards so that testing results (either government sampling results or public testing) can be shared in a way that is accessible and useful. The EPA will explore development of a PFAS inventory and data plan. The EPA intends to play a lead role in distributing tools that provide the public with an integrated look at what is known about PFAS detections.

Development of Field and Laboratory Methods to Measure PFAS in the Environment

When available, validated analytical methods for measuring PFAS and PFAS precursors in multiple environmental media enable a more accurate understanding of PFAS occurrence and exposures. This information in turn helps the EPA's effort to focus toxicity studies on the most prevalent PFAS exposures in the environment. With the information produced using validated analytical methods, decision makers can also understand the extent of PFAS contamination and better design and execute remediation and treatment. The EPA recently released an expanded drinking water Method 537.1 to include additional PFAS, including GenX chemicals. Longer-term efforts include the development and multi-lab validation of methods (e.g., SW-846, 40 CFR Part 136) for complex water matrices (e.g., wastewater, surface waters, groundwaters), solids (e.g., soil, sediment, biosolids, fish tissues), air (e.g., ambient, stack emission, off-gases), and other PFAS in drinking water not currently captured by Method 537. In

addition, the EPA continues to collaborate with others to refine and apply high resolution mass spectrometry (HRMS) analytical methods for discovery and identification of additional PFAS in environmental media (McCord et al. 2018, Newton et al. 2017, Strynar et al. 2015). These efforts will support federal partners, states, tribes, and other stakeholders in site assessment and remediation and help characterize the broader environmental occurrence and potential exposure to PFAS compounds in drinking water and other impacted environmental media. For more information on the EPA research plans related to PFAS, please see Section VII.

Risk Assessment Definitions

RESEARCH: The EPA conducts laboratory and field observations, compiles and synthesizes information, and develops models and tools in order to understand toxicity, exposure, treatment, and remediation.

HAZARD IDENTIFICATION & DOSE-RESPONSE ASSESSMENTS: The EPA determines whether exposure to a contaminant (e.g., PFAS) has the potential to cause harm to humans and/or ecological systems, and if so, under what circumstances.

EXPOSURE ASSESSMENTS: The EPA models or measures contamination (e.g., in drinking water) and predicts how people and ecological systems can come in contact with a contaminant, along with the size and characteristics of the population exposed (including the most vulnerable) to estimate exposure.

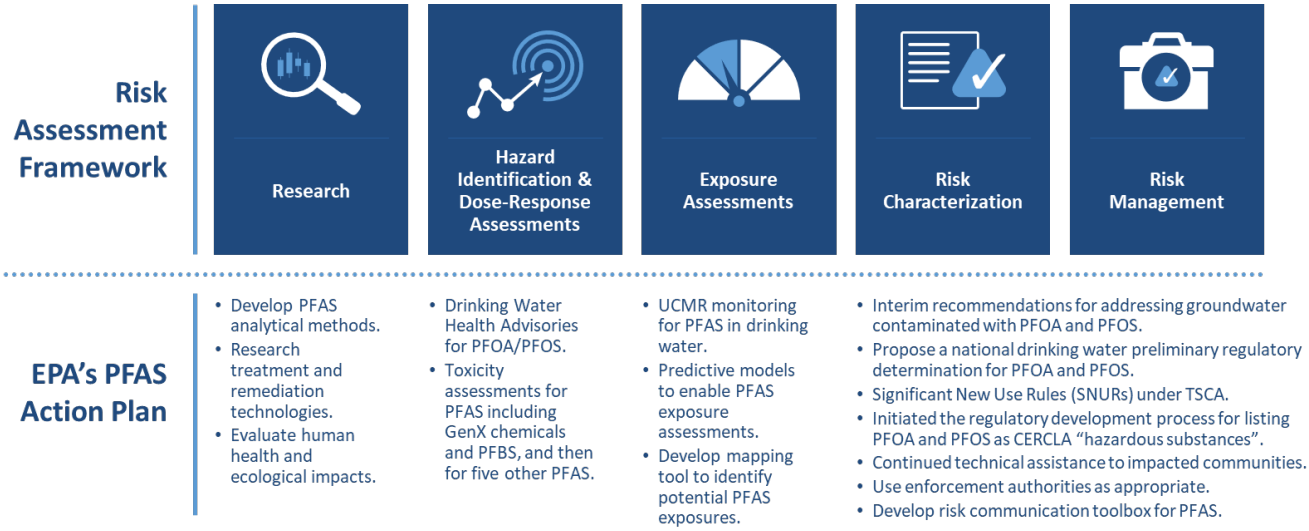
RISK CHARACTERIZATION: The EPA works to integrate the previous steps to create a comprehensive picture of potential PFAS risks, considering hazard, dose-response, and exposure information.

RISK MANAGEMENT: The EPA applies information attained in the previous steps to develop, analyze, and compare options and identify the most appropriate treatment, remediation, or policy response, including how to best exchange information about health or environmental risks among various stakeholders.

Utility of Additional Exposure Information on PFAS

Applying new analytical methods for discovering and measuring PFAS in the environment would enable a better understanding of the sources, types of PFAS, and the exposure pathways which bring PFAS into contact with people and ecosystems. This information could be used to prioritize PFAS for toxicity testing and to facilitate assessment of the relative importance of different pathways (how much PFAS exposure is via food, water, dust, or other media/pathways). This information, combined with more knowledge about PFAS toxicity, could enable stakeholders to identify the PFAS exposures which are of greatest relevance and potential impact to humans and ecosystems, enabling them to prioritize their management efforts and allocate their resources to achieve the maximum reduction in risk. For more information on the EPA's research efforts related to risk assessment, please see Section VII.

EPA Actions and the Risk Assessment Framework



Mitigating PFAS Exposures

To prevent adverse effects to human health and the environment both now and in the future, the EPA is prioritizing short-term exposure prevention and long-term cleanup goals. The EPA will work with federal, state, tribal, and local agencies to employ appropriate authorities, when necessary, to address or prevent PFAS contamination. Potential federal enforcement, regulatory, and response authorities include, for example, the SDWA; RCRA sections 3004(u) and (v); 3005; 3008(h); 3013; and TSCA sections 5, 6, 7, and 8. Additionally, the EPA will continue to develop tools and provide information to support decision-making on mitigating PFAS exposures.

Hazardous Substance Listing for PFAS

EPA Priority Action

ACTION: The EPA has initiated the regulatory development process for listing PFOA and PFOS as CERCLA "hazardous substances" using available statutory mechanisms.

PURPOSE: A "hazardous substance" designation under CERCLA provides more options for the federal government to facilitate use of response and enforcement authorities.

In addition to short-term exposure prevention, the EPA will continue to provide technical assistance on site-specific PFAS challenges across the country, including using CERCLA and other authorities, as appropriate, to investigate sites when needed. The EPA is also developing Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS to support site-specific cleanup efforts (see section V). An important long-term action for federal agencies, states, tribes, communities, and the public is the development of additional tools to facilitate cleanup of PFAS-contaminated sites and recover cleanup costs from responsible parties. In order to augment the EPA's ability to use its CERCLA federal response authority, the EPA is moving forward with how best to designate PFOA and PFOS as CERCLA "hazardous substances" using one of the available statutory mechanisms. Following the PFAS Summit in May 2018, the EPA began an intensive effort to examine the statutory options that could be used to designate PFOA and PFOS as CERCLA hazardous substances. This effort included consideration of the benefits and challenges, as well as the timing and criteria for each available option. There are several statutory authorities available to define PFOA and PFOS as CERCLA hazardous substances, including CERCLA, RCRA, TSCA, Clean Water Act (CWA), and the Clean Air Act (CAA). The EPA is initiating the regulatory development process for listing PFOA and PFOS as CERCLA hazardous substances.

Tools to Mitigate PFAS in Our Nation's Waters

The EPA will continue to work towards providing impacted communities with the tools they need to mitigate risks from PFAS. To further support communities in making decisions about mitigating exposures from drinking water, the EPA intends to continue to update the Drinking Water Treatability Database for PFAS, including treatability and cost information for different technologies and additional PFAS of concern. The treatability database presents information on the control of contaminants in drinking water through treatment processes such as activated carbon, ion exchange, and high-pressure membranes. The treatability database allows utilities, emergency responders, regulators, and other stakeholders access to comprehensive information gathered in a single location. The EPA is also conducting bench-, pilot-, and full-scale experiments to identify performance and cost of treatment (both capital and operations and maintenance), along with potential unintended consequences of employing specific technologies. Better understanding the capabilities of available treatment technologies will further enable the removal of PFAS in drinking water.

Several states are taking actions related to PFAS, including product labeling and consumer products laws, chemical action plans, listing select PFAS as hazardous wastes or designating select PFAS as hazardous substances through state-specific authorities, and developing standards and guidance values

to limit concentrations of PFAS in groundwater or drinking water (ITRC 2018b). PFAS can be considered pollutants under the Clean Water Act, and states can use National Pollutant Discharge Elimination System (NPDES) permits to control discharges from point sources containing PFAS into receiving waters, including sources of drinking water. To support states in managing their water quality, the EPA will evaluate development of ambient water quality criteria under section 304(a) of the Clean Water Act to facilitate state permitting efforts, if adequate data are available.

Parties responsible for PFAS releases, states, and utilities have acted to reduce exposure to PFAS in drinking water from community water systems and private wells through the installation of treatment systems, providing connections to public water systems, point-of-use filters, point-of-entry treatment systems, or through the provision of bottled water. Conventional drinking water treatment technologies (coagulation, flocculation, clarification, filtration, and disinfection) have not been found to be effective in removing PFAS. Technologies have been found to remove longer-chain PFAS, such as PFOA and PFOS, from drinking water including activated carbon adsorption, ion exchange resins, and high-pressure membranes (Rahman et al. 2014, Eschauzier et al. 2012, Flores et al. 2013). These technologies can be used in drinking water treatment facilities, in point-of-entry systems to treat all the potable water that enters a home or other building, or at the point-of-use of potable water, such as in a kitchen sink (USEPA 2018d). The EPA is currently working to better understand the efficacy of commercially available point-of-use and point-of-entry treatment applications for PFAS. In some cases, these treatment technologies can result in considerable cost to utilities or homeowners within communities that have been impacted by PFAS. Concerns continue to be expressed by communities regarding the potential for ongoing exposure to PFAS that are less well characterized or are less amenable to measurement and/or removal using existing treatment technologies.

Each state administers the Drinking Water State Revolving Fund (DWSRF) to provide low-interest loans for drinking water infrastructure and technical assistance to publicly-owned community water systems (CWSs), privately-owned CWSs, and non-profit non-CWSs to facilitate compliance with national primary drinking water regulations or to significantly further the health protection objectives of the SDWA (USEPA 2018d, USEPA 2018e). Under the SDWA, states may set aside up to up to 31% of their DWSRF capitalization grant to fund state programs and third parties to provide assistance and build the capacity of drinking water systems. DWSRF set-asides can fund laboratory or testing equipment for research or contamination prevention. In addition, states with a synthetic organic chemical monitoring waiver program can use the DWSRF to assist with special-purpose monitoring, including PFAS, at local systems that have not yet tested for PFAS (USEPA 2017).

A detailed understanding of the sources of PFAS contamination can help communities impacted by PFAS with the development of long-term solutions. Common sources of PFAS include groundwater plumes associated with areas where fire-fighting foam was used, wastewater effluent or air emissions from industrial facilities where PFAS are manufactured or used, and landfills, including leachate, where materials with high levels of PFAS have been disposed. If a source (or sources) can be identified, then actions can be taken to remediate, reduce or divert the source, or address exposure. As part of the EPA's statutorily-required Effluent Guidelines planning process, the EPA has reviewed readily-available information about PFAS surface water discharges to identify industrial sources that may warrant further study for potential regulation through national Effluent Limitation Guidelines and Standards (ELGs).

Based on the very limited amount of data available, the EPA has identified several industries that are likely to be discharging PFAS in their wastewater and will begin a more detailed study to evaluate the potential for PFAS presence in their wastewater discharges. As part of this study, the EPA plans to gather more detailed information for the following point-source categories: organic chemicals, plastics, synthetic fibers, pulp and paper, textiles, and airports.

Work with Federal Partners

The EPA continues to collaborate with federal agencies to address challenges associated with PFAS. As part of interagency cross-coordination efforts, additional actions may be taken by other agencies to mitigate existing PFAS exposures. The EPA is working with other federal partners, through outreach on EPA PFAS products such as the GenX chemicals and PFBS toxicity assessments as well as the Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS. The EPA plans to collaborate with other agencies on PFAS-related research, for example on toxicology studies of a broad number of PFAS with the National Institute of Environmental Health Sciences (NIEHS) National Toxicology Program (NTP). Additionally, the EPA will also work with other federal agencies such as the Food and Drug Administration (FDA), as appropriate, to support efforts regarding PFAS-related food safety issues. The EPA plans to continue coordinating with other federal agencies, such as ATSDR, FDA, and the United States Department of Agriculture (USDA), to ensure we are providing clear and consistent risk communications. The EPA also plans to work with federal partners, such as the Department of Defense (DoD) at military sites or USDA with respect to agriculture, to reduce PFAS exposures. DoD activities at military sites have included, for example, identifying the extent of PFAS contamination of drinking water sources as a result of releases from DoD facilities, ensuring that, where such contamination has occurred, communities at or near DoD facilities are not reliant on drinking water above the EPA's Health Advisory value for PFOA or PFOS.

VII. Research, Development and Technical Assistance for Addressing PFAS-Related Public Health Questions

Research, Development, and Technical Assistance

Problem Scoping and Formulation

The science needed to protect public health and the environment from PFAS exposure cuts across many applications and disciplines. The risk assessment/risk management paradigm provides a useful means to assess the state of the science available for informing decisions, and to identify gaps in knowledge needed to address the highest priority issues. *Risk assessment,* the integration of PFAS exposure and toxicity information, helps to determine if, when, and where risk exists (probability of harm) to human health or the environment from PFAS, considering both toxicity and exposure. *Risk management* involves solving a PFAS problem once it has been properly identified and characterized, considering available scientific tools and data, as well as economic, legal, social, technological, and policy factors.

The EPA's initial scoping of information available to decision makers for assessing and managing PFAS risks revealed deficiencies in all key areas of the risk paradigm:

- **Hazard and Toxicity:** There are many PFAS of potential concern to the public that may be found in the environment. Most of these PFAS lack sufficient toxicity data to inform our understanding of the potential for adverse human or ecological effects.
- **Exposure:** Information for many PFAS sources, fate and transport, and human and ecological exposure is sparse, both spatially and temporally.

- **Treatment and Remediation:** There is little information on effective methods and costs for treating or removing PFAS from drinking water, groundwater, wastewater, air, soils, and sediments.
- **Science Communication:** Stakeholders lack easy access to the growing body of technical information that can assist them in applying PFAS science to their specific problems and communicating to their constituents.

The EPA's research program will focus on an integrated set of research activities aimed at filling gaps in our current ability to conduct sound risk assessment and risk management activities. This research program is designed to address these data gaps and enable stakeholders to begin making effective decisions for identifying and mitigating risk from PFAS in the environment, as mentioned in Section VI.

The EPA's PFAS research plan consists of ***near term*** (<2 years) and ***long term*** (>2 years) research activities in four areas:

- What are the human health and ecological effects of exposure to PFAS?
- What are the significant sources, fate and transport pathways, and exposures to humans and ecosystems?
- What are the costs and effectiveness of different methods for removing and remediating PFAS in the natural and built environment?
- How does the EPA support stakeholders in using science to protect public health and the environment?

While the activities highlighted in this section are planned to be completed on a longer-term time horizon, many of these efforts will have visible interim milestones and may produce shorter-term products. Many different entities have an interest in—and are actively conducting—research to address PFAS, and so there is a substantial opportunity to advance PFAS science by effective coordination and collaboration amongst these entities. The EPA is committed to leading federal action to protect human health and the environment and to coordinating and cooperating with state and other federal agencies, academia, industry, and non-government organizations to build a body of best available science in the areas described below and to support policy and management decisions and actions by all stakeholders.

Research Area 1: *What are the human health and ecological effects of exposure to PFAS?*

One of the main research needs is a better understanding of the potential human health and ecological hazards from exposure to PFAS. Characterizing hazards through the development of hazard and dose-response assessments capitalizes on existing scientific information where available. For data-poor PFAS, an integrated approach to testing and assessment includes the use of existing hazard information, where available, coupled with data and information generated from new advances in computational and high throughput toxicology and ecotoxicology. These efforts will help the Agency develop toxicity values for additional PFAS, as discussed in Section V.

Research to advance our understanding of human health and ecological effects of PFAS will consist of three complementary lines of work:

- **Development of human health toxicity values where suitable data are available.** The EPA plans to develop cancer and noncancer toxicity values for PFAS where sufficient health effects data currently exist, are publicly available, and adequately support human health toxicity value derivation. The EPA will use established risk assessment guidelines and methods to develop standard toxicity values, such as oral reference doses (RfDs), inhalation reference concentrations (RfCs), oral cancer slope factors (CSFs), and cancer inhalation unit risks (IURs). These assessments will undergo interagency consultation, public comment, and independent external peer-review prior to finalization. The EPA currently has published toxicity assessments for PFOA and PFOS. ***In the near term*** the EPA plans to complete toxicity assessments for GenX chemicals and PFBS. The Agency has begun work on assessments for PFBA, PFHxA, PFHxS, PFDA, and PFNA. The EPA intends to coordinate with federal partners, including ATSDR, on prioritizing and conducting future PFAS toxicity assessments. The EPA will build on work by universities, industry, and other government agencies who are conducting and publishing the peer-reviewed toxicological and epidemiological studies needed to support toxicity assessment.

- **Using computational toxicology approaches to fill in gaps.** For the many PFAS for which published peer-reviewed data are not currently available, the EPA plans to use new approaches such as high throughput and computational approaches to explore different chemical categories of PFAS, to inform hazard effects characterization, and to promote prioritization of chemicals for further testing. These data will be useful for filling gaps in understanding the toxicity of those PFAS with little to no available data. ***In the near term***, the EPA intends to complete assays for a representative set of 150 PFAS chemicals, load the data into the CompTox Chemicals Dashboard for access, and provide peer-reviewed guidance for stakeholders on the use and application of the information. ***In the long term,*** the EPA will continue research on methods for using these data to support risk assessments using New Approach Methods (NAMs) such as read-across and transcriptomics, and to make inferences about the toxicity of PFAS mixtures which commonly occur in real world exposures. The EPA plans to collaborate with NIEHS and universities to lead the science in this area and work with universities, industry, and other government agencies to develop the technology and chemical standards needed to conduct this research.

- **Ecological toxicity.** Ecological toxicity information is also needed by stakeholders to inform risk assessment and management to protect ecosystems, animals, and plant resources they support, and ultimately the human benefits that stem from these resources, including, for example, the prevention of potential PFAS risks associated with consuming game animals and fish. ***In the long term***, the EPA plans to work to identify species which are sensitive or susceptible to PFAS exposure; gather and synthesize information on bioaccumulation of PFAS in organisms and food chains; and, where indicated, develop benchmarks and thresholds for ecological toxicity. The EPA plans to collaborate with the United States Geological Survey (USGS), United States Army Corps of Engineers (USACE), and universities to lead the science in this area.

Research Area 2: *What are the sources, fate and transport pathways, and exposures to humans and ecosystems?*

The diversity of the PFAS family of chemicals enables the use of PFAS for many diverse industrial processes and end use products, which in turn means there are numerous potential sources and pathways by which PFAS can move from a source through the environment. Understanding this complexity is necessary to understand PFAS exposure. The EPA plans to address this complexity through two lines of research and development:

- **New analytical methods.** Developing, validating, and applying new analytical methods for discovering and measuring PFAS in air, water, and soil will enable a better understanding of the specific subsets of PFAS that exist in the environment, as well as the exposure pathways that potentially bring those PFAS into contact with people and ecosystems. This will enable the creation of datasets to better understand fate and transport pathways and to identify cases where exposures exceed thresholds of concern. ***In the near term***, the EPA plans to develop, validate, and publish reliable sampling and laboratory analytical methods to detect, identify, and quantify PFAS in different environmental media (including drinking water, groundwater, wastewater, air, and soil) and in other kinds of samples (e.g., plant and animal tissue), as needed. This includes analytical methods for known PFAS of concern, as well as methods to identify and detect new, currently unknown, PFAS in the environment. ***In the long term,*** the EPA will continue to prioritize, develop, and validate analytical methods for emerging PFAS of concern. The EPA plans to collaborate with USGS, DoD, National Institute of Standards and Technology (NIST), FDA, and private industry to lead the science in this area and rely on universities and industry to develop the technology needed to enable new analytical methods.

- **Exposure assessment.** Exposure information enables decision makers to prioritize the PFAS exposures that are of greatest relevance and impact to human health and the environment, enabling them to prioritize management actions and allocate resources to achieve the maximum reduction in risk. ***In the near term***, the EPA plans to develop a mapping tool to house public datasets of known PFAS source and occurrence data, and tools to analyze PFAS exposure through multiple routes (via water, food, inhalation, or dermal contact). ***In the long term***, the EPA intends to build predictive models to enable PFAS exposure assessment from site-specific to national in scope, to better understand where and how PFAS move through the environment to impact people and ecosystems, and to estimate how much PFAS reaches people via air, water, food, and other pathways. The EPA plans to collaborate with the Department of Housing and Urban Development (HUD), ATSDR, and other federal agencies, as appropriate, to lead the science in this area.

Research Area 3: *What are the costs and effectiveness of different methods for removing and remediating PFAS in the natural and built environment?*

Current technology and approaches for treating or removing chemical contaminants from air, water, and soil are not always effective for PFAS. Better information is needed on the costs and effectiveness of different treatment systems for different PFAS of concern, as well as the development of new treatment technologies that are less expensive, easier to operate, and more sustainable than existing technologies. The EPA is addressing this information need through two related lines of research:

- **Drinking water treatment.** The EPA is evaluating treatment technologies for removal of PFAS from drinking water. States, public water utilities, communities, and federal facilities will benefit by having treatment technology guidance and accurate cost numbers for the treatment of PFAS in drinking water. ***In the near term***, the EPA plans to evaluate performance, cost, and potential unintended consequences of drinking water treatment technologies for different PFAS in small, medium, and large systems. The Agency plans to place data in the EPA's online Drinking Water Treatability Database and associated cost models. The EPA plans to collaborate with states, federal agencies, public water utilities, and private industry to lead the science in this area and will work closely with universities and industry who are developing the treatment technology advances needed to support this research.

- **Contaminated site cleanup.** The complexity of PFAS sources and uses means there are multiple ways that specific sites can become contaminated by PFAS. Examples include improper dumping or disposing of PFAS-contaminated waste, accidental or intentional spills of PFAS-containing products such as firefighting foam, or leaking of PFAS in leachate from landfills. This can result in the contamination of soils, sediments, groundwaters, and surface waters. ***In the near term***, the EPA plans to evaluate the effectiveness and cost of existing treatment and remediation technologies for a variety of PFAS-contaminated sites and develop and test new technologies and approaches for cleaning up PFAS contamination. The EPA plans to collaborate with DoD, states, industry, and non-government organizations to lead the science in this area and work closely with universities and industries developing the treatment technology advances needed to support this research.

Research Area 4: *How does the EPA support stakeholders in using science to protect public health and the environment?*

Stakeholders have varying levels of knowledge and expertise for using the science products that will result from the EPA's research. Part of the research process therefore involves communication of the Agency's research in multiple ways to make the science usable to all stakeholders. This communication needs to include the proper context and any applicable limitations inherent in the work. This may also include applying tools in collaboration with stakeholders through technical assistance. The EPA plans to conduct two lines of work in support of stakeholders.

- **Science communication.** PFAS are of interest to a variety of stakeholder groups. It is important that the EPA maintain suitable communication with each of these groups and facilitate access to new research products as they become available. ***In the near and long term***, the EPA plans to facilitate access to the research products described in this plan via multiple avenues, including publications, reports, online tools and databases, fact sheets, workshops, webinars, and summaries describing our science. The EPA plans to make this information readily available using the EPA PFAS website as the main point of access. The EPA intends to collaborate with states, tribes, and communities to lead work in this activity.

- **Technical assistance.** In certain cases, the EPA provides technical advice, assistance, and collaboration to state, tribal, federal, and community partners in a manner consistent with the Agency's goal of Cooperative Federalism. These technical assistance activities inform cost-efficient and cost-effective risk management decisions by the EPA and its partners, as well as help to advance the science through applied research. ***In the near and long term***, the EPA plans to continue to prioritize engagement in these activities.

VIII. Risk Communication and Engagement

Risk communication and engagement are critical for the EPA to effectively support communities across the country that are addressing PFAS issues. The EPA is actively working to enhance the way in which agencies communicate about potential human health risks that may be associated with these chemicals. PFAS are a complex group of chemicals that can differ in terms of how they are used, how people are exposed, and how they potentially impact public health and ecosystems. There is a lack of definitive scientific information about many chemicals in the PFAS family, making it challenging to communicate with the public about their associated health risks. The EPA also supports the efforts of other federal partners to develop information related to PFAS. Other agencies may issue different values based on factors such as their own statutory, regulatory, or case-specific analyses and exposure assumptions. The EPA continues to take concrete steps, in cooperation with our federal, state, and tribal partners, to communicate how the efforts of the EPA and other federal, state, and tribal agencies help to protect public health and the environment from risks related to PFAS.

Importance of Effectively Communicating PFAS Information to the Public

At the National Leadership Summit and throughout the community engagements, the EPA heard how important it is to communicate effectively with the public and to be transparent in sharing what is known and unknown in a timely manner. The EPA heard that speaking with one voice and providing consistent messaging across federal, state, tribal, and local authorities helps to build trust and ensures that the public has a clear understanding of any PFAS issues that need to be addressed. The EPA also heard that it is important to clearly explain the actions the Agency is taking, as well as the specific concerns that those actions are intended to address. Other comments submitted to the EPA highlighted how important it is to provide information to stakeholders as quickly as possible, while also taking into account the high levels of uncertainty that surround these chemicals. Appendix B provides additional

discussion about feedback from the community engagements and information submitted to the PFAS docket.

The EPA's Goals and Actions on PFAS Risk Communication

PFAS are of significant interest to a diverse set of stakeholders. Clear and consistent communication from all information sources will help stakeholders determine the most appropriate PFAS risk management approach and help the public understand the response. Through this Action Plan, the EPA's goal is to work with other agencies to:

1. Enhance the public's understanding of PFAS by providing clear and consistent information;
2. Enhance the public's understanding of the regulatory processes available to address PFAS and the different standards established for PFAS;
3. Build trust with the public as we work together to address these chemicals; and
4. Provide the public with an understanding of the uncertainties associated with PFAS measurement, exposure, and toxicity, and the importance of considering these uncertainties when identifying effective risk management actions.

For communities directly impacted by PFAS, the EPA plans to:

1. Work in coordination with other federal agencies and local, state, and tribal governments on clearly communicating PFAS information;
2. In support of responses to PFAS found in communities, work with the community to identify the lead agency and explain the role of each agency involved. Establish contact points responsible for managing community questions;
3. Communicate pathways of exposure and what is being done to mitigate exposure through those pathways;
4. Enhance the public's understanding of the potential human health effects associated with PFAS exposure; and
5. Provide information on tangible steps individuals can take on their own to manage risk.

To best support and leverage the efforts of other federal partners, the EPA is committing in the short-term to convene a federal interagency PFAS risk communication workgroup to ensure, as appropriate, collaborative interagency action and consistent messaging on PFAS toxicity that is informed by the best available science. In addition, the EPA plans to enhance communications with the public on PFAS through the following actions:

1. In 2019, develop a risk communication toolbox that includes materials and messaging for federal, state, tribal and local partners to use to inform the public, as they deem appropriate.
2. Continue to listen to and engage with the public; and

3. Continue to support states, tribes, and local officials who have purview in protecting the environment and public health, including the Environmental Council of States (ECOS), the Association of State and Territorial Health Officials (ASTHO), the Association of Clean Water Administrators (ACWA), the Association of State Drinking Water Administrators (ASDWA), the National Tribal Toxic Council, and the Association of State and Territorial Solid Waste Management Officials (ASTSWMO).

Information Needed by Stakeholders to Effectively Communicate About PFAS

Effective communication at the federal, state, tribal, and local level begins by clearly summarizing what is known and unknown about PFAS, with a focus on the key questions with which the public is most concerned. The EPA will help to advance these efforts by continuing its work with other agencies to develop a risk communication toolbox that will include the following:

- Key messages
- Questions and answers
- Infographics
- Fact sheets
- Sample language/template for potential notifications
- Sample communication materials
- Links to available data sources and tools

The EPA will make available materials and informational fact sheets on the EPA's PFAS webpage as part of the risk communication toolbox and, as necessary, will continuously update the information as the science around PFAS evolves. To find the complete set of tools, visit: https://www.epa.gov/pfas/pfas-communication-and-outreach-tools.

Stakeholder Engagement on PFAS

The EPA conducted extensive public outreach in the development of the PFAS Action Plan, including gathering diverse perspectives through the May 2018 National Leadership Summit, direct engagement with the public in impacted communities in five states, engagement with tribal partners, and roundtables conducted with community leaders near impacted sites (USEPA 2018f). The EPA also obtained recommendations from the Local Government Advisory Committee (LGAC), a chartered policy committee comprised of elected and appointed local officials. In addition, the Agency reviewed approximately 120,000 comments in the public docket that was specifically established to gather input for the Action Plan.

Through these engagements, a broad range of stakeholders provided input to the EPA about ongoing PFAS challenges facing states, tribes, and local communities, as well as specific actions needed from the EPA and state regulators in order to protect the public from PFAS in the environment. Key public priorities include the need for identification and remediation of known sources of contamination; source water protection for drinking water supplies; resources to support effective communication with the

public; long-term policy solutions; reliable, enforceable, and actionable standards and risk information; validated and cost effective analytical and sampling methods and tools; treatment solutions; enforcement strategies to reduce the cost burden on citizens; and coordination among all parties involved in mitigation and response. The Agency received comments identifying the importance of developing and relying on the best available science even if that means not rushing to implement regulatory actions in the near term. Stakeholders also emphasized the need to balance the potential cost and burden associated with managing PFAS with the costs and benefits of addressing other competing public health and environmental protection priorities such as the presence of lead in community water systems. Among other things, the LGAC recommended using existing funding tools, such as the State Revolving Funds to address PFAS, prioritizing PFAS-related risk communication activities, developing new methods and certification programs, and using risk-based approaches to address PFAS contamination issues, being mindful that clean and safe water are valued by every American citizen. The EPA plans to continue to seek feedback from stakeholders on actions to address PFAS.

National Leadership Summit

Over 220 participants, including senior officials from 40 states, 3 tribes, Guam, Northern Marianas Islands, 13 federal agencies, congressional staff, and dozens of associations, industry groups, and non-governmental organizations.

Community Outreach

Over 1,000 participants at 7 locations, including community engagements in New Hampshire, Pennsylvania, Colorado, North Carolina, and Kansas; engagement with tribes at the Tribal Lands and Environment Forum and the Saginaw Chippewa Tribe; and a roundtable in Michigan.

Public Docket

Approximately 120,000 comments received.

Information for Individuals Concerned about PFAS

Individuals in communities that are served by a public water system can contact their local water supplier to ask for information on any PFAS monitoring the utility may have conducted. Members of the public are also encouraged to request a copy of their drinking water Consumer Confidence Report. While there are currently no federal drinking water regulations for PFAS, this report provides useful information on other regulated contaminants found in local drinking water. If owners of drinking water wells not regulated by the SDWA (i.e., private potable wells) have reason to believe their well may contain PFAS (e.g., due to proximity to a known contamination site or probable source of PFAS), they could consider contacting their state or local health department for further guidance. Owners may also consider well testing to learn about PFAS that may be in their drinking water. For more information about well testing, please visit https://www.epa.gov/privatewells/protect-your-homes-water. The EPA recommends contacting your state for a list of laboratories that are certified to test for PFAS using EPA Method 537. If you find PFAS in your drinking water, certain PFAS can be reduced or removed through

the use of in-home point-of-use or point-of-entry water filters. It is important to keep in mind that any in-home treatment device should be certified by an independent party, currently available for PFAS (NSF 2018), and should be properly maintained to ensure that the treatment system remains effective over time.

For those concerned about food (plant or animal) collected from an environment that may contain PFAS, the EPA recommends contacting your local health department. All 50 states and some U.S. territories and tribes have fish consumption advisory programs to protect people from potential human health risks of eating contaminated fish caught in local waters. However, due to the limited sampling at this time, few locations have information specific to PFAS. In some states, pollutant levels in certain types of fish and shellfish collected from contaminated bodies of water have led to health-based consumption advisories for some PFAS, particularly PFOS (USEPA 2016d, State Impact Pennsylvania 2018, State of Michigan 2018). The EPA maintains a national database of fish and shellfish advisories issued by states where the public can find information on safe consumption guidelines (https://fishadvisoryonline.epa.gov/General.aspx) and for the most up to date information links to state and tribal fish consumption advisory websites (https://fishadvisoryonline.epa.gov/Contacts.aspx).

IX. Conclusion

In addition to the four priority actions the EPA announced at its May 2018 National Leadership Summit, this Action Plan highlights the many activities that the EPA plans to lead in collaboration with federal, state, tribal, and local partners to understand, communicate, and take steps to effectively manage potential concerns associated with the presence of PFAS in the environment. Where deemed appropriate and necessary, the EPA will prioritize preventing environmental contamination and identifying approaches that reduce the costs of PFAS management faced by local communities. Efforts discussed in this plan are also intended to encourage the use of safer PFAS formulations and/or PFAS alternatives and limit PFAS discharges, releases, and emissions. Where PFAS contamination in the environment has already occurred, the Agency will facilitate remediation efforts by providing groundwater cleanup recommendations and initiating the regulatory development process for listing certain PFAS as hazardous substances. For those cases where cleanup actions are necessary to prevent exposure to contaminated environmental media, the Agency is evaluating active management and treatment options and evaluating available treatment technologies. The EPA is also proposing a national drinking water regulatory determination for PFOA and PFOS in 2019 for public comment. The Agency will also gather and evaluate additional information that may inform the development of a national drinking water regulation for a broader class of PFAS in the future. The EPA is committed to working with other federal agencies, states, tribes, and local communities to coordinate and advance how we respond to PFAS concerns throughout the country.

The EPA is taking a leadership role to ensure that instances where PFAS pose risk to human health or the environment are identified and quickly addressed. The EPA plans to work in close coordination with multiple entities, including other federal agencies, states, tribes, local governments, water utilities, industry, and the public. This PFAS Action Plan highlights key EPA PFAS-related activities and reinforces the EPA's commitment to better understand potential impacts from a broad suite of PFAS, and, where necessary, take steps to reduce any risks they may pose to public health and the environment.

X. References

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Appendix A: EPA PFAS Activities

Appendix A contains a detailed list of completed and ongoing PFAS activities at the EPA. This list is not intended to be exhaustive of all the EPA's activities on PFAS.

Tool/Activity	Purpose	Timeframe
Preventing PFAS Exposures: What is EPA doing to reduce risks from PFAS?		
Significant New Use Rule; Final Rule and Supplemental Proposed Rule: Perfluoroalkyl Sulfonates (67 FR 11008)	The EPA published a SNUR to require notification to the EPA before any future manufacture (including import) of 13 PFAS chemicals specifically included in the voluntary phaseout of PFOS by 3M that took place between 2000 and 2002.	Completed March 2002
Significant New Use Rule: Perfluoroalkyl Sulfonates (67 FR 72854)	The EPA issued a SNUR for 75 PFAS, requiring manufacturers and importers to notify the EPA at least 90 days before starting the manufacture or importation of these chemical substances for the significant new uses described.	Completed December 2002
2010/2015 EPA PFOA Stewardship Program	The EPA launched 2010/2015 PFOA Stewardship Program with eight companies in 2006 to reduce PFAS emissions and product content by 95%; by 2015 reduce PFAS emissions and product content by 100%. All participating companies met the program goals.	Ongoing Started in 2006
Premanufacture Notification Exemption for Polymers; Amendment of Polymer Exemption Rule to Exclude Certain Perfluorinated Polymers (75 FR 4295)	The EPA published a final rule that amended the Polymer Exemption Rule to no longer exclude from eligibility polymers that include any one or more of the following: PFAS, PFAC, or perfluoroalkyl moieties that are covalently bound to either a carbon or sulfur atom where the carbon or sulfur atom is an integral part of the polymer molecule. Compliance date was January 27, 2012.	Completed May 2012
Significant New Use Rules: Perfluoroalkyl Sulfonates and Long-Chain Perfluoroalkyl Carboxylate Chemical Substances (78 FR 62443)	The EPA amended a SNUR to designate as a significant new use PFAS that have completed the new chemical review process under TSCA but have not yet commenced production or import and processing. The EPA also finalized a SNUR to designate as a significant new use LCPFAC chemical substances used in manufacturing (including importing) and processing of carpets or for treating carpet.	Completed October 2013
Significant New Use Rules: Long-Chain Perfluoroalkyl Carboxylate and Perfluoroalkyl Sulfonate Chemical Substances Proposed Rule (80 FR 2885)	The EPA proposed a SNUR for LCPFAC chemical substances that would require manufacturers (including importers) of PFOA and PFOA-related chemicals, including as part of articles, and processors of these chemicals to notify the EPA at least 90 days before starting or resuming new uses of these chemicals in any products. The EPA plans to follow up on the 2015 SNUR.	Completed January 2015

Tool/Activity	Purpose	Timeframe
New Chemicals Program Review of Alternatives for PFOA and Related Chemicals	The EPA has reviewed hundreds of new chemical substitutes for PFOA, PFOS, and other long-chain PFAS under the EPA's New Chemicals Program since 2000. The EPA reviews the new substances to identify whether the range of toxicity, fate, and bioaccumulation issues that have caused past concerns with perfluorinated substances may be present, as well as any issues that may arise by new chemistries, to ensure that the new chemical may not present an unreasonable risk to health or the environment. One outcome of the EPA's review of a PMN for a new chemical substance or review of a SNUN is the issuance of an order under section 5(e) of TSCA. Most TSCA section 5(e) Orders issued by the EPA are Consent Orders that are negotiated with the submitter of the notification.	Ongoing Started 2000
Understanding and Addressing PFAS Toxicity: What is the EPA doing to advance the science to support New Benchmarks?		
Lifetime Health Advisories for PFOA and PFOS	The EPA released lifetime health advisories (HAs) and health effects support documents for PFOA and PFOS. The EPA's HAs, which are not regulations, identify the concentration of PFOA and PFOS in drinking water at or below which adverse health effects are not anticipated to occur over a lifetime of exposure.	Completed May 2016
List of available scientific literature on toxicity for 31 PFAS of interest loaded to the HERO database	The EPA updated the Health and Environmental Research Online (HERO) database with available scientific literature (as of August 2017) on PFAS toxicity to detail which scientific studies the EPA has collected.	Completed April 2018
PFAS Chemical Library	Development of a chemical library of PFAS standards (pure samples of PFAS) to support consistent research and method development across the EPA.	Completed April 2018
Provide states access to GenX chemicals data	Provide states access to test data obtained under TSCA authority for information on GenX chemicals (acid and salt).	Completed March 2018
Information on Transcriptomic and *in vitro* assay toxicity testing (Tier 0 and Tier I)	Generate and publish first approximation toxicity and toxicokinetic data from the larger universe of PFAS compounds, in order to make inferences about which subcategories of PFAS might be of highest toxicological concern and thus prioritized for further near-term investigation. These data will also be useful for enabling read-across activities for PFAS with little to no available data. Tests will include a battery of transcriptomic *in vitro* assays (toxicity and kinetics) implemented by the EPA and the NTP.	Anticipated 2019
Tier II PFAS testing	Conduct Tier II *in vivo* toxicity testing for a subset of prioritized compounds based upon data provided from Tier I testing.	Anticipated 2019

Tool/Activity	Purpose	Timeframe
Tri-Services Ecological Risk Assessment Work Group	The EPA Ecological Risk Assessment Forum has a joint work group with the DoD Tri-Services Environmental Risk Assessment Work Group (TSERAWG) to develop ecological risk assessment screening values for PFAS. The DoD has an interagency agreement between the Air Force Civil Engineering Center and the Department of Energy (DOE) Argonne National Laboratory for the development of screening values for PFAS compounds. The PFAS screening values will be available for use at CERCLA sites and RCRA facilities.	Ongoing
Tools and data for evaluating ecotoxicity effects	Identify sensitive and susceptible taxa, synthesize information on bioaccumulation in organisms and food chains, and develop benchmarks and thresholds for ecological toxicity.	Anticipated 2022
Toxicity assessments for additional PFAS	Development of additional peer-reviewed PFAS toxicity assessments for PFBA, PFHxA, PFHxS, PFNA, and PFDA to support stakeholders.	Anticipated 2020
Toxicity assessments for GenX chemicals and PFBS	Provide toxicity assessments to stakeholders for GenX chemicals and an updated PFBS assessment. Both assessments underwent independent peer-review and review by federal partners prior to public comment.	Draft completed November 2018 Finalize 2019
Update Chemistry Dashboard with Information for Additional PFAS	The CompTox Chemicals Dashboard provides users with information on chemical structures, experimental and predicted physicochemical and toxicity data, and additional links to relevant websites and applications. The EPA updated the Dashboard with additional PFAS.	Completed March 2018
Water Contaminant Information Tool (WCIT) Profiles for PFOA and PFOS	Contaminant Profiles for two PFAS, PFOS and PFOA, to be added to the EPA's Water Contaminant Information Tool.	Completed December 2018
CWA Effluent Guidelines Planning PFAS Review	Through the Clean Water Act Effluent Guidelines Planning process, the EPA is examining readily-available information about PFAS surface water discharges to identify industrial sources that may warrant further study for potential regulation through Effluent Limitation Guidelines.	Ongoing
Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS	The EPA anticipates releasing interim cleanup recommendations to address groundwater contaminated with PFOA and/or PFOS to support stakeholders in their remediation efforts.	Anticipated 2019
Evaluation of CWA 304(a) Ambient water quality criteria for PFAS	The EPA is evaluating available data and research to support development of Clean Water Act Section 304(a) Ambient water quality criteria for PFAS.	Anticipated 2022

Tool/Activity	Purpose	Timeframe
Identifying and Addressing PFAS Exposures: What is the EPA doing to help identify communities with potential PFAS impacts, remediate PFAS exposures, and monitor compliance?		
Method Development	The EPA developed Method 537 for measuring PFOA, PFOS, and 12 other PFAS in drinking water to support the Unregulated Contaminant Monitoring Rule.	Completed 2009
Method Development	The EPA expanded Method 537 to measure four additional short-chain PFAS, including HFPO-DA (GenX chemicals) and ADONA. Method 537.1 is available on the EPA's website.	Completed November 2018
Method Development	Validated Direct Injection Method (SW-846) for quantifying 24 PFAS in surface, ground, and waste water matrices (non-drinking water) and solids (e.g., soil and sediment).	Anticipated 2019
Method Development	Validated Isotope Dilution Method (SW-846) for quantifying 24 PFAS in surface, ground, and waste water matrices (non-drinking water) and solids (e.g., soil and sediment).	Anticipated 2019
Method Development	New validated analytical method for PFAS in drinking water focusing on short-chain PFAS which cannot be measured by Method 537.1.	Anticipated 2019
Method Development	Method for sampling and analyzing PFAS in factory stack air emissions.	Anticipated 2020
Method Development	Testing and developing additional methods for possible refinement, including methods to quantify PFAS precursors; Total Organic Fluorine for a general PFAS detection method; and refinement of non-targeted high-resolution mass spectrometry approaches for suspect screening and novel PFAS discovery.	Ongoing
PFAS Geospatial Analytical Tool	Working with states and other federal partners, the EPA is evaluating how to best develop and maintain a GIS resource to consolidate and present PFAS data to inform analysis and understanding of PFAS sources and occurrence in the environment.	Anticipated 2019
Modeling atmospheric fate and transport of PFAS	Incorporate PFAS information into the EPA air models (e.g., the Community Multiscale Air Quality modeling system, AERMOD atmospheric dispersion model) to inform understanding of the potential and significance of atmospheric transport of PFAS.	Anticipated 2022
Unregulated Contaminant Monitoring Rule 3 for Public Water Systems	The third UCMR required monitoring for 30 contaminants (28 chemicals and two viruses) between 2013 and 2015 using analytical methods developed by the EPA, consensus organizations, or both. The purpose of UCMR3 was to collect occurrence data for contaminants suspected to be present in drinking water, but that do not have regulatory standards set under the SDWA. Six PFAS compounds were included in the UCMR3: PFOS, PFOA, PFNA, PFHxS, PFBS, and PFHpA. Of these six compounds, PFOA and PFOS were found in the greatest number of samples, and 1.3% of the public water systems sampled had results that exceeded the reference dose (lifetime HA limit of 70 ppt or 0.07µg/L).	Completed 2013-2015

Tool/Activity	Purpose	Timeframe
Unregulated Contaminant Monitoring Rule 5	The EPA intends to propose nationwide drinking water monitoring for PFAS under the next UCMR monitoring cycle utilizing newer methods available to detect more PFAS and at lower minimum reporting levels (MRLs) than previously possible in earlier monitoring.	Anticipated 2020-2025
Drinking Water Treatability Database-Update for Additional PFAS	Users can utilize the database to identify effective drinking water treatment processes for PFOA, PFOS, and additional PFAS chemicals. This database is continually updated as additional information becomes available.	Ongoing Updated September 2018
Research for Drinking Water Treatment	Conduct bench-, pilot-, and full-scale experiments to discern performance and cost of treatment (both capital and operations and maintenance), along with potential unintended consequences of employing specific technologies. Following a literature review for data gap identification, granular activated carbon and ion exchange treatment technologies will be tested under varying water qualities.	Anticipated Fall 2019
Treatability Cost Models	Updated drinking water PFAS treatability cost models.	Ongoing Updated September 2018
Evaluation of commercially Point-of-Use (POU) and Point-of-Entry (POE) home treatment systems	Investigate commercially available reverse osmosis and granular activated carbon units that can serve households in a point-of-use or point-of-entry applications for 6 PFAS included in UCMR3.	Completed 2018
Evaluation of treatment technologies for contaminated sites	A series of studies evaluating effectiveness and cost of different combinations of treatment train approaches for remediating contaminated sites.	2021
Fourth Contaminant Candidate List (CCL)	The EPA is required by the Safe Drinking Water Act to publish a list of contaminants known or anticipated to occur in public water systems which may require regulation under the Safe Drinking Water Act. The EPA included PFOA and PFOS on the fourth Contaminant Candidate List (the most recent CCL list).	2016
Fourth Regulatory Determination Process	The EPA is working on the Fourth Regulatory Determination process in which the EPA determines whether to regulate at least five contaminants on the CCL and issue final regulatory determinations after considering public input. The EPA is evaluating available information to determine if contaminants on the CCL, including PFOA and PFOS, meet the three criteria for regulation in accordance with the SDWA: (1) whether a contaminant may have adverse health effects; (2) whether a contaminant is found in public water systems with a frequency and at levels of concern; and (3) whether, in the sole judgment of the Administrator, there is a meaningful opportunity for health risk reduction through a national drinking water regulation.	Ongoing Anticipated 2019

Tool/Activity	Purpose	Timeframe
Collection of Great Lakes Environmental PFAS data	The EPA collects and analyzes environmental samples, including whole fish tissue, sediment, air, and water, to determine concentrations and trends of PFAS in the Great Lakes and occurrence in fish tissue.	Ongoing
Evaluate PFAS exposure through fish consumption	Evaluate temporal and demographic patterns of PFAS exposure and the relationship with fish consumption, in the U.S. general population.	Anticipated 2019
Fish Tissue Contamination Studies	To ensure that communities are aware of levels of PFAS in fish they may consume, continue to analyze PFAS in edible fish tissue as part of the National Rivers and Streams Assessment and the Great Lakes portion of the National Coastal Condition Assessment, and include PFAS in the revised list of target analytes that states may consider including in their fish and shellfish contaminant monitoring and advisory programs.	Ongoing
CERCLA Hazardous Substance Listing	The EPA has initiated the regulatory development process for listing PFOA/PFOA as CERCLA hazardous substances.	Ongoing
Scoping biosolids risk assessment for PFOA/PFOS	The EPA is in the early scoping stages of risk assessment for PFOA and PFOS in biosolids to better understand the implications of PFOA and PFOS in biosolids to determine if there are any potential risks.	Anticipated 2020
Identifying PFAS Risks from Chromic Acid Etch Facilities	The EPA's Office of Research and Development and Region 5 are collaborating on a study to characterize PFAS fume suppressants used at chromic acid etch facilities. Both Minnesota and Michigan have identified high levels of PFOS releases from these facilities, even after PFOS was phased out of the fume suppressant products in 2015. Region 5 is assessing if the current PFOS releases are the result of legacy use of PFOS fume suppressants or related to the replacement chemical formulations.	Ongoing
Identify PFAS sources, concentrations, uses, locations, and exposure routes most likely to pose threats to human health and the environment	Continue to make Toxic Substances Control Act (TSCA) data available where possible; identify sources, uses, and locations; develop information on potential high-impact locations; work with states to develop consistent sampling protocols.	Ongoing
Need to integrate data from multiple sources to better understand the presence of PFAS in the environment	Develop data sharing standards that allows states, tribes, communities, public water systems, and other organizations to contribute data about PFAS testing in a consistent manner.	Ongoing

Tool/Activity	Purpose	Timeframe
EPA TSCA section 5(e) order for GenX Chemicals	In 2009 the EPA entered into a Consent Order under TSCA section 5(e) with Dupont (now Chemours) that imposes requirements on the manufacture, processing, use, and disposal of GenX chemicals. Among other requirements, the Consent Order restricts the releases of the GenX chemicals by requiring the recapture of 99% of the chemicals. It also requires certain worker personal protective equipment as well as certain studies to be performed.	Ongoing
TRI listing for PFAS chemicals	Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) created the TRI Program. The TRI Program is another tool EPA may use to understand the releases of PFAS by industrial and federal facilities. Currently, no PFAS chemicals are included on the list of chemicals required to report to TRI; however, the EPA is considering whether to add PFAS chemicals. In considering listing, the EPA must determine whether data and information are available to fulfill the listing criteria and the extent and utility of the data that would be gathered. In addition, in considering if TRI will provide useful information to stakeholders, the EPA also will consider if those PFAS are still active in commerce. The process for listing includes notice and comment rulemaking to list PFAS chemicals for reporting prior to adding these chemicals to the TRI for annual reporting.	Ongoing

Tool/Activity	Purpose	Timeframe
Regions 1 and 3: Safe Drinking Water Act Section 1431 Emergency Orders to Department of Defense	2014 order to Navy at Warminster (PA) NPL Site directing the Navy to address high levels of PFOS discovered in three drinking water supply wells at and off the Warminster Naval Warfare Center where the elevated levels were four times the provisional health advisory level (which was 200 ppt for PFOS and 400 ppt for PFOA) in one case: Where levels in finished drinking water are above the HA for PFOA or PFOS, the Order required the Navy to provide a permanent drinking water supply as soon as practicable, but in no event later than 6 months after execution of the order. 2015 order to Air Force and Air National Guard at Horsham Air Guard Station/Willow Grove (PA) NPL Site (2015): The order directs the Air Guard/Air Force to treat two onsite public water supply wells and supply treatment to any private well found to exceed the provisional health advisory for PFOS in drinking water. Sampling confirmed that the Guard portion of the facility is also (like the Navy portion from Willow Grove) a source of PFOS offsite migration. The order covers long term treatment for private homes and also for short- and long-term public water supply concerns. 2015 order to Air Force for Contamination at Pease Air Force Base (NH) NPL Site: The order directs the Air Force to address contamination from perfluorinated compounds in drinking water at Pease Air Force Base including a number of actions to address the partial loss of the city's water supply attributed to firefighting foams used at the Base. The PFAS contamination resulted in the shutdown of one public water supply well, and two others could have been impacted if action were not taken to control PFAS migration. Under the order, the Air Force will restore contaminated groundwater in the Pease aquifer.	Ongoing
Annex 3, Chemicals of Mutual Concern, of the Great Lakes Water Quality Agreement	The goal of Annex 3 under the Canada-United States Great Lakes Water Quality Agreement (GLWQA) is to reduce the anthropogenic release of chemicals of mutual concern into the waters of the Great Lakes. In 2016, PFOS, PFOA, and LC-PFCAs—or collectively, PFAS—were designated as chemicals of mutual concern. In designating PFAS as a chemical of mutual concern, Canada and the United States have agreed that they may pose a threat to the Great Lakes. An Annex 3 binational strategy for PFAS is under development.	Anticipated September 2019
Belmont and Rockford, Michigan	The EPA is coordinating with the State of Michigan by overseeing a federal CERCLA time-critical removal action focused on hazardous substances at the Wolverine World Wide (Wolverine) Tannery and House Street Disposal Site and providing technical assistance to MDEQ while it responds to PFAS contamination of residential wells from Wolverine's former Tannery, shoe factory, and disposal locations in the Rockford area.	Ongoing

Tool/Activity	Purpose	Timeframe
Regions 3 and 5: Amendment to 2009 Safe Drinking Water Act Section 1431 Emergency Order on Consent with DuPont and Chemours	In 2009, the EPA issued a 1431 order on consent to Chemours' Washington Works Facility that contaminated sources of drinking water in WV and OH primarily via air deposition from the Facility. That order was amended in 2017, incorporating the Lifetime Health Advisory and requiring DuPont and Chemours to offer treatment, connection to a PWS, or bottled water to people on public or private water systems with PFOA levels above 70 ppt. In 2018, at the EPA's request, Chemours has also voluntarily sampled numerous private and PWSs for GenX chemicals.	Ongoing
Region 4 coordination of assistance to North Carolina Department of Environmental Quality (NCDEQ) – Chemours Fayetteville Works Facility	Region 4 has provided ongoing support to the NCDEQ as it has responded to GenX chemicals in the Cape Fear River and Fayetteville area. • Analytical testing via ORD-RTP and Region 4 Science and Ecosystem Support Division labs (testing of raw & finished water in the Cape Fear, rainwater, and air emissions stack testing for GenX chemicals and 22 other PFAS compounds) • Technical input as the state established its interim health goal • Coordinated treatment technique assistance for water systems • Technical assistance with NPDES permitting related matters and air emissions control.	Ongoing Started June 2017
Grant Funding Opportunity: National Priorities: Per- and polyfluoroalkyl substances	The EPA solicited proposals for EPA-G2018-ORD-A1 that included the below desired research areas: • Short-chain PFAS (C4 to C7) • PFAS found as residuals from manufacturing processes • Alternatives for long-chain PFAS (≥ C8) such as per- and poly-fluoroethers • PFAS generated through environmental chemical transformation	Ongoing Completed June 2018
Technical Support	The EPA will continue to assist states and tribes in bringing on PFAS analytical capabilities.	Ongoing

Tool/Activity	Purpose	Timeframe
Risk Communication and Engagement: What is the EPA doing to provide consistent and accurate information and guidance to the public?		
Clearinghouse of PFAS information for states, tribes and local communities	The EPA compiled information from a wide range of sources on measurement, health impacts, and treatment and remediation technologies. The EPA continues to update this site as additional information becomes available.	Ongoing Started 2018
Engagement with states and stakeholders	Ongoing robust engagement effort with states, tribes, local communities, utilities, industry, and the public. Extensive outreach in 2018 included: • 5/22-5/23/2018: PFAS National Leadership Summit • 6/25-26/2018: Exeter, NH (Region 1 wide) Community Engagement • 7/25/2018: Horsham, PA Community Engagement • 8/7-8/2018: Colorado Springs, CO Community Engagement • 8/14/2018: Fayetteville, NC Community Engagement • 8/13/2018: Spokane WA, PFAS session at the Tribal Lands and Environment Forum meeting • 9/5/2018: Leavenworth, KS Community Engagement • 10/4-5/2018: Michigan site visits, Kalamazoo, MI Roundtable	Completed October 2018
EPA Region 7 participation in Kansas PFAS Monitoring Plan Advisory Committee	Region 7 to serve on Kansas Department of Health and Environment Per- and Polyfluoroalkyl Substance Monitoring Plan Advisory Workgroup for drinking water. The KDHE requested the EPA's participation to serve in an advisory capacity on a monitoring plan to be developed with the focus on drinking water.	Started Fall 2018
EPA Region 7 updates on PFAS for states and tribes	Activated the EPA Region 7 Science Council with state representation which will also include a PFAS update on a quarterly basis. The EPA Region 7's Regional POC for PFAS will also update our tribal representatives at the Regional Tribal Operation Committee meetings.	Started March 2018
Federal Remediation Technologies Roundtable Meeting	One-day interagency technical meeting meant to identify and discuss the emerging science behind PFAS characterization and remedial technologies. Technical presentations also remotely broadcasted. Primarily federal agency participation.	Completed November 7, 2018
Internal EPA regional coordination network	Activated internal EPA regional coordination network with representation from all regions and program offices to further support rapid dissemination of information in order to better support states, tribes, and local communities.	Started February 2018
Internal EPA regional coordination for cleanup programs	Created an internal EPA regional coordination group for cleanup programs with representation from all regions to further support rapid dissemination of information in order to better support states, tribes, and local communities.	Started Summer 2016

Tool/Activity	Purpose	Timeframe
Internal EPA Region 7 team	Activated internal EPA Region 7 network with representation from all programs further support rapid dissemination of information in order to better support states, tribes, and local communities.	Started February 2018
Quarterly Meetings with Region 10 Environmental and Health Departments	Region 10 quarterly conference calls with Region 10 PFAS contacts in state environmental and health departments to share information and discuss issues and topics of mutual interest.	Ongoing
Webinar on PFAS State case studies	Webinar showcasing PFAS risk communication activities by states; developed in coordination with ECOS and ASTHO.	Completed June 2018

Appendix B: Summary of PFAS National Leadership Summit and Community Engagements

In 2018, the EPA held a series of public community engagement events that brought together the EPA and state officials, federal partners, local speakers, community groups, and citizens to share perspectives and help inform future Agency actions for managing PFAS. Following the PFAS National Leadership Summit, these sessions continued EPA's commitment to foster an ongoing dialogue with stakeholders to address PFAS.

The National Leadership Summit included representatives from over 40 states, tribes, and territories; 13 federal agencies; congressional staff; associations; industry groups; and non-governmental organizations to engage in discussions about PFAS monitoring, risk characterization, near-term actions, and risk communications strategies. Key perspectives emphasized by participants during the summit included interest in:

1. An expansion of monitoring and sampling in the environment supported by sources of funding;
2. Continued advancement of the understanding of PFAS compounds, potential toxicity, and further development of analytical methods;
3. Increased understanding of exposures beyond drinking water;
4. Robust near-term action while long term actions are completed;
5. Identifying opportunities for collaboration and coordinated data sharing efforts among partners; and
6. Continued public engagement and development of risk communication resources.

The Community Engagements included panel discussions on the current state of science and potential risks posed by PFAS, as well as state and local actions towards 1) Identifying PFAS; 2) PFAS Risk Communications; and 3) Identifying Solutions for PFAS. Following the panel discussions, members of the public shared input and personal stories. During the community listening sessions, the EPA interacted with over 1,000 members of the public and heard from approximately 200 citizens in Exeter, New Hampshire; Horsham, Pennsylvania; Colorado Springs, Colorado; Fayetteville, North Carolina; and Leavenworth, Kansas.

The EPA developed summaries for the PFAS National Leadership Summit and each of the community engagements that can be found on EPA's PFAS webpages: https://www.epa.gov/pfas/pfas-national-leadership-summit-and-engagement and https://www.epa.gov/pfas/pfas-community-engagement.

Appendix C: Summary of Docket Comments

Background

Following the PFAS National Leadership Summit, the EPA requested input from the public on how the Agency can best help states, tribes, and communities facing PFAS challenges. The EPA has considered these comments in the development of this PFAS Action Plan and will continue to be informed by these comments as the Agency plans its next steps.

Docket Process and Summary of Submissions

The EPA opened the docket on PFAS, OW-2018-0270, from May 2, 2018 to September 28, 2018 and received approximately 120,000 comments via Regulations.gov. The docket comments are summarized below according to the themes requested by the EPA. The docket is available at: https://www.regulations.gov/docket?D=EPA-HQ-OW-2018-0270.

1. Obtaining information on ongoing efforts to characterize risks from PFAS and develop monitoring and treatment/cleanup techniques;
2. Informing specific near-term actions, beyond those already underway, that are needed to address challenges currently facing states and local communities;
3. Developing risk communication strategies to address public concerns with PFAS; and
4. General comments.

All comments were reviewed, categorized, and used to support the development of the PFAS Action Plan. The majority of comments received, approximately 97%, were from the public from across the United States representing rural and urban communities. Public citizen comments generally included a request for the EPA and the federal government to assist in managing PFAS in their community, concern for the health of their families and themselves, specific requests for action in managing and limiting PFAS in the environment, a desire to see PFAS removed at the source, a desire for responsible parties to pay for cleanup, and a universal expression for the right to have access to clean and healthy water.

Approximately 2.5% of comments were submitted by organizations, members of Congress, industry, water associations, governmental organizations at all levels, and not-for-profit organizations. The comments generally included support for the development of the PFAS Action Plan, an expression of the need for regulatory action, the need for science-based decisions, a desire for better communication regarding the Agency's planned activities, a request for the EPA to use regulatory authorities to manage PFAS, and a coordinated response from the federal government.

The following information is intended to provide an overview summary of the comments received in the public docket within each theme and is not meant to be comprehensive. Comments provided to the EPA are available in the docket at the link provided above.

Characterize Risks from PFAS and Develop Monitoring and Treatment/Cleanup Techniques

- Undue burden placed on communities and private well owners. Concerns on the costs to the taxpayer associated with treatment of PFAS in water, purchasing bottled water, point-of-use filters, and/or the cost associated with health care stemming from potential PFAS exposure.
- Desire for responsible parties to pay for the cost of cleanup/treatment and monitoring.
- Requests that the EPA consider the cost of treatment in the rulemaking process.
- Federal prioritization of PFAS compounds for additional study and effort.
- Concern on the movement of PFAS through groundwater and the potential for contamination to spread.
- Need for more science-based research and method development to monitor PFAS.

Near-term Actions Needed to Address Challenges Currently Facing States and Local Communities

- Desire for the EPA to use its regulatory authority to regulate PFAS and provide regulatory certainty.
- List PFAS as hazardous substances.
- Develop groundwater cleanup values in a way that encourages site-specific solutions and allow for use of available resources.
- Request for better risk communication and education from the public on health effects, more research on PFAS, identification of PFAS in media other than drinking water, and prevention of industrial releases of PFAS.
- Develop consistent and enforceable standards, including a maximum contaminant level for PFAS that is based on best-available and current science. Some members of the public expressed support for lowering EPA's Health Advisory Level.
- Follow up or expanded water testing and/or blood testing in local communities.
- Concern with the UCMR detection levels (too low and not representative of PFAS presence) and requests to expand the list of PFAS for future UCMR efforts.
- Need for funding for the federal, state, tribal, and local governments to adequately address PFAS.
- Regulate PFAS at the source; prevent PFAS from entering commerce and prevent releases into the environment.
- Concern that families and communities located near military installations are disproportionally affected by PFAS.
- Concern from site-specific contamination, including GenX chemicals.
- Make available technical assistance and funding to individual households and private well owners to address PFAS. Communities need assistance in determining the extent of their contamination.
- Need for new analytical methods to achieve lower detection limits, identify additional PFAS, and monitor in media other than water.

- Need any guidance developed by the EPA to be scalable, with special emphasis for small and tribal communities.

Risk Communication Strategies to Address Public Concern with PFAS

- Concern regarding the quality and accessibility of information from the EPA and other federal agencies. Desire to have information on: the proximity of a community to a PFAS source; the potential exposure of communities to individual and mixtures of PFAS; products that contain PFAS; guideline, standard, and method development process; and access to technical resources such as data, methods, and research.
- Need for a clear and concise communication plan from the EPA to inform the public and stakeholders regarding the risk of PFAS exposure and related the EPA activities (both ongoing and planned).
- Concern on the unknown human health effects from PFAS exposure, the cost of health insurance and mental health coverage from exposure and stress of exposure, and the possible health effects from PFAS exposures.
- Request for comprehensive testing of PFAS in drinking water and blood and communication of risk information in a clear and concise manner that is easy for the public to understand.
- Concern on the lack of risk communication for PFAS in food, such as fish and shellfish.
- Need for a comprehensive risk communication strategy that includes stakeholders and allows for the opportunity for the public to provide comments and questions.

General Comments

- Request the EPA exercise its regulatory authority to limit the use and manufacture of PFAS due to health concerns from exposure from air, water, and food.
- Commenters at community engagements provided both support and appreciation for the opportunity to participate, in addition to implying frustration at feeling excluded from presenting information to the panelists.
- Commenters provided personal accounts of PFAS exposure in their local community and the health and financial impacts of that exposure.
- Encourage the EPA to abide by its mission to protect human health and the environment by ensuring all citizens are provided healthy and clean drinking water and air.

Appendix D: Other Reference Materials

EPA Resources

- EPA's Webpage for Per- and Polyfluoroalkyl Substances (PFAS): https://www.epa.gov/pfas
- Information on the EPA Community Engagement Sessions on PFAS: https://www.epa.gov/pfas/pfas-community-engagement
- Information on the National Leadership Summit on Per- and Polyfluoroalkyl Substances (PFAS): https://www.epa.gov/pfas/pfas-national-leadership-summit-and-engagement
- PFAS National Leadership Summit and Engagement Federal Public Input Docket: https://www.regulations.gov/ – enter docket number: OW-2018-0270
- Drinking Water Health Advisories for PFOA and PFOS: https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos
- Third Unregulated Contaminant Monitoring Rule: https://www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule
- Contaminant Candidate List 4: https://www.epa.gov/ccl/contaminant-candidate-list-4-ccl-4-0
- EPA Drinking Water Laboratory Method 537 Q&A: https://www.epa.gov/pfas/epa-drinking-water-laboratory-method-537-qa
- Research on Per- and Polyfluoroalkyl Substances (PFAS): https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas
- EPA Actions to Address PFAS: https://www.epa.gov/pfas/epa-actions-address-pfas
- EPA 2010/2015 PFOA Stewardship Program: https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/fact-sheet-20102015-pfoa-stewardship-program
- Drinking Water Treatability Database: https://iaspub.epa.gov/tdb/pages/general/home.do
- Case Studies on State-Level Risk Communication of PFAS (EPA and ECOS collaboration): https://www.ecos.org/documents/state-level-risk-communication-of-pfas-and-habs/

Additional Resources (Non-EPA Materials)

- ATSDR Webpage Per- and Polyfluoroalkyl Substances (PFAS) and Your Health: https://www.atsdr.cdc.gov/pfas/
- ATSDR Overview of Perfluoroalkyl and Polyfluoroalkyl Substances and Interim Guidance for Clinicians Responding to Patient Exposure Concerns: https://www.atsdr.cdc.gov/pfc/docs/pfas_clinician_fact_sheet_508.pdf
- ToxFAQs™ for Perfluoroalkyls: https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=1116&tid=237
- Toxicological Profile for Perfluoroalkyls: https://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=1117&tid=237
- CDC Per- and Polyfluorinated Substances (PFAS) Factsheet: https://www.cdc.gov/biomonitoring/PFAS_FactSheet.html

- CDC National Report on Human Exposure to Environmental Chemicals: https://www.cdc.gov/exposurereport/index.html
- Interstate Technology Regulatory Council (ITRC) PFAS website: https://pfas-1.itrcweb.org/
- ITRC PFAS fact sheets: https://pfas-1.itrcweb.org/fact-sheets
- Per- and Polyfluoroalkyl Substances (PFAS) Laboratory Testing Primer for State Drinking Water Programs and Public Water Systems: https://www.asdwa.org/wp-content/uploads/2018/10/ASDWA-PFAS-Lab-Testing-Primer-10-10-18-Final.pdf