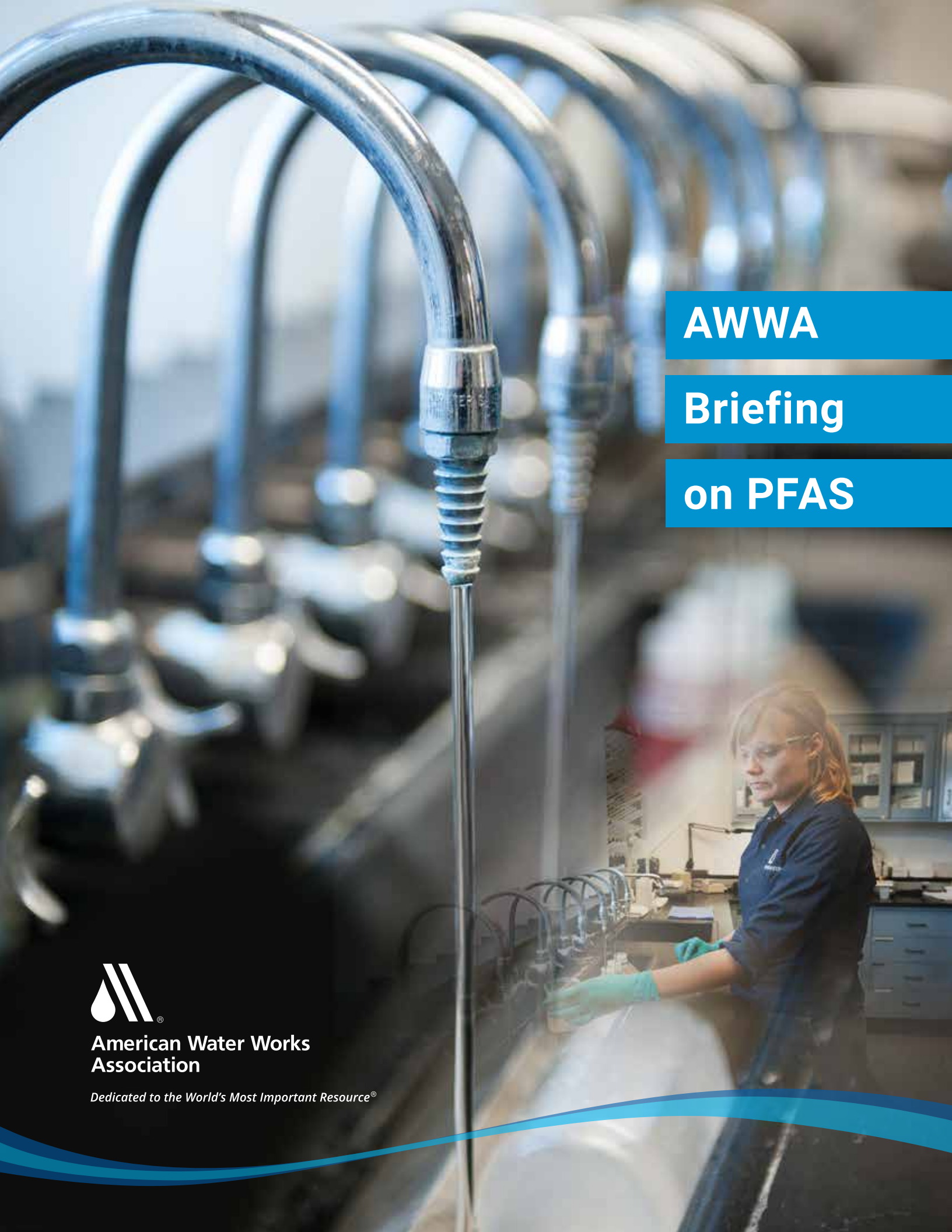

AWWA Briefing on PFAS

American Water Works Association

Dedicated to the World's Most Important Resource®

SOUND SCIENCE, PUBLIC HEALTH PROTECTION CRUCIAL FOR PFAS

AWWA members and friends,

If you are in the water sector, and even if you are not, you have likely heard about per- and polyfluoroalkyl substances (PFAS). PFAS are increasingly a topic of public concern, particularly when they are discovered in community drinking water supplies.

PFAS have been manufactured and used in various industries around the globe since the 1940s. Their prevalence and staying power in the environment—including drinking water sources—have raised concerns about the possibility of adverse health impacts.

In February 2019, after input from AWWA and other water organizations, EPA issued its PFAS Action Plan. The plan included a goal to move forward with a regulatory determination for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) before the year's end.

In the meantime, some states are unwilling to wait. As of October 2019, 21 states have established policies to protect drinking water sources from PFAS and three more are engaged in developing policies. Three states have drinking water MCLs for PFAS in effect, with five more somewhere in the development process.

PFAS concerns have also quickly generated a host of federal legislative proposals. In May 2019, AWWA testified on PFAS before both houses of U.S. Congress, noting that "we are eager to follow the data on PFAS compounds wherever it may go in the investigative process so that we may know how to best protect public health."

With PFAS, water systems again find themselves at the center of an emotional public health debate. It's worth noting that this cycle of uncertainty, public concern, and demand for action will likely be repeated with other emerging compounds. When that happens, just as with PFAS:

AWWA will stand by the twin pillars that uphold smart water policy: a commitment to public health protection and fidelity to rigorous scientific process.

AWWA provides this report—and many other resources related to PFAS—to help our communities understand and confront this latest challenge to water quality.

Sincerely,

David B. LaFrance, AWWA CEO

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Before a packed, early-morning audience at AWWA's 2019 Annual Conference and Exposition in Denver, Carel Vandermeyden, Deputy Executive Director of the Cape Fear Public Utility Authority (CFPUA) in North Carolina, shared a story that has been repeated in various forms in communities throughout North America.

CFPUA customers first learned in 2017 that a "soup" of PFAS was detected in the Cape Fear River supplying water to 80 percent of the utility's customers, a legacy from decades of industrial pollution. Little was known about the health impacts of the compounds being found. No federal or state regulations existed. But the demand for action was swift from politicians, media and consumers.

"In a two-year period, CFPUA has gone through a pretty significant customer interaction… we did research and pilot testing, designed an upgrade for a 44 MGD treatment plant…while trying to explain to our customers why CFPUA has to spend approximately $46 million of ratepayer money to deal with this problem that came from a point source," Vandermeyden said.

PFAS a growing community concern

CFPUA has since filed a federal lawsuit against Chemours and DuPont–which operate an upstream chemical manufacturing facility—to recover costs and damages. By summer of 2019, the utility reported spending more than $8 million to address the PFAS issue. Its Board also awarded a $35.9 million construction contract to build eight new deep-bed granular activated carbon contactors to reduce PFAS in its finished water from the Cape River.

Carel Vandermeyden, left, and Peter Grevatt discuss PFAS at ACE19.

Water Research Foundation CEO Peter Grevatt, who moderated the ACE19 panel discussion, observed that PFAS seemed to be among the issues of greatest concern at the conference.

"This conversation about PFAS, there's something for almost everybody in the water sector," he said. "Whether you're thinking about drinking water…or whether you're thinking about wastewater and what's coming into your treatment plant or whether you're a reuse person… whether you're managing stormwater and thinking about runoff and how you're going to deal with those issues…One of the conversations that I think has been flowing through the conference—as we're all aware of the extraordinary public concern and also political action—is how do we try to still keep a seat at the table for science in the conversation around PFAS?"

More AWWA resources available at awwa.org/PFAS

PFAS THEN AND NOW

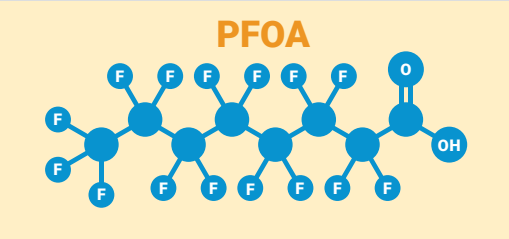
Chemical compounds are manufactured to make life easier, better or safer. But time and information sometime reveal unintended consequences, as exemplified by PFAS.

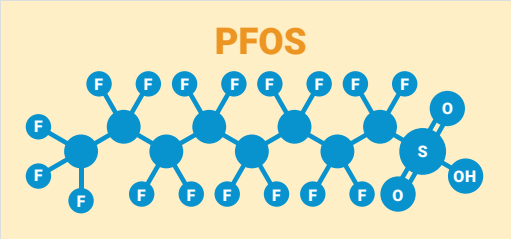
Over the last 70 years, these chemicals have been manufactured and used around the world to enhance many everyday products. They have been used to fight fires and recover oil, and to produce medical equipment, food packaging, cleaning products, nonstick cookware, stain- and water-resistant coatings, paints, inks and cosmetics.

Today, their use has led to a serious challenge for public water suppliers. PFAS are mobile, persistent and may have adverse health effects at very low concentrations.

Now phased out in the United States, PFOA and PFOS were among the first PFAS produced and remain the most well-understood and commonly detected PFAS. These and other legacy PFAS that are no longer used have already entered the environment at industrial sites, landfills, and at sites where firefighting foams were applied. While there are hundreds of banned PFAS, there are thousands more in existence, and more than 600 used commercially in the United States.

PFAS chemical properties





More AWWA resources available at awwa.org/PFAS

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The same properties that made these chemicals attractive for industrial and consumer applications have fostered the accumulation of PFAS in the human body and in the environment. We know these chemicals accumulate in various tissues of living organisms, and that some are toxic, but we know relatively little else about many of them. Fortunately, that's rapidly changing because of growing scrutiny from health agencies, utilities and the public.

Research, studies needed for answers

The speed with which PFAS have emerged as a challenge for the water sector is stunning. In AWWA's 2019 State of the Water Industry Report, PFAS was the sector's second-highest ranked regulatory concern. In 2014, PFAS had just broken into the SOTWI top-ten emerging contaminant issues.

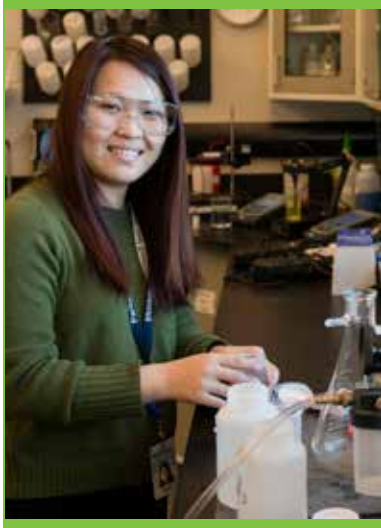
EPA and the U.S. Centers for Disease Control and Prevention describe the human health effects from exposure to low environmental levels of PFAS as uncertain. There are, however, studies of laboratory animals given large amounts of PFAS that found some PFAS compounds may negatively impact growth and development, reproduction, thyroid function, the immune system, and the liver. More research is needed to assess the human health effects of exposure to PFAS.

There is broad agreement that a great deal of research is needed to better understand which PFAS compounds – and at what levels -- pose serious public health risks and how to cost-effectively remove PFAS contamination. With those goals in mind, AWWA is joining with colleagues across the water sector to support federal research funding.

Excerpted from June 2019 Opflow article by Dustin Mobley and Chris Tadanier

PFAS on rise in AWWA's 2019 State of the Water Industry Report

CURRENT REGULATORY CONCERNS		
Rank	Area	% Extremely concerned
1	Non-point source pollution	17.1%
2	**Per- and polyfluoroalkyl substances (PFAS)**	**15.8%**
3	Cyanotoxins	14.6%
4	Chemical spills	16.0%
5	Point source pollution	13.5%
6	Combined sewer overflows	14.9%
7	Disinfection byproducts	12.3%
8	Nutrient removals	13.0%
9	Lead and copper	14.0%
10	Pathogens	14.4%
11	Radionuclides	10.9%
12	Arsenic	10.7%



In 2009, EPA included PFOA and PFOS on the Third Contaminant Candidate List and started the process of evaluating PFAS regulation under the Safe Drinking Water Act. The next step was developing a sound analytical method and sampling more than 4,900 water systems for six PFAS compounds through the Third Unregulated Contaminant Monitoring Rule (UCMR3). Samples collected from 2013 to 2015 showed a small number of water supplies–1.3%–had PFAS present above the current EPA Lifetime Health Advisory Level of 70 ng/L for PFOA and PFOS.

AWWA members are currently working with EPA to ensure that additional monitoring for PFAS compounds in the fifth UCMR cycle, 2021-2023, will utilize a well-tested analytical method and that states, EPA, and water systems are prepared to communicate effectively about observed levels.

Sources of PFAS Contamination

Aqueous film-forming foams (AFFFs)

AFFFs have been used at military bases, airports, and firefighting training sites to suppress flammable liquid fires, and several PFAS compounds have been ingredients in these products. Uncontained AFFF runoff has migrated through soil to contaminate nearby aquifers and surface waters at a number of sites in the United States.

Manufacturing

Facilities that produced PFAS products or used PFAS in manufacturing processes have released the chemicals through wastewaters, solid waste, and air emissions.

Landfill disposal

At several historic landfill sites, PFAS-contaminated waste has contributed to leachate—liquid that has passed through a landfill and extracted dissolved and suspended matter from it—that subsequently contaminated natural waters. Today, untreated landfill leachate may pose a contamination risk.

Excerpted from June 2019 Opflow article by Dustin Mobley and Chris Tadanier

Treatment options

To date, there are three widely applied technologies for PFAS reduction once water is contaminated. Each has advantages and limitations. All three generate waste streams that themselves must be managed. All require significant increases in capital and operating expenses. They include:

- Activated carbon, in which contaminants are adsorbed by the activated carbon media. The media needs to be regenerated periodically to renew adsorptive capabilities.
- Anion exchange, typically called ion exchange. The ion exchange process removes contaminants, such as PFAS, from water by exchanging them for another charged substance–typically chloride–on the surface of a resin. Removal rates vary by PFAS compound.
- Membrane filtration, using nanofiltration and/or reverse osmosis (RO) membranes. The technology removes dissolved substances by passage through a porous membrane at high pressure.

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PFAS treatment methods

Treatment Method	Considerations	
	Pros	Cons
Granular Activated Carbon (GAC)	• Widely used for PFAS removal, high removal rates possible • Powder activated carbon is useful for responding to spills	• Lower removal rates for perfluoroalkyl acids and short-chain PFAS • Possibility of competitive adsorption with other compounds present, such as TOC • Low rate of adsorption in GAC may result in long mass transfer zones and adjustment of associated operating requirements • Requires thermal regeneration of GAC; regenerated GAC may not be as effective as virgin GAC • Creates waste residuals to dispose of exhausted carbon and potential opportunity for pollution
Anion Exchange (IX)	• Sorption rates depend on the resin and porosity • Can partially remove PFOA, PFNA, and PFOS • Resin can be specialized for specific PFAS and allows IX to have a higher capacity than activated carbon	• Life-cycle costs are similar to GAC but depend greatly on resin and treatment system • Rate of exchange will depend on many factors, including influent PFAS concentration, design of the IX, solution ionic strength and bead material • Surface water supplies may need clarification/ filtration before treatment • Range of efficacy for long and short-chain PFAS
Membrane Filtration	• Excellent, broad spectrum removal of PFAS • Reasonable for groundwater systems	• Reject water must be treated before discharging • High capital expense with high energy demands • Susceptible to fouling and may require pre-treatment • Reverse osmosis is preferable to nanofiltration due to better removal efficiency but higher operating costs • Volume of water lost to brine waste stream can be significant

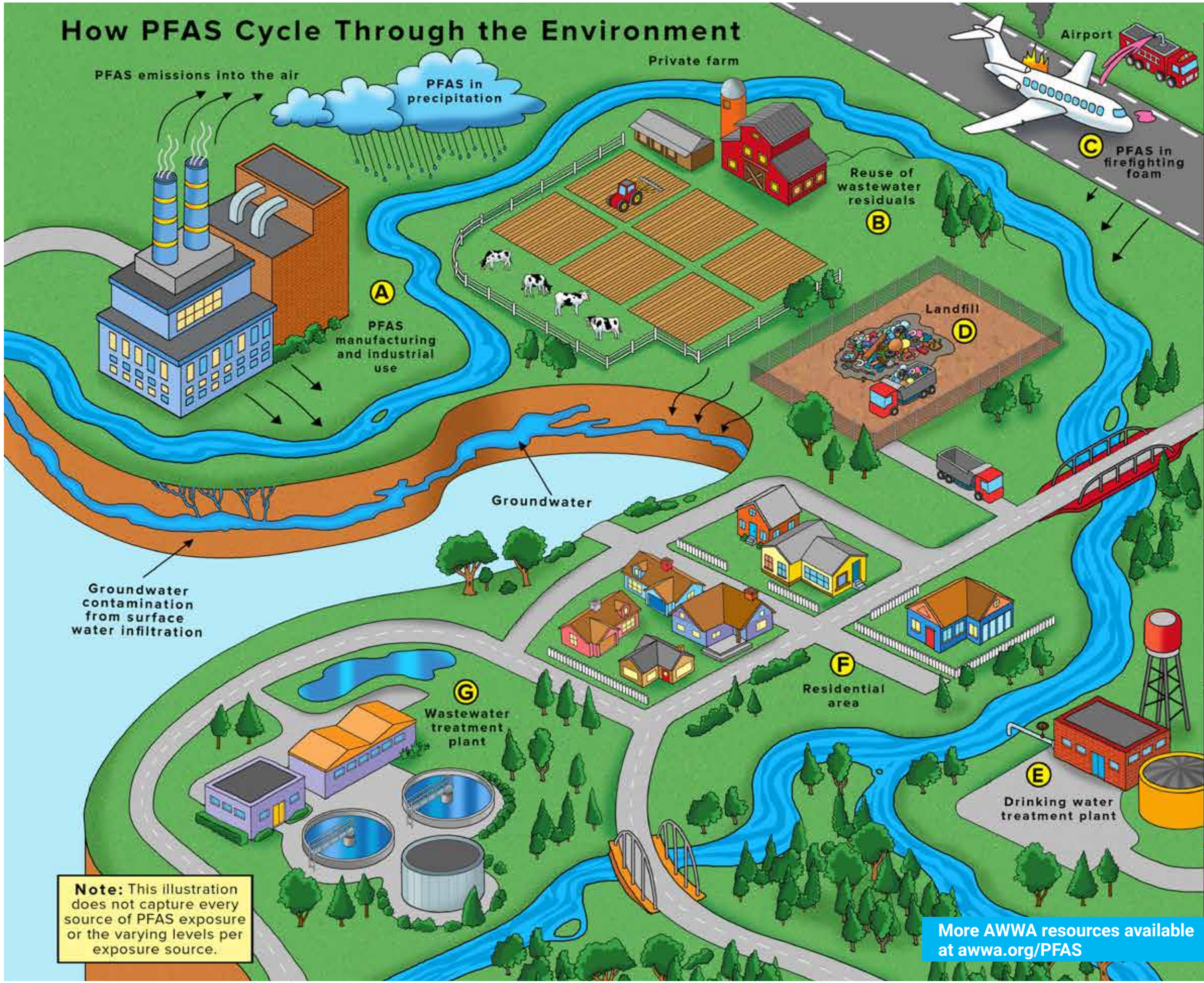
PFAS contaminated residuals

Water and wastewater treatment generate solid residuals as part of conventional treatment processes to protect public health. Biosolids from wastewater treatment are nutrient rich, and once treated and tested to meet federal and state or provincial standards, they often are recycled as lower-cost fertilizers and soil amendments on agricultural land.

PFAS are not used in water and wastewater treatment processes but may be found in drinking water sources or wastewater influent. PFAS compounds have been shown to accumulate in biosolids, so when there are significant contributions from industry, levels in biosolids have been high enough to lead to elevated levels in groundwater and uptake into the food chain. Reducing or eliminating PFAS at the source is the most efficient action to address potential concerns related to PFAS in biosolids and residuals.

More AWWA resources available at awwa.org/PFAS

How PFAS Cycle Through the Environment



Note: This illustration does not capture every source of PFAS exposure or the varying levels per exposure source.

More AWWA resources available at awwa.org/PFAS

A PFAS, which are unregulated in industrial discharges, enter the environment through air, surface water and groundwater.

B Nutrient-rich materials that remain after wastewater treatment and testing are used on farms as low-cost fertilizers. Significant contributions to wastewater from nearby industrial sites can lead to elevated PFAS levels in the residual materials that can seep into groundwater if not removed during treatment.

C Firefighting foams containing PFAS were previously used at airports, military bases and training sites. In some sites, the runoff migrated through soil into surface and groundwater.

D At older landfill sites, wastewater containing dissolved and suspended materials from contaminated waste may have leached into groundwater or entered surface water.

E New technologies have enabled recent detection of PFAS in drinking water supplies. Water treatment facilities that hadn't previously known of PFAS in their water supplies are determining the most effective treatments for removal.

F PFAS were used in common household products such as non-stick cookware, shampoo, food containers and paint. Because they don't easily break down, PFAS can accumulate in the human body and end up in source water and drinking water.

G Liquid waste that seeps from landfills and wastewater are treated at wastewater plants, but PFAS may remain in the water after treatment and contaminate groundwater.

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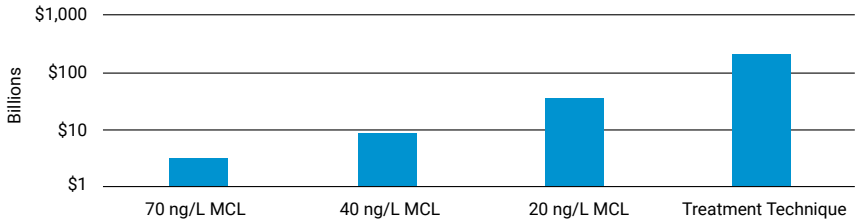
COSTS OF PFAS TREATMENT

With U.S. Congress considering legislation that would require a national regulation for PFAS, the Congressional Budget Office asked AWWA for information about the costs of PFAS removal through drinking water treatment.

AWWA prepared a preliminary estimate of drinking water treatment costs for two specific PFAS, PFOA and PFOS. The estimate detailed three different technologies for PFOA and PFOS removal – granular activated carbon (GAC), ion exchange and reverse osmosis. The cost of each of these technologies was estimated based on three potential maximum contaminant levels that EPA could set. A fourth scenario addressed the possibility of EPA setting a treatment technique standard that would apply to all community water systems. AWWA's full cost estimate analysis is available at awwa.org/pfas.

Depending on how PFAS-related legislation is finalized, the potential capital costs associated with treatment to remove PFOA and PFOS in drinking water would vary significantly. At a minimum, the potential capital cost would quickly exceed $3 billion nationally if regulation was aligned with EPA's lifetime health advisory level of 70 ng/L. It could exceed $38 billion if federal implementation mirrored state-level efforts of less than 20 ng/L. There is the potential, given the limited understanding of PFAS removal, that a treatment technique standard would be required and could entail more than $370 billion in capital investment and over $12 billion in annual O&M costs.

U.S. Cost of Drinking Water Treatment to Remove PFOA and PFOS Using GAC



Planning level costs are estimated to be conceptual and may be higher (+50%) or lower (-30%).

AWWA's cost estimate is based on several assumptions and is conservative because:

- It does not consider lost water supply capacity and associated system resiliency due to taking water sources off-line and water lost due to waste streams.
- It was not possible to account for the cost of treatment of waste residuals, particularly with the current regulatory uncertainty surrounding PFAS as a hazardous substance.
- It does not include administration costs for a primary drinking water standard.
- Available data on which to base a cost estimate is limited.

The Association analysis highlights the need for additional data and research to better understand the implications of a national drinking water standard.

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AWWA Guiding Principles on PFAS Regulation

1. Commitment to public health protection

Protecting public health is AWWA's first core principle concerning PFAS and all drinking water matters. While human health impacts from PFAS exposure at levels found in drinking water are uncertain, AWWA recognizes PFAS as a growing public health concern that merits swift and serious attention.

2. Fidelity to scientific process

The Safe Drinking Water Act mandates a consistent, transparent, and science-based process for the consideration of new regulations. AWWA supports following the essential SDWA steps–without undue delay–to assure PFAS risks are effectively and efficiently reduced.

3. Protection of source water

The best way to keep drinking water safe is to protect it at its source. AWWA believes EPA should utilize existing laws to understand and control PFAS risks before harmful substances are introduced into commerce, and that PFAS producers–not consumers and water utilities–should be liable for cleaning up drinking water and the environment.

4. Investment in research

More funding for research is needed to assess and address the human health effects of exposure to PFAS; identify analytical methods that quantify levels of PFAS in source water, drinking water and wastewater; and further develop technologies to cost-effectively remove PFAS compounds to levels that do not post health concerns.

"… Regulatory actions need to be prudently implemented to avoid aggravating affordability issues for customers, particularly those with low incomes … Water systems across the United States are striving to provide the best water quality possible at a reasonable cost to their customers. Investing in a treatment requirement based on inadequate information can leave fewer resources to address other known risks, such as failing infrastructure or lead service line replacement."
—AWWA response to the Congressional Budget Office

More AWWA resources available at awwa.org/PFAS

AWWA URGES PUBLIC HEALTH PROTECTION, SOUND SCIENCE

In Congressional testimony and communication with decision-makers, AWWA stressed the importance of source water protection, scientific process and continuing research to confront the challenge of PFAS in drinking water.

> "We caution against setting a precedent of by-passing these established processes via legislative action…That said, we are eager to follow the data on PFAS compounds wherever it may go in the investigative process so that we may know how to best protect public health."
> —*Tracy Mehan, AWWA executive director of government affairs*

AWWA emphasizes that EPA should use its existing authorities to address PFAS, including:

- The Toxic Substances Control Act of 1976, which gives EPA data-gathering authority to both collect data from manufacturers and restrict the use of industrial chemicals.
- The Safe Drinking Water Act (SDWA), which empowers EPA to decide which contaminants pose a meaningful opportunity to protect public health through drinking water standards.

AWWA advocates for proper federal funding to conduct research to:

- Understand the potential health effects and risks associated with PFAS
- Develop analytical methods to quantify levels of PFAS compounds in environmental samples, particularly in natural waters, wastewaters, and soil
- Develop technologies to more cost-effectively remove problematic PFAS from drinking water and wastewaters to levels that do not pose public health concerns

More AWWA resources available at awwa.org/PFAS

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ADDRESSING PFAS AT THE FEDERAL LEVEL

In 2016, EPA released 70 nanogram per liter drinking water lifetime health advisories for PFOA and PFOS, as individual compounds and cumulatively. Health advisories are not enforceable standards but rather guides to inform state and local risk management. Health advisories are a first step in setting treatment objectives, based on available health effects research. They do not take practical implementation considerations into account, nor do they consider cost.

In 2018, AWWA participated in a PFAS National Leadership Summit sponsored by EPA to inform the agency's decision process for PFAS regulation. AWWA advised EPA to:

1. Use its statutory tools to collect the information needed to make sound risk management decisions
2. Follow the Safe Drinking Water Act process to determine if and what drinking water standards should be set
3. Utilize its regulatory tools to protect drinking water supplies from PFAS compounds that pose health concerns
4. Coordinate with other federal agencies, local governments and utilities to communicate more effectively to the public about PFAS risks

In February 2019, EPA released its PFAS Action Plan to identify, understand and deal with the breadth of PFAS contamination across the nation and its territories. The action plan includes developing regulations for PFOA and PFOS, both to set enforceable standards for drinking water and to designate these compounds as Comprehensive Environmental Response, Compensation, and Liability Act (Superfund) hazardous substances. EPA is expected to make a regulatory determination for PFOA and PFOS by the end of 2019.

Trending in an Instant

With PFAS and all emerging contaminants, communicating risk is a monumental challenge for water utility professionals. AWWA recently published a new guide, *Trending in an Instant*, which helps utilities communicate with clarity in today's changing media landscape. Available as an AWWA utility member benefit, a summary of the guide is available at awwa.org/pfas.

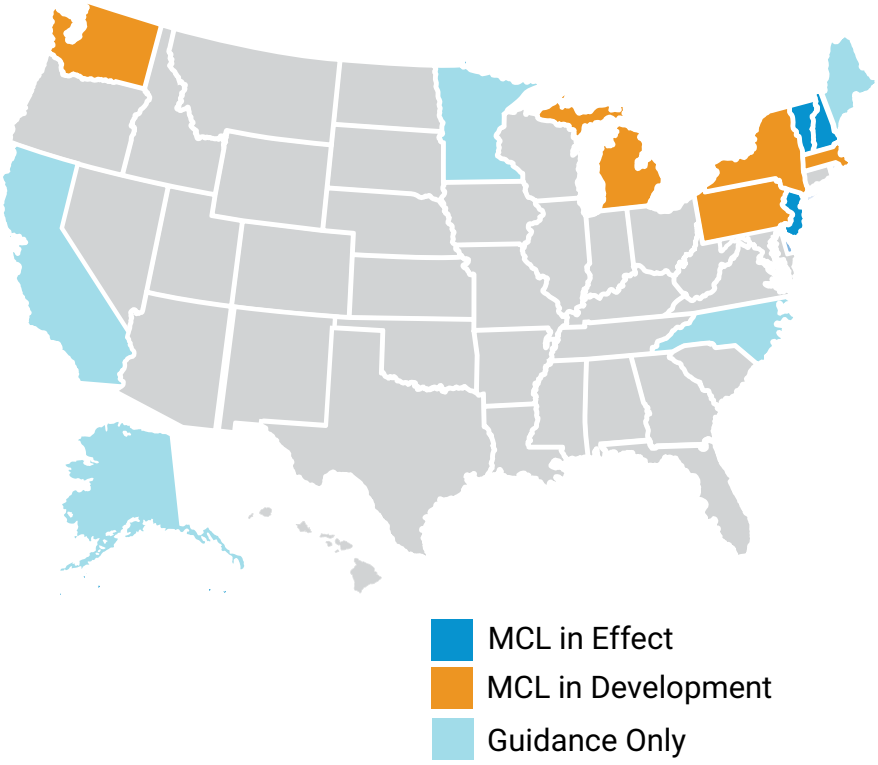
STATE REGULATORY OVERVIEW

Individual states are also taking steps to address PFAS contamination in the absence of federal regulations. As of October 2019, 21 states had established policies to protect drinking water sources and three more were engaged in developing policies.

As the map below shows, three states have drinking water MCLs for PFAS in effect and five more are somewhere in the development process.

AWWA's PFAS State Regulatory Overview, available at awwa.org/pfas, provides insight into the PFAS listed and maximum allowed concentrations reflected in each state's draft and final regulations.

State Drinking Water Standards and Guidance



"Our members are concerned about states setting a range of maximum contaminant levels for PFAS compounds using a range of different analytical techniques, sometimes without adequate cost-benefit analysis."

Tracy Mehan, AWWA executive director of government affairs

May 15, 2019 testimony before U.S. House Subcommittee on the Environment and Climate Change

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AWWA RESOURCES ON PFAS – AVAILABLE AT AWWA.ORG

AWWA provides the following PFAS resources for members and continues to develop them as the issue evolves. Many of these resources provide greater detail.

AWWA Resource Pages
awwa.org/PFAS • Policy and Advocacy: awwa.org/Policy-Advocacy/Legislative-Activities

Fact Sheets
Summary of State Regulation to Protect Drinking Water • Treatment Methods • Overview and Prevalence of PFAS • Monitoring, Sampling, Analysis • Cost Estimate to Remove PFAS

Journal AWWA
The PFAS Problem, Nov. 2019 • Fast and Furious, PFAS, Sep. 2019 • Litigation Combats Hazards of Aqueous Film-Forming Foam Product, Aug. 2019 • States are Acting without USEPA, Aug. 2019 • PFAS 101, July 2019 • Monitoring UCMR Compounds in Drinking Water System Components and Treatment Chemicals, March 2019 • AWWA: Public health protection, scientific process, resources key in addressing PFAS, Feb. 2019

Opflow
Litigation Combats Hazards of Aqueous Film-Forming Foam Products, Aug. 2019
• PFAS: Why They Matter and How to Treat Them, June 2019

AWWA Water Science
Effectiveness of point-of-use/point-of-entry systems to remove per- and polyfluoroalkyl substances from drinking water, March 2019

AWWA Standards
Activated Carbon Treatment: B600 Powdered Activated Carbon
• B604 Granular Activated Carbon • B605 Reactivation of Granular Activated Carbon

Ion Exchange: B116 Electrodialysis and Ion-Exchange Membrane Systems

Reverse Osmosis: B114 Reverse Osmosis and Nanofiltration Systems for Water Treatment • B110 Membrane Systems

G100 Water Treatment Plant Operation and Management

AWWA Manuals of Water Supply Practice
Reverse Osmosis: M46 Reverse Osmosis and Nanofiltration
• M62 Membrane Applications for Water Reuse

AWWA Technical Reports
Activated Carbon: Solutions for Improving Water Quality

AWWA Communications Tool
Trending in an Instant: A Risk Communication Guide for Utilities

AWWA Events
Water Quality Technology Conference

More AWWA resources available at awwa.org/PFAS

American Water Works Association

We Make Water Policy A Priority
Together We Protect Public Health

Through AWWA members' collective knowledge, our Government Affairs office informs decision makers on legislative and regulatory issues. We support effective measures that protect public health by advocating for sensible laws, regulations, programs and policies.

Join AWWA today and let's work together on the critical issues facing our industry.

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