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U.S. PIRG Education Fund

ENVIRONMENT AMERICA RESEARCH & POLICY CENTER

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Executive summary

PER- AND POLYFLUOROALKYL SUBSTANCES, more commonly known as PFAS, are found in products ranging from coatings for non-stick pans, paper products and textiles, to firefighting foam and electronics.[1] Their oil- and water-repelling capabilities, their stability even at high temperatures, and their friction-reduction qualities have led to PFAS becoming a common ingredient in product manufacturing – and a ubiquitous presence in our homes and our communities.[2]

However, PFAS are dangerous for public health. Sometimes known by the moniker "forever chemicals" because they are nearly indestructible in the environment, PFAS build up in the bodies of humans over time and persist in the environment.[3] Today, PFAS are so widespread that nearly every American has these chemicals in their blood.[4] PFAS can cause kidney cancer, thyroid disruption, reduced responses to vaccination, and other health problems.

Nonetheless, PFAS production continues, adding to the pollution that threatens our health and environment, both today and for decades to come.

To protect public health, the United States must take strong action to stop the flow of PFAS into our environment and our bodies, clean up existing PFAS contamination, and hold manufacturers and polluters responsible for cleaning up the pollution and public health damage they have caused.

PFAS are harmful to public health. Even low levels of exposure to PFAS are linked to a range of health effects, including:

- Harm to the kidneys, leading to chronic kidney disease or kidney cancer;[5]
- Reduced antibody responses to vaccinations in both children and adults;[6] and
- Increased risk of gestational diabetes, preeclampsia, low birth weight and childhood obesity.[7]

Despite industry claims to the contrary, newer types of PFAS are no safer for human health and the environment than older PFAS, such as PFOA and PFOS.[8]

- New PFAS travel more easily through water, resulting in widespread exposure, and thus may pose more risks to human and environmental health.[9]
- The U.S. Environmental Protection Agency has found that two newer PFAS chemicals create many of the same health impacts as older PFAS.[10] The EPA determined the toxicity of the PFAS known as GenX is in the same range as PFOA, the legacy PFAS it replaced.[11]
- Hundreds of public health experts around the globe have expressed concern about the health impacts of continuing to produce and use all varieties of PFAS.[12]

Many drinking water sources across the country are contaminated with PFAS. As of June 2022, 2,858 locations in 50 states and two U.S. territories were known to be contaminated with PFAS.[13] Recent analysis by the Environmental Working Group has concluded that PFAS are now likely present in all major drinking water supplies in the U.S.[14]

- In a 2022 study of PFAS in U.S. surface waters, 83% of the waterways sampled were found to contain at least one PFAS compound, with levels in some cases upward of 1,000 parts per trillion.[15] For some PFAS, concentrations as low as 0.004 parts per trillion are considered a risk to human health.[16]
- The same study detected 35 different PFAS chemicals in sampled waterways, with PFOA and PFOS appearing in around 70% of all samples taken.[17]
- A 2019 Environmental Working Group study analyzing tap water from 44 locations in 31 states plus the District of Columbia detected PFAS in all but one of the samples collected.[18] Some of the highest levels of contamination were in samples from major cities, including Miami, Philadelphia and New Orleans, and suburbs of New York City.[19]
- A 2022 analysis of groundwater from five aquifer systems in the eastern United States found that 60% of public-supply wells contained at least one PFAS.[20]

PFAS also contaminate food. A 2016 EPA report notes that food ingestion appears to be the primary route of exposure for PFOS in the general population.[21]

- A 2018 FDA study assessing produce grown near a PFAS manufacturing plant found PFAS in 80% of the samples taken.[22]
- A 2020 study analyzing 70 samples of finfish and shellfish from four regions of the U.S. and seven countries with sizable seafood imports to the U.S. found PFAS in around one third of all samples, with PFOS the main compound detected.[23] Some samples contained as many as 10 PFAS compounds.[24]

But there is reason for hope. The scientific evidence shows that when we halt the use of PFAS chemicals, we reduce their presence in the human body and risk to our health.[25]

Protecting human health and the environment from toxic PFAS will require policymakers to take a comprehensive approach.

Federal and state policymakers should act to stop this toxic threat at its source by banning the production and use of all PFAS.

- Banning all PFAS is crucial to protecting the environment and public health. The manufacturing and use of these toxic chemicals have already created widespread contamination that is extremely difficult to clean up and will create health risks for years to come. Because PFAS are persistent, soluable in water, and toxic at extremely low levels, any sensible strategy must center on moving our society to safer alternatives.
- PFAS regulations should apply to all PFAS chemicals as a single class.[26] Controlling the use of one type of PFAS at a time has historically led to the regrettable substitution of replacement chemicals that are less well understood, but not necessarily safer.

Federal and state policymakers should adopt measures to stop PFAS from contaminating our waterways, groundwater and food:

- State officials should use the full extent of their existing authority under the Clean Water Act and state laws to halt flows of PFAS into surface waters.
- State and federal authorities – including the Federal Aviation Administration – should move swiftly to end the use of PFAS in all firefighting foam, a major pathway for water contamination.
- The U.S. Environmental Protection Agency should update pollution control standards to eliminate direct discharges of all PFAS from all industrial sources.
- Federal decisionmakers should establish health-based drinking water standards for all PFAS. Several states have established limits on PFAS in drinking water, but while the process of formulating enforceable federal standards for a small number of PFAS chemicals is underway, currently no such standards exist at the federal level.[27]

Policymakers should take action to ensure comprehensive cleanup of existing PFAS contamination. This means mandating and providing dedicated funding for regular monitoring for PFAS in public drinking water, groundwater and waterways to jump-start remediation and thereby prevent PFAS contamination from spreading.

- **Dedicated state and federal funding should be made available to facilitate comprehensive cleanup of groundwater and drinking water supplies** and ensure compliance with any PFAS-in-drinking-water limit adopted at either state or federal levels. Funding already allocated through the 2021 Infrastructure Investment and Jobs Act is a positive step, but insufficient to cover the full costs of the scale of cleanup necessary.
- **The EPA should designate all PFAS, as a single class, as hazardous substances.** This would facilitate better management of the entire class of chemicals and also apply strict storage, transfer and disposal requirements to the chemicals under the federal Resource Conservation and Recovery Act. In addition, such a designation would ensure that PFAS chemicals are actually cleaned up at Superfund sites.
    - Regulators should ensure that PFAS removed from water or soil during remediation efforts do not create new pollution risks after disposal. The best solution is to store PFAS and PFAS-containing materials until they can be destroyed.
- **State and federal leaders should hold the companies and U.S. government agencies that are responsible for PFAS contamination accountable for cleaning up their pollution.** Cleaning up PFAS contamination on the timescale needed requires those who created the problem to pay their fair share. Accountability can be obtained through legislative action, enforcement of cleanup laws or lawsuits.

Introduction

IN THE EARLY 1980S, the family of a cattle farmer named Wilbur Tennant sold some of their West Virginia land to DuPont chemical company for a "non-hazardous" landfill.[28] Only a few short years later, as explained in a vivid history by Nathaniel Rich, more than 100 of Tennant's cattle that grazed on his land downstream from the landfill were dead, were struggling with malformations and illness, or appeared to have gone mad.[29]

In the late 1990s, Tennant approached lawyer Robert Bilott to help him figure out what was happening to his cattle, suspecting that it was related to a stream on his property that had become badly polluted after DuPont set up its landfill operation.[30] However, after a joint study by DuPont and the EPA, it was determined that "there was no evidence of toxicity associated with chemical contamination of the environment."[31] The investigation concluded that Tennant must have mismanaged his cattle. But as anyone who has seen the movie *Dark Waters* knows, that wasn't the case.

It was only when Bilott happened to find a letter from DuPont to the EPA that referenced a chemical called PFOA that a story began to emerge. Bilott had never heard of PFOA, it wasn't a regulated chemical, and no one at his law firm knew anything about it.[32] When Bilott asked for all of DuPont's documentation on PFOA the company refused, protesting until the court forced the company to comply.[33]

After poring over more than 110,000 pages of documentation relating to PFOA, it became clear to Bilott that not only was PFOA highly dangerous, but that DuPont and 3M, the company from which DuPont purchased PFOA, had been studying the effects of PFOA for years.[34] The companies were well aware that PFOA caused tumors, liver problems, birth defects and cancers in animal test subjects, and, in some cases, workers.[35] Despite these health risks, DuPont decided not to make the findings public, concealing ongoing practices that included venting contaminated dust out of factories, pumping hundreds of thousands of pounds of PFOA powder into the Ohio River, and dumping thousands of tons of PFOA-laced sludge into open, unlined pits that leached directly into the drinking water of tens of thousands of people.[36]

Strikingly, it was revealed that DuPont knew as early as 1991 that PFOA levels in the stream that supplied water to Tennant's cattle were 100 parts per billion, 100 times as great as DuPont's internal safety standards for drinking water.[37]

PFOA is part of a larger category of chemicals called per- and polyfluoroalkyl substances, or PFAS. PFAS are a group of human-made chemicals first invented in the 1930s.[38] They repel oil and water, as well as resist degradation at high heat –

all properties that make them very effective in a wide range of products and industrial processes.[39]

Another trait that makes PFAS so useful, but also so harmful, is that they never truly go away, earning them the nickname "forever chemicals." While PFOA and PFOS, two of the most widely used chemicals in the PFAS family, have been voluntarily phased out in the United States, they still linger in the environment and are found in the blood of nearly all people tested.[40] They also have been replaced with new PFAS that may be as dangerous as the original substances.[41]

Even today, years after the first indication of the harm PFAS can cause to humans and wildlife, all of us still have something in common with Wilbur Tennant: We continue to be exposed, without our consent, to chemicals with the potential to cause harm, and without adequate study of the effects or protection against them.

It is time to stop producing these dangerous chemicals and start cleaning up the existing mess. Fortunately, governments across the country, and around the world, have begun to take action – adopting policies and practices that both federal and state governments can follow.

PFAS are widely used and harmful to health

THE THOUSANDS OF CHEMICALS collectively known as PFAS have useful properties, such as resisting oil and water, that have led to their widespread use. However, PFAS also damage human health, interfering with and harming many systems in the body.

PFAS include thousands of chemicals

"PFAS" is an umbrella term for a group of per- and polyfluoroalkyl substances, of which there are more than 12,000.[42] They are made of a very strong chain of carbon and fluorine atoms that do not break down easily. They repel oil and water and resist high temperatures, and are used in many non-stick, heat resistant, and stainproof or waterproof products.[43]

Their durability is a problem, however, when they enter the environment or our bodies. Their chemical bonds do not break down.[44] In the bodies of people and wildlife, they can accumulate and even be passed from mother to child through the placenta or breast milk.[45]

The first PFAS were created in the 1930s. Manufacturing of PFAS began in the 1940s with perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA).[46] These two original PFAS were used for decades in a wide variety of products. As research accumulated proving the dangers of PFOA and PFOS, manufacturers voluntarily phased out their production in the U.S. from 2000 to 2015.[47] These chemicals continue to be manufactured in other countries and may be used in imported products.

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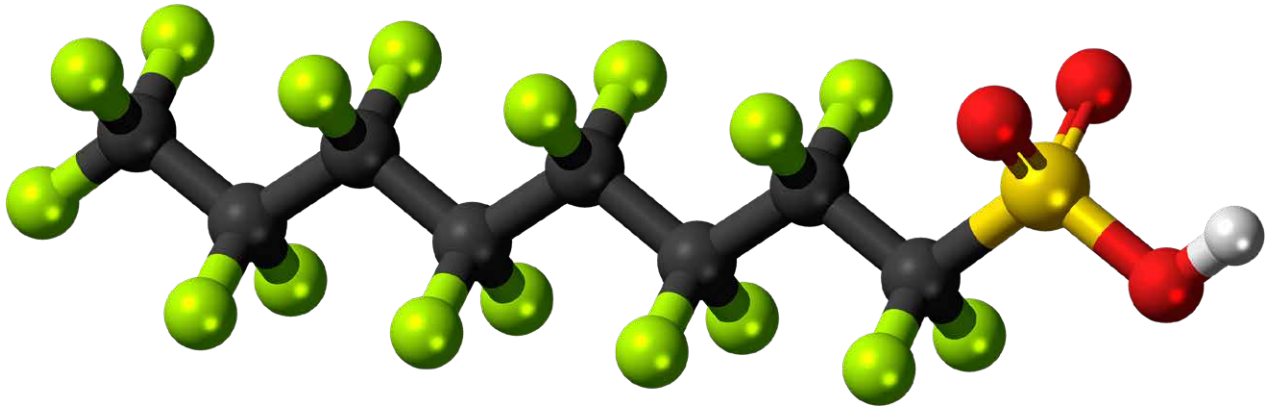


The chemical structure of PFOS, showing atoms of carbon (black), fluorine (green), sulfur (yellow), oxygen (red) and hydrogen (white).

Many companies that had previously used PFOA and PFOS switched over to using other PFAS to serve the same purposes.[48] However, these other PFAS are either highly persistent in the environment or can transform into other highly persistent PFAS in the environment.[49] They also carry many of the same risks to health.[50]

PFAS are widely used

PFAS are used in a variety of products and industrial processes. This provides ample opportunities for human exposure.[51]

Common uses for PFAS include:[52]

- Firefighting foams: PFAS have been used at airports, fire departments and military bases.
- Paints, varnishes and sealants: PFAS repel water, oil and stains.
- Non-stick pans: PFAS have slippery, water- and oil-repellent qualities.
- Food packaging: PFAS repel grease and oil in microwave popcorn bags, pizza boxes, fast food containers/wrappers and candy wrappers.
- Waterproof surfaces and stain- or water-repellent fabric and carpet coatings.
- Personal care products and cosmetics such as dental floss, shampoo, nail polish and eye makeup. PFAS increase the durability and water resistance of cosmetics, as well as help to make skin appear shimmery and smooth.[53]
- Electronics manufacturing and other industrial production. PFAS protect manufacturing equipment against harsh chemicals used in the production of semiconductors.[54] PFAS are also used in wire and cable insulation.[55]
- Pesticides. Many commonly used pesticides contain PFAS compounds. Six of the 10 pesticides analyzed in a study published in 2022 were found to contain PFOS at levels above the EPA's then-health advisory limits for drinking water.[56]

PFAS cause disease

PFAS are toxic chemicals that harm human health at even low levels of exposure. PFAS are not metabolized by the body and can only be excreted slowly through routine bodily processes.[57] The chemicals bind to tissue proteins and accumulate in the blood, liver, kidneys and brain.[58]

Health damage from PFAS may include:

- Increased risk of gestational diabetes, preeclampsia, low birth weight and childhood obesity.[59]
- Thyroid disruption, potentially including hyperthyroidism and changes to hormones that influence development and metabolism.[60]
- Harm to the kidneys, leading to chronic kidney disease or kidney cancer.[61]
- Liver disease.[62]
- Reduced antibody responses to vaccinations in both children and adults.[63]
- Testicular cancer.[64]
- Higher levels of cholesterol.[65]
- Increased risk of Type 2 diabetes in women.[66]
- Weakened immune system.[67]

Children are at increased risk from PFAS exposure, in part because they consume more food and water and breathe more air per pound of body weight than adults, which can increase their exposure.[68] Likewise, some adults are at higher risk than others, being exposed to high levels of PFAS in

the workplace. Some occupations – such as firefighters and the military – are known to be exposed more than the rest of the population.[69]

Exposure standards

In March 2023, the EPA issued proposed drinking water standards for six specific PFAS. Two, PFOA and PFOS, would be regulated individually at 4 parts per trillion (ppt) and the four others would be regulated as a mixture using a "hazard index" approach.[70] This approach is an innovative way to regulate multiple chemicals from a class.[71] While this is an important step, however, more needs to be done to protect the public from the over 12,000 PFAS that could be in drinking water.

Until the EPA's 2023 proposals are implemented, there remains no federally enforceable standard for PFAS contamination in drinking water or groundwater. The only currently existing standards issued at the federal level are non-binding health advisories applying only to a small number of specific PFAS. (See: "Establish a limit on all PFAS in drinking water strong enough to protect public health," page 22.) These advisory levels are not sufficiently protective of health, since they are too high, apply only to a small number of PFAS, and are non-enforceable.

As of February 2023, the EPA's recommended "preliminary remediation goal" (PRG) for contaminated groundwater that is a "current or potential source of drinking water" remained at 70 parts per trillion (ppt).[72] This level of contamination serves as the initial cleanup target for sites that are contaminated, and is not an enforceable standard.[73] In other words, some states may voluntarily use the standard as guidance for action, and others may ignore it. Furthermore, the EPA's advisory covers the combined levels of just PFOA and PFOS, despite the fact that many other PFAS may also be present in groundwater. The level of contamination at which the EPA determines that PFOA and/or PFOS is present at a site and "may warrant further attention" is 40 ppt – substantially higher than levels known to be damaging to human health.[74]

A 2013 research paper on the impact of PFOS and PFOA on children's response to vaccines recommended a limit of approximately 1 ppt in drinking water.[75] Based on this research and on studies of PFAS in animals, the Environmental Working Group (EWG) argues that the drinking water standard for total PFAS contamination should be 1 ppt.[76] The Natural Resources Defense Council (NRDC) suggests that toxicity assessments set at a level fully protective of human health would range from 0 to 2 ppt for drinking water.[77]

Several states have set limits on multiple PFAS (not just PFOA and PFOS) for drinking water that are more stringent than the recommendation of 70 ppt set by the EPA in 2016.[78] (See "Establish a limit on all PFAS in drinking water strong enough to protect public health," page 22, for more details.)

Photo: U.S. Environmental Protction Agency via Flickr

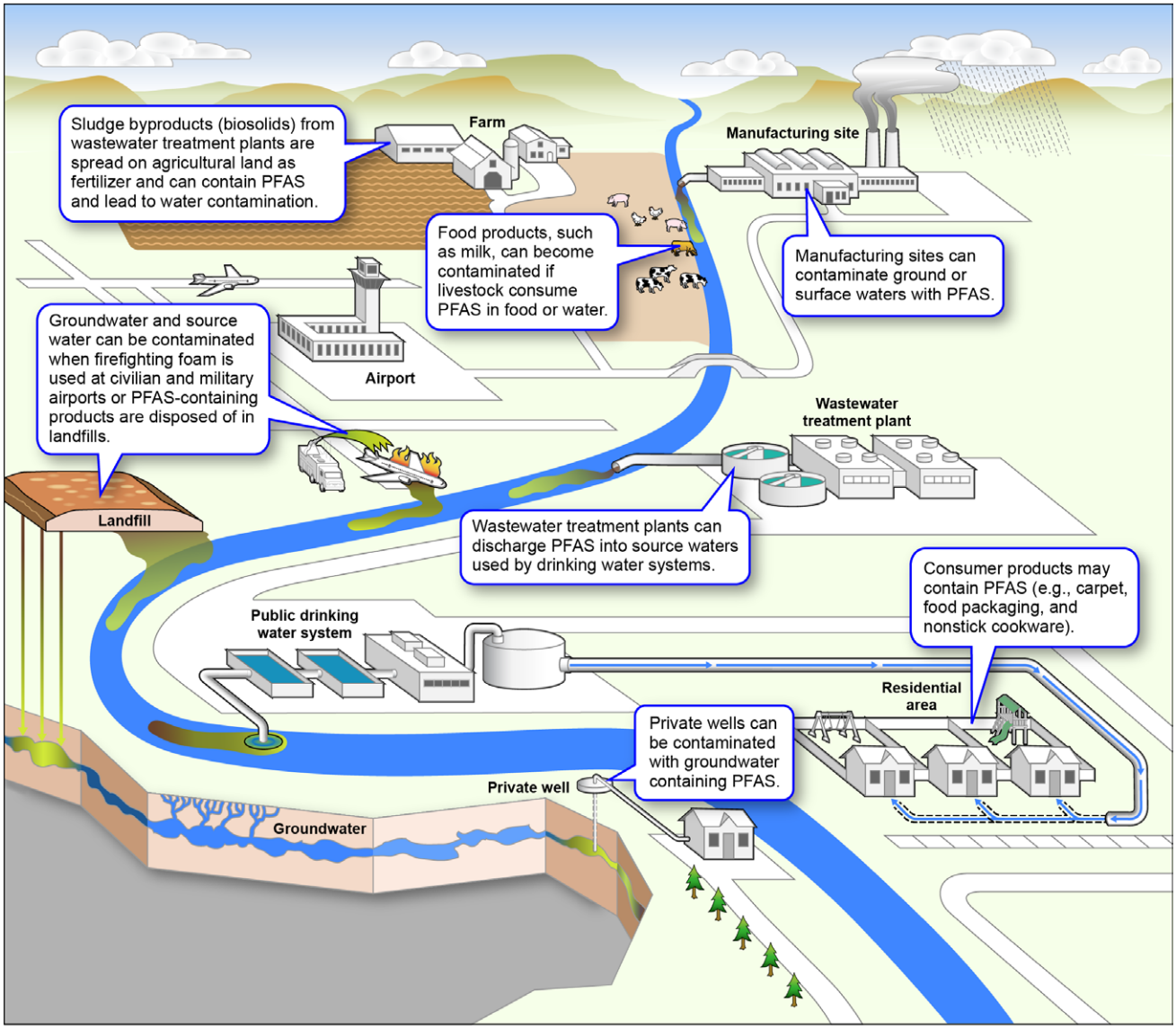
The U.S. Environmental Protection Agency has not established binding limits on PFAS in drinking water.

Our environment is contaminated with PFAS

PFAS CONTAMINATION in the United States has been found in drinking water, groundwater and food. This widespread pollution has been found despite limited testing for relatively few types of PFAS.

Environmental contamination can occur through many routes.[79] Industrial and manufacturing facilities that produce or use PFAS may release the chemicals into the water or air.[80] Landfills with products

FIGURE 1. EXAMPLES OF HOW PFAS ENTER THE ENVIRONMENT[81]



containing PFAS may leach PFAS into groundwater and waste incinerators burning those products may release PFAS into the air. Firefighting foam that contains PFAS, frequently used at airports, military facilities and industrial sites, can pollute surface waters or groundwater. Sewage treatment plants may discharge PFAS-contaminated water into streams or offer PFAS-tainted biosolids as agricultural fertilizer, which can pollute water, soil and crops. Consumer products that contain PFAS may pollute air, dust and food in homes. (See Figure 1.)

Drinking water

While the full extent of PFAS contamination is unknown for most U.S. waters, as of June 2022, 2,858 locations in 50 states and two territories had been confirmed as contaminated.[82] PFAS have been found in drinking water sources all over the country, both in groundwater and surface waters, and, according to the Environmental Working Group, are likely present in all major drinking water supplies in the U.S., and "almost certainly" in all drinking water systems that use surface water.[83]

In a 2022 nationwide study of PFAS in U.S. surface waters, 95 of the 114 waterways sampled (83%) were found to contain at least one PFAS, with levels in some cases as high as thousands of parts per trillion.[84] The study notes that since the detection level for PFOA and PFOS in this survey was significantly higher than the EPA's interim Drinking Water Health Advisory Limits for those substances, waterways that showed no contamination in testing could still contain PFAS at levels higher than the EPA limits.[85]

Thirty-five of the 55 PFAS compounds tested for in the 2022 study were found in at least one sampled waterway.[86] PFOA and PFOS were the most frequently detected PFAS compounds, appearing in around 70% of samples.[87] PFOA was found in 158 out of 228 sites tested (69%), with concentrations of up to 847 ppt – more than 200,000 times the interim EPA Health Advisory Limit (0.004 ppt) for PFOA issued in 2022.[88] PFOS was found in 159 sampling sites (70%), at concentrations as high as 1,364.7 ppt (more than 68,000 times the interim EPA limit of 0.02 ppt).[89] Lesser-known types of PFAS were also "extremely prevalent," including PFHxA (found at 153 [67%] of the 228 sampling sites, at concentrations of up to 607.1 ppt), and PFPeA (found at 126 [55%] of 228 sites, in concentrations of up to 166.5 ppt).[90]

A 2019 EWG study analyzing tap water samples from 44 locations in 31 states plus the District of Columbia detected PFAS in all but one of the samples collected.[91] Some of the highest levels were in samples from major cities, including Miami, Philadelphia and New Orleans, and suburbs of New York City.[92] In the samples where PFAS were detected, concentrations varied from less than 1 ppt (in Seattle and Tuscaloosa, Ala.), to nearly 186 ppt (in Brunswick County, N.C.). On average, the contaminated samples contained six or seven different PFAS compounds. One contained 13 different compounds.[93]

In 34 of the locations where the EWG study found PFAS in drinking water, contamination had not been publicly reported by the EPA or state environmental agencies.[94] The absence of regulation of PFAS enables utilities that have conducted their own independent testing to avoid having to make their results public or report them to state drinking water agencies or the EPA.[95]

Groundwater

Other testing has revealed additional widespread PFAS contamination of groundwater (fresh water in rock, sand and soil pore spaces and cracks in the rock

beneath the Earth's surface). A 2022 study focusing on the eastern United States, for example, analyzed 254 groundwater samples from five aquifer systems for 24 PFAS. Sixty percent of public-supply wells and 20% of domestic wells contained at least one PFAS compound, and 47% of the samples contained two or more.[96] Two or more PFAS compounds were found in 53% of public-supply wells and 10% of domestic wells.[97] Fourteen of the 24 PFAS included in the study were found to be present in at least one of the groundwater sources tested.

Individual states and other agencies, including the military, have conducted their own research on groundwater contamination. Testing for PFAS contamination at military facilities across the country revealed at least 64 with PFAS levels in groundwater higher than 100,000 ppt.[98] Thirteen sites have been found to have contamination above 1 million ppt in at least one groundwater source, and one – England Air Force Base in Louisiana – had levels of 20.7 million ppt.[99] A 2021 Department of Defense study found that the Pentagon served water containing dangerous levels of PFOA and PFOS to 175,000 military personnel every year at 24 facilities.[100] A subsequent EWG analysis of the data concluded that the actual figure was likely more than 600,000 personnel at 116 sites.[101] In total, the EWG has identified more than 400 DOD sites with known PFAS contamination in either groundwater or drinking water.[102]

PFAS contamination at military sites is often traceable to the use of firefighting foam.[103] PFAS from this foam leaches into shallow groundwater, and from there potentially into nearby surface waterways or deeper aquifers.[104]

Food

While much of the focus of the research and media around PFAS has been on water contamination, PFAS compounds have also been found in our food supply. Research has suggested that food ingestion is an important, and potentially even the main, route of exposure for PFOS in the general population.[105] This can occur via the packaging in which food is sold, but also through contamination of the soil, water and air in which food is grown or raised, and in particular through the widespread use of contaminated sewage sludge as agricultural fertilizer (see below).

Of the 20 samples taken in a 2018 FDA study assessing produce grown near a PFAS manufacturing plant, 16 (80%) were found to contain PFAS.[106] Research from Canada in 2007, analyzing 54 composite food samples, found PFAS – most often, PFOA and PFOS – in meat (including beef steak, ground beef and luncheon meats), fish and shellfish (including both marine fish and freshwater species), fast food, and microwave popcorn.[107] The authors concluded that diet is responsible for approximately 60% of total PFAS exposure.[108]

Other research has likewise found PFAS in fish and shellfish sold for human consumption.[109] Studies of U.S. fish have looked both at sport fish from areas known or suspected to be contaminated with PFAS, as well as the commercial seafood supply. A 2020 study analyzed 70 samples of finfish and shellfish, including a variety of marine and freshwater species from four regions of the U.S. and seven countries with sizable seafood imports to the U.S., for 26 PFAS compounds. PFAS were found in around one third of these samples, with some samples containing as many as 10 PFAS compounds. PFOS was the main compound detected.[110]

The discovery of PFAS in wildlife has prompted some states to warn residents against consuming certain species from particular areas. In Maryland, for example, the discovery of PFAS in three species of fish in Potomac River tributary Piscataway Creek prompted the Maryland Department of the Environment to issue a fish consumption advisory, warning people to limit their intake of particular species caught in the creek.[111] Authorities in Maine have issued a similar advisory, recommending that hunters do not consume deer or wild turkey harvested within a "Do Not Eat" advisory area in the greater Fairfield region of Somerset County, where high levels of PFAS have been detected in these species.[112] Minnesota and Wisconsin have also advised their residents to limit the number of fish they eat, and in Michigan, ranchers have been notified that their beef cattle are contaminated due to polluted wastewater ending up in fertilizer.[113]

The use of PFAS-contaminated sewage sludge as agricultural fertilizer is a major pathway by which PFAS can enter the food supply, contaminating dairy, meat, crops and other food products, and has been responsible for serious PFAS contamination on farms in Maine, Michigan, Wisconsin, Alabama, Florida and elsewhere.[114]

In Maine in 2019, testing of 44 sites fertilized with sewage sludge found high levels of PFAS in the ground, livestock and farmers' blood, forcing one dairy farm to close.[115] Of the 44 samples tested, all contained at least one PFAS, and in all but two, contamination levels were above the safety thresholds for sludge that Maine set in 2018.[116]

As of February 2023, 56 agricultural sites in Maine had been confirmed as being contaminated with PFAS.[117] Of the 1,500-plus groundwater samples tested at those sites, 23% have been found to contain levels of PFAS substantially higher than the state's interim standard of 20 ppt for the cumulative total of six types of PFAS.[118] Officials are currently testing more than 1,000 sites considered high-risk for PFAS pollution due to their use of potentially contaminated sludge.[119]

PFAS are in our bodies

WITH PFAS CONTAMINATION in water and the chemicals being widely used in a variety of products, people can be exposed to PFAS through a number of different routes. As a result, nearly all Americans have PFAS in their bodies.[120]

How PFAS enter our bodies

People may ingest or inhale PFAS, or absorb them through the skin. In addition, babies can be exposed *in utero*.

Contaminated water

Drinking water contaminated with PFAS is one of the most common exposure routes.[121] In total, an estimated 200 million Americans drink water containing detectable amounts of PFAS.[122] Conventional drinking water treatment does not remove PFAS.[123]

Workplace exposure

Workers who make products with PFAS and soldiers or firefighters who work with firefighting foam may be particularly at risk for exposure.[124] For example, these individuals may inhale or swallow PFAS-contaminated dust.[125] They may also absorb PFAS through their skin.[126] PFAS used in certain kinds of work clothing create particular risks for certain occupations. Firefighters, for example, are at increased risk due to the high levels of PFAS contained in turnout gear.[127]

Consumer products

People can be exposed to PFAS through a variety of consumer products. PFAS migrate from consumer products, resulting in toxic exposure. Non-stick pans can transfer PFAS to food.[128] As stain-resistant furniture and carpets and waterproof clothing break down, they produce dust that can be inhaled or swallowed.[129] People can also be exposed to PFAS by using household cleaning products or personal care products containing PFAS.

Contaminated food

Food may be contaminated with PFAS if it is raised in contaminated soil, fertilized with contaminated sewage sludge, or irrigated with contaminated water.[130] PFAS have been found in fish, shellfish, meat, eggs, milk, fruits and vegetables.[131] Processing equipment and packaging that contain PFAS may also add PFAS to food.[132] One analysis of fast food packaging in the U.S. found that 46% of paper used to package food (for example, to wrap hamburgers) and 20% of paperboard (such as for french fry boxes) contained PFAS.[133]

The Food and Drug Administration has done inadequate testing for PFAS in food. The FDA found PFAS contamination in only 3 of 167 foods it tested in a 2021 study.[134] However, the FDA's tests had major limitations. The FDA used a testing method

that is not very sensitive to the presence of PFAS and thus likely missed lower concentrations of the chemicals. In addition, the agency did not test for any of the types of PFAS that are approved for use in food packaging.[135]

Exposure in utero or through breast milk

Babies can be exposed to PFAS before they are born, if the mother has been exposed to PFAS.

Infants may be exposed to PFAS through their mother's breast milk.[136] For example, a 2021 study found PFAS in all breastmilk samples collected from 50 nursing mothers in the U.S.[137]

Longer duration of breastfeeding is associated with higher PFAS levels in infants, which may result in adverse health effects.[138] However, the EPA and the American Academy of Pediatrics argue that the benefits of breastfeeding to the infant almost always outweigh risks of passing along environmental pollutants.[139]

Most Americans have PFAS in their bodies

Almost all Americans have PFAS in their bodies. This is the result of the widespread manufacturing and use of PFAS, combined with the structural longevity of the chemicals and their ability to bioaccumulate, or build up in the body over time. A survey by the Centers for Disease Control and Prevention (CDC) found at least one PFAS in the blood every one of the nearly 2,000 Americans who were tested.[140]

Tools to protect our health from PFAS

PFAS CONTAMINATION presents a widespread public health threat. The chemicals, which cause health damage ranging from low birth weight to diabetes to cancer, have been found in drinking water, groundwater and seafood. Though PFOA and PFOS are no longer produced in the U.S., Americans may still be exposed to them in imported products or through contaminated water. Replacement chemicals are equally hazardous. To avoid inflicting illness on even more people, policymakers should take a comprehensive approach to ending the threat from PFAS production, monitoring for dangers, and cleaning up existing pollution.

Stop the problem at the source

The first step to addressing the threat from PFAS is to stop making the problem worse. PFAS are essentially permanent; the chemicals produced today present a risk to human health and the environment for generations to come. Limiting this threat requires a comprehensive approach to ending the production and use of PFAS.

State policymakers have already begun banning PFAS in some applications.[141] As of May 2023, according to the most recent analysis by Safer States, 111 policies had been adopted across 24 states, and a further 201 were currently under discussion in 35 states.[142] For example:

- Maine has banned the sale of goods containing intentionally added PFAS, beginning in 2030, with some exceptions such as for medical devices.[143] The first products to come under the ban were carpets, rugs and fabric treatments; the sale of any such products containing intentionally added PFAS has been banned in Maine since January 2023.[144]
- California has banned PFAS in children's products, textiles and cosmetics.[145]
- Twelve states (California, Colorado, Connecticut, Hawaii, Maine, Maryland, Minnesota, New York, Oregon, Rhode Island, Vermont and Washington) have implemented phase-outs of PFAS in food packaging.[146]
- Multiple states, including California, Colorado, Connecticut, Illinois, Maine, Maryland, New Hampshire, New York, Vermont and Washington, are taking action to limit the use or sale of PFAS-containing firefighting foam.[147]
- Vermont has banned PFAS in ski wax.[148]
- Colorado has passed a comprehensive law banning PFAS from a number of different consumer products, including carpets, furniture, cosmetics, certain types of food packaging and the fluids used in oil and gas production, and requiring full containment and safe storage of waste produced as a result of use of PFAS-based firefighting foam.[149]

Nationally, Congress has acted on one major source of PFAS pollution in groundwater and drinking water by directing the Department of Defense to end the use of

firefighting foam containing PFAS by 2024, and to immediately quit using it during training exercises.[150]

Internationally, the Stockholm Convention on Persistent Organic Pollutants (POPs) requires that all signatory countries cease the use and manufacture of PFOS and PFOA, although there are some exceptions.[151] The United States signed on in 2001 but has yet to ratify the treaty.[152] In 2019, the Danish government also announced that it was banning the use of PFAS in paper and cardboard in food containers and wrappers.[153]

Bans on specific PFAS are a piecemeal solution that do not adequately protect human health. With thousands of PFAS in use in a vast variety of products, more comprehensive bans on these substances are necessary to protect public health and the environment.

Regulate PFAS as a class

The wide variety of PFAS compounds share characteristics that make them a serious threat to public health: they are highly persistent, accumulate in the environment and in human bodies, and often move easily through water and/or air.[154] PFAS should be regulated as a class, rather than on a chemical-by-chemical basis.[155] This should include both polymeric and nonpolymeric PFAS.[156] Both state and federal regulators should use this class-based approach.

Regulating one individual chemical, rather than the whole class, allows companies to replace a regulated or banned chemical that has well-studied impacts with one

Photo: Navy Petty Officer 3rd Class Manuel Najera, DOD

A military researcher prepares to test firefighting foam that does not contain PFAS.

of thousands of less-examined PFAS, a regrettable substitution because these replacements lack evidence that they are safer for the environment or human health. In essence, regulating one PFAS chemical at a time falsely treats replacement chemicals as if they are safe until enough damage has accrued to demonstrate otherwise.

Treating PFAS as a class has multiple additional benefits. It could allow governments to set exposure limits for all PFAS combined, resulting in lower exposure levels.[157] In areas where PFAS contamination already exists, regulating PFAS as a class would encourage development of remediation tactics that are effective for the entire class, not just individual chemicals. For example, treating contaminated water with granular activated carbon removes older types of PFAS but not newer versions, whereas high-pressure membranes remove both older and newer PFAS.[158] Thus, regulating PFAS as a class could help ensure that industries clean up all PFAS rather than just a few, and that investments in cleaning technologies do not become obsolete if the list of regulated PFAS grows longer.

Regulators in various states and countries have regulated or are considering regulating PFAS as a class. For example, Washington state is using its Safer Products for Washington program to regulate multiple uses of PFAS.[159] Maine recently passed a law banning all non-essential uses of PFAS and requiring manufacturers to disclose their use of PFAS to the state.[160] California has banned PFAS in textiles and cosmetics and Colorado recently passed a measure eliminating PFAS from a long list of consumer products.[161] In February 2023, the European Union proposed what effectively amounts to a total ban on PFAS use and production, to be phased in through the late 2030s, depending on the product.[162] There is even some precedent for treating PFAS as a class at the federal level in the U.S., with Congress doing so in 2020 legislation regarding the packaging of prepared military foods.[163]

Reducing PFAS exposure lowers human contamination levels

Banning PFAS has been shown to lower contamination levels in people. The experience with the phase-out of PFOA demonstrates that banning PFAS can be an effective way to limit public exposure.

The EPA's PFOA Stewardship Program began to phase out PFOA and chemicals that can break down into PFOA in 2006.[164] Eight major companies participated in the program and agreed to reduce their use of the specified PFAS by 95% by 2010 and work toward elimination by 2015.[165] PFOA manufacturing in the U.S. has now ended.

When production of PFOA ended, people excreted the toxic chemical faster than they were exposed to it. This lowered total accumulation levels in the body, though the chemical itself did not break down and remains in the environment. In 1999-2000, levels of PFOA in the bloodstream of the general population were 5.2 ppb.[166] Those numbers decreased to 1.56 ppb after the phase out of PFOA.[167]

End the direct discharge of PFAS into waterways

Until the manufacturing and use of PFAS ends, all facilities that use these chemicals should be expected to end all releases of this pollution into waterways. Nearly 30,000 industrial facilities, in addition to landfills and commercial airports, release PFAS into the nation's waterways or to water treatment plants that then discharge to waterways.[168] Currently, these industrial and waste facilities are subject to only limited monitoring, pollution limits, or treatment requirements.

The EPA should adopt pollution control standards (known as effluent limitation guidelines, or ELGs) for all industrial sources that release wastewater containing PFAS to waterways. Facilities that send their wastewater to treatment plants should have to meet pretreatment standards. Under the Clean Water Act, ELGs are supposed to be set based on available technology, and technology does exist to capture most if not all PFAS in industrial wastewater. The EPA is currently reviewing/updating pollution control standards for some industrial users of PFAS.[169] The agency should set standards binding *all* users and applying to all PFAS, therefore essentially eliminating the discharge of PFAS into waterways.

Even before action by the EPA, state regulators could reduce most water releases of PFAS from manufacturing facilities by requiring technology-based effluent limits on facilities that have permits under the Clean Water Act. In December 2022, the EPA issued non-binding guidelines and recommendations to this effect to state regulators.[170] Water treatment technologies such as granular activated carbon and reverse osmosis can reduce PFAS to near zero. Industrial facilities that have installed such treatment units have demonstrated that these technologies can lower very high PFAS contamination levels to nearly nondetectable concentrations.[171]

Designate PFAS as hazardous waste

Regulators need the ability to better oversee management of PFAS to protect the environment and public health. PFAS are manufactured or used at an estimated 120,000-plus facilities around the country, each creating the potential for environmental contamination and public health damage.[172]

In September 2022, two specific PFAS – PFOA and and PFOS – were designated as "hazardous substances" under the 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or as it is more commonly known, Superfund), making them subject to regulation under federal waste disposal laws.[173] Superfund gives the federal government the authority to respond to a release or threatened release of an environmentally hazardous substance and to make entities releasing these chemicals liable for the cleanup costs.[174] As of September 2022, the EPA was accepting comments on its designation of PFOA and PFOS as hazardous substances and plans to publish a final designation in the summer of 2023.[175]

The EPA should regulate PFAS as a class and designate all PFAS as hazardous waste, instead of approaching the problem one or two chemicals at a time. In addition, the EPA should establish PFAS as hazardous waste under the Resource Conservation and Recovery Act (RCRA), allowing the agency to set standards for the handling, transportation and disposal of PFAS-contaminated waste. Such a listing would give the EPA the ability to regulate PFAS from cradle to grave.[176] In the absence of federal action, states should take action to designate PFAS as a hazardous substance.

Protect public health with strong limits on PFAS in water and food

Clean water is essential for life. Unfortunately, PFAS spread readily through water, and this contamination is currently one of the most common ways that people are exposed to PFAS. Limiting how much PFAS pollution in water is acceptable and quickly identifying potential problems is critical to protecting public health. In addition, food, especially fish, can contain PFAS. Setting exposure standards and warning consumers when food may be unsafe can help reduce PFAS intake.

Establish a limit on all PFAS in drinking water strong enough to protect public health

Regulators should establish an enforceable limit on the amount of PFAS that is permitted in drinking water sufficient to protect public health.

In March 2023, the EPA proposed the first federally enforceable maximum contaminant levels (MCLs) for PFAS in drinking water. The regulation applies only to six PFAS chemicals out of the thousands that exist: PFOA, PFOS, GenX, PFBS, PFNA and PFHxS.[177] For PFOA and PFOS, the MCLs are 4 ppt. For the other four PFAS, the EPA has proposed a "hazard index" to address cumulative risks from combinations of chemicals.[178] The EPA proposal also sets a Maximum Contaminant Level Goal (MCLG – the highest level at which a contaminant in drinking water is deemed as having no negative health impacts) for PFOA and PFOS of zero, based on identified cancer risks.[179] The EPA anticipates finalizing the rule by the end of 2023.[180]

Until that happens, however, the federal government has no enforceable limit on the amount of PFAS that can be safely present in drinking water or the environment. To date, the only limits issued at the federal level have been in the form of non-binding, non-enforceable health advisory levels (HALs), applying only to a small number of PFAS.[181] In 2016, the EPA adopted interim HALs of 70 ppt for PFOA and PFOS in drinking water – non-enforceable, well above the levels known to be damaging to health, and applicable only to the combined level of two specific PFAS.[182] Then in 2022, the EPA adopted new HALs of 0.004 ppt for PFOA and 0.02 ppt for PFOS, and also included HALs for GenX chemicals (10 ppt) and PFBS (2,000 ppt).[183] While a clear improvement on the 2016 guidance, like the earlier advisory levels, these new limits are not enforceable and apply only to a tiny number of the many PFAS that may be present in drinking water and groundwater.

The new MCLs proposed in 2023, if adopted, would be the first enforceable federal standards for drinking water.

A number of states have established limits on PFAS in drinking water. These mandatory standards typically require water treatment facilities to install additional water treatment technologies and limit upstream contaminants in order to comply with the state limits.[184] As of summer 2021, six states had set limits for PFAS in drinking water that were more stringent than the EPA's original HAL of 70 ppt, for two types of PFAS.[185] Furthermore, most of these states have set standards for more than just the two PFAS that were covered by the EPA's advisory levels as they existed prior to 2022. For example, Massachusetts limits the sum of six types of PFAS to a total of 20 ppt, Vermont limits five types of PFAS to a total of 20 ppt, and New Hampshire limits four types of PFAS each to 18 ppt or less.[186]

As regulators work to determine the level at which to set the drinking water standard, they should ensure that the standard is strong enough to protect public health

and the environment from the entire class of PFAS. The standard must also be enforceable, and violations should trigger clean up protocols to guarantee compliance and public safety.

In addition, regular monitoring for PFAS in public drinking water, groundwater and wastewater is critical for identifying and understanding threats. Identifying PFAS contamination quickly can help jump-start remediation efforts, helping to prevent the spread of PFAS and reducing the long-term health effects associated with sustained exposure to PFAS. Mandated regular testing is crucial to discovering contamination and cleaning it up to reduce its effect on public health or the environment.

In 2021, the EPA published a monitoring rule that requires public water systems to sample for 29 different PFAS between 2023 and 2025 in order to gain a clearer understanding of the current state of PFAS contamination in drinking water nationwide.[187] However, while this would provide much needed data on those 29 PFAS, it would fail to provide information about many thousands of others that may be in the environment. Current technologies for detecting PFAS are able to reliably quantify only around 50 specific PFAS out of the thousands known to exist.[188] Monitoring should include all of the PFAS detectable by currently available technologies.

Establish a limit on PFAS in food and warn consumers about potential contamination

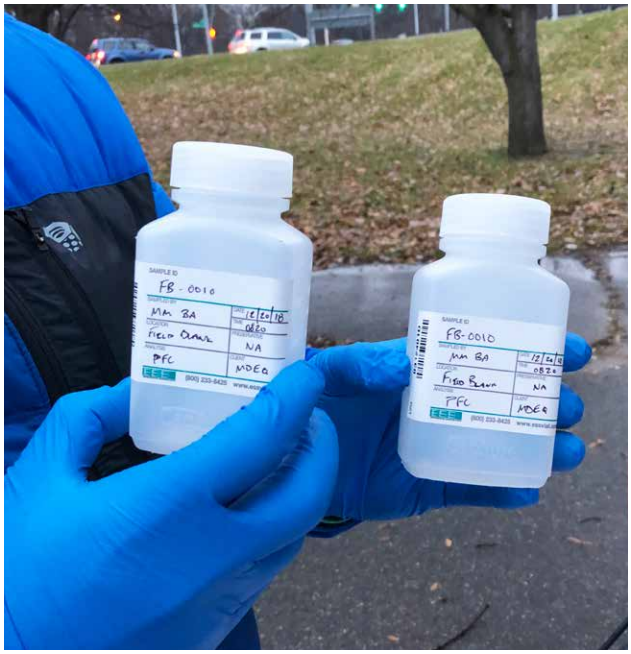
Food, especially fish, can be contaminated with PFAS. Regulators should identify levels that present a health risk and warn consumers when food may exceed that level.

New Jersey has established limits on acceptable amounts of PFAS consumption to avoid increased health risk.[189] Based on this, New Jersey has issued fish consumption advisories for 12 species of fish that may contain PFAS.[190] The warnings are specific to fish commonly caught in New Jersey rivers and lakes that are close to known sources of PFAS. Based on the amount of contamination present in fish, consumption advisories range from warning people to limit their fish consumption to one meal per week to avoiding some fish entirely.[191]

Maryland has issued a consumption advisory for three species of fish in a tributary of the Potomac River after testing revealed the fish contain PFAS.[192] The state plans to expand testing of fish in the Potomac area.

European regulators recommend that people not consume too much of four types of PFAS in food.[193] The recommendation is based on the level above which PFAS can interfere with the immune system's response to vaccination.

Photo: Michigan Department of Environment, Great Lakes and Energy, via Flickr, CC BY-ND 2.0



Regular monitoring for PFAS in public drinking water, groundwater and wastewater is critical for identifying and understanding threats.

Clean up existing PFAS contamination

PFAS contamination is common in drinking water, groundwater and soil, especially near manufacturing facilities and military sites. In addition, consumer products containing PFAS are ubiquitous. Cleaning up existing contamination and sources of exposure is essential to addressing the health threat from PFAS.

Unfortunately, PFAS remediation is difficult and expensive.[194] To fully clean up PFAS pollution on the scale and timeline needed will require dedicated federal funding, as well as ensuring that those who created the problem in the first place pay their fair share. The right solution varies depending on the type of PFAS, the concentrations found, and the presence of other contaminants.[195]

Decontaminate drinking water

PFAS contamination in drinking water can be addressed at water treatment facilities through several methods. PFAS can be removed from water using granular activated carbon, ion exchange, and reverse osmosis.[196] Installing a utility-scale treatment system can cost millions of dollars, with annual maintenance costs of hundreds of thousands of dollars.[197] Ann Arbor, Michigan, spent $1 million to convert its water filtration system to granular activated carbon, and budgeted $300,000 per year for maintenance.[198] Madison, WI, received an estimate that the equipment for removing PFAS from just one of the 22 wells that provides drinking water to the city would cost as much as $875,000 to install and approximately $700,000 annually to maintain.[199] Federal assistance should be made available to help state and local agencies to cover these substantial costs.

Clean up military sites

Hundreds of military facilities across the country have been polluted by PFAS, creating a widespread exposure hazard and need for cleanup. The Defense Department has acknowledged that PFAS have leached into groundwater on military bases, but has thus far moved slowly to address the problem.[200]

The cleanup of polluted bases is estimated to cost billions of dollars and take decades.[201] A task force has been appointed to oversee the Pentagon's response to this contamination, focusing on sites contaminated with PFOS and PFOA beyond the EPA's HAL guidelines.[202] Thus far, almost no cleanup of soil or groundwater has occurred, including at military installations with the highest levels of contamination.[203]

Cleaning up pollution at military sites requires federal action and dedicated funding. For example, legislation introduced in 2021 would allocate $10 billion for PFAS cleanup and require that the Defense Department clean up all contaminated military installations within the next 10 years.[204] The legislation specifies 50 installations that should be cleaned up in the first five years. Funding included in the 2021 Bipartisan Infrastructure Law for PFAS cleanup is a positive start, it is not even close to covering the full cost of the nationwide cleanup required.

The Department of Defense must take more aggressive steps to monitor for and quickly clean up PFAS contamination in soil before it leaches into groundwater and surrounding waterways. In addition, the DOD should monitor for PFAS as a class to ensure that the public is protected from all potential contamination, not just individual chemicals.

Regulate the disposal of PFAS and items containing PFAS

An additional challenge to cleaning up PFAS contamination is the question of what to do with the chemicals once they have been removed from water or soil. PFAS are challenging to dispose of because of their durability, the difficulty of breaking carbon-fluorine bonds designed to survive extreme conditions, and the many products in which they exist. The best solution may be to store PFAS and PFAS-containing materials until better technology is available to destroy them. Clear guidelines are needed to prevent PFAS from contaminating the environment and harming human health.

The EPA has not yet established a national policy on PFAS disposal or destruction, though it has announced it will issue new guidance by the end of 2023.[205] The agency issued interim guidance on the destruction and disposal of PFAS as required by the National Defense Authorization Act for Fiscal Year 2020, but notes that its guidance is neither a rule nor a policy.[206] The EPA's guidance document presents a number of destruction or disposal options:

- Storing PFAS and materials that contain PFAS may prevent their release into the environment until better tools in the future enable safer destruction or disposal of the chemicals.[207]
- The EPA has identified underground injection in Class I wells as a disposal method for liquid forms of PFAS.[208] However, there is evidence that underground injections do not always sequester the hazardous chemicals away from the environment as they are designed to, and that consequently this disposal method may result in contamination of drinking water.[209]
- PFAS are allowed to be disposed in landfills specifically built for hazardous waste or those with pollution controls that are believed to be adequate.[210] The EPA acknowledges that this strategy will not prevent all contamination, noting that disposing of PFAS in landfills has many unknowns, such as how the waste will interact with landfill liners and the possibility of chemicals escaping into the environment.[211]
- Low on the EPA's list of possible methods of disposing of PFAS is incinerating them in hazardous waste combustors or using other thermal methods. Though high temperatures potentially can destroy PFAS, the EPA notes that more research is needed to understand the environmental impacts of this approach.[212] Incomplete destruction could create byproducts that might be chemicals of concern, which would cause concentrated harm on communities near incinerators.[213]

Policymakers must impose standards to regulate the disposal of PFAS and PFAS-containing products to prevent leaching and contamination. Given that all currently available disposal and destruction options involve a large degree of uncertainty about how much environmental and health protection they provide, the best approach may be to securely store PFAS and PFAS-containing substances. This is the approach California adopted when it banned the use of PFAS in Class B firefighting foam: any remaining foam after March 2022 needs to be stored until California's the EPA identifies a safe disposal technology.[214] Furthermore, the fact that there is currently no way to deal with existing contamination only strengthens the argument to shut off contamination at the source.

Hold polluters accountable

Companies and U.S. government agencies responsible for PFAS contamination and health damage should be held accountable for their actions. Cleaning up PFAS contamination and dealing with the harm it causes is difficult and expensive, and cannot be done on the timescale needed without those who created the problem paying their fair share. Accountability can be obtained through legislative action, enforcement of cleanup laws, or lawsuits.

The largest companies responsible for PFAS contamination have refused to take responsibility for cleanups, arguing that the chemicals they released have not been shown to harm human health, that they do not have the money to foot such a bill, and that they took their products containing PFOA and PFOS off the market decades ago.[215] However, companies that made and used these chemicals knew for many years that exposure to PFAS could have detrimental health effects and failed to take appropriate steps to protect the public and the environment.[216] Furthermore, these companies have "engineered complex corporate transactions to shield themselves from legal liability," according to the *New York Times*.[217]

A number of lawsuits have begun to hold companies responsible for the damage caused by the PFAS they manufactured or incorporated into products. At least 17 state attorneys general have filed lawsuits against PFAS manufacturers and polluters.[218] For example, Minnesota won an $850 million settlement from 3M in 2018, and has used the funding for drinking water and other water projects.[219] Additionally, in November 2022, the City of Baltimore filed suit against more than 20 manufacturers of aqueous film-forming foams (AFFF), including DuPont, Chemours, 3M and others, for knowingly allowing the city's waterways and water systems to become contaminated with PFAS.[220] The City of Philadelphia filed a similar lawsuit the same day.[221] Individuals have also successfully sued the makers of PFAS, as well as a company that manufactured firefighting foam containing PFAS.[222]

These are just a few among the growing number of lawsuits currently being filed. In fact, liability claims are now so prevalent and so high that insurance carriers are attempting to find ways to avoid paying these claims, and it is becoming increasingly difficult for manufacturers to obtain insurance on PFAS.[223]

Conclusion and policy recommendations

PFAS ARE DANGEROUS, durable chemicals that are used in a wide variety of products and purposes. They have escaped into our environment, contaminating drinking water, groundwater and food. The danger of these substances has been clear for decades, but state and federal responses to protect the environment and public health while holding polluters responsible for cleaning up pollution have been limited.

There are a number of steps that policymakers can take to help protect human health and the environment. All actions should address PFAS as a class, rather than one chemical at a time.

Federal and state policymakers should act to stop this toxic threat at its source by banning the production and use of all PFAS, as well as the sale of any goods containing them.

- Banning all PFAS is crucial to protecting the environment and public health. The manufacturing and use of these toxic chemicals have already created widespread contamination that is extremely difficult to clean up and will create health risks for years to come. Because PFAS are persistent, soluble in water, and toxic at extremely low levels, any sensible strategy must center on moving our society to safer alternatives.
- PFAS regulations should apply to all PFAS chemicals as a single class.[224] Controlling the use of one type of PFAS at a time has historically led to the regrettable substitution of replacement chemicals that are less well understood, but not necessarily safer.
- Until a federal ban on production and sale of PFAS takes effect, state policymakers should enact state-level bans on the production, sale and use of goods containing any PFAS, and can consider additional steps to protect their states' residents, such as requiring manufacturers to disclose the use or presence of PFAS in their products.

Federal and state policymakers should adopt measures to stop PFAS from contaminating our waterways, groundwater and food:

- State officials should use the full extent of their existing authority under the Clean Water Act and state laws to halt flows of PFAS into surface waters.
- State and federal authorities, including the Federal Aviation Administration, should move swiftly to end the use of PFAS in all firefighting foam, a major pathway for water contamination.
- The U.S. Environmental Protection Agency should update pollution control standards to eliminate direct discharges of all PFAS from all industrial sources.
- Federal decisionmakers should establish health-based drinking water standards for all PFAS. Several states have

established limits on certain PFAS in drinking water, but while the process of formulating enforceable federal standards for a small number of PFAS chemicals is underway, currently no such standards exist at the federal level.

Policymakers should take action to ensure comprehensive cleanup of existing PFAS contamination. This means mandating and providing dedicated funding for regular monitoring for PFAS in public drinking water, groundwater and waterways to jump-start remediation and thereby prevent PFAS contamination from spreading.

- Dedicated state and federal funding should be made available to facilitate comprehensive cleanup of groundwater and drinking water supplies and ensure compliance with any PFAS-in-drinking-water limit adopted at either state or federal levels. Funding already allocated through the 2021 Infrastructure Investment and Jobs Act is a positive step, but insufficient to cover the full costs of the scale of cleanup necessary.
- The EPA should designate all PFAS, as a single class, as hazardous substances. This would facilitate better management of the entire class of chemicals and also apply strict storage, transfer and disposal requirements to the chemicals under the federal Resource Conservation and Recovery Act. In addition, such a designation would ensure that PFAS chemicals are actually cleaned up at Superfund sites.
    - Regulators should ensure that PFAS removed from water or soil during remediation efforts do not create new pollution risks after disposal. The best solution is to store PFAS and PFAS-containing materials until they can be destroyed.

State and federal leaders should hold the companies and U.S. government agencies that are responsible for PFAS contamination accountable for cleaning up their pollution. Cleaning up PFAS contamination on the timescale needed requires those who created the problem to pay their fair share. Accountability can be obtained through legislative action, enforcement of cleanup laws or lawsuits.

- Attorneys general should evaluate whether legal action is possible against the chemical industry and foam manufacturers for damage caused to public health and the environment in their state. States should ensure they have the necessary laws in place to enable them to hold polluters accountable.

Without these changes, PFAS will continue to pollute our drinking water and harm our families. Federal and state officials both have important roles to play in protecting the public from the toxic legacy of PFAS contamination and stopping the flow of "forever chemicals" into our environment.

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