



| The Threat of “Forever Chemicals”

How PFAS put Marylanders’ health at risk,
and what we can do about it

Maryland PIRG
Foundation

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| Executive summary

PER- AND POLYFLUOROALKYL substances, more commonly known as PFAS, are found in products 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 today and for decades to come.

To protect public health, Maryland 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 damages, 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 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 in Maryland are contaminated with PFAS. In late 2019, the Maryland Department of the Environment tested for contamination from legacy PFAS at water treatment plants that provide drinking water to 70% of Maryland's population.¹³

- Approximately 75% of the samples had quantifiable levels of PFOA and PFOS.¹⁴
- The two highest readings were from Westminster and Hampstead, both in Carroll County.¹⁵
- Testing by the U.S. Department of Defense has found PFAS in drinking water at or near a dozen military facilities in Maryland.¹⁶

PFAS also contaminate groundwater and seafood in Maryland. PFAS contamination at military sites in Maryland often is traceable to the use of firefighting foam.¹⁷ PFAS from firefighting foam have leached into shallow groundwater, potentially flowing from there into nearby rivers and streams.

- PFAS contamination has been found in groundwater at eight military facilities in six counties in Maryland.¹⁸
- Testing found nine different types of PFAS in striped bass, crabs and oysters from the Potomac River and St. Inigoes Creek in southern Maryland.¹⁹ The Maryland Department of the Environment has detected PFAS in three species of fish from Piscataway Creek, a tributary of the Potomac River in Prince George's County, and has warned people to limit their intake of particular species caught in the creek.²⁰

To limit the spread of PFAS in the environment and reduce the risk of health impacts, policymakers should take a comprehensive approach to addressing the threat from PFAS.

The first step is to stop the problem from becoming worse.

- PFAS should be regulated as a class.²¹ Controlling the use of a single type of PFAS at a time has historically led to the regrettable substitution of replacement chemicals that are less well understood, not necessarily safer.
- Banning all PFAS will reduce exposure and harm. Eliminating the use of PFAS is crucial to protecting the environment and public health. The manufacturing and use of these chemicals have created widespread contamination that is extremely difficult to clean up and will create health risks for years.

Maryland policymakers should adopt measures to protect water quality, as several other states already have. PFAS spread readily through water, and this contamination is currently one of the most common ways that people are exposed to PFAS.

- Maryland policymakers should establish a limit strong enough to protect public health on the amount of PFAS that are permitted in drinking water. The federal government has no enforceable limit on the amount of PFAS that can be safely present in drinking water or the environment, but a number of states have established limits on PFAS in drinking water.
- The state should require and potentially help fund regular monitoring for PFAS in public drinking water and groundwater. Identifying PFAS contamination quickly can help jump-start remediation efforts, helping to prevent PFAS from spreading and reducing the long-term health effects associated with sustained contact with PFAS.

- The state should support efforts to decontaminate drinking water supplies so that they comply with any PFAS-in-drinking-water limit that is adopted by the state.

Existing PFAS contamination should be cleaned up before it spreads into more drinking water supplies, groundwater, or rivers and streams.

- Federal officials should mandate and fund cleanup of military facilities where water has been polluted with PFAS.
- The U.S. EPA should designate PFAS as hazardous substances, which would facilitate better management of the entire class of chemicals. It would also apply strict storage, transfer and disposal requirements to the chemicals under the federal Resource Conservation and Recovery Act. In addition, a designation under the federal Superfund law could make it easier for EPA to mandate cleanups.
- Regulators should ensure that PFAS removed from water or soil during remediation efforts do not create new pollution after disposal. The best solution would be to store PFAS and PFAS-containing materials until better technology is available to destroy them.
- 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.

| 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.²² Only a few short years later, as explained in a vivid history by Nathaniel Rich, more than one hundred of Tennant’s cattle that grazed on his land downstream from the landfill were dead, struggling with malformations and illness, or appeared to have gone mad.²³

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.²⁴ 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.”²⁵ 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.²⁶ When Bilott asked for all of DuPont’s documentation on PFOA the company refused, protesting until the court forced them to comply.²⁷

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.²⁸ The companies were well aware that PFOA caused tumors, liver problems, birth defects, and cancers in animal test subjects, and, in some cases, workers.²⁹ 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.³⁰

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.³¹

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.³² 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.³³

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 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.³⁴ They also have been replaced with new PFAS that may be as dangerous as the original substances.³⁵

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 around the country, and around the world, have begun to take action – adopting policies and practices that Maryland 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

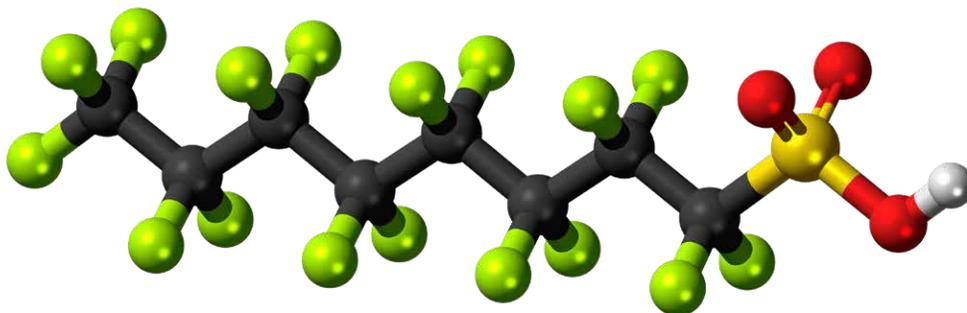
“PFAS” is an umbrella term for a group of per- and polyfluoroalkyl substances, of which there are more than 9,000.³⁶ They are made of a very strong chain of carbon and fluorine atoms that do not break down easily. They repel oil and water and resist high temperatures, and are used in many non-stick, heat resistant, and stainproof or waterproof products.³⁷

Their durability is a problem, however, when they enter the environment or our bodies. Their chemical bonds do not break down.³⁸ In the bodies of people and wildlife, they can accumulate and even be passed

from mother to child through the placenta or breast milk.³⁹

The first PFAS were created in the 1930s. Manufacturing of PFAS began in the 1940s with perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA).⁴⁰ 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 2015.⁴¹ These chemicals continue to be manufactured in other countries and may be used in imported products.

Many companies that had previously used PFOA and PFOS switched over to using other PFAS to serve the same purposes.⁴² However, these other PFAS are either highly persistent in the environment or can partially transform into highly persistent substances in the environment.⁴³ They also carry many of the same risks to health.⁴⁴



The chemical structure of PFOS, showing atoms of carbon (black), fluorine (green), sulfur (yellow), oxygen (red) and hydrogen (white). Photo: Jynto via Wikimedia, CC0 1.0

PFAS are widely used

PFAS are used in a variety of products and industrial processes. This provides ample opportunities for human exposure.⁴⁵

Common uses for PFAS include:⁴⁶

- Firefighting foams: PFAS are used to extinguish oil-based fires.
- 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 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.⁴⁷

- Electronics manufacturing and other industrial production. PFAS protect manufacturing equipment against harsh chemicals used in the production of semiconductors.⁴⁸ PFAS are also used in wire and cable insulation.⁴⁹

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.⁵⁰ The chemicals bind to tissue proteins and accumulate in the blood, liver, kidneys and brain.⁵¹

Health damage from PFAS may include:

- Increased risk of gestational diabetes, preeclampsia, low birth weight and childhood obesity.⁵²

PFAS are widely used in consumer products



Carpets



Waterproof apparel



Paints + sealants



Cosmetics



Food packaging



Non-stick cookware



Furniture

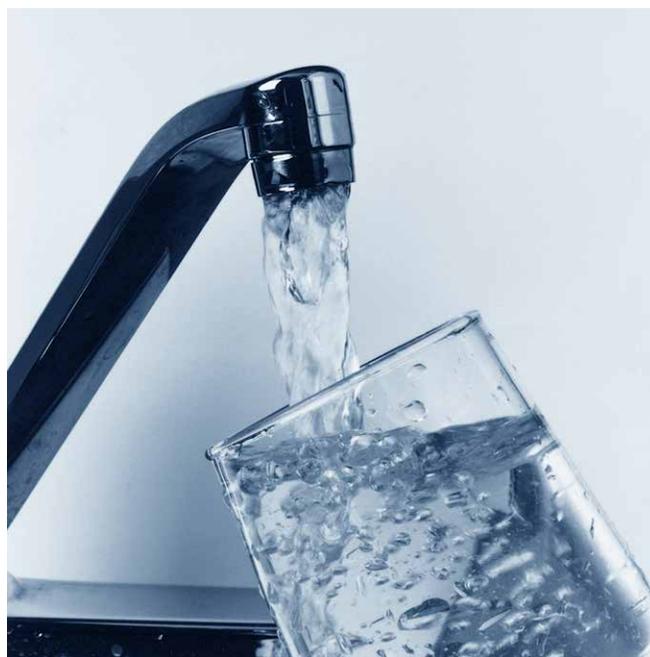
- Thyroid disruption, potentially including hyperthyroidism and changes to hormones that influence development and metabolism.⁵³
- Harm to the kidneys, leading to chronic kidney disease or kidney cancer.⁵⁴
- Liver disease.⁵⁵
- Reduced antibody responses to vaccinations in both children and adults.⁵⁶
- Testicular cancer.⁵⁷
- Higher levels of cholesterol.⁵⁸
- Increased risk of Type 2 diabetes in women.⁵⁹
- Weakened immune system.⁶⁰

Exposure standards

The federal government has set exposure standards for several specific PFAS, though the standards are not sufficiently protective of health. The levels are both too high and do not reflect the fact that people are exposed to many kinds of PFAS.

The Agency for Toxic Substances and Disease Registry, a federal agency, has established human exposure limits for just four PFAS compounds.⁶¹

The U.S. Environmental Protection Agency has established an advisory level for two types of PFAS in water that is far weaker than is needed to protect health. The Health Advisory Level is 70 parts per trillion (ppt) for PFOA and PFOS for groundwater that is or could be used as a drinking water source.⁶² This level of contamination serves as the initial cleanup target for sites that are contaminated, and is not an enforceable standard.⁶³ EPA's advisory covers the combined levels of just PFOA and PFOS, though other PFAS may also be present in drinking water. EPA has announced that it will issue new regula-



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

tions for PFOA and PFOS in drinking water by 2023.⁶⁴

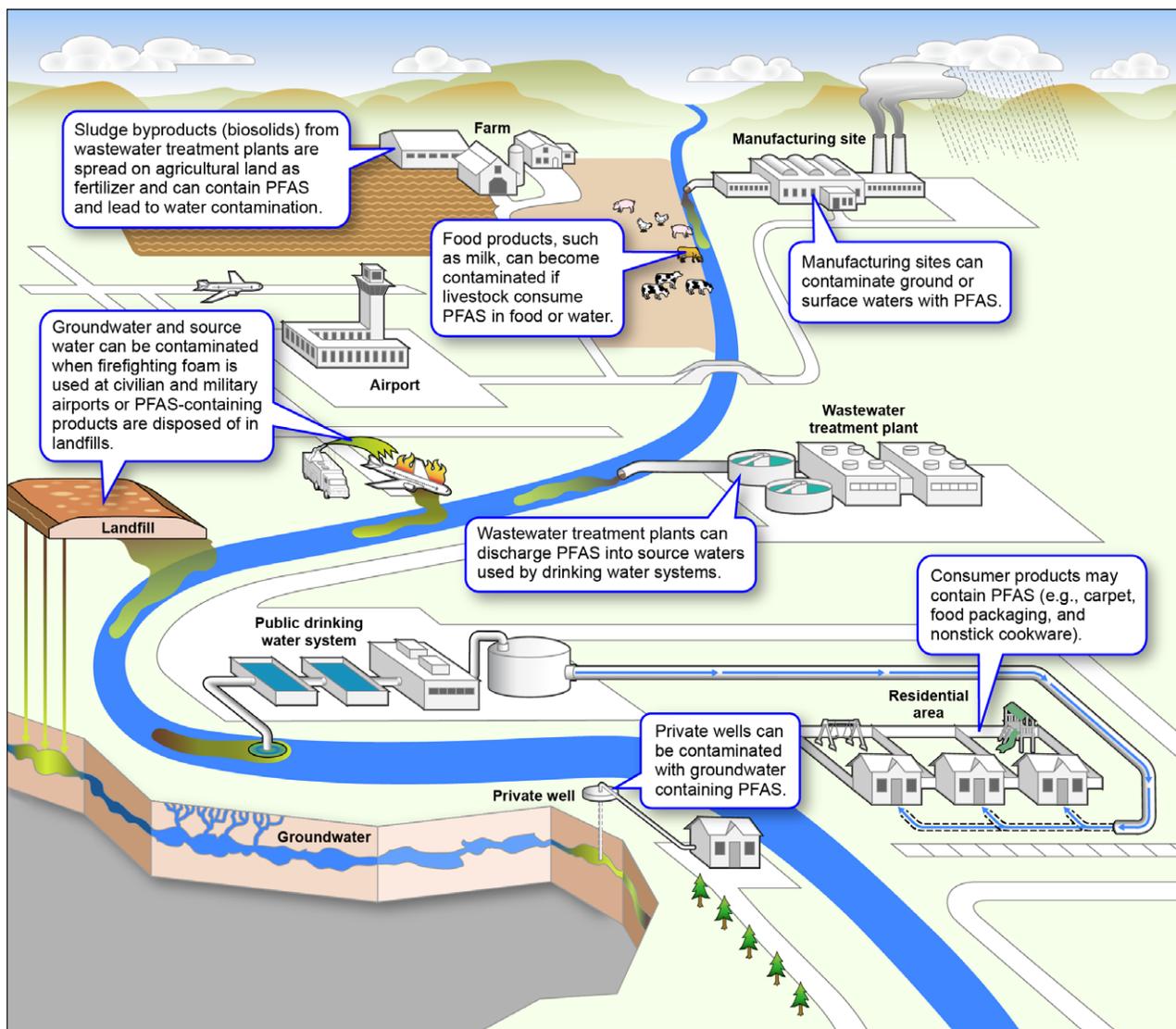
The standard should be set much lower and cover all PFAS to protect health. A 2013 research paper on the impact of PFOS and PFOA on children's response to vaccines recommended a limit of approximately 1 ppt in drinking water.⁶⁵ Based on this research and on studies of PFAS in animals, Environmental Working Group (EWG) argues that the drinking water standard for total PFAS contamination should be 1 ppt.⁶⁶ This level would protect against PFAS-related increases in cholesterol and liver and testicular cancers.

Several states have set limits on multiple PFAS (not just PFOA and PFOS) for drinking water that are more stringent than the EPA's recommendation of 70 ppt.⁶⁷ (See "Establish a limit on PFAS in drinking water strong enough to protect public health," p. 20, for more details.)

Maryland's environment is contaminated with PFAS

PFAS CONTAMINATION in Maryland has been found in drinking water, groundwater and seafood. This widespread pollution has been found despite limited testing for relatively few types of PFAS.

Environmental contamination can occur through many routes.⁶⁸ Industrial and manufacturing facilities that produce or use PFAS may release the chemicals into the water or air. Landfills with products con-



Source: GAO. | GAO-21-421

Figure 1. Examples of how PFAS enter the environment⁶⁹

taining PFAS may leach PFAS into groundwater and waste incinerators burning those products may release PFAS into the air. Fire-fighting 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

Many drinking water sources in Maryland are contaminated with PFAS. In late 2019, the Maryland Department of the Environment (MDE) tested for PFOA and PFOS contamination at 129 water treatment plants that serve 59 community water systems. The tested plants provide drinking water to 70% of Maryland's population.⁷⁰ Approximately 75% of the samples tested had quantifiable levels of PFOA and PFOS.⁷¹ Of those 98 samples with positive results, 23 were contaminated with 10 ppt to 35 ppt of PFOA and PFOS, two were contaminated with 35 ppt to 70 ppt, and two were contaminated above the EPA's recommended level of 70 ppt.⁷²

At least 27 of the samples from water treatment plants had levels above the EWG's proposed limit of 1 ppt.⁷³ Up to 71 more may fall into this category, but because Maryland categorized all data less than 10 ppt together, the exact number is unclear.⁷⁴ (See Figure 2.) These testing results likely understate the total amount of PFAS in drinking water because the tests were for only two types of PFAS.

Maryland has not established a drinking water standard for PFAS contamination.⁷⁵ When MDE tests drinking water supplies for PFAS contamination, it relies on the

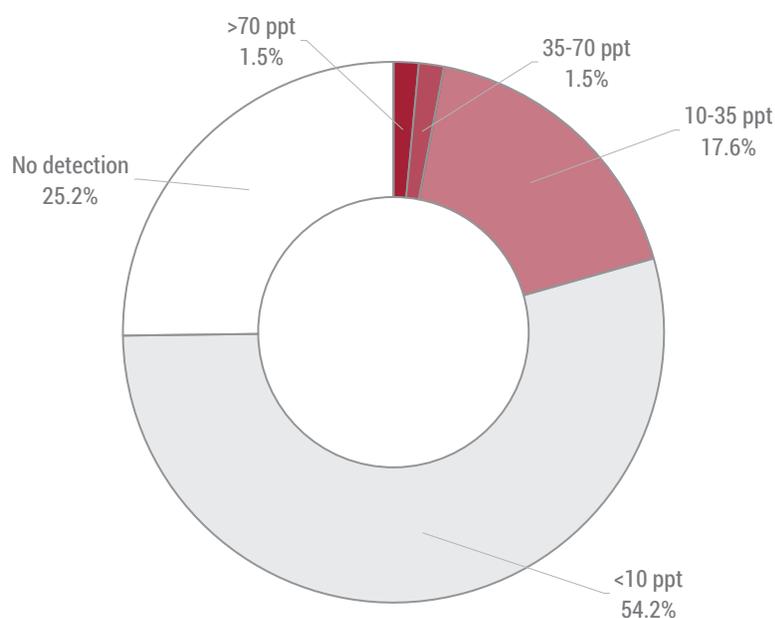


Figure 2. PFOA and PFOS contamination test results for 129 water treatment plants in Maryland⁷⁷

EPA's recommendation that a combined level of PFOA and PFOS below 70 ppt provides a margin of protection.⁷⁶

The two samples above 70 ppt were from Westminster and Hampstead.⁷⁸ The Westminster sample contained 155 ppt of PFOA and PFOS, and the Hampstead sample contained nearly 250 ppt.⁷⁹ Westminster and Hampstead have taken the contaminated water sources offline – in line with MDE's recommendation when pollution levels are this high – as they seek treatment options.⁸⁰ When detection levels are below 70 ppt, MDE requires or recommends that water system operators continue to test water for contamination, depending on the level of contamination, but does not recommend taking the contaminated source offline.⁸¹ The U.S. Department of Defense has also tested drinking water at selected sites in Maryland. Data collected by the Environmental Working Group from the Department of Defense shows that PFAS have contaminated drinking water on or near a dozen military facilities.⁸²

Groundwater

MDE's testing of drinking water supplies for PFAS contamination included water drawn from both groundwater and surface waters. Other testing has revealed additional PFAS contamination of groundwater.

PFAS contamination at military sites in Maryland often is traceable to the use of firefighting foam.⁸³ PFAS from firefighting foam have leached into shallow groundwater, potentially flowing from there into nearby rivers and streams.⁸⁴

PFAS contamination has been found in groundwater at eight military facilities in Maryland: Fort Meade Tipton Airfield (Anne Arundel County); Naval Research Lab, Chesapeake Beach Detachment (Calvert County); the former Navy Bayhead Annex in Annapolis (Anne Arundel County); the former Naval Research Laboratory in White Oak (Montgomery and Prince George's counties); Aberdeen Proving Ground (Harford County); Naval Air Station Patuxent River (St. Mary's County); Joint Base Andrews (Prince George's County); and the former Brandywine Defense Reutilization and Marketing Office (Prince George's County).⁸⁵

PFAS pollution levels at some military sites are very high. Groundwater at the U.S. Naval Research Laboratory, Chesapeake Bay Detachment, contains more than 240,000 ppt of PFOA and PFOS.⁸⁶ At the Naval Air Station Patuxent River in St. Mary's County, the Navy found 16 areas with very high levels of PFAS contamination in shallow groundwater, including four sites with more than 10,000 ppt of PFOS or PFOA.⁸⁷

MDE is concerned about the potential for high levels of PFAS found in shallow groundwater to migrate to surface waterways or deeper aquifers.⁸⁸ MDE has also requested that the Navy sample Naval Air Station Patuxent River's contaminated sites and on-base drinking water more frequently, generate a plan to prevent the spread of PFAS, and work to prevent future contamination.⁸⁹

MDE, the U.S. EPA, and the Department of Defense are conducting additional assessments to look for PFAS contamination at all other military facilities in Maryland.⁹⁰

Seafood

PFAS have been detected in seafood caught or harvested in Maryland.

Public Employees for Environmental Responsibility (PEER) tested for 36 kinds of PFAS in multiple species in the Potomac River and St. Inigoes Creek in southern Maryland, near an outpost of the Patuxent River Naval Air Station.⁹¹ The tested striped bass contained nine different PFAS, collectively adding up to 23,100 parts per trillion.⁹² The meat of the crab that was tested contained 6,650 ppt of eight different PFAS, and oyster meat contained 2,070 ppt of a total five PFAS.⁹³

The Maryland Department of the Environment has detected PFAS in three species of fish from Piscataway Creek, a tributary of the Potomac River in Prince George's County.⁹⁴ In response, the agency issued a fish consumption advisory, warning people to limit their intake of particular species caught in the creek.

| PFAS are in our bodies

WITH PFAS CONTAMINATING water and in wide use in a variety of products, people can be exposed to these chemicals through a number of different routes. As a result, nearly all Americans have detectable levels of PFAS in their bodies.⁹⁵

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.⁹⁶ Nationally, 6 million people obtain their drinking water from supplies contaminated with levels of PFOS and PFOA at or above EPA guidelines.⁹⁷ In total, an estimated 200 million Americans drink water containing detectable amounts of PFAS.⁹⁸ Conventional drinking water treatment does not remove PFAS.⁹⁹

WORKPLACE EXPOSURE

Workers who make products with PFAS and soldiers or firefighters who work with fire-fighting foam may be particularly at risk for exposure.¹⁰⁰ For example, these individuals may inhale or swallow PFAS-contaminated dust.¹⁰¹ They may also absorb PFAS through their skin.¹⁰²

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.¹⁰³ As stain-resistant furniture and carpets and waterproof clothing break down, they produce dust that can be inhaled or swallowed.¹⁰⁴ 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.¹⁰⁵ PFAS have been found in fish, shellfish, meat, eggs, milk, fruits and vegetables.¹⁰⁶ Processing equipment and packaging that contain PFAS may also add PFAS to food.¹⁰⁷ 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.¹⁰⁸

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.¹⁰⁹

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.¹¹⁰

EXPOSURE *IN UTERO* OR THROUGH BREASTMILK

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.¹¹¹ For example, a 2021 study found PFAS in all breastmilk samples collected from 50 nursing mothers in the U.S.¹¹²

Longer duration of breastfeeding is associated with higher PFAS levels in infants, which may result in adverse health effects.¹¹³ 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.¹¹⁴

Most Americans have detectable levels of PFAS

Almost all Americans have detectable levels of 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 PFAS in the blood of 97% to 100% of nearly 2,000 Americans who were tested.¹¹⁵

Tools exist to limit PFAS contamination and exposure

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.

REGULATE PFAS AS A CLASS

PFAS are highly persistent and accumulate in the environment and in human bodies, and often move easily through water and/or air.¹¹⁶ PFAS should be regulated as a class, rather than on a chemical-by-chemical basis.¹¹⁷ This should include both polymeric and nonpolymeric PFAS.¹¹⁸ 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 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.¹¹⁹ 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.¹²⁰ 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. Through its “Safer Products for Washington” program, Washington state is evaluating how to regulate

PFAS as a class.¹²¹ California has also begun to regulate some uses of PFAS as a class.¹²² Congress dealt with PFAS as a class in 2020 legislation regarding the packaging of prepared military foods.¹²³ The European Chemicals Agency (ECHA) has acknowledged that assessing and managing risks for the 2,000 individual PFAS in use would be time consuming and impractical, and that the agency should consider regulating them as a group.¹²⁴ Denmark, Germany, the Netherlands, Sweden and Norway are expected to propose that PFAS be managed as a class.¹²⁵ Canada is also considering regulating PFAS as a class, based on similar concerns.¹²⁶

Maryland has a track record of addressing an entire class of chemicals. In 2020, the state banned all chemical flame retardants in furniture and children's projects.¹²⁷

BAN THE USE OF ALL PFAS

Eliminating the use of PFAS is crucial to protecting the environment and public health. The manufacturing and use of these chemicals have created widespread contamination that is extremely difficult to clean up and will create health risks for years. Banning PFAS will reduce exposure and harm. Temporary exceptions to a ban could be granted if stopping use of a particular PFAS would create immediate health harms.

State policymakers have already begun banning PFAS in some applications. For example:

- Maine has banned the sale of goods containing intentionally added PFAS, beginning in 2030, with some exceptions such as for medical devices.¹²⁸ The ban first applies to carpets and treated fabric



A military researcher prepares to test fire-fighting foam that does not contain PFAS.

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

in 2023. On that date, manufacturers of other products are required to disclose if their products contain PFAS and their purpose in the product.¹²⁹

- California has banned PFAS in children's products.¹³⁰
- California, Connecticut, Maine, Minnesota, New York, Vermont and Washington have banned paper-based food packaging with PFAS.¹³¹
- Multiple states, including California, Colorado, Connecticut, Illinois, Maine, New Hampshire, New York, Vermont and Washington, are taking action to limit the use or sale of PFAS-containing firefighting foam.¹³² Though Maryland has banned the use of PFAS-containing firefighting foam for training or testing purposes, the state did not restrict its manufacture, sale or distribution.¹³³ Nonetheless, National Foam, a leading manufacturer of firefighting foam, announced that it would no longer sell foams containing PFAS in Maryland.¹³⁴

- Vermont has banned PFAS in ski wax.¹³⁵

Nationally, Congress has acted on a 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.¹³⁶

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.¹³⁷ The United States signed on in 2001 but has yet to ratify the treaty.¹³⁸ In 2019, the Danish government also announced that it was banning the use of PFAS in paper and cardboard in food containers and wrappers.¹³⁹

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.

REDUCING PFAS EXPOSURE LOWERS HUMAN CONTAMINATION LEVELS

Reducing PFAS exposure 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.

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. The EPA's PFOA Stewardship Program began to phase out PFOA and chemicals that can break down into PFOA in 2006.¹⁴⁰ 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 2015.¹⁴¹ PFOA manufacturing in the U.S. has ended. Human blood levels of PFOA declined as exposures declined. In 1999-2000, levels of PFOA in the bloodstream of the general population were 5.2 ppb.¹⁴² Those numbers decreased to 1.56 ppb after the phase out of PFOA.¹⁴³

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.¹⁴⁴ Currently, these industrial and waste facilities are subject to only limited monitoring, pollution limits, or treatment requirements.

EPA should adopt effluent limitation guidelines 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. For both types of facilities, EPA should set standards that will essentially eliminate the discharge of PFAS into waterways.

Even before action by 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. 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.¹⁴⁵

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 PFAS IN DRINKING WATER STRONG ENOUGH TO PROTECT PUBLIC HEALTH

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

The federal government has no enforceable limit on the amount of PFAS that can be safely present in drinking water or the environment. In 2016, the EPA issued a non-regulatory Health Advisory Level (HAL) of 70 ppt for PFAS in drinking water, but this HAL applies only to the combined level of the two most studied PFAS determined to have adverse health effects, PFOA and PFOS.¹⁴⁶ In October 2021, EPA announced it will establish an enforceable limit on PFOA and PFOS in drinking water by fall 2023, which will also require monitoring for these pollutants.¹⁴⁷ The agency will evaluate other types of PFAS but has not announced a plan to control them in 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.¹⁴⁸ As of summer 2021, six states had set limits for PFAS in drinking water that are more stringent than the EPA's advisory level of 70 ppt for two types of PFAS.¹⁴⁹ Furthermore, most of these states have set standards for more than just the two PFAS that are covered by EPA's advisory. 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 at 18 ppt or less.¹⁵⁰

None of the state limits are as restrictive as the Environmental Working Group's recommended limit of 1 ppt for PFOA and PFOS.

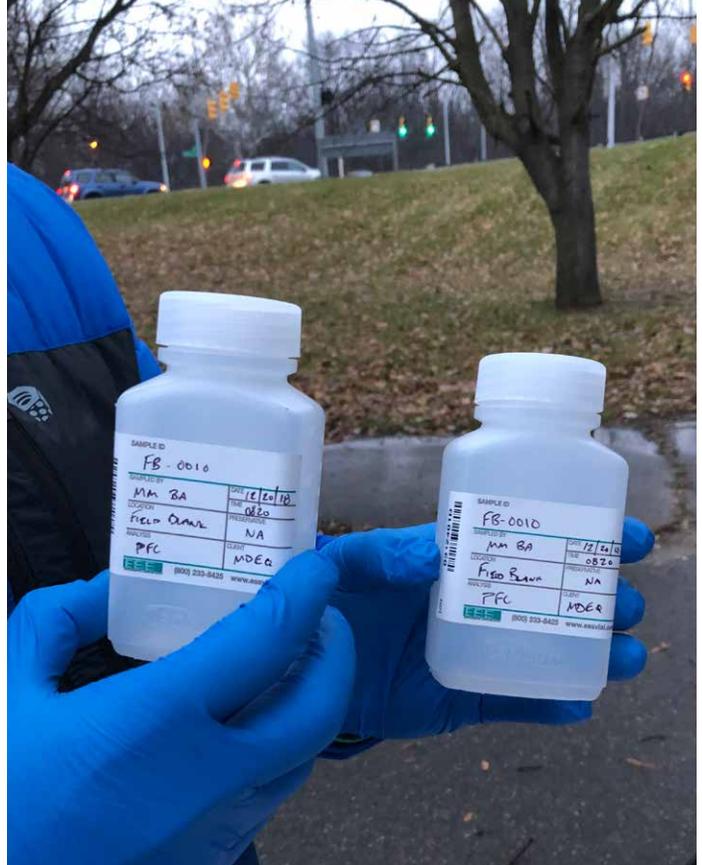
California is currently evaluating proposed contamination goals that are tighter than EPA's advisory level for PFOA and PFAS. Based on the risk of developing kidney cancer, or liver or pancreatic tumors from exposure to PFAS, California has proposed limiting PFOA to 0.007 ppt and PFOS to 1 ppt.¹⁵¹ These levels are not binding, but, if approved, will be used by the state as it sets drinking water regulatory standards.

As regulators work to determine the level at which to set the drinking water standard, they should ensure that the standard is strict 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 contact with PFAS.

Monitoring conducted by the Maryland Department of the Environment unearthed two instances where the PFAS contamination level was above the EPA's guidelines, while the Department of Defense has found numerous instances of highly contaminated military bases through testing for 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 proposed a monitoring rule which, if adopted, would require that public



Regular monitoring for PFAS in public drinking water, groundwater and wastewater is critical for identifying and understanding threats. Photo: Michigan Department of Environment, Great Lakes and Energy, via Flickr, CC BY-ND 2.0

water systems sample for 29 different PFAS between 2023 and 2025.¹⁵² This proposed rule would provide much-needed data on the frequency and quantity of certain PFAS in drinking water. However, it would fail to provide information about many thousands of other PFAS that may be in the environment. Monitoring should include more chemicals.

ESTABLISH A LIMIT ON PFAS IN FOOD AND WARN CONSUMERS ABOUT POTENTIAL CONTAMINATION

Food, especially fish, can be contaminated with PFAS. Regulators can 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.¹⁵³ Based on this, New Jersey has issued fish consumption adviso-

ries for 12 species of fish that may contain PFAS.¹⁵⁴ 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.¹⁵⁵

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.¹⁵⁶ 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.¹⁵⁷ The recommendation is based on the level above which PFAS can interfere with the immune system's response to vaccination.

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.¹⁵⁸ The right solution varies depending on the type of PFAS, the concentrations found, and the presence of other contaminants.¹⁵⁹

DECONTAMINATE DRINKING WATER

PFAS have been detected in water supplies in more than 2,000 locations nationally.¹⁶⁰ An estimated 200 million people receive water that contains more than 1 ppt of PFOA and PFOS.¹⁶¹

This contamination in water can be addressed at water treatment facilities through several methods. PFAS can be

treated using granular activated carbon, ion exchange, and reverse osmosis.¹⁶² Installing a utility-scale treatment system can cost millions of dollars, with annual maintenance costs of hundreds of thousands of dollars.¹⁶³ Ann Arbor, Michigan, spent \$1 million to convert its water filtration system to granular activated carbon, and budgeted \$300,000 per year for maintenance.¹⁶⁴ 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.¹⁶⁵

In addition, treatment systems produce waste products. Because PFAS are persistent and hazardous chemicals, this waste can be difficult to dispose of and may need to be stored.

For homes that are on wells, smaller PFAS decontamination systems are available.

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 thus far moved slowly to address the problem.¹⁶⁶

The cleanup of polluted bases is estimated to cost billions of dollars and take decades.¹⁶⁷ The Pentagon's response to this contamination will focus on sites contaminated with PFOS and PFOA beyond the EPA's HAL guidelines.¹⁶⁸ Thus far, almost no cleanup of soil or groundwater has occurred, including for military installations with the highest levels of contamination.¹⁶⁹

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 surround-

ing 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.

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 more than 120,000 facilities around the country, each creating the potential for environmental contamination and public health damage.¹⁷⁰

Currently, no PFAS are listed as hazardous substances subject to regulation by federal waste disposal laws.¹⁷¹ EPA has announced it will propose designating PFOA and PFOS as hazardous substances under the 1980 Comprehensive Environment Response, Compensation, and Liability Act (CERCLA, or as it is more commonly known, Superfund) by 2023.¹⁷² Superfund gives the federal government the authority to respond to a release or threatened release of an environmentally hazardous substance.¹⁷³

EPA should regulate PFAS as a class and designate all PFAS as hazardous waste, instead of approaching the problem one chemical at a time. In addition, 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.¹⁷⁴

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.

EPA has not established a policy on PFAS disposal or destruction, though it has announced it will issue new guidance by 2023.¹⁷⁵ 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.¹⁷⁶ EPA's guidance document presents a number of destruction or disposal options, from approaches that entail the least uncertainty about impact on the environment to most.

- Storing PFAS and materials that contain PFAS may prevent their release into the environment until better tools in the future may enable safer destruction or disposal of the chemicals.¹⁷⁷
- EPA has identified underground injection in Class I wells as a disposal method for liquid forms of PFAS.¹⁷⁸ However, there is evidence that underground injections do not always contain hazardous chemicals as they are designed to, and that consequently this disposal method may result in contamination of drinking water.¹⁷⁹
- PFAS can be disposed in landfills specifically built for hazardous waste or those with adequate pollution controls.¹⁸⁰ 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.¹⁸¹

- Low on 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, EPA notes that more research is needed to understand the environmental impacts of this approach.¹⁸² Incomplete destruction could create byproducts that might be chemicals of concern, which would cause concentrated harm on communities near incinerators.¹⁸³

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 EPA identifies a safe disposal technology.¹⁸⁴ 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 should be paid for by those who created the problem. 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.¹⁸⁵ 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.¹⁸⁶ Furthermore, these companies have "engineered complex corporate transactions to shield themselves from legal liability," according to the *New York Times*.¹⁸⁷

A number of lawsuits have begun to hold companies responsible for the damage from the PFAS they manufactured or incorporated into products. Minnesota won an \$850 million settlement from 3M in 2018, and has used the funding for drinking water and other water projects.¹⁸⁸ Individuals have also successfully sued the makers of PFAS, as well as a company that manufactured firefighting foam containing PFAS.¹⁸⁹

Cleaning up pollution at military sites requires federal action. 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.¹⁹⁰ The legislation specifies 50 installations – including two in Maryland – that should be cleaned up in the first five years.

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 Maryland 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.

To stop adding to the problem:

- Maryland should ban the production, sale and use of goods containing any PFAS. Maryland should start by joining other states that have already restricted the use of PFAS in products such as rugs, carpets, apparel, food packaging and firefighting foam.
- Until a ban on the production and sale of PFAS takes effect, Maryland policymakers can consider additional steps to protect the state's residents:

- Manufacturers and producers should disclose the use or presence of PFAS. Marylanders deserve to know the sources of PFAS contamination that threaten their health and environment.
- Environmental regulators should seek to eliminate most air and water releases of PFAS from manufacturing facilities. For example, MDE could impose technology-based effluent limits on facilities that have permits under the Clean Water Act.¹⁹¹ Based on the effectiveness of the best technologies, this could nearly eliminate PFAS pollution into waterways.

To protect water quality:

- Maryland policymakers should establish a limit strong enough to protect public health on the amount of PFAS that are permitted in drinking water.
- The state should require and potentially help fund regular monitoring for PFAS in public drinking water and groundwater. Identifying PFAS contamination quickly can help jump-

start remediation efforts, helping to prevent PFAS from spreading and reducing the long-term health effects associated with sustained contact with PFAS.

- Maryland should support efforts to decontaminate drinking water supplies so that they comply with any PFAS-in-drinking-water limit that is adopted by the state. This may require the state to help water utilities with the cost of installing PFAS-removal technology.

Maryland will still need to deal with existing PFAS at manufacturing facilities and in the environment to minimize the harm they cause.

- Regulators should ensure that PFAS removed from water or soil during remediation efforts do not create new pollution after disposal. The best

solution would be to store PFAS and PFAS-containing materials until better technology is available to destroy them.

- Hold polluting industries accountable for the pollution and public health damage they have caused. The Maryland Attorney General should evaluate whether legal action is possible against the chemical industry and foam manufacturers for damage caused to Marylanders' health and the environment.

Without these changes, PFAS will continue polluting our drinking water and our families while companies continue to profit off these dangerous chemicals. Maryland can take important steps to implement these recommendations to protect the public and environment and lead the way for national action.

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