PFAS

Epidemiology Educational Guide
February 2023

city of CINCINNATI HEALTH DEPARTMENT

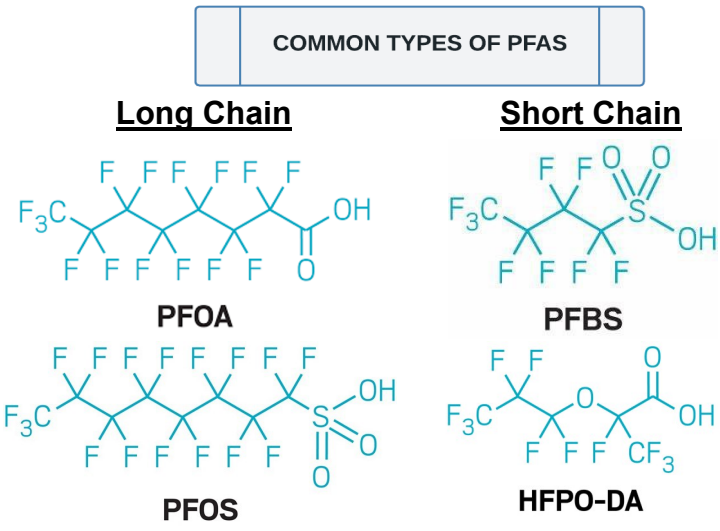
Issue 2

What Are PFAS?

Perfluoroalkyl Substances (PFAS) are a group of synthetic chemicals that are long lasting and detrimental to our health. Known as "forever chemicals", PFAS cannot be broken down by natural systems in the environment or metabolized in our bodies. Some types of PFAS are known to be stored in plants and animals in processes called bioaccumulation and biomagnification. (1, 2)

These man-made chemicals were first created in the 1940s. Today, there are over **9,000 different kinds of PFAS** used in consumer and industrial products. Some of the most common PFAS include: Perfluorooctanoic acid (PFOA or C8), Perfluorooctane sulfonate (PFOS), Hexafluoropropylene Oxide-dimeracid (HFPO-DA or GenX), and Perfluorobutanesulfonic acid (PFBS). PFAS are often discussed in two categories: long-chain PFAS which were created first and are more widely studied, and short-chain PFAS which are relatively new. (2, 3)

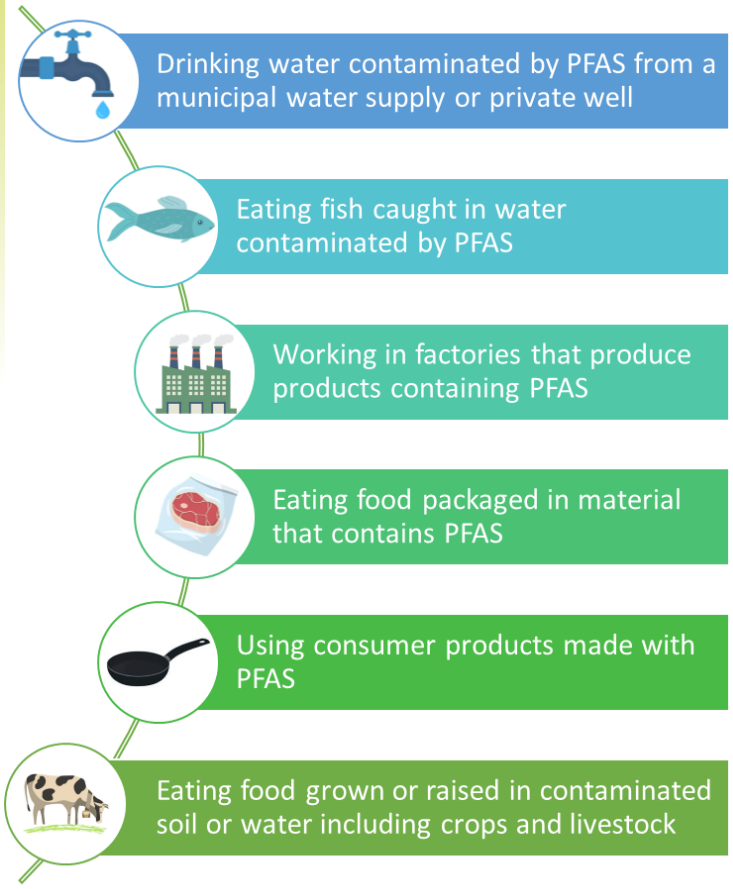
PFAS are a risk to public health primarily by environmental contamination from chemicals released at military sites, airports, and industrial sites. These areas often have increased PFAS concentration in soil and water that can enter the food chain, and effect the health of entire communities. (1, 2, 3, 4)



PFAS have fluorocarbon chains. This chemical shape reduces surface tension, so when applied to products makes the surfaces water and oil resistant. (3, 4, 5)

Exposure

Exposure to PFAS happens when an individual absorbs a PFAS chemical through the skin, ingests it, or inhales it. According to the Centers for Disease Control and Prevention (CDC), **98% of people in the U.S. have been exposed to PFAS**. Most known exposures are relatively low, but prolonged exposure to a concentrated source can result in high PFAS concentrations in the body over time. Some ways an individual can be exposed to high concentrations of PFAS are: (1, 2, 6)



Research shows minimal amounts of PFAS can get into the body through skin absorption, such as applying cosmetics containing PFAS. However, showering, bathing, or washing dishes in water containing PFAS is generally considered safe. (1, 4, 6, 7)

Where Are PFAS Found?

PFAS are used in many everyday products: (2, 3, 6, 7)

Water Resistant Clothing: Raincoats, Jackets, and Moisture Wicking Athleticwear

Grease–Resistant Paper: Fast Food Containers, Microwave-Popcorn Bags, Pizza Boxes, Food Wrappers.

Stain-Resistant Coating on Textiles, Upholstery, and Carpets

Teflon Skillets, Non-Stick Pots and Pans

Firefighting Foam: Aqueous Film-Forming Foam (AFFF)

Personal Care Products: Spray Shampoos, Hairspray, Facewash Beads, and Dental Floss

Paints, Varnishes, and Sealants

Cosmetics: Nail Polish, Eye Makeup and Liquid Lipsticks

Some Cleaning Products

Chalks

How do PFAS Enter the Environment?

Exposures happen due to PFAS contamination in the environment, specifically in water and soil. When water or soil becomes contaminated, PFAS enter the food chain and can be unknowingly ingested. PFAS are created in the manufacturing of consumer goods, but enter the environment in the form of waste (i.e. wastewater or air emissions) from industrial facilities. PFAS can also enter the environment from Aqueous Film–Forming Foam (AFFF) when released during firefighting training or used in response to a petroleum-based fire event. (8, 9, 10)

Waste from both individual and industrial sites can contain PFAS that end up in local sewer systems which can be released into the environment. Liquid waste, called effluent, is treated to remove solids and harmful bacteria before being released back into local waterways such as rivers and streams. Solid waste, called sludge, is incinerated at high temperatures that break down long-chain PFAS. The remaining solid matter is transported to landfills. Landfilled waste may potentially release PFAS through water that has accumulated within the site; this contaminated liquid is called leachate. That leachate is then collected, stored, and returned to the wastewater treatment plant for continued chemical and biological treatment . (8, 9, 10, 11, 12)

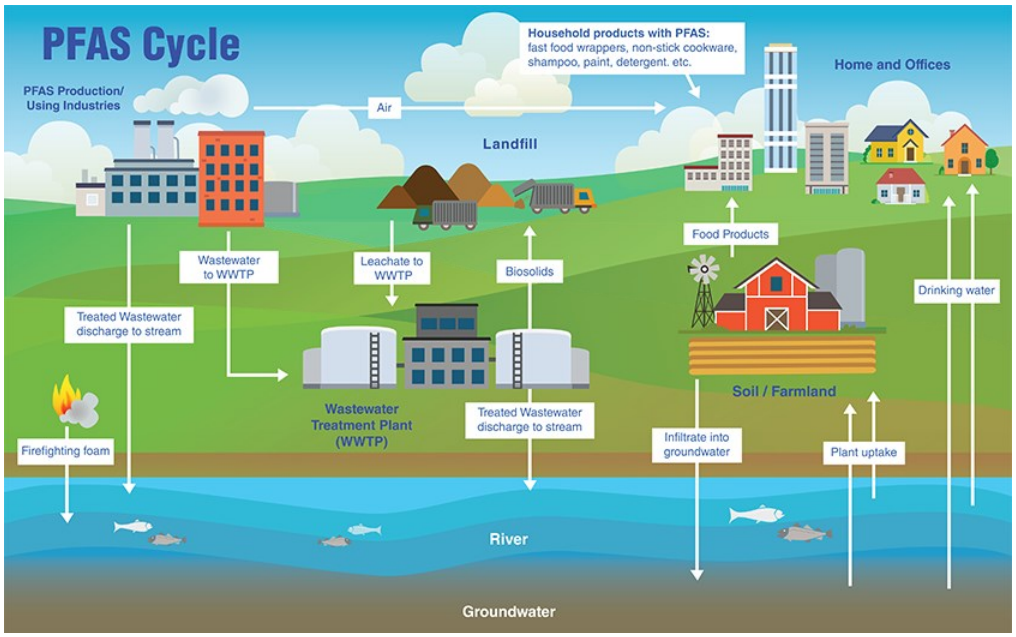


Image from New Jersey Department of Environmental Protection

What does PFAS do to the body?

There are thousands of PFAS with potentially varying effects and toxicity levels. PFAS enter cells, disrupting the body's signaling pathways. This alters the immune system's ability to maintain balance and can ultimately cause damage to tissues and organs due to inflammation.

PFAS interact with cell membranes or proteins inside of cells to form a protein corona (coating). This eventually combines with external pollutants, chemicals, and pathogens to induce greater toxicity and strong adverse effects within the body. (1, 13)

Bioaccumulation/Biomagnification:
Bioaccumulation is the **"build-up" of chemicals in living organisms**. PFAS accumulate in the body from direct uptake because it does not break down or become metabolized easily. PFAS then become concentrated as they are stored in the body over time. This happens in both plants and animals.

Biomagnification, also known as bioamplification, is the **increase in concentration over time** as chemicals move through the food chain. This occurs when a contaminant, such as PFAS, are persistent in the body; meaning it cannot be, or is very slowly, broken down by natural processes. These contaminants are then transferred up the food chain faster than they are broken down or excreted. (14)

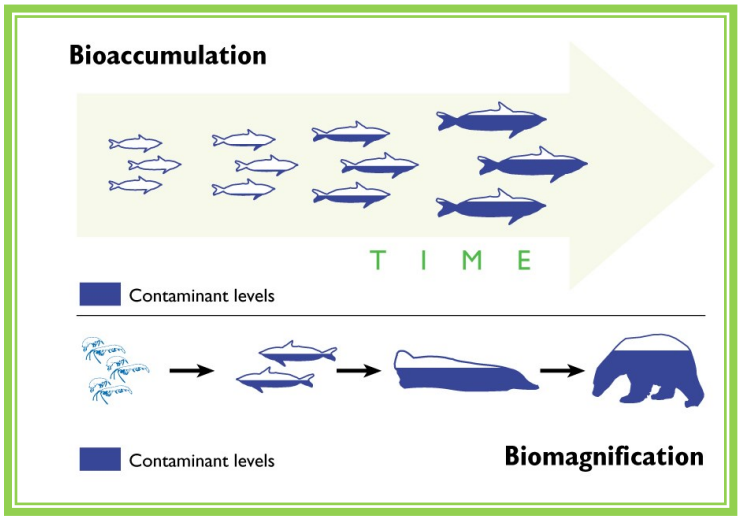


Image From Massachusetts Institute of Technology

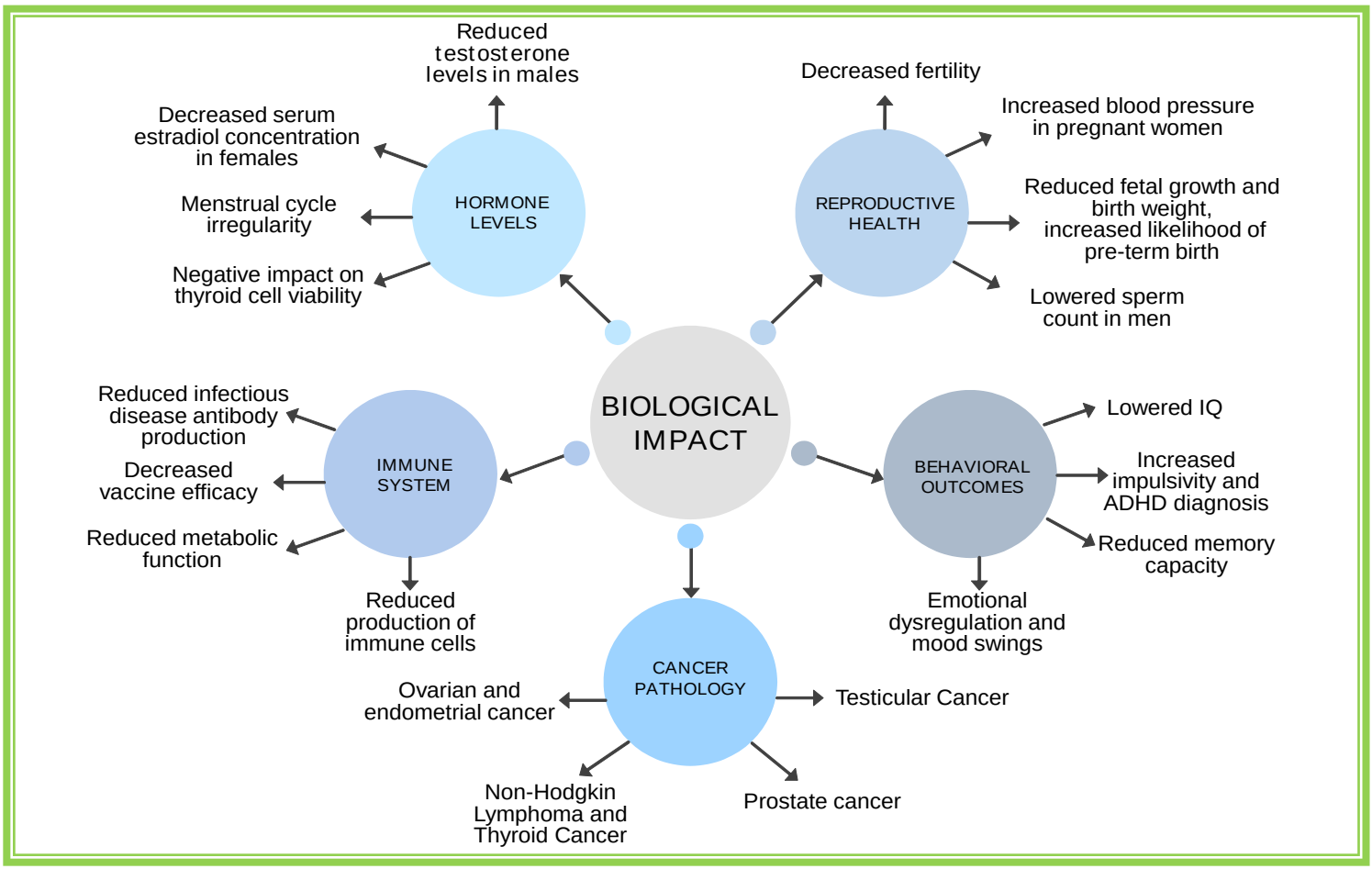
Who is most susceptible to the impacts of PFAS?

There are many different types of PFAS with effects and toxicity levels that vary. Individuals may experience exposure in a combination of ways and at different stages of their life. However, some parts of the population are more susceptible: (1, 15, 16)

- Adults with certain occupations may have greater exposures to PFAS. Primarily, factory workers who are actively involved in making PFAS and PFAS-containing material.
- Individuals who live near PFAS-producing facilities, can face larger exposures than the typical adult.
- Pregnant and lactating women are at an increased risk of exposure to PFAS from contaminated water, since they drink more water per pound of body weight than the average person.
- A fetus can be exposed to PFAS if the mother is exposed during pregnancy.
- Mothers who have been exposed to PFAS may pass it to infants through breastmilk.
- Young children are also at an increased risk of exposure due to their likelihood of hand-to-mouth behavior. PFAS that may be present in carpets, household dust, toys, and cleaning products can accidentally be ingested.

Biological Impact of PFAS Exposure

The most notable impacts on human health include: (16, 17, 18)



Blood Testing for PFAS

Environmental exposure to PFAS can be seen in the level of PFAS in human blood samples. Most people have measurable amounts of PFAS in their body due to its prevalence in many consumer and industrial products. The CDC states that a sum of **20 ng/mL or higher** of PFAS in blood serum or plasma is related with the greatest risk of negative health effects. Blood testing will not inform you of where the exposure is from or the length of time you have been exposed. Additionally, blood testing for PFAS is not routinely conducted within the hospital or clinical setting. However, if an individual is interested in testing PFAS levels in their blood, they can request testing by their healthcare provider. If you are unable to receive testing through your health care provider, external lab testing is also an option. (19)

Types of Blood Testing

- Venous (vein) blood draw: Done in a lab and allows for a larger sample of blood to be tested and studied making the test more accurate. This test uses blood plasma serum.
- Capillary finger-prick: Allows for at-home sample collection and sent to a lab for testing of whole blood. (red blood cells, white blood cells, and platelets). (19)

Limitations

Only about 40 types of PFAS can be tested for concentrations in the blood, which is relatively low compared to the thousands of PFAS that exist in the environment. Blood testing for PFAS concentration may not be covered by most health insurances. Also testing may not be offered in a typical clinical setting and can require traveling to an external lab facility. (19)

A Brief History of PFAS Regulation

1940s

Water resistant properties of PFAS were discovered.

3M and DuPont start using PFAS in consumer products like Teflon and Scotchguard.

1960s

Animal and human studies link chemicals to liver damage.

3M and U.S. Navy use PFAS to develop "aqueous film-forming foam" (AFFF), a fire fighting foam.

1970s

Research by 3M finds that long-chain PFAS, PFOA and PFOS, are toxic.

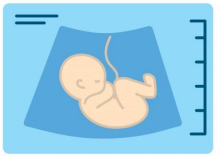
Military sites, airports and fire training facilities start using AFFF worldwide.

1980s

U.S. Navy finds AFFF are environmentally hazardous and kills aquatic life.

3M discovers employees have PFOA and PFOS in their blood.

DuPont discovers PFOA can be passed from mother to unborn baby via umbilical cord.



1999

The EPA and 3M find PFOS contamination in blood banks nation wide.

DuPont is sued by local farmer in West Virginia, after his cattle die.

Investigation revealed DuPont plant dumped PFOA into local landfill, poisoning the local water supply and the Ohio River, polluting the drinking water of the cattle and ~80,000 people.

2000

3M announces it will voluntarily halt production of long-chain PFOA and PFOS.

3M replaces their use with newly created short-chain PFAS suspected to be similarly hazardous.

2005

EPA advisory panel concludes PFOA is a "likely human carcinogen."

EPA encourages all major manufacturers to stop making long-chain PFAS, citing potential birth defects and other risks.

DuPont agrees to phase out long-chain PFAS but begin creating new short-chain PFAS to replace them.

2007

98% of all Americans are estimated to have PFOA and PFOS in their blood.

2009

EPA issues a non-enforceable "lifetime drinking water health advisory" levels (HAL) recommending a maximum of 200 ppt for PFOS and 400 ppt of PFOA.

2012

EPA directs large public water systems to test for PFAS. Results suggest 110 million Americans are exposed to PFAS in their drinking water.

Studies find a link between PFOA exposure and six diseases: testicular cancer, kidney cancer, high cholesterol, ulcerative colitis, thyroid disease and pregnancy-induced hypertension.

2016

EPA revises HAL to 70 ppt for PFOS and PFOA.

2018

Department of Defense finds 121 out of 594 military sites are likely to have contaminated ground water and 564 have drinking water that exceed the EPAs health advisory PFA level.

2021

The Biden-Harris Administration accelerated the pace for research and action in the PFAS crisis. In order to protect the public; research of PFAS, contamination, exposure and environmental effects were conducted. In February, nationwide monitoring for PFAS in drinking water began to establish a national primary drinking water standard for PFOA and PFOS. In April, an EPA Council on PFAS was formed to review data and findings. In June, the EPA council ruled to require all manufacturers of PFAS (including importers), to provide data on their PFAS and how they are using certain PFAS.

2022

In April, the EPA announced three Clean Water Actions that include testing and research of PFAS on local aquatic life, pollution discharge and PFAS monitoring. In May, the EPA added five PFAS to the Contaminated Site Cleanup Tables, allowing EPA to collect more data on PFAS contaminated areas and determine if response or remediation activities are needed. In June, the EPA issued it's first order to test for PFAS under PFAS Testing Strategy and released four new drinking water HAL. **Revising PFOA to 0.004 ppt, PFOS to 0.02 ppt, HFPO to 10 ppt, and PFBS to 2000 ppt.**

Bipartisan Infrastructure Law grant funding can be requested by local water authorities to improve filtration and treatment equipment to reach these thresholds. In August, EPA proposed to designate PFOA and PFOS, as hazardous substances. This proposed rule would increase transparency around releases of these harmful chemicals and help to hold polluters accountable for cleaning up their contamination.

In December, The EPA removed PFAS from their approved inert ingredient list for pesticide products. This will prevent new pesticide formulations from adding PFAS without going through additional EPA review.

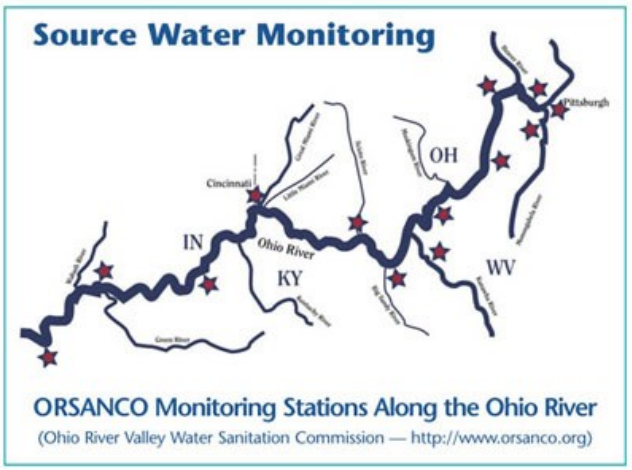
In late December 2022, 3M announced that it will be phasing out all manufacturing and use of PFAS by the end of 2025. (20, 21, 22)

Local Public Health Action

The City of Cincinnati strives to provide a safe and healthy environment for all residents. On the local level, Greater Cincinnati Water Works (GCWW) ensures the safety of the pubic from PFAS exposure by monitoring, protecting, and treating the public water supply. Cincinnati sources its water locally; 88% of water used by GCWW customers comes from the Ohio River and the remaining 12% comes from the Great Miami Buried Valley Aquifer (GMBVA). (23)

Monitoring

GCWW routinely tests all water sources before the water enters the treatment plant. The Ohio River is monitored by participating in a coordinated early warning organic detection system. The Ohio River Valley Water Sanitation Commission (ORSANCO) oversees 17 monitoring stations on the Ohio River which monitor for the most commonly spilled contaminants, volatile organic compounds. In addition, they have conducted sampling events during which locations along the river were sampled for PFAS. The results of those sampling events can be found on their website at www.orsanco.org. It is incredibly vital because the Ohio River is highly susceptible to contamination because the surface water is open to the environment and pollution can spread quickly. This warning system is the first of its kind in the United States. (23, 24).



Protecting

To ensure safe, PFAS-free public water, GCWW works to protect our water sources from contamination by a source water protection program. The Ohio EPA regulates PFAS through wastewater discharge permits. US EPA is currently working on implementing stricter standards that will reduce the amount of PFAS run off into our water sources. GCWW also conducts investigations to determine possible polluters of PFAS upstream. (23, 24, 25)

To further protect our drinking water, GCWW can close the Ohio River intake pump until a contaminant spill passes. Meanwhile stored and supplementary water is utilized. The GMBVA is susceptible to contamination due to the aquifer lacking a protective clay layer and potential contaminate sources nearby. Currently, **0.2% - 2.0% of the U.S. aquifers are contaminated** with a majority being in urban and intensely farmed areas. The GMBVA aquifer is protected by the Hamilton to New Baltimore Groundwater Consortium who develop legislation that requires businesses to register their facilities with the Consortium, delineated the source water protection areas, detailed contingency plan for spill response and alternate water supply planning both short term and long term. Though regulation can help avoid major accidents that cause groundwater contamination, it does not protect against individual actions. Personal actions can have direct consequences on the quality of the environment that can effect the drinking water. The following Hamilton to New Baltimore Groundwater Consortium Guidance can help protect local drinking water. (23, 26)

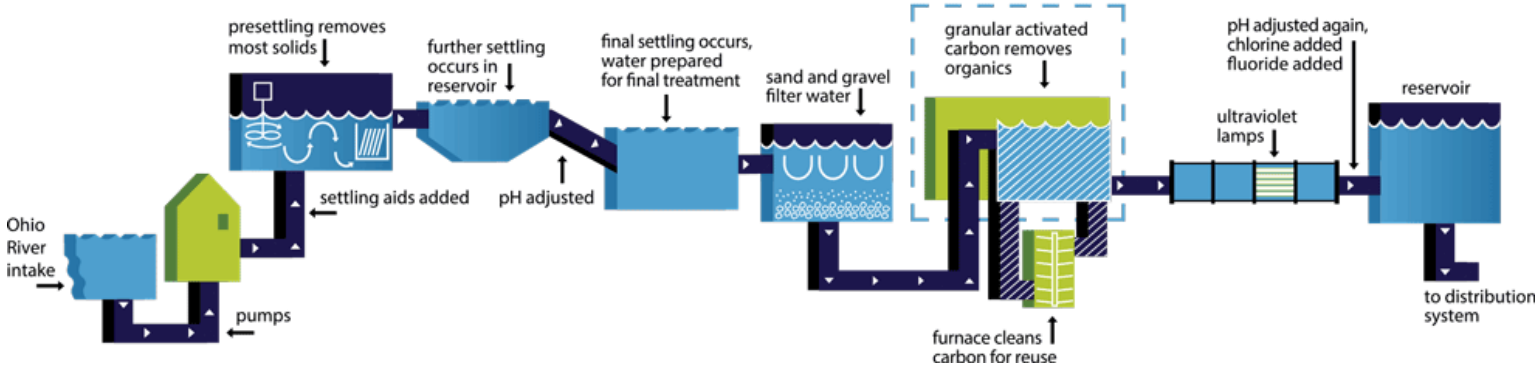
- Never dump paints, oils, or other household hazardous wastes in dry wells, storm sewers, gutters or other improper areas. Many auto repair shops will accept used oil. City of Cincinnati asks residents to reach out to Hamilton County R3source to collect and properly dispose of hazardous waste.
- Follow application directions for fertilizers, pesticides, and herbicides. Where possible use environmentally friendly alternatives.
- Properly maintain private wells. Cracked casings or concrete pads can lead to groundwater contamination. Have them properly sealed if they are no longer in use.
- Use safe alternatives to commercial cleaning products.
- Have septic systems checked regularly.
- Conserve water.

Treating

GCWW cleans and treats Cincinnati's drinking water at two different facilities to remove harmful contaminants. Cincinnati has some of the highest quality water in the nation thanks to its state-of-the-art facilities. Most of Cincinnati's water is treated in the Richard Miller Treatment Plant that filters the water through a Granulated Active Carbon (GAC) treatment system. GAC has been recognized as the best available technology for removing the most common chemicals found in spills in the Ohio River including some PFAS. GAC is made from organic materials that are naturally high in carbon such as coconut shells and coal. These small particles are called Granulated Carbon (GC). GC particles are heated up, or "activated" to create microscopic fractures that increase their surface area. These tiny cracks allow water to pass but catch chemical particles such as PFAS. (23, 24)

Granulated Carbon (GC)

Granulated Active Carbon (GAC)



GCWW tests water before and after the water treatment process for chemicals, impurities and other harmful contaminants to ensure Cincinnati's drinking water meets all regulatory standards. The EPA has issued health advisory levels (HAL) for some PFAS. HAL is the minimum concentration of a chemical which may present health risks to an individual over a lifetime of exposure. As research into PFAS continues, these HALs have been revised based on current information and data. These HALs act as guidance and are not enforceable thresholds to water utilities. HALs do inform data and are a precursory step to forming EPA regulations addressing some of the most common PFAS. Cincinnati's test results are publicly available on the GCWW website. (23, 24)

EPA Interim Health Advisory Levels (HAL)

	Year	2009	2016	2022
PFAS	**PFOA**	200 ppt	70 ppt	0.004 ppt
	PFOS	400 ppt	70 ppt	0.02 ppt
	HFPO		700 ppt*	10 ppt
	PFBS		140,000 ppt*	2000 ppt

Health Advisory Levels were not determined previously for these compounds. Ohio EPA Action Levels are shown as references. Thresholds are measured in parts per trillion (ppt) ; 1 ppt = 1 drop in 500,000 barrels of water. (24)

Cincinnati Metropolitan Sewer District (MSD) works to collect and treat wastewater and stormwater for the city of Cincinnati. Currently, MSD is working to further the understanding of PFAS in wastewater that it collects and treats. This research will inform future actions as we learn more about different kinds of PFAS. (27)

Steps to Reduce your Risk

Water

Protect yourself by protecting your water source. The two types of water filtration methods that are most effective against PFAS are **granular activated carbon (GAC)** and **reverse osmosis (RO)** filters (28). GCWW uses GAC to filter Cincinnati's water. If you do not receive your water from GCWW, check with your local water service authority to find out how your water is filtered prior to reaching your home. If you are still concerned, additional precautions against PFAS can be taken by implementing hand held water pitcher filters, fridge filters, and under the sink or full home water line filters. Ensure that the filters used are National Sanitation Foundation (NSF) and American National Standard Institute (ANSI) certified to effectively reduce the amount of PFAS in your drinking water. The certification process of these water filtration systems are extensive, requiring thorough testing to meet the requirements put in place for drinking water units.

Food

Certain foods may provide major routes of PFAS exposure. A primary example being fish that are caught for sport from waterways that are contaminated by PFAS. Follow fish consumption guidelines that stop or limit individuals from eating fish from contaminated sources. Contaminated waterways can be identified by reaching out to state or tribal fish advisory contacts.

Materials used for food preparation can also be major contributors to PFAS exposure. Non-stick cookware when heated at high temperatures exude toxic fumes which are then released into food and the surrounding environment. This chemical release can be inhaled or ingested both proving to be incredibly harmful. Stainless steel and cast iron cookware are safer and healthier alternatives.

Additionally, to-go food containers from restaurants can also provide PFAS exposure. When heated, PFAS can leach into food and also be released into the air when opened. A safer approach is removing food from fast food containers prior to reheating in order to minimize toxic chemical ingestion.

Consumer Products

Items that may appear to be helpful in your daily life may contribute to PFAS exposure and lead to adverse health outcomes. To minimize unknown exposures, research and read labels on products when purchasing. Avoid buying items that include "perfluor" in the list of ingredients. (29)

Even though recent efforts to remove certain PFAS from commerce have reduced the likelihood of exposure, some products may still contain PFAS. If you have questions or concerns about products you use in your home, you may contact the Consumer Product Safety Commission's Consumer Ombudsman by calling (301) 504-8120 or emailing ConsumerOmbudsman@cpsc.gov, or visit the CSPC's website.

Stay Informed on PFAS

Utilize government resources that provide current information on PFAS impacts, prevention efforts, and legislation.

- U.S Environmental Protection Agency (EPA)
- Agency for Toxic Substances and Disease Registry (ATSDR)
- National Institutes of Health (NIH)
- Food and Drug Administration (FDA)
- U.S Department of Defense (DOD)
- Association of State Drinking Water Administrators (ASDWA)

Authors: Meriel Vigran, MPH & Swairah Rehman, MPH

Contact: Meriel Vigran, MPH, meriel.vigran@cincinnati-oh.gov

References:

1.) U.S. Environmental Protection Agency. (2022). *Our current understanding of the Human Health and Environmental Risks of PFAS*. [Accessed November 2022]. Available: Our Current Understanding of the Human Health and Environmental Risks of PFAS | US EPA,
2.) National Institute of Environmental Health Services. (2022). *Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS).* [Accessed November 2022]. Available Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) (nih.gov)
3.) Agency for Toxic Substances and Disease Registry (ATSDR). (2021). *Toxicological profile for Perfluoroalkyls. Atlanta, GA: U.S. Department of Health and Human Services*, Public Health Service. *DOI: 10.15620/cdc:59198* Available: Agency for Toxic Substances and Disease Registry (cdc.gov)
4.) U.S. Food and Drug Administration. (2022). *Per– and Polyfluoroalkyl Substances (PFAS).* [Accessed November 2022]. Available:Per- and Polyfluoroalkyl Substances (PFAS) | FDA
5.) American Water Works Association (2022). *Per– and Polyfluoroalkyl Substances (PFAS) Overview and Prevalence.* [Accessed November 2022]. Available: Per-andPolyfluoroalkylSubstances(PFAS)-OverviewandPrevalence.pdf (awwa.org)
6.) Calafat AM, Wong LY, Kuklenyik Z, Reidy JA, Needham LL. *Polyfluoroalkyl chemicals in the U.S. population: data from the National Health and Nutrition Examination Survey (NHANES) 2003-2004 and comparisons with NHANES 1999-2000.* Environ Health Perspect. 2007 Nov;115 (11):1596-602. doi: 10.1289/ehp.10598. *PMID: 18007991; PMCID: PMC2072821.* Available: Polyfluoroalkyl Chemicals in the U.S. Population: Data from the National Health and Nutrition Examination Survey (NHANES) 2003–2004 and Comparisons with NHANES 1999–2000 - PMC (nih.gov)
7.) Environmental Protection Agency *et al.* (2018). *Risk Assessment of Fluorinated Substances in Cosmetic Products*. The Danish Environmental Protection Agency (978-87-93710-94-8). Available: Rapport (mst.dk)
8.) Hunter Anderson R, Adamson DT, Stroo HF. (2019). *Partitioning of poly- and perfluoroalkyl substances from soil to groundwater within aqueous film-forming foam source zones. J Contam Hydrol. 2019;220:59-65. doi:10.1016/j.jconhyd.2018.11.011* Partitioning of poly- and perfluoroalkyl substances from soil to groundwater within aqueous film-forming foam source zones - PubMed (nih.gov)
9.) ITRC. *(2018). Fate and Transport for Per-and Polyfluoroalkyl Substances.* [Accessed November 28, 2022] Available: Fate and Transport of Per- and Polyfluoroalkyl Substances (PFAS) (itrcweb.org)
10.) Post, G. *et al.* (no date) *NJDEP New Jersey Department of Environmental Protection*. [Accessed November 2022]. Available: https://www.nj.gov/dep/rules/
11.) Wang, J. *et al.* (2022) "Critical review of thermal decomposition of per- and polyfluoroalkyl substances: Mechanisms and implications for thermal treatment processes," *Environmental Science & Technology*, 56(9), pp. 5355–5370. Available: https://doi.org/10.1021/acs.est.2c02251.
12.) Metropolitan Sewer District of Greater Cincinnati (2021). *Mill Creek Wastewater Treatment Plant Tour Brochure.* [Accessed Jan 2023]. Available: https://acrobat.adobe.com/id/urn:aaid:sc:VA6C2:824c1cb2-437b-4031-82c6-d74feabda9a4.
13.) Chambers, W.S., Hopkins, J.G. and Richards, S.M. (2021). *A review of per- and polyfluorinated alkyl substance impairment of reproduction, Frontiers in Toxicology, 3.* [Accessed November 2022]. Available: https://doi.org/10.3389/ftox.2021.732436.
14.) Boisvert, G., Sonne, C., Rigét, F. F., Dietz, R., & Letcher, R. J. (2019). *Bioaccumulation and biomagnification of perfluoroalkyl acids and precursors in East Greenland polar bears and their ringed seal prey*. Environmental pollution (Barking, Essex : 1987), 252(Pt B), 1335–1343. [Accessed November 2022]. Available: https://doi.org/10.1016/j.envpol.2019.06.035
15.) Harris, M.H. et al. (2018). *Prenatal and childhood exposure to per- and polyfluoroalkyl substances (pfass) and child cognition Environment International*, 115, pp. 358–369. Available: https://doi.org/10.1016/j.envint.2018.03.025.
16.) Xie, X. et al. (2021). *Perfluoroalkyl and Polyfluoroalkyl Substance Exposure and association with sex hormone concentrations: Results from the NHANES 2015–2016*, Environmental Sciences Europe, 33(1). Available: https://doi.org/10.1186/s12302-021-00508-9.
17.) Luo, J., Xiao, J., Gao, Y., Ramlau-Hansen, C. H., Toft, G., Li, J., Obel, C., Andersen, S. L., Deziel, N. C., Tseng, W. L., Inoue, K., Bonefeld-Jørgensen, E. C., Olsen, J., & Liew, Z. (2020). Prenatal exposure to perfluoroalkyl substances and behavioral difficulties in childhood at 7 and 11 years. *Environmental research*, *191*, 110111. https://doi.org/10.1016/j.envres.2020.110111
18.) Harris, M. H., Oken, E., Rifas-Shiman, S. L., Calafat, A. M., Bellinger, D. C., Webster, T. F., . Sagiv, S. K. (2021). Prenatal and childhood exposure to per- and polyfluoroalkyl substances (PFAS) and Child Executive Function and behavioral problems. *Environmental Research, 202*, 111621. doi:10.1016/j.envres.2021.111621
19.) *Pfas blood testing: What you need to know - pfas exchange*. [Accessed: November 2022]. Available at: https://pfas-exchange.org/wp-content/uploads/PFAS-Blood-Testing-Document-May-2022.pdf
20.) Linn, A, *A Toxic timeline: A brief history of PFAS. (*2019). [Accessed November 2022]. Available: Toxic timeline: A brief history of PFAS | Searchlight New Mexico (searchlightnm.org)
21.) U.S. Environmental Protection Agency. (2022). *EPA Actions to Address PFAS*. [Accessed November 2022]. Available: EPA Actions to Address PFAS | US EPA
22.) U.S. Environmental Protection Agency. (2022). PFAS Strategic Roadmap: EPA's Commitments to Action 2021-2024. [Accessed November 2022]. Available: PFAS Strategic Roadmap: EPA's Commitments to Action 2021-2024 | US EPA
23.) Greater Cincinnati Water Works. (2021). *GCWW Water Quality Report 2021.* [Accessed November 2022]. Available: http://WQR.myGCWW.org
24.) Pfas and genx. (n.d.). Retrieved January 6, 2023, from https://www.cincinnati-oh.gov/water/water-quality-and-treatment/water-your-health/pfas-and-genx/
25.) (n.d.). Retrieved January 6, 2023, from https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/individual-wastewater-discharge-permits
26.) Home. (2022, October 27). Retrieved January 6, 2023, from https://gwconsortium.org/
27.) The Metropolitan Sewer District of Greater Cincinnati. (n.d.). Retrieved January 6, 2023, from https://msdgc.org/
28) Remodel Or Move. (2022). *What does NSF certified mean for water filter?* [Accessed: December 2022]. Available at: https://www.remodelormove.com/what-does-nsf-certified-mean-for-water-filter/
29.) Clean Water Action. (2022). *10 things you can do about toxic pfas chemicals.* [Accessed: December 2022]. Available at: https://www.cleanwateraction.org/features/10-things-you-can-do-about-toxic-pfas-chemicals

This report is intended to provide more information about PFAS and is not intended to be individual medical advice. If you have questions specific to your situation, contact your healthcare provider.