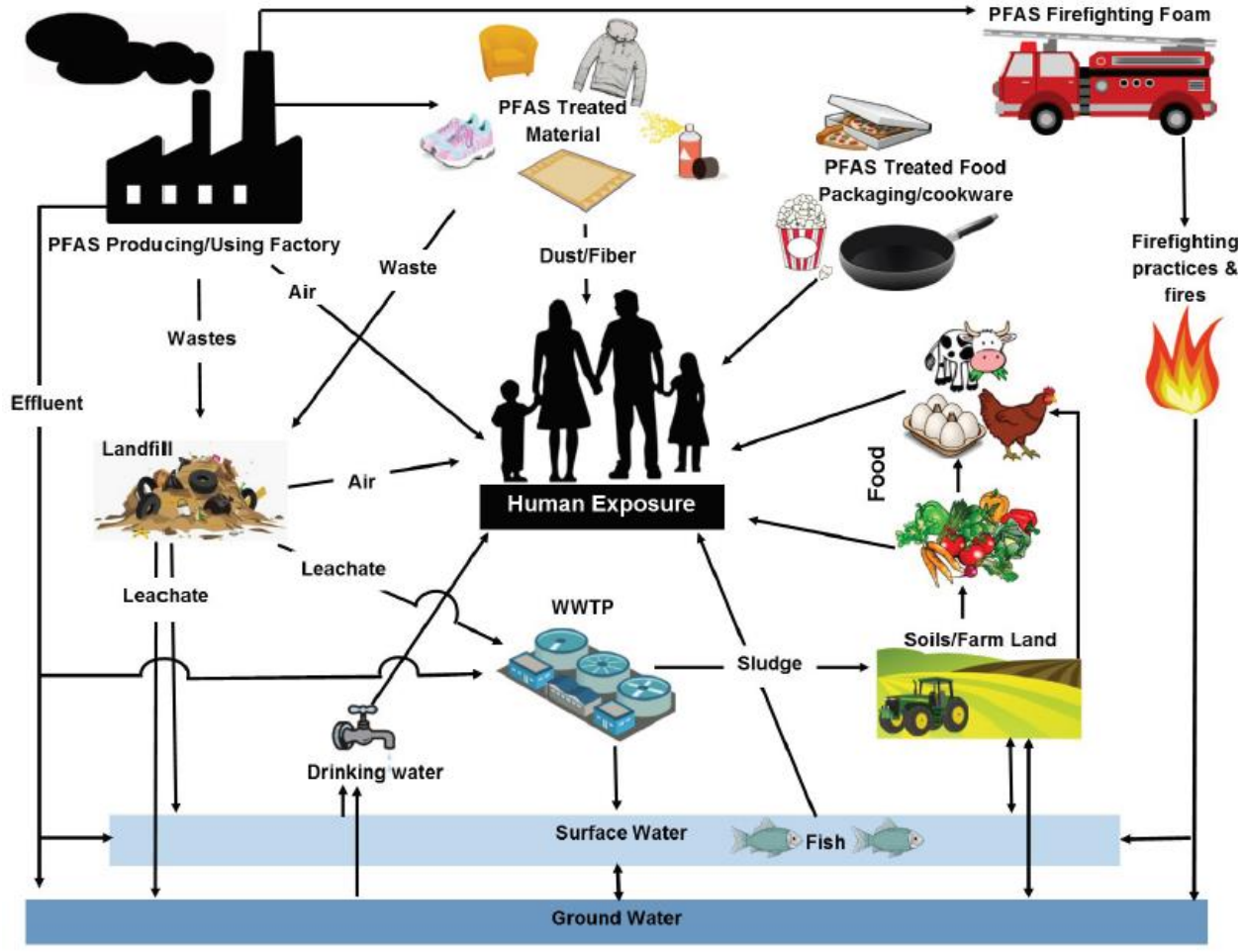
PER- AND POLYFLUORINATED ALKYL SUBSTANCES

What are they?

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a large group of human-made chemicals that have been used in industry and consumer products worldwide since the 1940s. Their ability to repel water and oil and withstand high temperatures has made PFAS a particularly useful ingredient in industrial and commercial products, including non-stick products, stain- and water-repellent clothing, and aqueous film forming foams (AFFFs). These chemicals do not easily break down in the environment and have been known to accumulate in the environment and humans. The acronym PFC has been used to describe PFAS in the past. This acronym is no longer used to describe per- and polyfluoroalkyl substances (PFAS) because it is used to describe perfluorocarbons (i.e., refrigerants), which are a different family of chemicals.



Sources of PFAS and modes of human exposure. *Image credit: Maine Drinking Water Program, Service Connection newsletter, Volume 25, Issue 4. Image adapted from Oliaei et al., 2013.*

Humans may be exposed to PFAS in several ways, including: drinking municipal or private well water contaminated by PFAS, eating wildlife (such as fish) in which PFAS have bioaccumulated, accidentally or unknowingly inhaling dust contaminated by PFAS (an original source could be couch or mattress coverings that were treated with PFAS), and eating food that was packaged in material that contains PFAS. Although numerous consumer products are thought to contain PFAS, direct exposure from consumer products may be more acute in certain cases in which a PFAS-containing product could be ingested (e.g., lipstick). In a nationwide study, low levels of PFAS were determined to be present in the blood of most Americans.

Although PFAS have been used extensively since the mid-20th century, in recent years the scientific health research community has made progress to better understand their potential impacts to human health. This understanding continues to evolve based on ongoing research. The four perfluoralkyl acids (PFAAs) perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonic acid (PFHxS), and perfluorononanoic acid (PFNA) are among the most studied PFAS chemicals. Current studies of these PFAS suggest exposure may affect childhood development, decrease female fertility, increase the risk of high blood pressure in pregnant women, increase cholesterol levels, increase the risk of thyroid disease, and decrease antibody response to vaccines. EPA research suggests that some PFAS may have the potential to cause cancer, but the topic requires further research.

Currently, there is limited regulatory authority regarding PFAS at the federal level. In 2016, the EPA issued a non-enforceable Lifetime Health Advisory level for PFOA and PFOS of 70 parts per trillion (ppt) in drinking water and in February 2020 released an updated PFAS action plan titled EPA PFAS Action Plan: Program Update, that, among other steps, pledges to work under the Safe Drinking Water Act (SDWA) to make a regulatory determination for PFOA and PFOS. Currently, the DNR, under Chapter 292, Wisconsin Statutes, has authority to require parties that discharge PFAS to the air, land,

Firefighters training with firefighting foam. A specific type of firefighting foam, known as Aqueous Film Forming Foam, contains significant amounts of PFAS and is designed for use on fires involving flammable liquids (Class B).

and waters of the State to take action to restore the environment to a practicable level. DNR's Water Quality Program has authority to regulate discharges to surface water on a site-by-site basis in accordance with the federal Clean Water Act.

Occurrence in Wisconsin

Under the Safe Drinking Water Act's third Unregulated Contaminants Monitoring Rule (UCMR-3), about 90 municipal water systems statewide were sampled for PFOA and PFOS between 2013 and 2015. PFAS were detected in municipal water systems in La Crosse, West Bend, and Rhinelander. At the time, laboratory analysis was only done for six PFAS analytes, whereas since the beginning of 2020, laboratory analysis for Wisconsin samples has often been done for at least 33 PFAS analytes. Also, laboratory reporting limits were considerably higher in the UCMR-3 project than they are today. In the case of PFOA and PFOS, the UCMR-3 laboratory reporting limits were 20 ppt and 40 ppt, respectively. Currently, the Wisconsin Department of Health Services (DHS) recommended groundwater protection standard and drinking water health advisory level is 20 ppt for PFOA and PFOS individually or combined. The data from UCMR-3 served as an initial indicator of the fact that both groundwater and drinking water supplies in Wisconsin have been impacted by PFAS.

Since UCMR-3 was conducted, sampling has also been conducted voluntarily by several municipal water systems and in some cases laboratory analysis included a more comprehensive list of PFAS. These sampling efforts identified PFAS in varying concentrations in municipal water systems in Marinette (surface water source), Madison, and Rhinelander, as well as additional impacts in La Crosse and the Town of Campbell on French Island.

Other than UCMR-3 sampling, there has not yet been any statewide sampling of PFAS in groundwater in Wisconsin. However, DNR is currently planning a project to sample at least 90 of the state's 611 municipal water systems for PFAS in groundwater-sourced drinking water. Finished drinking water from all groundwater sources to each system will be sampled. These groundwater sources in the 90 selected systems represent about 30% of all groundwater sources of municipal drinking water statewide. The project is expected to begin during the summer/fall of 2021. The Wisconsin PFAS Action Council (WISPAC), a multi-agency PFAS task force created by Governor Evers' Executive Order 40, recommends sampling of every municipal system and additional priority public water systems for PFAS, contingent upon availability of sufficient funding.

Much work on PFAS in Wisconsin has focused on contaminated site investigations. As of June 2021, there are approximately 60 open site investigations statewide in which one or more PFAS have been identified as a contaminant. Such contaminated site investigations include former firefighting training areas (civilian, corporate and military), industrial facilities, landfills, and an area where biosolids were land applied.

The latter two types of sites are secondary sources, were PFAS were not produced or used directly but rather released to the environment due to their presence in consumer products or other waste streams. Among landfills, older unlined landfills may present a higher risk to groundwater. The environmental stability and lack of effective treatment of PFAS in municipal sewage plants may lead to their presence in biosolids, which might threaten the practice of biosolids land spreading as a beneficial reuse of municipal waste. In areas without municipal sewerage, PFAS may also be released to groundwater from septic systems due to their presence in numerous commercial products.

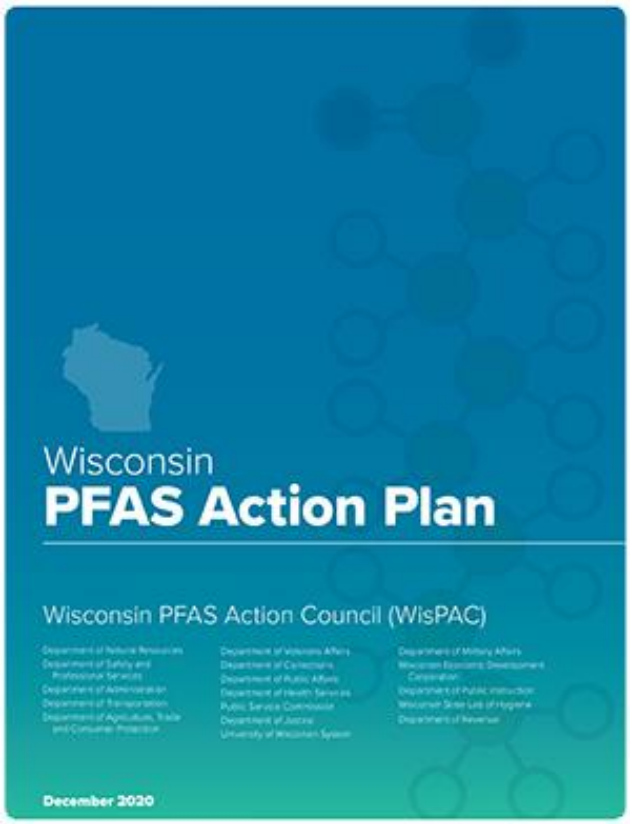
Where PFAS are discovered in groundwater and attributed to a responsible party, the resulting site investigation and remedial actions may be a multi-year process and for larger and more complex sites may take decades. This work includes all impacted media, not just groundwater. Meanwhile, DNR is reviewing scientific findings indicating that relatively low concentrations of PFAS may be common in groundwater, even at locations far away from known contaminated sites. Despite the fact that PFAS are exclusively created by industrial production and they do not occur naturally, the term 'background' is nevertheless sometimes used to refer to low concentrations of PFAS commonly found in groundwater and that may not be readily attributable to a specific industrial or commercial release to the environment. The paradox that PFAS are not naturally occurring but nevertheless may be widespread in the environment (potentially including groundwater), even at locations distant from known or suspected sources under investigation by responsible parties, makes PFAS especially challenging compared to many other contaminants.

GCC Agency Actions

Currently, there are no state or federal groundwater protection standards for PFAS. To address this regulatory gap, DNR requested DHS review of a total of 36 PFAS as potential updates to the NR 140 groundwater standards. As part of the Cycle 10 and Cycle 11 NR 140 updates, DHS searched for toxicity information for 36 individual PFAS. In June 2019, DHS recommended a groundwater enforcement standard of 20 parts per trillion (ppt) as a combined standard for PFOA and PFOS (part of the Cycle 10 recommendations). DNR is currently in rulemaking to potentially establish PFOA and PFOS DHS-recommended groundwater standards in NR 140. In November of 2020, DHS recommended groundwater enforcement standards for 16 additional PFAS as part of DHS's Cycle 11 groundwater standard recommendations. DHS recommended that four of those Cycle 11 PFAS be regulated as combined standards, along with PFOA and PFOS. For the remaining 12 PFAS, individual standards were recommended. On June 23rd, 2021, the Natural Resources Board approved the NR 140 Cycle 11 statement of scope, allowing for rulemaking for the 16 additional PFAS to proceed.

The DHS-recommend PFAS groundwater quality standards currently serve as guidance for safe drinking water levels. Until such time when rulemaking is completed, entities undertaking groundwater cleanups of PFAS contamination are required to work with DNR and DHS to establish site-specific cleanup standards. As additional guidance regarding cumulative health effects of PFAS mixtures, DHS recommends a hazard index be calculated for all PFAS drinking water samples. The hazard index effectively combines all of the recommended PFAS standards into a single value. If the hazard index exceeds 1.0, DHS recommends that the water not be consumed. Guidance for temporary water for private well owners affected by PFAS is available.

The Wisconsin PFAS Action Plan was released in December 2020. The plan was developed by the Wisconsin PFAS Action Council, or WISPAC, to serve as a roadmap for addressing PFAS contamination in diverse environmental media and settings in the state. The PFAS Action Plan presents several recommendations, including one specifically for drinking water (including groundwater sources). That recommendation is to conduct statewide drinking water testing, including all municipal systems as well as some other priority community and non-community public water systems. Work on sampling municipal systems is tentatively anticipated to begin during the summer/fall of 2021.



The Wisconsin PFAS Action Plan was released in December 2020.

The PFAS Action Plan also presents several other recommendations that directly or indirectly relate to groundwater. The following table presents an overview of recommendations most directly related to groundwater (readers are referred to the PFAS Action Plan for more detail and other recommendations not listed here) and the status of implementation:

Recommendation number	**Summary of recommendation (see the PFAS Action Plan for full text)**	**Status of groundwater-related implementation**
1.1	Establish science-based environmental standards for PFAS	In progress with the DHS Cycle 10 and Cycle 11 (NR 140) recommended groundwater standards.
1.2	Safely manage PFAS in landfill leachate	DNR is reviewing scientific studies on PFAS in landfill leachate.
2.4	Test public water systems for PFAS	Sampling of drinking water from about 90 groundwater-sourced municipal systems tentatively expected to start during summer/fall 2021.
3.4	Identify PFAS sources and reduce discharges to wastewater facilities	DNR's Water Quality program has been conducting sampling of industrial wastewater treatment effluent. Any actions taken to reduce loading of PFAS to wastewater treatment plants are expected to have benefits for surface water as well as groundwater.
5.2	Monitor background[1] levels of PFAS in the environment (includes groundwater and a variety of other environmental media).	DNR is reviewing studies relevant to background[1] PFAS levels in groundwater and exploring what practical options might be feasible for sampling related to evaluation of background levels

Table footnote:

[1] Multimedia research has shown that PFAS can be transport long distances from a source. 'Background' is meant in the sense that some low concentrations of certain PFAS might be widespread and/or not readily attributable to a local source. However, PFAS do not occur naturally.

Further Reading

DNR PFAS page: https://dnr.wi.gov/topic/Contaminants/PFAS.html

DHS Groundwater Contaminant recommendation process: https://www.dhs.wisconsin.gov/publications/p02432.pdf

Interstate Technology and Regulatory Council fact sheets: https://pfas-1.itrcweb.org/

US Agency for Toxic Substances and Disease Registry PFAS page: https://www.atsdr.cdc.gov/pfas/index.html

US Environmental Protection Agency PFAS page: https://www.epa.gov/pfas

References

Oliaei, F., Kriens, D., Weber, R., Watson, A., 2013. PFOS and PFC releases and associated pollution from a PFC production plant in Minnesota (USA). Environ. Sci. Pollut. Res. 20, 1977–1992. https://doi.org/10.1007/s11356-012-1275-4