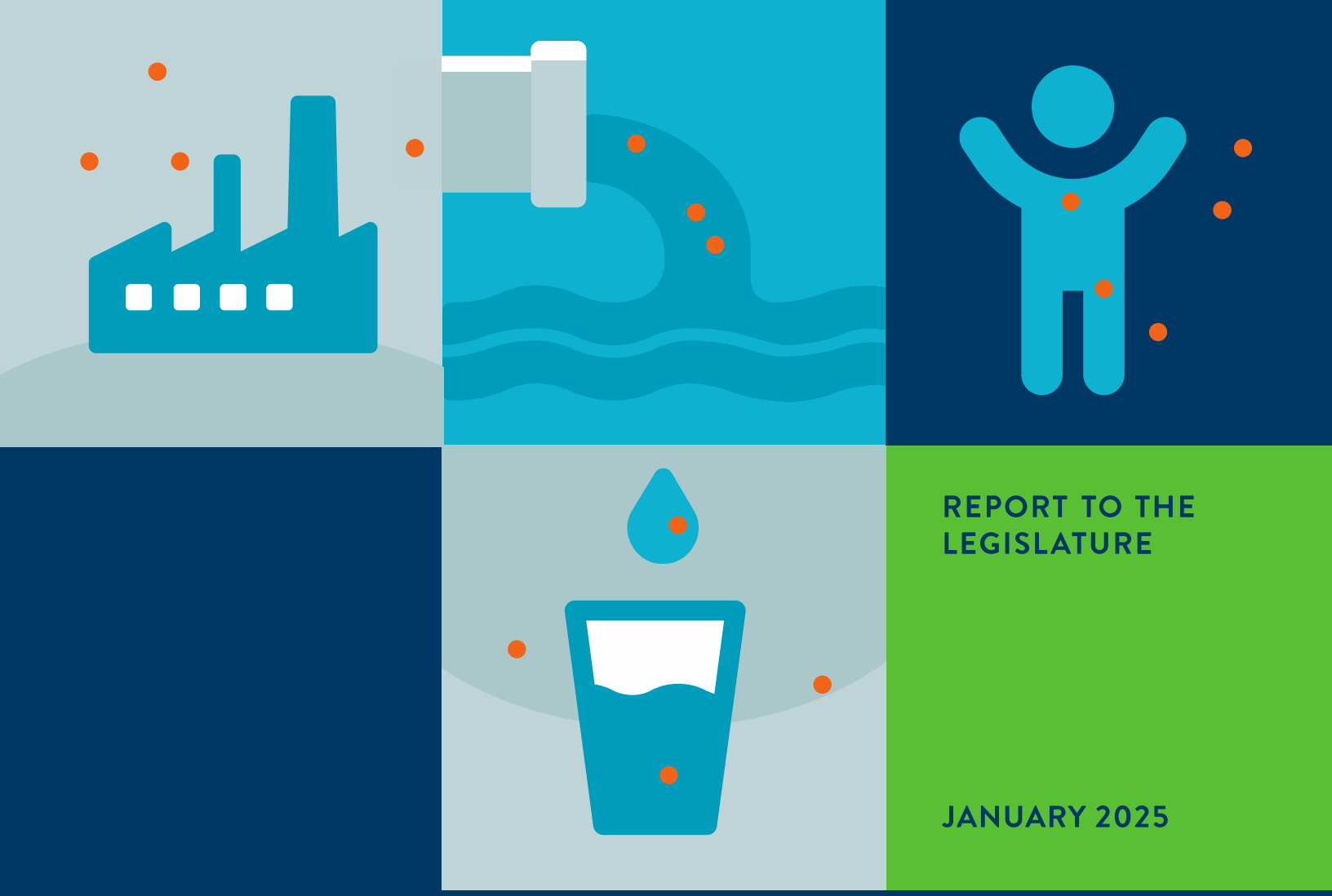

REPORT TO THE LEGISLATURE

JANUARY 2025

PFAS removal report

Strategies and funding options to address PFAS removal in drinking water and wastewater.

MINNESOTA

Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194 |

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This report is available in alternative formats upon request, and online at www.pca.state.mn.us.

Document number: lrc-pfc-4sy25

Legislative charge

2024 Session Law, Chapter 116, Article 2, Sec. 29.

MINNESOTA POLLUTION CONTROL AGENCY AND DEPARTMENT OF HEALTH; PFAS REMOVAL REPORT.

(a) By January 15, 2025, the commissioners of the Pollution Control Agency and health must submit a report to the chairs and ranking minority members of the legislative committees with jurisdiction over health finance and policy, environment and natural resources finance and policy, and capital investment. The report must provide recommendations for:

> *(1) strategies or fee mechanisms the state may use to require companies that manufacture, use, or release perfluoroalkyl and polyfluoroalkyl substances (PFAS) to pay for the cost of providing safe drinking water to people that have had their private and public water sources contaminated by PFAS; and*
>
> *(2) strategies or fee mechanisms the state may use to require companies that manufacture, use, or release PFAS to:*
>
> > *(i) prevent or remove PFAS from influent waters entering municipal wastewater facilities so that treatment of effluent is not required; or*
> >
> > *(ii) pay the cost of treating and disposing of the PFAS from municipal wastewater facilities effluent.*

(b) The report must include recommendations for any legislation needed to implement the strategies or fee mechanisms. The report must consider options from the report submitted by the PFAS manufacturers fee work group required under Laws 2023, chapter 60, article 3, section 30, in developing the recommendations. The recommendations in the report must be specific and actionable and may not include recommendations for further reports or studies.

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Foreword

Per- and polyfluoroalkyl substances (PFAS) are a class of human-made chemicals that have been widely used in commerce since the 1950s. PFAS are characterized by carbon-fluorine bonds, which are one of the strongest bonds known in organic chemistry and consequently do not break down in the environment. PFAS are highly mobile and are therefore capable of long-range atmospheric transport and long migration distances in groundwater compared to many conventional pollutants. Due to their persistence, mobility, and numerous applications in industrial processes and consumer products, PFAS are now virtually ubiquitous in the environment. They have been discovered in water, soil, air, fish, wildlife, snow, ice, and humans around the globe, including in remote regions with little or no industrial activity.

Many PFAS have been associated with adverse human health effects at relatively low concentrations compared to other types of pollutants. The Minnesota Department of Health has conducted risk assessments and developed health-based guidance values for six PFAS compounds in water and air. Potential health impacts include immune suppression, changes in liver function, lower birth weight, and certain cancers.

Minnesota has been addressing PFAS contamination since 2002, when perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) were discovered in groundwater resulting from historical disposal sites of industrial PFAS waste. In the last two decades, further investigation has revealed concerning levels of PFAS in water, soil, air, fish, and wildlife across the state. In 2021, the State of Minnesota released Minnesota's PFAS Blueprint, a strategic approach to prevent, manage, and clean up PFAS pollution. Then, in 2023, the Minnesota Legislature passed Amara's Law, a sweeping prohibition on PFAS intentionally added to products. Minnesota is among a small but growing number of states that are national leaders in the prevention of PFAS pollution via prohibitions on adding PFAS to consumer and other products.

PFAS pollution prevention, mitigation, and cleanup efforts based on concepts introduced in the PFAS Blueprint are ongoing.

Contents

Background

Despite being manufactured, used, and released by a myriad of industries for decades, our understanding of the sources and amounts of PFAS entering the environment, and their effects on the environment and human health, are limited. Some state and federal laws and regulations [for example, the Minnesota Environmental Response and Liability Act (MERLA) and the National Primary Drinking Water Regulation (NPDWR) for PFAS] require reporting on PFAS pollution at certain types of facilities and/or in certain amounts, but there is no regulatory or programmatic structure in place to intentionally collect fees associated with the manufacture, use, or release of PFAS in Minnesota for the purpose of treating PFAS pollution in the environment.

Ongoing disagreement on the definition of what chemicals are PFAS compounds has further complicated efforts to address PFAS pollution. The Minnesota Legislature has broadly defined PFAS as "a class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom."[1] The Minnesota definition, used by several other states, includes chemicals that the U.S. Environmental Protection Agency (EPA) and other federal agencies do not consider to be PFAS under any of their own definitions. As such, Minnesota state agencies are working to address PFAS under the Legislature's broad definition, which includes ultrashort-chain PFAS, some pesticides, and some pharmaceuticals that are otherwise excluded by federal agencies.

As required by 2024 Session Law, the Minnesota Pollution Control Agency (MPCA) and Minnesota Department of Health (MDH) have, in this document, identified strategies to address PFAS contamination in drinking water and wastewater, such that companies that manufacture, use, or otherwise release PFAS would be financially responsible for their contributions to PFAS contamination.

The strategies identified in this document expand on the work described in the published report "Fee collection options for PFAS manufacturers in Minnesota" (lrc-pfc-3sy24) (2024 report), which was required by 2023 Session Law. The 2024 report more narrowly explores fee mechanisms and structures that may be applicable to addressing PFAS in Minnesota.[2]

[1] Minnesota Statutes 325F.072, Subd. 1(c) (2023); Minn. Stat. 116.943 Subd. 1(p) (2023); Minn. Stat. 18B.01, Subd. 15c (2024); Minn. Stat. 18C.005, Subd. 23a (references 18B.01, Subd. 15c) (2024).
[2] Minnesota Pollution Control Agency (MPCA). Fee collection options for PFAS manufacturers in Minnesota (lrc-pfc-3sy24) (January 2024).

Recommendations

PFAS pollution prevention is Minnesota's best hope for reducing current and future PFAS contamination. Holding PFAS manufacturers, users, and releasers financially accountable for their role in contaminating our wastewater and solid waste systems and, subsequently, our environment and drinking water sources, is a logical consequence.

This section of the report summarizes the MPCA's and MDH's recommendations. These recommendations would maximize the use of fee revenue collected from manufacturers to provide safe drinking water and to pretreat wastewater. There will not be a one-size-fits-all solution, and many current technologies have only been proven effective for small-scale applications. The remainder of this report provides more detailed information supporting these recommendations, including our current understanding of PFAS contamination in drinking water and wastewater and the potential costs associated with addressing that contamination.

Fee structure

Given the unknown number of PFAS manufacturers in the state, our best recommendation at this time is for the Legislature to identify a fee revenue target – either as a specific dollar amount or by the actions/strategies that need to be implemented – then develop a process to assign a fee by splitting it up amongst the universe of fee payers, rather than setting a specific fee structure in statute. This is the model used for air emission permit fees and the Dry Cleaner Environmental Response and Reimbursement Law under MERLA.[3,4] In these cases, the Legislature determines the specific dollar amount of the revenue target, and this revenue target then is divided amongst fee payers to set an annual fee applicable to an individual manufacturer.

In the case of fee collection for PFAS manufacturers, the Legislature could set a total revenue fee target as either a dollar amount or as a list of recommended strategies that would need to be covered by the fee revenue. Further, the Legislature could determine, in statute, what universe of potential PFAS manufacturers, users, and/or releasers would be required to remit payment. Whatever fee target and universe of potential PFAS manufacturers are chosen would then be used to determine how much individual PFAS manufacturers, users, and/or releasers (between 1 and 20,000) are to remit each year.

Setting a fee revenue target for PFAS manufacturers, users, and/or releasers would ensure stability in the amount of revenue available for drinking water or wastewater-related projects and could create some level of certainty for affected entities, especially if they are identified specifically in statute. Assessing fees on a per-manufacturer basis, or on a per-pound of PFAS released basis, would create an unviable and insufficient revenue stream. Further, the cost of PFAS treatment and/or destruction will fluctuate; inflation or other market forces may drive the costs of treatment infrastructure higher (or lower), while the costs of current and possibly future available technologies decrease as they become more widely adopted. Fee targets could be adjusted annually or biennially, as needed, to account for these and other changes.

[3] Air Emission Permit Fees are included in Minn. R. Ch. 7002.0005 through 7002.0110.
[4] Dry Cleaner Environmental Response and Reimbursement Law is part of MERLA, Minn. Stat. 115B.47 through 115B.53.

Determining fee targets

It is unlikely that any fees collected will be sufficient to address both drinking water and wastewater treatment needs. We therefore recommend that the actions/strategies outlined for addressing PFAS contamination in drinking water should take priority, with a minimal goal of at least covering the costs of infrastructure at the CWS with known PFAS contamination ($163.3 million), plus additional PFAS sampling and subsequent treatment at contaminated private wells. Any fee revenues collected beyond that needed to address drinking water would be best used for source identification and reduction in municipal WWTF collection systems.

Drinking water

Based on this report's recommended strategies to address PFAS contamination in drinking water, MDH and MPCA have identified the following potential actions and associated costs for the Legislature's consideration when determining an overall fee target:

- Cover the cost to install PFAS treatment at CWS currently known to have PFAS contamination greater than EPA's MCLs ($163.3 million – does not include operations or maintenance costs and does not include CWS receiving settlement money from 3M).
- Cover the costs of testing 10% of the total estimated number of private wells in Minnesota for PFAS contamination ($583.1 million – includes the costs of sample analysis and sample collection for 98,000 private wells; does not include expanded lab or other resource capacity to process samples).
- Cover the cost to install POETS for homes/structures dependent on drinking water from PFAS-contaminated private wells ($7.3 million, assuming high-end cost of furnishing and installing GAC systems for 1,960 homes/structures – equivalent to an estimated statewide 2% PFAS contamination rate of 98,000 sampled wells).[5]
- Offer grants, no or low interest loans, or other funding to support other drinking water delivery or treatment strategies ($250 million – could be used to deliver bottled water and/or expand municipal drinking water delivery areas, for example).

The Legislature could of course choose to decrease or increase a final fee revenue target based on the recommended strategies provided in this report. Cost estimates listed above could be assessed as one-time fees or divided and assessed over the course of several years.

Municipal wastewater

Any additional fee revenue collected would be best spent on PFAS source identification and load reduction in municipal wastewater influent. Load reduction is best achieved through pollution prevention and/or the installation of pretreatment technology, including for solid waste leachate and other municipal, commercial, and/or industrial sources. Removing PFAS from wastewater effluent is, in most cases, the least economically feasible option. Based on this report's recommended strategies to address PFAS contamination in municipal wastewater, MDH and MPCA have identified the following

[5] Based on well sampling conducted by the MPCA at 50 wells across Minnesota, which found approximately 2% of wells had detectable concentrations of PFOA, PFOS, and/or PFBS. These wells were chosen because they were located on "undeveloped" land, so this may be a low contamination rate estimate for urban/developed areas. *See* PFAS ambient background concentrations (tdr-g1-25). March 2024.

potential actions and associated costs for the Legislature's consideration when determining an overall fee target:

- Cover the costs, in whole or in part, for source investigation and reduction activities at approximately 700 permitted municipal WWTFs ($7 million to $87.5 million, assuming an estimated allotment of $10,000 to $125,000 per facility; actual costs would depend on the size of the facility and types of users in/complexity of their collection systems).
- Provide grants and/or low or no interest loans for the planning and designing of regional PFAS treatment and/or destruction facilities ($6 million, renewed annually for up to 20 years).
- Provide grants and/or low or no interest loans for the construction of pretreatment systems at certain facilities ($10 million, renewed annually for up to 20 years).
- Cover the costs, in whole or in part, of end-of-pipe PFAS treatment at approximately 700 permitted municipal WWTFs (up to $23.3 billion over 20 years, based on the number of WWTFs in Minnesota belonging to each size category identified in Table 3, above).

Fee collection mechanisms

The 2024 report, as summarized in Table 1 (below), provides the Legislature with several options to utilize to determine the universe the fee will be assessed on. The number of PFAS manufacturers, users, and releasers in Minnesota in any of these categories are likely to fluctuate year to year, and in theory will continue to decrease as PFAS prohibitions take effect through 2032 and beyond.

Many of the recommended strategies involve costs that are bondable – for example, drinking water treatment costs at CWS. Bonding would allow the total cost of these strategies to be spread over time, in some cases 20 to 30 years, and would lessen the impacts on individual PFAS manufacturers, users, and/or releasers required to remit payment. Several types of bond options are available for the Legislature's consideration, including revenue bonds, appropriation bonds, and/or general obligation bonds. Each of these types of bonds has different eligibility requirements, maturity timelines, and Legislative support. Minnesota Management and Budget provides information about these bonds in Minnesota on their website.[6]

Universe of affected PFAS manufacturers, users, and/or releasers

In addition to determining fee revenue targets, we would recommend that the Legislature identify, in statute, who would be subject to fee collection relating to the manufacture, use, and/or release of PFAS in Minnesota. For example, fees could be assessed on facilities reporting under TSCA 8(a)(7) and/or Amara's Law, in addition to those reporting under the TRI, or some other combination of facilities required to report as listed in Table 1.

The Legislature could then assess the chosen fee mechanism in one of two ways.

1. *All identified PFAS manufacturers, users, and or/releasers pay equally.* This would mean that any identified entity would be responsible for remitting equal annual payments, regardless of how much PFAS is manufactured, used, or released.
2. *Some entities pay more based on the way they manufacture, use, and/or release PFAS.* Fee revenue would still need to be sufficient to meet the identified fee revenue target but could be prorated so

[6] Minnesota Management and Budget. State of Minnesota Bond Fact Sheet (August 2013). PDF accessed 12/24/2024.

that facilities manufacturing PFAS chemicals or intentionally adding it to their products pay more than retailers importing and selling articles containing PFAS, for example.

Additional considerations

This report focuses on the removal of PFAS from drinking water and the effluent from the municipal WWTFs, but there are other routes of environmental contamination (and subsequent human exposure) that are not insignificant in terms of both PFAS loads and mitigation and remediation costs. Examples of other contamination sources include land-applied wastes, like landfill leachate and biosolids from municipal WWTFs; aqueous film-forming foams (AFFF) used for structural and wildland fire suppression; and historical contamination from unlined landfills, among others. Treating drinking water and the effluent from municipal WWTFs, though crucial, are parts of a much larger puzzle.

PFAS manufacture, use, and release in Minnesota

The 2024 report outlined ways in which to identify facilities that manufacture, use, or otherwise release PFAS in Minnesota through existing or planned reporting (Table 1). The known number of PFAS manufacturers in Minnesota remains uncertain but expected future reporting will clarify how many facilities exist. Further, the definitions of “manufacture”, “manufacturer”, and “manufactured” vary across state and federal laws; the inclusion of “use” and “release” in this report are intended to capture the greatest number of facilities that may be subject to PFAS manufacturing-related fees.

A reporting mechanism not discussed in detail in the 2024 report is the MPCA’s existing air emissions inventory (EI) program. The EI program collects estimated air emission data from facilities with certain types of air permits in Minnesota. Emissions of criteria air pollutants are reported through the EI program every year, while air toxic pollutant emissions are reported, on a voluntary basis, every three years. Under the three-year cycle, 2024 was an air toxics emissions reporting year (wherein facilities reported emissions from calendar year 2023). The EI program asked facilities to report specifically on their PFAS air emissions for the first time in 2024, in addition to other air toxic pollutants. Through this effort, 10 of 157 identified facilities reported estimated actual emissions of at least one of 435 reportable PFAS compounds.

Table 1. Reporting mechanisms that may be used to identify PFAS manufacturers in Minnesota. Table based on the 2024 report (lrc-pfc-3sy24), with updated information on which facilities may be required to report under each rule and when those data may become publicly available.

Reporting mechanism (rule)	Facilities required to report (who is a "manufacturer"?)	Estimated # of PFAS-reporting facilities in MN	Reporting frequency	Data availability
Chemical Data Reporting rule (CDR) (40 CFR Part 711)	Facilities belonging to certain industrial categories that manufacture, process, or use chemical substances in commerce exceeding 25,000 pounds per year.	1[A]	Approx. every four years	Data from reporting year (RY) 2020 are currently available. RY24 data were due to EPA November 22, 2024. Data from RY24 may not be publicly available until 2026 or beyond.
Toxic Substances Control Act (TSCA) Section 8(a)(7) (40 CFR Part 705)	Facilities belonging to certain industrial categories that import PFAS chemicals, produce articles containing PFAS, or manufacture PFAS chemicals for commercial purposes, in any amount, including importers of articles containing PFAS.	Unknown (EPA estimates 253 manufacturers and 13,115 article importers will be affected by this reporting requirement)[B]	One-time, retroactive to 2011 through 2022	Data reporting begins July 11, 2025; most data due by January 11, 2026, all data due July 11, 2026.It is unclear when these data will be publicly available.
Toxics Release Inventory (TRI) (40 CFR Part 372)	Facilities in certain economic sectors that have manufactured, processed, or used more than 100 pounds per year of a PFAS chemical or chemical mixture including PFAS.	Unknown (1 incidental release reported in 2022)	Ongoing annual reporting	Data are made publicly available the year in which they are reported. Data for RY24, due July 1, 2025, will be available for review late 2025.
Amara's Law (Minn. Stat. § 116.943)	Manufacturers responsible for the creation, production, branding, importation, or distribution of a product, under certain conditions, must report on the final amount of intentionally added PFAS in products and product components not prohibited beginning January 1, 2025.	Unknown (estimated 15,000 to 20,000 reporters total)[C]	Ongoing annual reporting	Reporting on PFAS intentionally added to products and product components is due January 1, 2026. Ongoing reporting will only be required annually until no PFAS remains in the product.
2023 Air Toxics Emission Inventory Reporting	Certain air permitted facilities (157 total) asked by the MPCA to submit PFAS emissions data for CY2023.	10	One-time, PFAS Monitoring Plan	Data were provided to MPCA in April 2024; data will be publicly available early 2025.

[A] This facility plans to cease the manufacture of PFAS in 2025.

[B] U.S. EPA. Economic Analysis for the Final Rule entitled: "TSCA Section 8(a)(7) Reporting and Recordkeeping Requirements for Perfluoroalkyl and Polyfluoroalkyl Substances" (RIN 2070-AK67), Docket ID No. EPA-HQ-OPPT-2020-0549-0271. Accessed 10/24/2024.

[C] MPCA staff estimate based on TSCA Section 8(a)(7) economic analysis and conversations with other states.

PFAS pollution prevention and reduction in Minnesota

While ensuring safe drinking water for all Minnesotans is essential, drinking water is not the only significant human exposure pathway for PFAS. People can be exposed to PFAS from eating contaminated food, swallowing or inhaling contaminated soil, dust, or air, being exposed at their workplace, and/or from using household and other products either made with or packaged in materials containing PFAS.[7] These myriad exposure pathways only compound the complexity of addressing PFAS from a public health standpoint, and emphasize that a sound approach to protecting human health and the environment means addressing PFAS exposure and contamination from all sources.

This report focuses on PFAS contamination in drinking water and municipal wastewater, but the successfulness of MDH's and MPCA's efforts to address that contamination will depend heavily on preventing PFAS pollution in the first place. Lawmakers in Minnesota have been among the first in the nation to pass laws prohibiting intentionally added PFAS in firefighting foams, food packaging, pesticides, and consumer products (Amara's Law). These groundbreaking prohibitions will lead to lessening use of PFAS in our everyday lives and, in the long term, less PFAS-contaminated waste.

Addressing PFAS contamination after it has been released into the environment is more expensive and more difficult than preventing release in the first place. Championing PFAS pollution prevention efforts is critical to protecting human health and eventually reducing environmental contamination, including the protection of drinking water and surface water.

More information on PFAS use prohibitions is available on the MPCA's website on PFAS use prohibitions.

Firefighting foams

The manufacture and use of PFAS-laden aqueous film-forming foams (AFFF) has been increasingly associated with soil and groundwater contamination across the United States. Minnesota is no exception to this trend. Military installations like Camp Ripley and the Duluth Air National Guard Base, as well as a variety of regional airports, municipal firefighting training sites, and other locations are associated with AFFF-related PFAS contamination in groundwater.[8] In addition to environmental contamination, firefighter exposure to AFFF and other PFAS-contaminated personal protective equipment (PPE) continue to be linked to adverse health outcomes in firefighters and other first responders.[9]

Prohibitions on intentionally added PFAS in Class B firefighting foams first went into effect in Minnesota on July 1, 2020.[10] At that time, the prohibition applied to Class B firefighting foams used for testing or training purposes, except where mandated by federal law. Additional prohibitions on the use of Class B

[7] U.S. EPA. Our Current Understanding of the Human Health and Environmental Risks of PFAS. Accessed 12/24/2024.
[8] MPCA. Minnesota Groundwater Contamination Atlas. https://www.pca.state.mn.us/about-mpca/minnesota-groundwater-contamination-atlas. Accessed 11/13/2024.
[9] CITATION. PFAS in turnout gear report?
[10] Minnesota Statute 325F.072, which regulates Class B firefighting foam, was created by Minnesota Session Law 2019.

firefighting foams went into effect on January 1, 2024 – effectively banning the use of PFAS-containing AFFF in most cases. The 2024 prohibitions expand on the 2020 law and address other specific uses of Class B firefighting foams containing PFAS, providing a temporary extension beyond 2024 for use at airports and petroleum refineries and terminals.[11] The MPCA has been working with the State Fire Marshal, Minnesota Department of Transportation, airports, and other stakeholders to develop guidance for the transition away from PFAS-containing AFFF use.[12]

Phasing out the use of AFFF will remove a significant source of surface water, soil, and groundwater contamination resulting from PFAS in Minnesota, and will reduce occupational exposure to PFAS for firefighters and others. Further, the phase out of PFAS-containing AFFF Class B foams will result in decreased expenses associated with remediating AFFF contaminated sites.

Food packaging

PFAS in food packaging exposes humans to PFAS through the ingestion of contaminated food and can contribute to environmental contamination when PFAS-containing food and/or packaging is composted or sent to municipal landfills. PFAS monitoring efforts in Minnesota have shown that there is PFAS contamination in compost contact water at source-separated organics facilities.[13] There is also evidence that PFAS enters groundwater through unlined landfills and municipal solid waste facilities that receive non-composted household food and food packaging wastes.[14] Landfills are also responsible for managing leachate, which is also known to contain PFAS; leachate is typically sent to municipal wastewater treatment facilities. Historically, leachate has not been treated for PFAS at landfills or at wastewater treatment facilities, resulting in the eventual release of those PFAS into the environment.

The intentional addition of PFAS to food packaging has been prohibited in Minnesota as of January 1, 2024.[15] The statute prohibiting PFAS in food packaging is broad and includes packaging and food containers used to serve food to the tape and shrink wrap used to protect food during shipping.

Prohibiting the use of food packaging with intentionally added PFAS will reduce human exposure from food and environmental releases associated with composting and could lessen the impact to municipal landfills or municipal wastewater treatment facilities. Reducing or eliminating PFAS from food packaging may subsequently help lessen the cost burden of PFAS treatment.

The MPCA is actively purchasing and testing food packaging to evaluate compliance with the law.

Pesticides

The potential environmental impacts of pesticide active ingredients are relatively well-studied, as the federal approval process for pesticide registration and use (under the Federal Insecticide Fungicide, and

[11] Minn. Stat. 325F.072 was amended by Minnesota Session Law 2023. The amendments included a prohibition on the sale, manufacturing, or offer for sale of Class B firefighting foam known to contain PFAS, except as required under federal law. Minn. Session Law 23, Sec. 31 temporarily exempts oil refineries and terminals from the requirements in Minn. Stat. 325F.072. The exemption expires January 1, 2026, unless operators apply for and are granted a waiver.
[12] MPCA guidance, Firefighting foam use, replacement and disposal (w-hw4-17). June 2024.
[13] MPCA. PFAS at Minnesota compost sites (w-sw4-37a). March 2021.
[14] MPCA. PFAS Monitoring Plan: Initial findings and next steps (p-gen1-22h). May 2024.
[15] Minn. Stat. 325F.075.

Rodenticide Act, or FIFRA) requires that pesticides "will not generally cause unreasonable adverse effects on the environment."[16] In addition to federal reviews, the Minnesota Department of Agriculture (MDA) conducts state-level reviews of pesticide active ingredients, in certain scenarios, to better understand the potential impacts of registering a given pesticide in Minnesota.[17]

As required by Minnesota Session Law 2023, MDA has been investigating the occurrence of intentionally added PFAS in pesticide products in Minnesota.[18] To date, the MDA has identified 98 active ingredients and 12 inert ingredients that may be found in pesticide products registered in Minnesota and that meet Minnesota's definition of a PFAS.[19] The MDA is also in the process of implementing new statutory prohibitions on the registration of pesticide products containing intentionally-added PFAS. Starting January 1, 2026, the MDA may not register or renew registration of any cleaning products including intentionally added PFAS. The sale and distribution of all products (pesticides, fertilizers, soil and plant amendments, and agricultural liming products) containing intentionally added PFAS will be prohibited starting January 1, 2032.[20]There may be some exceptions made for products that are determined to have a "currently unavoidable use". The MDA is still determining the process for which pesticide registrants may apply for or be considered to have a "currently unavoidable use".

Reducing the number of approved pesticide products with intentionally added PFAS has the potential to reduce surface water, soil, and groundwater contamination in Minnesota. Though PFAS treatment efforts in Minnesota have historically prioritized PFAS that are not approved for use in pesticide products, such as the PFAS on the analyte list for EPA method 1633A), reducing the number of pesticide products containing intentionally added PFAS in Minnesota may help lessen the cost burden associated with PFAS treatment.[21]

Consumer products (Amara's Law)

PFAS compounds have been used in a variety of commonplace consumer products for decades. As a result, humans have been exposed to those compounds directly from interacting with those products, or from environmental contamination caused by product manufacture and/or disposal. The passing of Amara's Law in 2023 marked recognition of the potential health risks associated both with the use of PFAS-laden products and with risks caused by widespread environmental contamination.[22]

As of January 1, 2025, products with intentionally added PFAS belonging to eleven categories are prohibited from being sold in Minnesota. These product categories are carpets or rugs; cleaning

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[16] U.S. EPA website. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Federal Facilities. Accessed 11/06/2024.
[17] MDA website. Pesticide product registration. Accessed 11/06/2024.
[18] Minnesota Session Law 2023. Chapter 43, Article 2, Sec. 138. Reports required; PFAS in pesticides.
[19] MDA. PFAS in Pesticides: Interim Report to the Legislature. February 1, 2024.
[20] Minnesota Session Law 2023, Chapter 43, Article 2, Sec. 29; Minn. Stat. 18B.26, Subd. 8.
[21] U.S. EPA. Method 1633, Revision A. Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS (December 2024). Accessed 12/23/2024.
Note that prior versions of Method 1633 include the same PFAS target analytes (40), though there are some differences in the analytical methods between Draft Method 1633, Method 1633 (January 2024), and Method 1633A (December 2024). Method 1633A is in the process of being promulgated into EPA rules as a Clean Water Act-compliant method (see Docket ID No. EPA-HQ-OW-2024-0328 for more information).
[22] Amara's Law was first passed in Minnesota Session Law 2023, Chapter 60, Article 3, Sec. 21; Session Law is now reflected in Minn. Stat. 116.943, Products Containing PFAS.

products; cookware; cosmetics; dental floss; fabric treatments; juvenile products; menstruation products; textile furnishings; ski wax; and upholstered furniture. For products not affected by the January 1, 2025, prohibition, the MPCA will require reporting from manufacturers about which of their products contain PFAS, and how much. Reporting requirements go into effect January 1, 2026.

Starting on January 1, 2032, all other products containing intentionally added PFAS will be prohibited, except those with exemptions or that otherwise receive a "currently unavoidable use" designation. The MPCA is in the process of a rulemaking to determine what constitutes a "currently unavoidable use" and how those designations are made.

Amara's Law is the cornerstone of Minnesota's efforts to prevent PFAS pollution and its health and environmental impacts. Work to prevent future drinking water contamination from PFAS and to address PFAS entering our environment through wastewater will rely heavily on source reduction and pollution prevention efforts, including the product prohibitions of Amara's Law.

The MPCA is in the process of developing the reporting and fees rule for implementing Amara's Law. It is expected that the rule will be available for public comment in the first quarter of 2025. Reporting is expected to start in 2026.

PFAS contamination in drinking water

Current efforts to understand PFAS contamination in drinking water

The MDH has been leading efforts to understand PFAS contamination in public water supplies across the state. The MPCA has partnered with MDH to address contamination in certain circumstances, like in the East Metro and other locations with large numbers of contaminated private wells with identified sources of contamination.

Community water systems

Community water systems (CWS) are public systems that provide water to residents in their primary living spaces. The MDH has been sampling CWS for PFAS since 2006, starting with those in the East Metro and in other areas with suspected contamination from AFFF. In 2021, under the Statewide PFAS Monitoring Project, MDH began efforts to more broadly sample CWS for PFAS. During this time, MDH published a series of health-based values (HBVs) for PFAS in drinking water; many of those HBVs have been promulgated into state rule as health-risk limits (HRLs) and have been used as guidance values against which to assess PFAS contamination in drinking water in Minnesota.[23]

The MDH's efforts to understand PFAS in Minnesota's CWS therefore began many years prior to EPA's final rulemaking identifying maximum contaminant levels (MCLs) for five PFAS and one PFAS mixture through the National Primary Drinking Water Regulation (NPDWR), a component of the Safe Drinking Water Act (SDWA). Since the finalization of the MCLs, MDH has continued sampling, and is working to implement the monitoring and treatment requirements required under the NPDWR.

To date, MDH has sampled for PFAS at 98% CWS in Minnesota (916 systems). PFAS were detected at concentrations greater than at least one MCL (or a Hazard Index greater than 1) at 21 CWS, though this number may change as monitoring continues.[24,25] Compliance with the NPDWR will be assessed using samples collected according to the rule monitoring framework established by EPA. A CWS is determined to be out of compliance when the annual running average exceeds the MCL. Each of the CWS with PFAS detections currently exceeding EPA's MCLs use groundwater as their drinking water source.

For CWS affected by known sources of contamination, recuperating the costs of providing safe drinking water to residents may be the responsibility of sources known to contribute PFAS to the water source, such as the groundwater supply. This could be an important source of funds to supplement other federal and state funds.

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[23] MDH. PFAS and Health. Accessed 12/24/2024.

[24] A Hazard Index is a unitless value used to assess health concerns associated with exposure to chemical mixtures. In the case of the PFAS Hazard Index MCL, the value is calculated by dividing measured concentrations of individual PFAS (HFPO-DA or GenX, PFBS, PFNA, and/or PFHxS) by each applicable MCL, then summing the results. Values greater than 1 are considered to be in exceedance of the Hazard Index MCL. More information on the Hazard Index is available from the U.S. EPA. *See* Fact Sheet: Understanding the Final PFAS National Primary Drinking Water Regulation Hazard Index Maximum Contaminant Level (April 2024). Accessed 12/24/2024.

[25] Findings from MDH's testing for PFAS at public water systems are updated periodically and published on their website, PFAS Testing of Public Water Systems. Accessed 1/8/2025.

Non-transient, non-community water systems

The MDH is in the process of establishing services under contract for PFAS sampling at all non-transient, non-community (NTNC) water supply systems as required under the NPDWR. These types of systems include schools, offices, factories, and childcare facilities that serve at least 25 of the same people for more than six months each year.

There are just over 5,000 NTNC systems in Minnesota. At this time, it is unknown how many of them may have PFAS contamination.

Transient, non-community water systems

These types of systems include those at restaurants, resorts, and campgrounds that serve an average of 25 or more people every day for at least 60 days every year. These systems currently are not required to comply with the PFAS regulation under the NPDWR, but on occasion are tested for PFAS contamination as part of an MPCA contaminated site investigation.

There are just under 500 transient, non-community systems in Minnesota. At this time, it is unknown how many of them may have PFAS contamination.

Private wells

Although the exact number is unknown it is estimated that there are over 980,000 private wells across Minnesota.[26] The MDH does not have the authority to require private well owners to test their wells, or to impose other water quality regulations on private well owners. Further, the NPDWR applies only to public water systems. As such, MDH relies on state Health Risk Levels (HRLs) for PFAS when addressing private well contamination, and statewide private well testing is not feasible nor recommended by MDH at this time.

Private well owners are encouraged to test their water sources for certain pollutants at least once, more regularly for others; testing for PFAS, however, is not commonplace. Community members living in areas with known PFAS contamination may be able to receive financial or other assistance to test and/or treat their drinking water through the MPCA, MDH, or Responsible Parties identified under the Superfund program, if applicable. In said cases with known contamination, testing and treatment costs are paid for through legal settlements and/or Superfund programs. Broadly speaking, neither MDH nor MPCA pay for the costs of testing or treatment outside of these programs (for PFAS or any other contaminants).

There are over 3,500 private wells with known PFAS contamination in Minnesota. Given limitations on private well testing, and the uncertainty around the number and condition of private wells across Minnesota, there is no way to know how many more have PFAS contamination at this time.

Alternatives for providing safe drinking water

Addressing PFAS contamination in drinking water requires both immediate actions to reduce or eliminate exposure via drinking water and long-term solutions that are protective of human health and the environment across many varied exposure pathways. Cost estimates in this section are based on

[26] University of Minnesota Extension. Pure and simple: first of its kind support for MN private well owners. Emily Haeg Nguyen, September 25, 2023. Accessed 12/23/2024.

current billing amounts from contractual and other work overseen by MPCA and/or MDH.[27] These dollar amounts are intended to serve only as an approximation of what costs may be. Actual costs vary based on contractual rates for different contractors handling sampling, labs contracted to analyze PFAS samples, and water providers serving various communities.

A key aspect of providing recommendations for creating strategies or fee mechanisms for providing safe drinking water in Minnesota is characterizing the costs for the various existing methods. This section will address both immediate and long-term actions to meet that goal.

Immediate actions

Private well sampling

For Minnesotans that obtain their drinking water from private wells, sampling and testing well water for PFAS is the first step to understand if there is contamination and a need for an alternative source of drinking water.

Cost estimates

- Laboratory analysis costs: $400 to $450 per sample
- Contractor costs (including travel to and from sampling site, field prep, sample collection and delivery to lab, documentation): $1,700 to $5,500

Who pays?

Currently, private well testing by MPCA and/or MDH and their contractors is only conducted in association with the investigation of known or suspected sources of contamination. In these instances, the source of the contamination (Responsible Parties under Superfund laws, for example) pays the costs of private well testing.

The MPCA, MDH, and other state agencies do not have the authority, funds, or capacity to sample all private wells in Minnesota. Further, MDH does not recommend testing every private well for PFAS, as not all private wells are at risk of PFAS contamination, and the laboratory capacity that would be needed to analyze samples from all private wells in the state does not currently exist.

Private well owners that are interested in PFAS testing of their wells outside of regulatory actions and programs are responsible for the costs and effort associated with the testing process.

Some Minnesota counties provide private well testing to residents, either free or at reduced cost. In Dakota County, for example, different communities (on a rotating basis) are eligible for one free water test if they meet the Community-Focused Sampling Program criteria.[28] All Dakota County residents can purchase pre-paid sampling kits to test common pollutants like Coliform bacteria, arsenic, lead, and nitrate.[29] Funding for Dakota County's Community-Focused Sampling program comes from landfill fees assessed through the County's Environmental Legacy Funding (ELF) program. Testing private wells for pollutants beyond the Community-Focused Sampling Program, including PFAS testing in areas with no known contamination sources, is the responsibility of the well owner.[30]

[27] Contractual rates are current as of December 2024. New contractual rates may apply after January 1, 2025.
[28] Dakota County. Community Sampling Results. Accessed 11/13/2024.
[29] Dakota County. Testing well water. Accessed 11/07/2024.
[30] Dakota County. Per- or Polyfluoroalkyl (PFAS) Substances. Accessed 11/07/2024.

Delivering bottled water

The MDH and MPCA provide bottled water in cases where drinking water has been contaminated and treatment either is not an option or is delayed. Although useful in emergency or rapid response situations, this strategy may become complicated for individuals living in rural areas that are hard to reach and is not an ideal long-term strategy.

Cost estimates (based on 2024 state contractual rates)

The cost of bottled water (five-gallon jugs delivered, plus cooler rental) for family of two for 30 days is $53 to $100.

Costs for individual private well owners to purchase their own water will, of course, vary.

Who pays?

Currently, water delivery by MPCA and/or MDH contractors is only available in areas associated with known or suspected sources of contamination. The source of contamination (Responsible Parties under Superfund laws, for example) pays the costs of the delivery. Otherwise, the costs of water delivery are the responsibility of the state.

Outside of the Superfund program, with no identified Responsible Parties, costs would fall to the homeowner.

Long-term solutions

Private well monitoring

Monitoring for PFAS in private wells is one component of a long-term solution. Costs for continued monitoring would be consistent with initial sampling as described above.

One option is to establish a fee on manufacturers, users, and/or releasers of PFAS. Funds collected from fees could go towards the costs of private well monitoring. Fees collected could also go towards an expansion of MDH's Public Health Lab and/or the creation of new labs in Minnesota that are capable of analyzing samples for PFAS (and other contaminants).

Installing in-home treatment: point-of-entry treatment systems (POETS)

Point-of-entry water filtration systems (often referred to as POETS) are commonplace; reverse osmosis (RO) systems, for example, are often used to soften water in homes with hard drinking water. Reverse osmosis systems are capable of PFAS removal but are rarely installed by MPCA and MDH contractors. Systems using granular activated carbon (GAC) are more popular and are also capable of PFAS removal. Both RO and GAC systems produce waste that needs to be carefully disposed of or recharged (in the case of GAC). Disposal and/or regeneration costs may or may not be included in product or service estimates. In many cases, RO waste concentrate (reject) ends up in septic systems because there is no other disposal pathway for homeowners. Spent GAC resins, on the other hand, must be managed by contractors.

Note that PFAS are not destroyed using RO or GAC technologies, only removed from treated water and transferred to waste concentrate or resin.

Cost estimates (based on 2024 state contractual rates)

System costs are size dependent. Prior to installation, homeowners and contractors consider the space available for installation of tanks and household water use.

- RO systems:

    - Furnish and install 35 GPD RO module, 2-gallon storage tank: $1,075 to $1,550
        - 3-gallon storage tank: add $25-$50 each
        - 9-gallon tank: add $100-$150 each
    - Annual maintenance with filter change: $200 to $750
        - Filter change plus RO module changeout: $275 to $990
- GAC systems
    - Furnish and install two new 90lb GAC vessels: $2,600 to $3,757
- Single vessel exchange plus spent GAC destruction: $959 to $2,200
    - GAC system removal: $536 to $750

Costs to independently install and maintain these types of systems may be higher than prices contracted by state agencies and their contractors.

Who pays?

Currently, point-of-entry system replacement by MPCA and/or MDH contractors is conducted only in association with known or suspected sources of contamination. The source of the contamination (Responsible Parties under Superfund laws, for example) pays the costs of installation and maintenance. Otherwise, under Superfund law, the costs of water delivery would fall to the MPCA. Outside of the Superfund program, with no identified Responsible Parties, costs would fall to the homeowner.

Private well owners with PFAS contamination not associated with any sources are responsible for paying any installation and maintenance costs for these systems.

Installing in-home treatment: point-of-use systems

Point-of-use systems are an option for private well owners who only want to treat contamination at specific fixtures/faucets in their homes or properties. Point-of-use systems are commonplace and include low-tech options like water pitcher filters and faucet-mounted filters. Though readily available to consumers from many retailers, these products do not necessarily treat water for PFAS contamination.[31]

More technology-intensive point-of-use options, like RO under-sink systems, are also commonly installed where water is used consistently for drinking and cooking. Although useful in limited contexts, RO point-of-use systems are largely inefficient, typically requiring 5 to 10 gallons of water to produce one gallon of treated water for drinking or cooking. More efficient systems may use as little as 2 gallons to produce on gallon of treated water.[32] GAC under-sink systems are also available.

It should be noted that in places where PFAS contamination is significant and human exposure via private well water is high, point-of-entry systems are better at reducing overall exposure.

Cost estimates (based on current retail pricing; not all systems will remove PFAS)

- Water pitcher with filters (costs depend on pitcher size): $30 to $50+
    - CycloPure Purefast® countertop filters[33]: $40 to $45 each

[31] U.S. EPA. WaterSense® Guide to Selecting Water Treatment Systems. November 2024.
[32] U.S. EPA. Point-of-Use Reverse Osmosis Systems. Accessed 11/14/2024.
[33] These filters were developed using a small business innovation grant from the National Institute of Environmental Health Sciences (Environmental Factor, April 2022) and are advertised to be used specifically with Brita-brand filters (see CycloPure product website). There may be filters from other brands that are also capable of PFAS removal; these are included as an example.

- Under-sink treatment
    - RO systems: $170 to $700+
    - GAC systems: $130 to $225+

Who pays?

The MPCA and MDH contractors do not currently provide any point-of-use systems. The systems are relatively inexpensive and commercially available to private well owners from many retailers.

Treating PFAS at water treatment systems with PFAS contamination

Providing infrastructure and technology upgrades to CWS to treat for PFAS is often the focus of efforts to address PFAS contamination in drinking water sources.

At the time of report publication, there are 21 CWS exceeding EPA's MCLs for PFAS. Six of the 21 CWS are party to the 3M Settlement in the East Metro; seven are on the Minnesota Project Priority List (PPL) to secure funding for PFAS treatment.

Cost estimates

The estimated cost to construct PFAS treatment infrastructure at the 15 CWS not party to the 3M Settlement is over $163.3 million. This number does not include any operations or maintenance costs.

Estimating costs for individual CWS depends on several factors, including the water treatment system design and population served and plans for residuals management. The EPA has developed a work breakdown structure model for more precisely estimating the potential costs of either RO or GAC water treatment facilities.[34] These or similar models should be used on a by-facility basis when exploring potential costs.

Who pays?

As noted previously, six of the communities that have PFAS concentrations exceeding EPA's MCLs are in areas with contamination attributed to 3M and, as such, are receiving the funding for their infrastructure upgrades to treat PFAS through the 3M Settlement. Funding for other communities with PFAS contamination in their CWS may come from appropriations through the Minnesota Legislature, grants, local utility fees and/or tax levies, and/or other sources.

For communities outside of the East Metro that are not associated with specific, known sources of contamination, the local government are responsible for securing funding for infrastructure upgrades at CWS. Currently, the MPCA has a grant opportunity for drinking water planning and design for PFAS treatment; this grant is only available to communities identified by MDH has having one more exceedances of EPA's MCLs for PFAS. A total of $22 million has been made available through this grant program, which is accepting requests for proposal through June 30, 2025, or until all funds have been dispersed. Planning and design projects awarded funding through this RFP must be completed by June 30, 2027. This grant does not cover construction costs.[35]

Hooking private well users into CWS where possible/appropriate.

In a limited number of cases, it may be possible to connect individual residences or businesses with contaminated private wells to a local CWS that does not have PFAS contamination. This option is applicable only in areas where individual structures are still using private wells but are within the

[34] U.S. EPA. Drinking Water Treatment Technology Unit Cost Models. Accessed 12/3/2024.
[35] MPCA. Drinking water planning and design funds for PFAS treatment. Accessed 11/25/2024.

existing service area for a community or regional CWS. The expectation would be that contaminated wells would be sealed once a structure is connected to CWS service.

There are a limited number of households across Minnesota that are geographically located within communities served by CWS but are not existing customers of those systems.

Cost estimates

Costs to hook up a structure to a CWS distribution system varies based on several factors, including distance of pipe needed, structure setbacks, and soil/substrate characteristics. The MPCA estimates $15,000 per connection if the structure is in close proximity to other structures already connected to a CWS line. In cases where new water delivery lines are needed to reach a structure, costs would increase significantly (depending on how much pipe is needed).

Costs of sealing a private well are around $2,000 to $5,000 per wellhead, depending on site accessibility and other factors.

Who pays?

If assumed by local government, these costs would likely be reflected in local tax levies or bonding plans and would be spread across ratepayers. Otherwise, costs would fall to individual private well users unless a Responsible Party was identified under Superfund law, in which case the Responsible Party would cover costs.

Regionalization of drinking water treatment and/or delivery

For some communities with contaminated drinking water, regionalizing water treatment and/or delivery may be an option. The feasibility of regionalization depends on several factors, including the proximity of the communities and the ability of the proximate water distribution system to expand into new areas (costs are much higher if new treatment infrastructure is required in addition to laying new delivery pipe, for example). Regionalization may also mean pooling resources to both treat and deliver water at a new water treatment facility, while in some areas it may only mean expanding existing pipelines.

Existing regional water services in Minnesota include Lincoln-Pipestone Rural Water, Red Rock Rural Water System, and Marshall-Polk Rural Water System in northwestern Minnesota. These systems serve communities in southwestern, south central, and northwestern Minnesota, respectively. Logically, communities geographically within or near the service areas for these systems are more feasible candidates for receiving expanded service if/as needed. This type of regionalization comes with its own costs and challenges, but it is possible that dispersing costs across a greater service area/population may ease treatment costs.

Though not necessarily a regionalized system, several communities across the state purchase water from other nearby communities, including several communities around Duluth and communities in the Twin Cities metro area. In these cases, expansion may or may not be possible. Costs for water treatment upgrades may or may not be reduced by this type of expansion.

Cost estimates

- Per mile of new drinking water pipe: $2,000
- New WTP capable of treating for PFAS: $30 million to $330 million

Who pays?

If assumed by local government, these costs would likely need to be reflected in local tax levies or bonding plans and would be spread across ratepayers.

Recommended strategies

Addressing PFAS contamination in drinking water is context-specific and depends on the type of drinking water contaminated (private well vs. CWS, for example). In a few cases, contaminated drinking water is already associated with identified sources of PFAS, and those sources are already paying, in whole or in part, for safe drinking water to affected community members. That said, if a fee structure were to be developed to collect money from PFAS manufacturers, users, and/or releasers, fees collected via that structure (outside of legal settlements and/or the Superfund program) could be pooled and spread to communities or individuals in need of assistance that are outside of existing programs.

Collectively, MPCA and MDH recommend that any action taken by the Legislature to have PFAS manufacturers, users, or releasers pay for safe drinking water involve some combination of immediate and long-term actions as discussed in this report. Based on our best understanding of the economic and technical landscape that exists today, MPCA's and MDH's recommended alternatives are, in order of strategic priority for addressing PFAS contamination in drinking water, as follows.

3. *Focus on providing safe drinking water in communities not party to legal settlements or with assigned Responsible Parties under the Superfund law.* Communities with PFAS-contaminated CWS that are not receiving any settlement funding and/or do not have costs covered by a Responsible Party under Superfund law should take priority for any fee revenue generated to cover the provision of safe drinking water.
4. *Expand access to private well testing for PFAS*. Efforts here could include free or subsidized sample collection and analysis for certain private well owners, modeled after Dakota County. Efforts could also include adding analytical lab capacity in Minnesota.
5. *Plan for drinking water treatment needs at contaminated non-community water systems.* MDH is already contracting work to test for PFAS in non-transient, non-community systems, but any non-community systems with PFAS exceedances beyond the MCLs will need treatment support.
6. *Subsidize or cover the costs of point-of-entry treatment at any residences with PFAS-contaminated wells.* Minnesotans with PFAS-contaminated wells should have access to funding to help cover the costs of installing point-of-entry treatment in their homes.

PFAS contamination in municipal wastewater

Current efforts to understand PFAS in municipal wastewater

Municipal wastewater treatment facilities (WWTFs) serve a critical role in the protection of both human health and the environment. Waste sent to municipal WWTFs is treated to remove a myriad of pollutants, both biological (like *E. coli* bacteria) and inorganic (like phosphorus). Once pollutants are removed, wastewater is discharged into Minnesota's surface waters. It is imperative that discharged wastewater is treated appropriately, according to the requirements in a given WWTF's National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) permit.

Unlike industrial WWTFs, which may use PFAS either in product production or in final products, municipal WWTFs act as conduits – there are no PFAS compounds used by these facilities or added to influent wastewater. The PFAS in municipal WWTF influent, as with other pollutants, comes from the sewer users in a community. WWTF influent may include wastewater from one or more commercial or industrial facilities in addition to homes and other structures where humans live, work, or otherwise spend a significant amount of time.

Historically, municipal WWTFs have not been designed to treat or remove PFAS compounds from the water entering their facility. As such, municipal wastewater facilities have been discharging any PFAS present in wastewater for as long as products have contained PFAS. Further, there are few technologies that have been shown to be effective at PFAS treatment, and those only in limited situations and at great expense to install and maintain.

Moving forward, the MPCA's municipal wastewater program is working to understand industrial and non-industrial sources in municipal WWTFs' collection systems, through both nonregulatory sampling efforts and via NPDES/SDS permit requirements in some cases. Preventing or removing PFAS pollution before it reaches a WWTF is going to be imperative – and is the most effective way to reduce discharges of PFAS into the environment and subsequent future contamination.

Nonregulatory sampling

Early efforts to categorize PFAS in municipal wastewater were undertaken in 2007 and 2008, when the MPCA conducted surveys of PFAS (then referred to as perfluorocarbons, or PFCs) in wastewater influent, effluent, and sludge. These early sampling efforts, which were not intended to be used for regulatory purposes, found PFAS to be ubiquitous across facilities which data were collected.[36] These data are no longer representative of the community sewer use, facility operations, or other aspects of wastewater treatment at those locations, but nonetheless demonstrate that PFAS have likely been present in municipal wastewater effluent for decades.

Most recently, 83 municipal WWTFs participated in the MPCA's PFAS Monitoring Plan, first published in 2022.[37] Participating WWTFs agreed to create a PFAS sampling plan; collect, analyze, and share the results of four influent samples; create an inventory of industrial users that may be potential PFAS sources; and develop a PFAS pollutant management plan. To date, all four rounds of sampling have been

[36] MPCA. PFCs in Minnesota's Ambient Environment: 2008 Progress Report (c-pfc1-02).
[37] MPCA. PFAS Monitoring Plan (p-gen1-22b). March 2022.

completed, though third and fourth round sampling data are still undergoing review. As with the 2007-2008 sampling, PFAS have been found ubiquitously in the influent at all 83 WWTFs that participated.[38]

Permitted (regulatory) monitoring requirements

There are six municipal WWTFs that are currently required to monitor for PFAS through their NPDES/SDS permits, with the oldest monitoring requirements dating back to a permit reissuance in September 2009 (Table 2). One of these permits has effluent limits associated with PFAS; the remainder only require PFAS monitoring. Monitoring requirements vary slightly from permit to permit, including which PFAS are monitored and how associated data are reported to the MPCA. Discharge monitoring report (DMR) data for all six facilities show that at least some PFAS are present at quantifiable concentrations in facility effluent.[39]

Table 2. List of all municipal WWTFs with PFAS monitoring requirements at the time of report publication.

Facility	Effective date of first permit issued with PFAS monitoring	Monitoring frequency	Effluent limits for PFAS	Total number of PFAS monitored in current permit
Brainerd WWTP (MN0049328)	December 2010	Once per calendar quarter	PFOS only 287.0 ng/L quarterly average 497.0 ng/L daily max	1 (PFOS)
Met Council – Blue Lake WWTP (MN0029882)	March 2010		n/a	4 (PFHxS, PFOA, PFOS, PFBA)
Met Council – Eagles Point WWTP (MN0029904)	December 2018			13*
Met Council – Empire WWTP (MN0045845)	August 2020			13*
Met Council – Metro WWTP (MN0029815)	December 2015			4 (PFBS, PFHxS, PFOA, PFOS)
Met Council – Seneca WWTP (MN0030007)	September 2009			4 (PFHxS, PFOA, PFOS, PFBA)

*These facilities monitor for PFBS, PFHxS, PFOA, PFOS, PFNA, PFBA, PFHxA, PFDA, PFDoA, PFHpA, PFOSA, PFPeA, and PFUnA.

[38] MPCA published an update to the PFAS Monitoring Plan, PFAS Monitoring Plan: Initial findings and next steps (p-gen1-22h) in April/May 2024, along with influent data from the first two rounds of sampling at the 83 WWTFs, PFAS Monitoring Plan sampling data (p-gen1-22i). Third and fourth round sampling data have not been published but will be available by request once reviewed.

[39] Monitoring data reported from both municipal (domestic) and industrial wastewater treatment facilities are available on MPCA's Tableau Public server, "Wastewater facility and discharge monitoring report data".

The number of NPDES permits with PFAS monitoring requirements will increase, particularly as the MPCA develops a statewide implementation strategy to address PFAS in municipal wastewater effluent. Moving forward, facilities required to monitor for PFAS will monitor for the 40 PFAS target analytes quantifiable using EPA Method 1633A (December 2024), so the number of unique PFAS monitored will also increase as more NPDES permits are reissued.[40]

The MPCA is also developing a strategy to specifically implement Minnesota's Class 1 Water Quality Standards applicable to drinking water sources, for PFAS, through NPDES permits.[41] The MPCA expects to have a final policy and guidance available by early 2025.

Alternatives for addressing PFAS in municipal wastewater

In 2023, the MPCA published a report associated with a PFAS removal alternatives report summarizing work funded by the Legislative Commission on Minnesota Resource. [42] The PFAS removal alternatives report analyzed available technologies capable of treating and destroying PFAS from certain wastewater streams in Minnesota, and associated costs. Ultimately, the report found that the estimated cost of PFAS removal and destruction from municipal WWTFs ranges from $2.7 million to $18 million per pound, which amounts to an estimated cost of $14 billion to $28 billion over 20 years.

Given the astronomical costs associated with end-of-pipe PFAS treatment, source identification and pollution prevention/reduction actions are the best way to prevent wastewater discharges of PFAS into Minnesota's surface waters. The report notes that there are limited technologies available to treat and remove PFAS from industrial facilities (pretreatment) and at municipal WWTFs (end-of-pipe). This section addresses these considerations, in turn.

Pretreatment

Pretreatment includes the treatment of wastewater by industrial facilities and other non-domestic wastewater sources to remove pollutants of concern before the wastewater is discharged to a municipal sewer system. Many municipal WWTFs rely on pretreatment agreements or permits and source identification and reduction programs to reduce pollutants coming into the WWTF that may inhibit treatment and to avoid discharging pollutants that pass through their treatment system. Municipal WWTFs are required by their NPDES/SDS permits to control significant industrial users (SIUs) and other

[40] U.S. EPA. Method 1633, Revision A. Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS (December 2024). Accessed 12/23/2024.
Note that prior versions of Method 1633 include the same PFAS target analytes (40), though there are some differences in the analytical methods between Draft Method 1633, Method 1633 (January 2024), and Method 1633A (December 2024). Method 1633A is in the process of being promulgated into EPA rules as a Clean Water Act-compliant method (see Docket ID No. EPA-HQ-OW-2024-0328 for more information).
[41] Minn. R. Ch. 7050.0221 incorporates U.S. EPA Maximum Contaminant Levels (MCLs) by reference into water quality standards protecting surface water used for domestic consumption. When EPA's National Primary Drinking Water Regulation (NPDWR) for PFAS went into effect on June 25, 2024 (89 FR 32532, April 26, 2024), Minnesota automatically gained surface water quality standards for those PFAS at the levels finalized by EPA.
[42] Prepared by Barr Engineering Co. and Hazen and Sawyer, published by MPCA. Evaluation of Current Alternatives and Estimated Cost Curves for PFAS Removal and Destruction from Municipal Wastewater, Biosolids, Landfill Leachate, and Compost Contact Water (c-pfc1-26). May 2023.

sewer customers to prevent those users from causing a violation of their own WWTF permit requirements.[43]

Source identification and reduction

Consistent with the MPCA's PFAS Monitoring Plan, the 83 WWTFs that agreed to sample influent for PFAS were asked to submit pollutant management plans (PMPs). The MPCA expects to receive the PMPs from 78 of the 83 WWTFs; the remaining five facilities had very low influent PFAS concentrations and were given the chance to opt out of developing a formal PMP.

The overall goals of the PFAS PMPs are to:

- Develop continuing education with industries and communities;
- Identify sources of PFAS; and
- Implement activities that lead to a reduction of PFAS entering the wastewater treatment facility.

The findings from the efforts described in WWTFs' PMPs will help direct attention to entities contributing the greatest loads of PFAS coming into WWTFs. As stated, PFAS pollution prevention and reduction are the most effective ways to prevent PFAS from being discharged by municipal WWTFs into the environment.

In some cases, the MPCA offers support to municipal WWTF owners and operators to help address pretreatment needs for SIUs and other sewer users, particularly to help achieve source identification and reduction activities. In the case of PFAS, the MPCA has released two rounds of grant funding.

The first grant opportunity, released May 2024, is open to all communities and industries that want to apply, with extra funding available for facilities in environmental justice areas. The $2 million grant, which was funded through a legislative appropriation, supports community efforts to plan, develop, and implement source identification and reduction plans, product substitutions, and system improvements. The maximum award under this grant is $125,000 per applicant/organization, and requires a 10% match, which can include in-kind services. Requests for proposal (RFPs) are due by April 2, 2025, or until funds run out. Projects must be completed by December 18, 2026, to be eligible for reimbursement.[44]

Cost estimates

The scope of PFAS source identification and reduction work will vary for each community depending on the number and type of users of a given system (residential, commercial, industrial, and/or municipal).

Who pays?

Municipal WWTFs are responsible for covering costs associated with source investigation and reduction efforts. There may be limited public funding opportunities available for some facilities (grants, for example).

[43] Significant Industrial Users (SIUs) are defined as industrial sewer users that 1) discharge an average of 25,000 gallons per day or more of process wastewater to a given municipal WWTF; 2) have discharges that comprise >5% of the receiving WWTF's capacity; and/or 3) are designated by the MPCA or receiving WWTF as significant, based on the potential to affected WWTF operations or violate pretreatment standards.

[44] MPCA. PFAS source identification and reduction grant program. Accessed 12/03/2024.

Individual facilities/sewer users

There are a limited number of treatment options that could, in theory, be installed at individual facilities to treat process wastewater entering the municipal WWTF collection system (leaving the industrial facility). Many (but not all) industrial or commercial SIUs already use some form of pretreatment to meet the requirements set forth by the municipality to which they send their wastewater, but those systems may or may not remove PFAS. As very few municipal WWTFs have needed to meet effluent limits for PFAS (only the six identified previously), virtually no other municipalities have had to either introduce or enforce user agreements limiting PFAS discharges to their WWTFs.

The two technologies best suited for PFAS removal from wastewater are RO (particularly in combination with anion exchange) and GAC. There are small, off-the-shelf RO and GAC systems available to treat relatively small waste streams. Larger users may not be able to find off-the-shelf systems capable of treating greater amounts of contaminated wastewater and could be on the hook for individualized, more complex infrastructure. The more water treated by either RO or GAC systems, the greater the operational and maintenance costs of the system.

Cost estimates

Costs of PFAS treatment using RO or GAC depend on the treatment system design and how often spent media must be exchanged or replaced, among other things. RO and GAC can also be installed as point-of-entry treatment in industrial applications or could be installed at various points or end-of-pipe to help control releases of certain pollutants from process wastewater.

- Off-the-shelf RO systems are available from a variety of retailers. Costs for systems generally fall into the following categories, and do not include maintenance.
    - Low-flow (200 to 300 gallons per day): $1,500 to $2,500
    - Mid-flow (500 to 7,000 gallons per day): $4,500 to $9,000
    - High-flow (10,000 to 50,000 gallons per day): $15,000 to $58,000
- Off-the-shelf GAC systems are also available from a variety of retailers. Costs for systems generally fall into the following categories, and do not include maintenance.
    - Low-flow (15 to 35 gallons per minute): $,2000 to $3,500
    - Mid-flow (60 to 185 gallons per minute): $5,000 to $17,000
    - High-flow (200 to 310 gallons per minute): $16,000 to $25,000
- Custom systems
    - Most facilities will not be able to use off-the-shelf products to remove PFAS from their waste streams. Costs of unique systems capable of PFAS removal vary widely; at the high end, as an example, is 3M's new wastewater treatment facility at their Cottage Grove site. The new facility will use proprietary, cutting-edge technology to treat PFAS to levels below detection limits. The cost of developing and building that facility is estimated at $330 million.

Who pays?

SIUs and other individual sewer users are responsible for the costs of treating their process wastewater before it is discharged to a municipal WWTF for final treatment. There may be limited public funding opportunities available for some facilities (grants, for example).

Regionalized PFAS treatment and/or destruction

Most currently available technologies are intended to treat and destroy PFAS from concentrated waste streams. Given PFAS destruction costs, it may be more economically viable to build regionalized infrastructure intended to destroy PFAS in concentrated wastes from a collection of sources, rather than from municipal WWTF effluent.

Regional facilities intended to destroy specific wastes from certain industrial or municipal sources could be built using existing technologies that have been proven effective at small scales, like high-temperature incineration. PFAS-contaminated process wastewater, RO brine, spent anion exchange resins, landfill leachate, and other wastes generated by industrial users or other sewer users would be ideal candidates for a regional destruction system. Given the nature of these types of systems, however, their applicability would be limited to communities with industrial users or other identified users; it is unlikely that this type of technology would be useful in a community where PFAS loading comes primarily from residential sources.

Cost estimates

In addition to addressing specific technologies, the PFAS removal alternatives report included detailed analyses regarding the potential costs of regionalizing PFAS destruction. Costs of regionalized destruction would be dependent on the types of waste sent to the facility, and the nature of other technologies that would be required to prepare the concentrated streams for PFAS treatment. There are potentially cost benefits to regional treatment and destruction facilities, including reduced shipping costs for waste and reduced emissions associated with out-of-state shipping.

Cost estimates for regional destruction technologies assessed in the 2023 report are below.

- High-temperature incineration
    - Capital cost: $260 million to $550 million
    - Annual operations and maintenance costs: $52 million
    - Annual operating net income: $10 million
- Pyrolysis/Gasification (estimates for dewatered biosolids treatment only, treating up to 50 dtpd)
    - Capital cost: $110 million to $240 million
    - Annual operations and maintenance costs: $2.56 million
- Supercritical water oxidation (SCWO) was listed as an alternative destruction method, but costs were not assessed because SCWO had not yet been proven at an industrial/commercial scale at the time the report was written.

Although the PFAS removal alternatives report did not specifically address the costs of PFAS removal (treatment) technologies in the context of regionalization, those costs could be incurred in two ways.

- Individual facilities send concentrated waste streams to a regional destruction facility post-treatment (PFAS removal). In other words, facilities would send wastes like spent GAC, ion exchange resins, biosolids (wet or dewatered), or RO reject water to a regional facility for destruction only. Treated waste streams would still be sent to an existing WWTF.

  In this case, PFAS removal (pretreatment) costs would be incurred at an individual facility; the costs of PFAS destruction would be shared with all users of the regional facility. This is the scenario that was examined in the PFAS removal alternatives report, which focused on the cost of regionalized PFAS destruction of concentrated waste streams from facilities in geographic proximity.

- Individual facilities do not pretreat for PFAS, thereby sending all untreated waste streams (dilute or concentrated) to one regional facility for treatment and/or destruction.

  In this case, PFAS removal and treatment costs would be equivalent to constructing, operating, and maintaining a new wastewater treatment facility with end-of-pipe PFAS removal and adding on infrastructure with destruction capabilities.

Who pays?

In this case, costs for a regional facility could be covered by a combination of businesses paying some amount and public funding from whatever municipal facilities also contribute to the regional facility. There are currently no regional facilities like this in Minnesota, but the PFAS removal alternatives report demonstrates that there is a possibility that such facilities would be economically viable.

End-of-pipe (effluent) treatment

The most effective treatment alternatives identified in the PFAS removal alternatives report for municipal wastewater effluent were GAC with reactivation and GAC in combination with anion exchange.

Considerations of technology and cost in this section are based on the findings of the PFAS removal alternatives report.

Individual municipal WWTFs

Although technologically the best at PFAS treatment, at the scale required for removing PFAS at WWTFs, GAC and anion exchange technologies are exceptionally expensive. Much of the cost of treatment is driven by additional processes needed to effectively remove PFAS [primarily from pretreating effluent streams with tertiary treatment (filtration) prior to the GAC removal process], as well as significant operation and maintenance costs associated with energy use and frequent replacement of spent media in the treatment train. Further, most currently available PFAS treatment systems are modular, and do not scale well for large facilities.

Cost estimates

- Statewide, for an estimated 283 municipal WWTFs likely to need PFAS removal infrastructure, 20-year costs are projected to be $12 to $25 billion.
  - Projected 20-year costs are $2.7 to $18 million per pound of PFAS removed from municipal WWTF effluent. Higher costs are associated with smaller facilities (size based on design flow).

Table 3. Estimated cost per mass of PFAS removed from targeted waste streams over 20 years.

	Size/Production		
Municipal WWTF size	**0.1 MGD**	**1 MGD**	**10 MGD**
Capital	$7,300,000	$32,000,000	$120,300,000
Operations and maintenance	$500,000	$1,400,000	$6,400,000
Total 20-year cost	$12,600,000	$46,900,000	$188,200,000
Cost per pound of PFAS removed over 20 years	$18,100,000	$6,800,000	$2,700,000

Table adapted from Table 11-1 in the PFAS removal alternatives report.

Who pays?
Currently, infrastructure upgrades at municipal WWTFs are paid for in a combination of ways: increased user fees, public loans or grants, and/or bonding, for example, are all common means of paying for costly projects.

Solid waste/wastewater PFAS treatment grant
The second of MPCA's legislatively-funded grants, announced November 2024, provides an opportunity for municipal and industrial facilities to apply for funding related to planning and design of PFAS treatment, separation, and/or destruction technologies, including pilot projects. This grant has a maximum award amount of $500,000 per applicant/organization, and requires a 10% match, which could include in-kind services. The RFP closes on February 14, 2025; planning and design projects must be finished by December 18, 2026, to be eligible for reimbursement.[45]

Recommended strategies

Understanding how collected potential manufacturer, user, or releaser fee revenues could be spent may inform what type of fee structure would be most appropriate, even in the case of an unknown universe of manufacturers. The PFAS removal alternatives report demonstrates that end-of-pipe PFAS treatment is not necessarily the best answer for preventing future releases of PFAS into the environment. Preventing PFAS-contaminated waste from entering municipal WWTFs in the first place is our best chance at reducing costs and avoiding further environmental contamination.

Based on our best understanding of the economic and technical landscape that exists today, MPCA's recommended alternatives are, in order of strategic priority for addressing PFAS contamination in wastewater, as follows.

1. *Support source identification and reduction activities.* Identifying PFAS sources and either removing or reducing the load from those sources is critical for achieving Minnesota's goals of reducing future PFAS contamination.
2. *Provide financial assistance to assess and install pretreatment infrastructure at critical points in a municipal collection system.* Fee revenue could be made available to certain industrial, commercial, and/or municipal facilities identified as contributing significant PFAS loads to their WWTF.
3. *Invest in the planning, design, and buildout of regionalized facilities to treat and/or destroy PFAS in Minnesota.* These types of facilities could be publicly or privately owned and operated, and existing technology could be used or adapted to meet the needs of potential customers.
4. *Pool funding to cover the costs of end-of-pipe PFAS treatment at certain municipal WWTFs.* Facilities with high PFAS loads in their influent should take priority, particularly in cases where there are no identifiable industrial or other users contributing to the high loads. The astronomical costs of end-of-pipe treatment may require some prioritization for using revenues.

[45] MPCA. Solid waste/wastewater PFAS treatment grant. Accessed 11/22/2024.