

MICHIGAN INDUSTRIAL PRETREATMENT PROGRAM (IPP) PFAS INITIATIVE

Identified Industrial Sources of PFOS to Municipal Wastewater Treatment Plants

August 2020, Revised and Updated May 2025

EGLE, WATER RESOURCES DIVISION 800-662-9278 | Michigan.gov/EGLE

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INTRODUCTION

2025 Update

This document was originally published in August 2020 and has been updated in May 2025 to include additional and updated wastewater treatment plant (WWTP) actions, significant PFOS sources, regulatory criteria, pretreatment and reduction efforts, and evaluations of the overall progress of the Industrial Pretreatment Program (IPP) Per- and Polyfluoroalkyl Substances (PFAS) Initiative.

IPP PFAS Initiative

As a special effort under the National Pollutant Discharge Elimination System (NPDES) program, the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Water Resources Division (WRD), launched the IPP, PFAS Initiative in February 2018. This initiative aims to reduce and eliminate certain PFAS from industrial sources that may pass through municipal WWTPs and enter lakes and streams, potentially causing fish consumption advisories or polluting public drinking water supplies. The program was developed after EGLE identified a WWTP passing through perfluorooctane sulfonate (PFOS) from an industrial user discharging to their system to the Flint River at concentrations far exceeding the state's water quality value (see discussion below on *PFAS Regulation in Michigan Surface Waters*) in June 2017. This effort is just one part of a comprehensive, multi-media approach by the State of Michigan to address PFAS in the environment. For more information on the larger program, visit <u>Michigan.gov/PFASResponse</u>.

Although not covered in this report, three WWTPs that are permitted to discharge to groundwater were also required to undertake the IPP PFAS Initiative. Groundwater discharges in Michigan are regulated by state law. For more information about how Michigan is addressing PFAS in groundwater discharges, see the <u>Compliance Strategy for Addressing PFAS from Public and Private Municipal Groundwater</u> <u>Discharges (michigan.gov)</u>.

PFAS Regulation in Michigan Surface Waters

EGLE determines the concentration of substances in surface waters that would not be expected to cause adverse effects to human health, aquatic life, and wildlife using the methodology described in Michigan's state laws and rules, Rule 323.1057 ("Rule 57") of the Part 4, Water Quality Standards (WQS), administrative rules promulgated pursuant to Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. The Part 4 rules include a narrative method to develop water quality values (WQV) protective of human health and aquatic life. On August 2, 2020, the US Environmental Protection Agency approved the revision to Michigan's Part 4 Rules, including Rule 57 (R 323.1057), Toxic Substances. Due to limited studies and data on PFAS, the only PFAS that have Michigan Rule 57 values are PFOS, perfluorooctanoic acid (PFOA), perfluorobutanesulfonic acid (PFBS), perfluorononanoic acid (PFNA), and perfluorohexanesulfonic acid (PFHxS) as listed below in Table 1. These values were established in March 2014 for PFOS, May 2011 (revised July 2022) for PFOA, July 2022 for PFBS, and October 2023 for PFNA and PFHxS. The most stringent values are the human noncancer values, which are based on human fish and water consumption. Values for protection of aquatic life (the other three values) are much less restrictive.

Dischargers are regulated with water quality-based effluent limits that are based on the most restrictive criteria for their receiving waters.

For more information about WQVs, see the <u>Rule 57 Water Quality Values webpage</u>.

Table 1. Michigan Rule 57 Water Quality Values for PFAS

PFAS, ng/l or ppt*	Human Noncancer Value (nondrinking water source)	Human Noncancer Value (drinking water source)	Final Chronic Value	Final Acute Value	Aquatic Maximum Value
PFOS	12	11	140,000	1,600,000	780,000
PFOA	170	66	880,000	15,000,000	7,700,000
PFBS	670,000	8,300	24,000,000	240,000,000	120,000,000
PFNA	30	19	-	-	-
PFHxS	210	59	-	-	-

(*) ng/l=nanograms per liter, ppt=parts per trillion. These units are considered equivalent.

(-) Aquatic Life Values for PFNA and PFHxS are currently under development.

Due to the relatively low criteria and the historical use of PFOS containing chemicals in Michigan, PFOS has been the regulatory driver for surface water discharges. As of January 2025, effluent sampling has determined that 44 WWTPs with IPPs have exceeded Michigan's WQV for PFOS at least once since the start of the IPP PFAS Initiative. Two WWTPs have exceeded the 66 ppt WQV for PFOA but did not have the potential to exceed the site-specific water quality-based effluent limit. Three WWTPs have been found to exceed the 170 ppt WQV for PFOA. One of the three WWTPs exceeded the site-specific water quality-based effluent limit to exceed their applicable WQV for PFOS. None of the WWTPs with IPPs have been found to exceed their applicable WQV for PFBS, PFNA, and PFHxS. Note that EGLE is using the WQVs as screening levels for the statements above, but any regulatory controls would use water quality-based effluent limits, which take site-specific conditions into account. EGLE has therefore focused its efforts on reducing PFOS in WWTP effluent.

IPP PFAS Initiative Implementation

To date, EGLE has required 102 WWTPs with required IPPs to evaluate their industrial users as potential sources of PFOS and PFOA. While some non-IPP WWTPs have undergone PFOS source investigations, this document strictly summarizes the efforts of the IPP WWTPs and does not include the findings from non-IPP WWTP investigations. It should be noted that in Michigan, municipalities act as

IPP Control Authorities, even for WWTPs of less than five million gallons per day (MGD) in design flow, meaning that IPP compliance and enforcement is implemented locally. EGLE began the IPP PFAS Initiative with a series of regional meetings and a webinar for municipal WWTP staff to inform them about PFAS, suggest potential sources for evaluation, and outline EGLE's expectations for actions under the initiative (to learn more, see the IPP PFAS Initiative webpage.

Based on literature reviews and knowledge of Michigan, EGLE highlighted the following industrial categories as potential sources of PFOS and/or PFOA to WWTPs: metal finishers and electroplaters utilizing fume suppressants, tanneries, leather and fabric treaters, paper and packaging manufacturers, landfill leachate, centralized waste treaters, and sites where aqueous film forming foam (AFFF) was used. WWTP staff were asked to evaluate these potential sources via records review and interviews with industry staff and then sample the effluent of those industries that were likely to have used PFOS and/or PFOA in the past or were currently using some type of PFAS-containing chemical in their processes.

FINDINGS: SIGNIFICANT AND OTHER SOURCES AND VARIABLE IMPACTS

Significant Sources

Significant sources of PFOS identified in the IPP PFAS Initiative were similar to those identified in literature reviews. EGLE's WRD defined sources as those industrial users with discharges greater than 12 ppt PFOS, which was used as a screening level. For this document, significant sources will be referred to generally as "sources." The majority of PFOS sources to WWTPs were landfills that accepted industrial wastes containing PFOS (54), metal finishers with a history of fume suppressant use (50), and contaminated sites associated with industries or activities with PFOS usage (23). Other sources found included facilities which historically or currently used and/or trained with AFFF (16), centralized waste treaters or CWTs (13), chemical manufacturers (8), paper manufacturing/packaging (6), commercial industrial laundries (6), septage (5), leather tanning and finishing (2), and transportation equipment cleaning (1). It should be noted that there were facilities in all these sectors that discharged PFOS at concentrations less than the PFOS screening level. Some potential sources suggested by literature were likely absent since those industries are not prevalent in Michigan. Figure 1 shows the number of PFOS source types by number in each sector. Note that this simple count does not indicate concentrations of PFOS in nondomestic user effluent or impact on WWTP effluent. It also should be noted that several sources were found by other means than the IPP PFAS Initiative, i.e., other reports or communications.



Figure 1. Significant Sources of PFOS to WWTPs, Number by Industrial Type

Effluent discharged by municipal WWTPs without significant industrial sources typically met WQVs, leading EGLE to conclude that general consumer use of products with PFAS coatings and/or ingredients (residential laundering, cleaning carpets, etc.) is generally considered a lower risk based on flow, concentrations, and other factors compared to significant industrial discharges. As of January 2025, 48 IPP WWTPs without known sources of PFOS were meeting the water quality standard for PFOS. There are three IPP WWTPs that have not yet identified source(s) of PFOS and sometimes exceed water quality values. In at least two of these cases, discharges may be related to historical contamination impacting WWTP collection and treatment systems.

As of January 2025, 45 WWTPs with known sources of PFOS were meeting WQVs, while 6 WWTPs with known sources were not yet meeting WQVs. Sources of PFOS to WWTPs in Michigan are shown in Table 2, which lists the total numbers of facilities evaluated in each general industrial type, the numbers of facilities per type and subtype found to be sources and the percentages of facilities discharging PFOS within their industry types and subtypes, and the ranges of concentrations found in wastewater discharged to sanitary sewers above the IPP PFAS Initiative screening level of 12 ppt. The

concentration ranges shown include those prior to pretreatment or reduction efforts. The percentages by source type relate to the same line of the table. For example, 54 of the 64 landfills (or 84 percent of all landfills evaluated) were found to be sources of PFOS, with 100 percent of active Type II landfills and 79 percent of closed Type II landfills found to be sources.

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Industrial Type/Subtype	Total Number Evaluated¹	Number (%) Sources by Type/Subtype ²	PFOS Effluent Range Exceeding Screening Level of 12 ppt
Landfills	64	54 (84%)	13-9,800
Type II Sanitary Landfills	52	47 (90%)	13-9,800
o Active	28	28 (100%)	14-9,800
o Closed	24	19 (79%)	13-3,000
Type III Sanitary Landfills	11	6 (55%)	13-9,410
o Active	3	1 (33%)	33-110
o Closed	8	5 (63%)	13-9,410
Hazardous Waste Landfill	1	1 (100%)	13-480
Metal Finishers	323 ³	50 (15%)	19-240,000
Chrome Platers	51	35 (68%)	30-240,000
Chromate Conversion Coaters ⁴	27	6 (22%)	33-9,950
Other Types Metal Finishers or Unknown	242	9 (4%)	19-270
Contaminated Sites	47	23 (49%)	14-220,000
Metal Finishers	10	5 (50%)	14.5-8,000
Miscellaneous	15	4 (27%)	14-33
Closed Landfills	8	4 (50%)	13-9,410
Paper Manufacturing	4	4 (100%)	17-140
Mixed Manufacturing	5	3 (75%)	16-39,000
Paint or Chemical Manufacturing	4	2 (50%)	130-220,000
Leather Tannery	1	1 (100%)	19-514
AFFF Use	21	16 (76%)	13-65,000
Airport	8	5 (63%)	22-65,000
Miscellaneous	5	5 (100%)	13-39,000
Military	5	3 (60%)	17-65,000
Chemical Manufacturing	1	1 (100%)	630-3,300
Metal Finishing	1	1 (100%)	14.79-54.18
Petroleum Refinery	1	1 (100%)	13-970
Centralized Waste Treaters (CWTs)	16	14 (88%)	13-53,000
Chemical Manufacturers	25	8 (32%)	13-4,600,000
Paper Manufacturing, Packaging	17	6 (35%)	13-810
Commercial Industrial Laundries	23	7 (26%)	13-98

Table 2. Significant Sources of PFOS to WWTPs in Michigan

MICHIGAN IPP PFAS INITIATIVE: IDENTIFIED SOURCES OF PFAS TO MUNICIPAL WASTEWATER TREATMENT PLANTS

Industrial Type/Subtype	Total Number Evaluated¹	Number (%) Sources by Type/Subtype ²	PFOS Effluent Range Exceeding Screening Level of 12 ppt
Septage	6	5 (83%)	13-160
Leather Tanning and Finishing	4	2 (50%)	13-83
Transportation Equipment Cleaning	4	1 (25%)	15-640
Soap and Detergent Manufacturing	1	1 (100%)	16-60
Industrial Waste Management	2	1 (50%)	14-27
Mixed Manufacturing	1	1 (100%)	16-240
Paint Formulating	1	1 (100%)	25-180

¹Estimated based on industries surveyed and sampled from 2018-2023 during the IPP PFAS Initiative. Number of facilities per subcategory may be underestimated for some categories since sewer users that did not meet local screening criteria may not have been sampled. The information presented in this document has been compiled from many sources including, but not limited to, compliance submittals, laboratory reports, voluntary surveys, emails, internet searches, and personal communications. These sources contained variable levels of detail. This document represents our best effort to compile, organize, and summarize this information through December 2023.

²Significant Sources are those exceeding the screening level of 12 ppt PFOS and are considered a source of PFOS by the WWTP regulating their discharge.

³Estimated based on 2022 WWTP IPP Annual Report data and industries surveyed and sampled from 2018-2023 during the IPP PFAS Initiative.

⁴Excludes chromate conversion coaters that also perform chrome plating.

Variable Impacts on WWTPs and Receiving Streams

Since both WWTPs and industrial sources of PFOS vary in size, some WWTPs with sources have been able to meet Michigan's WQVs while others have not. The highest concentrations of PFOS in WWTP effluent, indicative of significant pass through of pollutants from industrial users, were found primarily in small to medium-sized (0.19 to 2 MGD) WWTPs with one or more industrial sources discharging PFOS-contaminated process wastewater that made up a significant portion (around five percent) of WWTP flow. Loading is important; lower concentrations at higher flows may also cause or contribute to pass through of pollutants. Pass through from WWTPs is sometimes intermittent when sources discharge low volume but high strength batches, especially for smaller WWTPs.

Similarly, EGLE has found that in-stream PFAS concentrations may vary widely due to the intermittent nature of some source discharges (i.e., point sources as well as storm water and groundwater discharges from contaminated sites, some of which may not yet be identified) as well as seasonal stream flow variation and size of the receiving stream. Accumulations of PFOS found in fish tissue may be the best indication of long-term average concentrations in lakes and streams. Fish tissue sampling resulted in more restrictive fish consumption advisories downstream from two WWTPs that were found to be passing through PFOS from significant industrial sources.

DISCUSSION OF SOURCES

Landfill Leachate

Sanitary landfills and hazardous waste landfills that accept or have accepted industrial wastes containing PFOS and discharge leachate, or truck leachate, to WWTPs are a significant source. In Michigan, sanitary landfills are classified as either Type II or Type III landfills. A Type II landfill is a municipal solid waste landfill which receives household waste but may also receive other types of nonhazardous wastes such as commercial solid waste, nonhazardous sludge, conditionally exempt small quantity generator waste, and industrial nonhazardous solid waste. A Type III landfill is any landfill that is not a municipal solid waste landfill or hazardous waste landfill and includes all of the following: construction and demolition waste landfill; industrial waste landfill; a landfill that accepts waste other than household waste, municipal solid waste incinerator ash, or hazardous waste from conditionally exempt small quantity generators; coal ash landfill; and an existing coal ash impoundment that is closed or is actively being closed as a landfill. Hazardous waste landfills receive non-liquid hazardous waste. Leachate from 47 Type II sanitary landfills, six Type III sanitary landfills, and one hazardous waste landfill have been identified as significant sources, with concentrations ranging from 13 to 9,800 ppt PFOS. Figure 2 below shows the highest PFOS concentration in leachate for the 47 landfills. Only nine of the 54 landfills, or 17 percent, were discharging PFOS concentrations greater than 1000 ppt. Included in the number of active Type II landfills counted in Table 2 is a facility that receives leachate from three separate landfills.



Figure 2. Highest Leachate PFOS Concentrations by Landfill

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The impact to a WWTP from leachate is dependent on the amount of leachate received, the concentration of PFOS in the leachate, and the overall volume of sanitary sewage treated by the WWTP. Municipal WWTPs are not designed to remove PFOS from wastewater, but if the leachate volume is small compared to the volume of sanitary sewage received by the WWTP, the acceptance of leachate may not result in PFOS passing through at concentrations above the WQV. The range of volume of leachate discharged or hauled daily to WWTPs can be from the thousands to the hundreds of thousands of gallons. For this reason, smaller WWTPs are more likely to pass through PFOS when receiving landfill leachate. There are WWTPs in Michigan where landfill leachate is their primary source of PFOS. Like WWTPs, landfills are passive receivers, not generators, of PFAS due to their acceptance of waste containing PFAS. EGLE recognizes the importance of the relationship between WWTPs, who accept landfill leachate, and landfills, who accept WWTP residuals/sludge. Current industrial waste and WWTP residuals disposed at landfills would theoretically have lower concentrations of PFOS and PFOA compared to what was historically disposed.

Some WWTPs have restricted the volume of landfill leachate accepted rather than require pretreatment to meet the WQV. Furthermore, some landfills have tried various ways to reduce the volume of leachate generated to therefore minimize the loading to the WWTP. It is unclear if these approaches will be successful over the long term. EGLE has recommended or required that local limits be developed for PFOS (and evaluated for the other PFAS with WQVs) to ensure the leachate accepted does not result in pass through of PFAS. As local limits are adopted by municipalities, the volume and/or concentration of leachate accepted by the WWTPs may be impacted.

In 2018, the Michigan Waste and Recycling Association conducted a statewide study to determine levels of PFOS and PFOA in leachate of 32 active municipal solid waste landfills. All the leachate samples collected had detectable levels of PFOS and PFOA. The concentration range of PFOS and PFOA identified in the study aligns with the findings of the IPP PFAS Initiative.

Metal Finishing

Facilities that conduct metal finishing (including electroplaters) are a significant PFOS source for many WWTPs in Michigan. They are categorized by federal regulation according to specific core processes that change the surface of an object to improve its appearance and/or durability and are regulated under 40 Code of Federal Regulation (CFR), Parts 413 and 433. Michigan has historically been home to a number of metal finishers associated with automobile manufacturing as well as other industries. In August 2020, the majority of sources at six of the ten WWTPs discharging at 50 ppt or greater PFOS were metal finishers. Five of those six WWTPs had a single chrome plating metal finisher source and were WWTPs of medium size (less than 2.5 MGD discharge). The remaining WWTP was larger (43 MGD) and had multiple sources, the majority of which were chrome plating metal finishers. Since that time, chrome platers have been found to be sources of PFOS and have played a significant role in reduction of PFOS discharged to surface waters in the state through the installation of pretreatment and other actions.

This finding aligns with known uses of PFAS. The United States Environmental Protection Agency (USEPA) allowed for use of PFOS-based fume suppressants as a control technology for hexavalent chromium emissions under the National Emissions Standards for Hazardous Air Pollutants (NESHAP) for chromium electroplating in 1995. Hexavalent chromium is a known hazardous compound and human studies have established that inhaled hexavalent chromium is a human carcinogen, resulting in an increased risk of lung cancer. Adding fume suppressants to the plating bath reduces the surface tension and, subsequently, the ability for hexavalent chromium to be released into the air. Fume suppressants are widely used across the industry due to their effectiveness in reducing hexavalent chromium emissions and their relative costs compared to other available control technologies. The USEPA did not ban the use of PFOS-based fume suppressants in chrome electroplating tanks until September 2015.

The following discussion about types of metal finishers is based on information gleaned from WWTP investigations, surveys, IPP submittals, and company webpages. Of the approximately 322 metal finishers discharging to WWTPs in Michigan, the effluent of 276 was sampled at least once as part of the IPP PFAS Initiative. Metal finishers sampled included those conducting one or more of the following processes: chrome plating (both hexavalent and trivalent chromium and decorative and hard chrome plating), chromate conversion coating, aluminum anodizing, copper plating, phosphate coating, passivating, and powder coating. Not all metal finishers were able to be tallied by type. A number of metal finishers were sampled where the specific processes used were not reported to EGLE. Some metal finishers were not sampled because they did not meet screening criteria to be considered a likely source of PFOS.

In general, metal finishers that had a history of using fume suppressants were found to discharge PFOS. Of the approximately 323 metal finishers discharging to WWTPs during the period of this report, only 50 (15 percent) were found to be discharging PFOS greater than the screening criteria, with 23 (7 percent) discharging greater than 1,000 ppt PFOS. Forty-one of the 50 metal finishers (82 percent) considered to be sources of PFOS were known to use hexavalent chromium and/or trivalent chromium in their current or past processes. Nine reported no known chromium use or no information on processes was provided to EGLE.

Chrome Platers

Decorative chrome plating, hard chrome plating, and chromate conversion coating, all using hexavalent chromium in their process, appear to be the predominant types of metal finishing that are sources of PFOS to WWTPs. Chrome platers either using or previously using hexavalent chromium were the most significant source of PFOS among metal finishers. PFOS-containing fume suppressants were often used to control air emissions related to the use of hexavalent chromium prior to the September 2015 ban. Chrome plating involves electroplating a thin layer of chromium to provide corrosion resistance, increase surface hardness and/or provide a decorative finish. Hard chrome plating is used to improve corrosion and abrasion resistance and is generally a thicker plating than decorative chrome plating, which is generally thinner and used for cosmetic purposes, such as plating plastic with a shiny chrome surface. Decorative chrome plating deposits a 0.003-2.5-micron chrome layer in less than five minutes

with an electrical current range of 540-2,4000 amperes; hard chrome plating deposits a 1.3-760micron layer in 20 minutes to 36 hours with an electrical current range of 1,600-6,500 amperes.

In either type of chrome plating, the electrical current generates chromium fumes. The temperature of chromic acid etch tanks and chrome plating tanks is also a factor. These tanks are heated (up to approximately 160 degrees Fahrenheit for some applications) and water constantly evaporates and must be replenished. In addition, chromium fumes may be generated from chrome plating and chromic acid etch tanks when aerated to prevent settling of chromium in the bottom of the tanks.

Decorative chrome platers that plate on plastic typically etch plastic parts with chromic acid, which is hexavalent chromium, to prepare them for plating. Several of the decorative chrome platers in Michigan use chromic acid etch baths and fume suppressants to control associated air emissions. Plating on plastics (also referred to as POPs) is a growing sector of the industry. Plating on plastic allows for both lower costs for raw materials and lower weight parts, which may be attractive to certain industrial customers.

Of the approximately 51 chrome platers in Michigan that discharge to a WWTP, 35 (68 percent) were found to be sources of PFOS. Most, if not all, of the chrome platers either use or used hexavalent chromium, although many use trivalent chromium as well. Due to employee safety concerns, environmental hazards and the associated increased costs, there has been a movement to replace hexavalent chrome with trivalent chrome in decorative chrome plating. Trivalent chromium has a relative inability to cross cell membranes compared to hexavalent chromium (<u>USEPA, August 1998</u>). Therefore, the trivalent chromium process is considered significantly less toxic, which makes it subject to both less regulations and operation costs than hexavalent chromium. However, trivalent chromium generally cannot be used for hard chrome plating because there are limits to the thickness that can be achieved. There are also differences in the plating color as well as additional costs for new equipment, chemicals, testing, and maintenance for manufacturers (TURI, 2012).

The chrome platers that were not found to be sources of PFOS most likely chose mechanical controls (such as enclosed lines, air jet systems, etc. along with large capacity scrubbers) to manage hexavalent chromium rather than fume suppressant chemicals containing PFAS (typically used in conjunction with scrubbers). In at least one case, a decorative chrome plating facility was found to be a source of PFOS that was built after the 2015 PFOS ban, and PFOS-based fume suppressants were never used at that facility, although fume suppressants containing other PFAS, specifically 6:2 fluorotelomer sulfonic acid (FTS), are used.

PFOS discharges from chrome platers found to be sources of PFOS varied widely, but concentrations at some were significant. See Figure 3 to see the range of highest effluent PFOS results, most prior to effective pretreatment. Since these samples were taken, most chrome platers have installed pretreatment for PFOS and/or conducted cleaning/equipment replacement. More recent effluent results either meet local requirements or show significant reductions.





Chromate Conversion Coaters

Six metal finishers that conduct chromate conversion coating (and do not also conduct chrome plating) were found to be sources of PFOS to WWTPs, but concentrations of PFOS were generally much lower than those for chrome platers. Chromate conversion coating is an extra step used to inhibit corrosion, act as a primer, or provide a decorative finish. The process uses chromate, which is hexavalent chromium, to create a micro-coating from a chemical reaction with the base metal. See Figure 3 below for highest effluent results for six factories conducting chromate conversion coating that exceeded screening levels and are considered to be sources of PFOS by the WWTPs accepting their effluent.

Many chromate conversion coaters have reduced effluent concentrations over time. Some have eliminated source lines or conducted cleaning and/or replacement of equipment. One facility stopped accepting parts to process that were believed to be contaminated with PFOS. One chromate conversion coater thought that the source of PFOS was a PTFE lubricant which had been eliminated. They subsequently replaced associated equipment and their PFOS was reduced below the screening level of 12 ppt. The three chrome platers that also conduct chromate conversion coating are excluded from this discussion and Figure 4 since concentrations of PFOS are likely associated with chrome plating rather than chromate conversion coating.





Figure 4. Highest PFOS Effluent Sampled by Chromate Conversion Coating Facility Sources

Conclusions and Discussion, Metal Finishers

Based on data we have seen from a range of sources, it appears that the PFOS found in chrome plating (and to a lesser extent chromate conversion coating) wastewater originates from historical use of fume suppressants (also called demisters, defoamers, surfactants, mist suppressants, etc.). These chemicals were lawful to use until September 2015 and were used to protect worker health and safety as well as contribute to product quality. After September 2015, PFOS-based fume suppressants were prohibited from being added to chromium electroplating and anodizing tanks under the 2012 revisions of the <u>National Emission Standards for Chromium Emissions from Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks (ESHAP) (40 CFR Part 63, Subpart N)</u>. These rules define PFOS-based fume suppressants as those containing one percent or greater PFOS by weight.

The NESHAP revision was developed concurrently with a national effort to phase out the manufacture and use of long-chain PFAS, including PFOS and PFOA, under the <u>USEPA's 2010/2015 PFOA</u> <u>Stewardship Program</u> due to concerns about the impact of PFOA and long-chain PFAS on human health and the environment. The NESHAP regulation does not prohibit PFOS-based fume suppressants for chromate conversion coating, but these products are generally not available due to the stewardship program phase out.

The conclusion that PFOS currently found in wastewater is from historical use of PFOS-containing chemical products is supported by the findings of a study published in June 2020 by EGLE and the USEPA Office of Research and Development (ORD) to research the question of whether chemicals currently used by chrome platers might be contributing to PFOS concentrations observed in their effluent. EGLE sampled nine different fume suppressant products and effluent (prior to pretreatment for PFOS) from 11 chrome platers and sent samples to the USEPA ORD for detailed analysis. USEPA

researchers did not find PFOS or PFOS precursors in currently used fume suppressants, although most contained PFAS, primarily 6:2 FTS. However, PFOS was found in chrome plater effluent, leading EGLE to conclude that PFOS originates from historical use of PFOS-containing fume suppressants. For more information about this study, refer to <u>Targeted and Non-Targeted Analysis of PFAS in Fume</u> <u>Suppressant Products at Chrome Plating Facilities</u>.

EGLE did not find that metal finishers were using fume suppressants containing PFOS after the 2015 USEPA ban. In 2018 EGLE's Air Quality Division (AQD) inspected all 58 chrome platers then subject to regulation under 40 CFR Part 63, Subpart N. This rule limits the addition of PFOS-based fume suppressants after September 2015. The AQD did not find any chrome platers in violation of this federal requirement. About half of the inspected sources subject to Subpart N were found to still use PFAS-based fume suppressants, likely 6:2 FTS as discussed above and in the USEPA/EGLE study *Targeted and Non-Targeted Analysis of PFAS in Fume Suppressant Products and Effluent Samples*.

It should be emphasized that some chrome platers did not use PFOS-containing chemicals to control fumes and have not been found to be sources of PFOS to WWTPs. PFAS-based fume suppressants are not the sole mechanism for complying with the NESHAP. In an EGLE survey, nearly half of the chrome platers regulated under the NESHAP utilized mechanisms other than chemical fume suppression. These include enclosures and physical controls such as scrubbers and composite mesh pad scrubbers, physical fume suppression via plastic balls, and non-PFAS based chemicals. Some platers have substituted trivalent chromium, which has lower toxicity, for hexavalent chromium or have avoided chromium altogether.

Contaminated Sites

Forty-seven contaminated sites were evaluated for PFOS by WWTPs. Contaminated sites evaluated included facilities that actively pump treated and untreated groundwater into sanitary sewers as well as sites where contaminated groundwater reached the sanitary sewers via infiltration or inflow. Contaminated sites include facilities that no longer have industrial operations as well as active industrial sites, some with new owners and processes and some that have had the same operations for decades. The wastewater from these sites is all related to contaminated groundwater from previous industrial activities rather than process wastewater from current operations. The sites were contaminated by a wide range of industrial activities. The 23 confirmed sources included 5 contaminated groundwater from former metal finishers, 4 closed landfills, 4 former paper manufacturing sites, 3 mixed manufacturing sites, 2 former paint and/or chemical manufacturers, and 1 former leather tannery. Table 2 includes a miscellaneous category with 15 difficult to categorize sites that were evaluated by WWTPs. Four of the 15 miscellaneous sites were confirmed as sources which are construction dewatering sites. Also included in the miscellaneous category are four WWTPs that conducted sanitary sewer monitoring to evaluate potential PFOS/PFOA infiltration due to general concerns about contaminated sites but did not confirm any sources. It is worth noting that some of the identified sources of PFOS are due to infiltration/inflow of contaminated groundwater into sanitary sewers rather than pump and treat operations. These sources were identified as part of contaminated site investigations under the IPP PFAS Initiative.

The general types of contaminated sites found to be sources of PFOS are shown below in Figure 5.

Figure 5. Number of Contaminated Sites by Type that are Significant Sources of PFOS to WWTPs



Miscellaneous

As mentioned above, the miscellaneous category includes 15 facilities that were difficult to categorize. Besides the four WWTPs included in the category, the other 11 facilities consist of various groundwater cleanups or groundwater remediation projects. The four sites that are sources of PFOS to WWTPs were short term construction dewatering projects. The exact reasons why PFOS was detected at elevated concentrations in these particular areas is unknown, but all were in areas where there was historical industrial activity.

Metal Finishers

Ten former metal finishing operations were evaluated by the WWTPs and five were found to be a source of PFOS. Four of the five are facilities which conducted chrome plating operations. The fifth source manufactured military components like take engines and transmissions. Many of these facilities had existing pump and treat groundwater systems in place due to other pollutants of concern prior to being sampled for PFAS.

Closed Landfills

The majority of the count for this category includes landfills that were specifically located at an industrial facility; three of which are counted under the closed Type III sanitary landfill category. Two of the facilities are also counted under the closed Type II sanitary landfill category. These eight closed landfills have been included in the contaminated sites section since the WWTPs they discharge to regulate them as contaminated sites. Of the eight facilities, four were found to be a source of PFOS and they are associated with receiving waste from various historic industrial activity.

Mixed Manufacturing

Some contaminated sites in Michigan have a complicated history and the origins of PFOS discharges are unclear as they may stem from multiple sources. Because of this, we have classified five facilities under mixed manufacturing, with three of them being a source of PFOS. One is a 413-acre former manufacturing complex operated from 1904 to 2010. PFAS contamination has been documented at the site in the last few years, including PFOS at 34,000 ppt infiltrating into the sanitary sewer. Since significant amounts of groundwater infiltrate into the sanitary sewers at the site, the site contributes significant loadings of pollutants. It is the primary known source of PFOS to the WWTP. Various former operations that may be contributing PFOS to sanitary sewers include metal finishing and associated pretreatment of wastewater, fire-fighting training, and paint/enameling operations. Although not the focus of this discussion, it should be noted that PFAS contaminates soils, groundwater, and storm water runoff at this site.

Another source facility is a 315-acre former manufacturing complex operated from 1941 to the early 2000s. Operations included machining, metal cleaning, metal plating, painting, and assembly of metal parts and products for war armaments and automotive transmissions. Due to the wide variety of historic industrial processes at the facility, the exact source of PFOS to the WWTP is unknown.

The third facility was a former manufacturer of coil springs and bumpers from 1954 to the early 2000s. There were plating operations and fire training operations at the site, which are the likely source of PFOS to the WWTP.

Paper Manufacturing

Contaminated sites can also impact WWTPs when PFAS contaminates the drinking water source that, following use, is discharged into the sanitary sewers as municipal, commercial, and industrial wastewater. For example, a WWTP eliminated a significant source of PFOS when a municipal well was found to be contaminated by a former paper manufacturer using a 3M product for coating paper. The municipality was able to switch to an alternative source and this resulted in a significant reduction of PFOS loading to the sanitary sewers.

Three other paper manufacturers are sources of PFOS to WWTPs, two of which are no longer in business. These three facilities likely used PFOS as part of past specialty paper making processes.

Paint or Chemical Manufacturing

The four facilities under the paint or chemical manufacturing category are all pump and treat groundwater cleanups. Two of them were found to be sources of PFOS. One of the sources is a chemical manufacturer that has been in operation since the late 1800s. The PFOS is believed to have been from the historical manufacturing of automotive paint, container coatings, and furniture finishes in the 1980s and 1990s. The other source is a paint manufacturing facility where historical operations included formulating paints and filling spray cans with 3M Scotchgard.

Leather Tannery

One WWTP receives PFOS when groundwater contaminated by leather tannery waste enters sanitary sewers located in the zone of contamination through cracks in the sewers. PFOS loadings to the WWTP are likely affected by seasonal groundwater fluctuations. The impacted municipality is currently undertaking an investigation to better understand the extent and nature of the inflow and infiltration of the contaminated groundwater.

AFFF Use

Sometimes floor drains, sanitary sewer lines, and pump stations have become contaminated by the historic or current use of AFFF, causing discharges of PFOS above screening levels to sanitary sewers. AFFF is used to extinguish highly flammable liquid fires where gasoline, oil, and jet fuel is present. The WWTPs have evaluated a total of 21 facilities based on knowledge of past and/or current use of AFFF. Of those evaluated, 16 facilities were found to be sources of PFOS including 5 miscellaneous facilities, 5 airports, 3 military installations, 1 chemical manufacturer, 1 former metal finisher, and 1 petroleum refinery. See Figure 6 below.

Airport

At least one WWTP is receiving PFOS from a fire station where a floor drain and sanitary sewer were contaminated by a firetruck containing AFFF that had a leaky valve. Although the valve was fixed and AFFF and contaminated fire truck water disposed of off-site, it appears that sanitary sewer lines contain residual PFOS that continue to discharge PFOS to the WWTP. This community plans to clean the drain and sanitary sewer to reduce PFOS.

The use of AFFF at commercial airports is a source of PFOS to WWTPs. At one commercial airport that only has a sanitary wastewater discharge to a WWTP, the elevated levels of PFOS detected are thought to be from the historical use of AFFF on the airport property which has infiltrated into the sanitary sewers. A second commercial airport was identified that discharges a mixture of sanitary and de-icing fluid wastewaters. As is the case at the other airport, the use of AFFF on the airport property is believed to have infiltrated the sanitary sewer resulting in elevated levels of PFOS being discharged to two separate WWTPs.

Military

The historical and current use of AFFF at military installations is another source of PFOS to WWTPs. At one facility, when the fire suppression system (which contained AFFF) was tested, the foam was discharged to the sanitary sewer system. Over time, this practice has contaminated the sanitary lines. The facility does discharge a small volume of process wastewater; however, most of the discharge is sanitary wastewater. It is believed that the source of PFOS to the WWTP as this site is due to the AFFF-contaminated sewer lines.

A former air force base with contaminated soils and groundwater from repeated training exercises using AFFF has been found to be a source of PFOS to the sanitary sewers in another community, with 82 to 456 ppt PFOS found in nearby sanitary sewers. Contaminated groundwater from the former air force base has migrated off-site and impacted residential wells and surface waters. In addition, AFFF was used on several fires in the area, creating other contaminated areas.

Miscellaneous

The use of AFFF at the petroleum refinery along with the use of AFFF to extinguish a fire at a scrapyard facility upstream of the refinery caused foaming events to occur out of a sewer manhole during periods of heavy rainfall. The foam entered road drains that lead to the combined sanitary/stormwater water system for the same WWTP as mentioned in the Petroleum Refinery section. This is one of the sources included in the miscellaneous category.

Another facility is a former automotive manufacturing facility. The property contained a former firefighting training area where AFFF is believed to have been used. The facility is also counted and is further discussed under the Contaminated Sites section.

A fire department is another facility counted under the miscellaneous category. The property historically contained a fire training tower which is believed to have been used for AFFF training. There were also AFFF containers stored in the tower which were suspected to have leaked over the years. The tower was demolished in early 2020. The collection system in this area has been impacted due to contaminated groundwater.

The fourth facility is a State of Michigan owned complex which houses offices and workstations for various government agencies. It was determined that a portion of sanitary sewer was being impacted by contaminated groundwater near the Michigan State Police Training Facility. It is believed that past fire training activities using AFFF is the likely cause of contamination.

Chemical Manufacturing

At a chemical manufacturing facility, the source of PFOS appears to be from the use of AFFF, instead of from the manufacturing process. The training with AFFF was conducted on site due to the nature of chemicals that are stored on the premises. The use of AFFF has contaminated the groundwater, which is pumped and discharged to a WWTP, along with other process wastewater.

Metal Finishing

The use of AFFF at a former metal finisher is the source of PFOS to one WWTP. The metal finisher manufactured fire protection systems, mainly sprinklers and valves, and conducted testing of fire suppression foam. Records from the facility indicated AFFF manufactured by 3M was used in the testing from 1998/1999 until 2001.

Petroleum Refinery

WWTPs can also receive PFOS via inflow of contaminated storm water run-off into sanitary sewers. WWTPs with combined sanitary and storm water systems could be impacted by storm water contaminated by PFOS. A WWTP is receiving storm water contaminated with PFOS due to a petroleum refinery's use of AFFF in a fire training area. This facility is located within a section of combined sewers that discharge to the WWTP. The AFFF usage contaminated the surrounding ground and entered an onsite drainage ditch.



Figure 6. Number of AFFF Users by Type that are Significant Sources of PFOS to WWTPs

Centralized Waste Treaters

Centralized Waste Treaters (CWT) treat wastewater and industrial process by-products that come from other industries. These facilities receive a wide variety of hazardous and non-hazardous industrial waste for treatment. If a CWT receives waste from sources of PFOS such as landfill leachate, plating waste, and/or paper sludge, PFOS may be discharged to the receiving WWTP if adequate treatment is not used. Fourteen of the sixteen CWTs in Michigan (88%) were found to be sources of PFOS, with a wide range of effluent results (13-53,000 ppt PFOS). Most CWTs in Michigan discharge to larger WWTPs. As indicated above, municipal WWTPs are not designed to remove PFOS; however, larger WWTPs typically receive larger volumes of sanitary sewage, which is typically low in PFOS. This may reduce PFOS concentrations in WWTP effluent, thereby lessening a CWT's potential impact on surface waters.

Chemical Manufacturers

A small percentage of chemical manufacturers sampled had levels of PFOS above the screening levels. The PFOS ranged from 13 to 4,600,000 ppt. Included in this category are facilities classified under 40 CFR Part 414, Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) along with facilities which produce chemical formulations not regulated under the OCPSF category. Three out of the eight facilities with levels of PFOS above the screening levels in their discharge manufacture chemical compounds that are used by the metal finishing industry. Another facility manufactures synthetic lubricating oils and greases and uses a synthetic fluoropolymer of tetrafluoroethylene in the manufacturing process. The remaining three facilities manufacture specialty chemicals to be used in a variety of industries. None of the eight facilities classified as sources are regulated under the OCPSF category.

Paper, Cardboard and Packaging Manufacturers

Manufacturers of paper, cardboard and packaging products have been found to discharge low to moderate concentrations of PFOS (13 to 810 ppt) under the IPP PFAS Initiative. Included in this category are facilities classified under 40 CFR Part 430, *Pulp, Paper, and Paperboard Point Source Category* along with facilities which produce paper products not regulated under the federal category. These facilities are currently active or were active during the years of the initiative. Of seventeen sources evaluated, six were found to have discharges of PFOS above the screening level. Of the six sources, three are classified under 40 CFR Part 430. Most paper/cardboard manufacturers under the IPP PFAS Initiative are still attempting to identify the source of PFOS in their discharge; however, at three facilities the PFOS source is believed to be the use of recycled paper and/or cardboard used in the manufacturing process.

In other paper manufacturing cases, it is believed that previously used paper coatings contained PFOS. Previous use of PFOS-containing coatings is a "legacy" issue similar to the chrome plating industry's use of fume suppressants containing PFOS. Residual PFOS contamination from previous use is still impacting current discharges of PFOS. These findings are consistent with recent literature on PFAS in paper manufacturing. One paper making facility used a PFOS process chemical from 3M in combination with a starch during the paper making process from 1980 to 1989. The process wastewater along with any unused or excess product was discharged to the sanitary sewer system. The facility ceased discharging process wastewater to the WWTP in 1989 and has only been discharging sanitary wastewater. However, due to the 1980s-era process wastewater discharge, residual PFOS has remained in the sewer lines resulting in PFOS from the facility's sanitary wastewater discharging to the WWTP.

Some paper manufacturing companies have operated their own landfills for their waste products. These landfills produce leachate containing PFOS that is often discharged to WWTPs. The on-site landfill at one former paper manufacturing facility, which discharged to a WWTP, counted as a closed Type III landfill, had PFOS concentrations ranging from 13 to 290 ppt.

Commercial Industrial Laundries

Seven out of the twenty-three commercial industrial (including medical clothing and linens) laundry facilities were found to discharge concentrations (13 to 98 ppt) of PFOS under the IPP PFAS Initiative. Two of these facilities were laundering articles of clothing that were likely treated with a PFAS-based stain and/or dirt resistant coating. After discontinuing the practice of laundering those articles of clothing, the level of PFOS in the effluent decreased to below PFOS screening levels. At least one facility was laundering items used by manufacturers that were sources of PFOS. These items are now dry cleaned and PFOS concentrations so far have been below screening levels. The exact source of the PFOS at the other four laundry facilities is unknown at this time; however, they all accept garments from various industry sectors that may be the pathway for PFAS entering the waste stream at the laundries.

Septage

Septage waste consists only of food establishment septage, domestic septage, domestic treatment plant septage, sanitary sewer cleanout septage, or any combination of these. Domestic waste is human and/or household waste. Septage hauled by truck to IPP WWTPs as well as wastewater from septage receiving stations and septage pretreatment facilities are included in this industrial type. Five of the six septage haulers/facilities evaluated were found to be sources of PFOS. Septage from those five sources ranged from 13 to 160 ppt PFOS. IPP WWTPs that accept septage are taking septage PFAS loadings into account when developing PFAS local limits (limits for industries).

Leather Tanning and Finishing

Included in this category are one facility classified under 40 CFR Part 425, *Leather Tanning and Finishing*, two that are wholesale tanneries for taxidermists not covered by 40 CFR Part 425, and one which is a research and development facility that manufactures a variety of interiors for automotives but is not categorized under the federal regulation. Two of the facilities were found to be sources of PFOS with concentrations ranging from 14 to 83 ppt. One of the sources is a facility that processes previously tanned hides and skins into finished leather for the automotive industry. According to the facility, they were able to trace the source of PFAS to Teflon-coated parts from the spray booths. The PFOS levels decreased from their discharge after removing the Teflon-coated parts. The other facility has reviewed their chemical inventory, none were identified as the source of PFOS, and their investigation is ongoing into their source of PFOS at the time of this writing. The two wholesale tanneries for taxidermists were not found to be sources of PFOS.

Transportation Equipment Cleaning

Four facilities classified under the federal regulation of *Transportation Equipment Cleaning* (40 CFR Part 442) were sampled as part of the Initiative. One of the facilities was found to be a source of PFOS with concentrations ranging from 15 to 640 ppt. The facility cleans tank trucks and intermodal tank containers which have been used to transport chemical or petroleum cargos.

Soap and Detergent Manufacturing

One Soap and Detergent Manufacturer (no pretreatment standards for this industrial category) found concentrations of PFOS above the screening level ranging from 16-60 ppt PFOS. After conducting inplant sampling, the factory found that intermittent PFOS discharges originated from their Research and Development laboratory, which was testing cleaning products on various carpet samples and disposing of the resultant wastewater along with soap manufacturing wastewater. This facility now segregates their Research and Development wastewater and sends it offsite for pretreatment and disposal and is no longer considered a source of PFOS by their WWTP.

Industrial Waste Management

Included in this category are two facilities which receive, treat, and dispose of industrial waste. One facility is a source of PFOS with concentrations ranging from 14 to 27 ppt, specializing in non-hazardous liquid waste management. The facility provides services to restaurants, grocery and convenience stores, food processing industries, and automotive industries. The precise source or sources of PFOS within this facility are unknown at this time.

Mixed Manufacturing

One facility which discharges wastewater from stamping and truck body operations is a source of PFOS with concentrations ranging from 16 to 240 ppt. The precise source or sources of PFOS within this facility are unknown at this time.

Paint Formulating

One facility classified under 40 CFR Part 446, *Paint Formulating*, is a source of PFOS with concentrations ranging from 25 to 180 ppt. The facility's products include industrial paints and coatings for a wide range of industrial sectors. The precise source or sources of PFOS within this facility are unknown at this time.

Plastic Product Manufacturers

For the purposes of this document, this industry type includes plastic injection molding, unlaminated plastics profile shape manufacturing, plastics molding and forming, and a resealable plastic bag manufacturer. Industries that etch, coat, or plate plastic products (as well as create plastic parts or products prior to plating) are counted as metal finishers rather than this industry type. Six facilities were evaluated within this category, with four monitored for PFAS. None of the plastic product manufacturers were determined to be sources of PFOS.

PFOS TREATMENT AND REDUCTION

EGLE has encouraged pretreatment and reduction at the source, since it is generally more efficient and effective to treat or reduce pollutants at the lower volume, concentrated source than to treat the higher volume, more dilute wastewater at the WWTP. At least one WWTP in Michigan tried to augment its treatment for PFOS by increasing the powder activated carbon dosing in its secondary treatment tanks from 4,460 lbs/day to 7,400 lbs/day, but the effort was not determined to significantly reduce effluent PFOS. To date, all effective treatment or reduction has been conducted at the source rather than at the municipal WWTP.

EGLE currently counts 86 sources of PFOS have installed pretreatment and/or conducted other activities to reduce PFOS discharged to WWTPs. These activities include cleaning or replacement of equipment, disconnecting contaminated tanks/pipes/sewers/process lines, and/or reducing or eliminating discharges to specific WWTPs. Figure 7 below shows the number of facilities by industry sector or type that have taken part in PFOS pretreatment and reduction activities, including 28 metal finishers, 19 contaminated sites, 11 centralized waste treaters, 9 landfills, 7 AFFF users, 4 chemical manufacturers, 4 others, 2 paper manufacturers, 1 recycling/scrap yard, and 1 transportation equipment cleaner. Other industrial sectors that have installed pretreatment or conducted cleaning/reduction activities include a food industry drain cleaner, a waste to energy facility, automotive mirror production, and aluminum forming. In general, industries with existing pretreatment for other pollutants installed pretreatment for PFOS more readily.

Figure 7. PFAS Pretreatment/Reduction by Industry Type, Number Each Sector



As seen in Figure 7, PFOS is being managed at the source by both pretreatment and/or reduction efforts at 82 facilities in Michigan. For complex facilities with higher concentrations of PFOS, pretreatment has generally been needed to reduce PFOS to acceptable levels. Pretreatment has been installed at the source for discharges ranging in volume from 5,000 gallons discharged four times a year to 400,000 gallons per day. These initiatives have resulted in significant PFOS reductions in WWTP effluent and biosolids. See Table 3 for highlights in source reduction under the IPP PFAS Initiative.

A variety of pretreatment systems and/or reduction efforts have been used at PFOS sources, both by industries and WWTPs, as shown in Figure 8. Note that the Methods in Figure 8 have been implemented by facilities discharging PFOS unless otherwise noted. The 86 industrial users (IUs) discussed above, joined by 4 WWTPs, have employed 94 pretreatment or PFOS reduction methods. Note that some facilities have used more than one pretreatment or reduction method and are therefore counted more than once. For example, one facility did extensive cleaning and is also restricting the processing of parts that were believed to be contaminated and is therefore counted twice. In addition,



the count includes temporary pretreatment systems, such as those used for dewatering during construction activities. As of the writing of this report, the top three pretreatment/reduction methods are granular activated carbon (GAC), cleaning/replacement and/or disconnection of contaminated equipment or processes, and GAC and ion exchange (IX). The remainder of this section discusses the PFOS pretreatment and reduction methods in more detail.

Figure 8. PFAS Reduction Methods, by Number of Facilities Using



GAC pretreatment systems are currently predominant at 60% (56) of the 94 pretreatment/reduction methods. GAC is typically used as a filter in a series of two or more tanks. Change out of GAC media may be needed frequently to control PFOS levels, and there have been issues with media fouling due to other pollutants in wastewater (e.g. iron) and interference with other treatment chemicals used, such as polymers used as coagulants.

Other methods have been successfully used to reduce PFOS discharged to WWTPs. In less complicated facilities and situations, especially those without extensive contamination and/or relatively lower levels of PFOS, cleaning, replacing contaminated equipment, and disconnecting contaminated processes has been effective. As of the writing of this report, 12% (11) of facilities with successful PFOS reduction cleaned and/or replaced equipment and/or disconnected contaminated process lines.

It should be noted that at least two chrome platers with high levels of PFOS conducted extensive cleaning of tanks, pits, and equipment associated with their plating lines. Both efforts may have resulted in some PFOS reduction, but pretreatment remained necessary prior to discharge. These facilities are not counted within the "clean, replace, disconnect" category in Figure 8 since pretreatment is the primary method of PFOS reduction. Cleaning may be problematic at industries with high concentrations of PFOS and complicated systems, since PFOS may be found in etch tanks, plating tanks, rinse tanks, secondary containment pits, parts racks, air pollution control equipment (which may return contaminated liquids to plating tanks and/or pretreatment systems), and associated pipes, ducts, and valves. In addition, cleaning may not reduce PFOS to acceptable levels, and equipment and surfaces may require replacement. It is expensive to clean and/or replace all affected equipment, especially if done all at once to prevent recontamination.

Five facilities, including 3 centralized waste treaters and 2 landfills, have used GAC followed by an ion exchange system, with ion exchange typically used for "polishing" or final pretreatment. Some facilities have abandoned the use of ion exchange units reportedly due to the success of GAC alone, the additional operational knowledge needed to successfully operate this system, and cost.

Landfill leachate volumes discharged to specific WWTPs have been reduced or eliminated at 4 WWTPs. Two WWTPs who accepted landfill leachate addressed the PFAS loading by limiting the volume of wastewater received each day from the landfill. These WWTPs conducted an informal maximum allowable headworks loading evaluation to determine the amount of leachate they can receive without passing through PFOS above the water quality value. Two other WWTPs stopped accepting landfill leachate altogether to reduce PFOS levels in their effluent.

Unable to find any PFAS use at their facilities, three industries investigated materials that they were receiving from other facilities for processing and concluded these items were their PFAS source. Two metal finishers concluded that parts they were accepting from specific customers were contaminated and stopped accepting them. An industrial laundry suspected that gloves from certain customers (likely metal finishers known to be sources of PFOS) and switched to dry cleaning the items to reduce PFOS in wastewater discharged to the WWTP.

Three facilities addressed PFOS-contaminated groundwater that was infiltrating into sanitary sewers by bulkheading sections of the sanitary sewer. In one case, contamination was near the end of a sewer line owned by the facility that has limited discharge and can be hauled for disposal. This sewer user subsequently lined the sanitary sewer to prevent infiltration of contaminated groundwater and is now planning to reroute the sewer to avoid the contaminated area. In the other situation, a large, vacant contaminated site was able to bulkhead a sewer segment in an area with significant contaminated groundwater infiltration. Two other facilities lined leaky sanitary sewers to prevent PFOS-contaminated groundwater from infiltrating. It should be noted that bulkheading and lining sanitary sewers will require maintenance and may be a temporary measure, since contaminated groundwater may travel and find a way to enter downgradient sanitary (or storm) sewers if the source is not cleaned up.

Two facilities' effluent was positively impacted by its source water being treated by GAC, one treated by their municipality and the other their own private well.

Two chrome platers are now using cyclodextrin-based adsorbent media to treat their effluent for PFOS.

One facility, a chrome plater, added powdered activated carbon or PAC to their bulk pretreatment tanks prior to their filter press. This same facility also benefited by having treatment installed on the water source used in their process.

A number of PFOS pretreatment technologies are unique in Michigan. The facility mentioned in the petroleum refining section under AFFF use above is using an in-situ treatment technology installed near an open-air stormwater drain to address contaminated stormwater before it enters a combined sewer system. One CWT is using foam fractionation to treat landfill leachate, which is followed by GAC, reverse osmosis, and an ion exchange system if test results show further pretreatment is needed. A landfill has installed a foam fractionation, GAC, and ion exchange system to treat their leachate. Another is processing waste AFFF with Super-Critical Water Oxidation, ion exchange resin, and GAC. One facility has not disclosed its pretreatment type.

EFFECTIVENESS OF IPP PFAS INITIATIVE

Through the IPP PFAS Initiative, EGLE has successfully identified WWTPs that received PFOS from industrial and non-domestic wastewater dischargers. EGLE has incorporated the IPP PFAS Initiative requirements into NPDES permits as they are reissued and effectively worked with WWTPs that have exceeded the PFOS water quality value to implement source reduction to decrease the PFOS concentrations in the influent, effluent, and biosolids/sludge. About two years into the start of the IPP PFAS Initiative, 28% percent of the IPP WWTPs were exceeding the PFOS WQV at some point in time and had identified at least one PFOS source. Seven years into the implementation of the IPP PFAS Initiative, the percentage of IPP WWTPs in exceedance of the PFOS WQV has dropped to 6% (Figure 9).

Figure 9. IPP WWTP Compliance Status with the PFOS Water Quality Value (WQV) December 2019 vs. January 2025



- WWTP Discharge in Compliance with PFOS WQV, but PFOS Source(s) Identified
- WWTP Discharge Not in Compliance with PFOS WQF and PFOS Sources Identified
- WWTP Discharge in Compliance with PFOS WQV and No Source(s) of PFOS Identified

Seven years into implementation, there is significant evidence to support that utilizing the established authorities under the IPP to identify and control industrial and non-domestic sources of PFAS (specifically PFOS) to WWTPs is highly effective at reducing the discharge of this pollutant into the environment. Key to this effort is the existence in Michigan of enforceable water quality values for PFOS, PFOA, PFBS, PFHxS, and PFNA, with PFOS as the regulatory driver. Source reduction efforts have resulted in substantial drops in PFOS concentrations being discharged at the WWTPs as shown in Table 3. Likewise, there have been corresponding reductions in PFOS concentrations in biosolids.

Municipal WWTP	PFOS, Effluent (ppt, most recent**)	PFOS Reduction in Effluent (highest to most recent)	PFOS, Biosolids (ppb, most recent**)	PFOS Reduction in Biosolids (highest to most recent)	Actions Taken to Reduce PFOS
City of Lapeer	5.1	99%	31	99%	Treatment (GAC) at source (1)
City of Wixom	3.1	99%	17	99%	Treatment (GAC) at sources (2)
City of Port Huron	13*	99%	17	78%	Elimination of PFOS sources (3)
City of Grand Rapids	6.4	98%	NA	NA	Treatment (GAC) at sources (13)
City of Bronson	2.67	99%	27	97%	Treatment (GAC) at source (1)
lonia Regional Utilities Authority	<2	99%	18	99%	Treatment (GAC) at source (1)
City of Kalamazoo	3.5	99%	NA	NA	Treatment (GAC) at sources (2), change water supply
Marquette County – K. I. Sawyer	<3.7	99%	47	99%	Eliminate leak AFFF, sewer cleaning, haul impacted wastes
City of Howell	4.6	96%	14	78%	Treatment (GAC) at source (1)
Great Lakes Water Authority	7	87%	3.8	68%	Treatment (GAC) at sources (16)
City of Belding	3.1	78%	1	56%	No longer accepting landfill leachate
City of Warren	7.61	52%	NA	NA	Treatment (GAC) at sources (3)

Table 3. Substantial Reductions in PFOS concentrations at IPP WWTPs

* Greater than Water Quality Value

**Data and information received as of January 30, 2025

Figure 10 shows the annual average PFOS concentration reductions from 2017 to 2024 for ten of the WWTPs in Table 3. The chart shows the impact of ongoing efforts to reduce PFOS in effluent as well as setbacks, such as spills or recontamination, that sometimes occurred. Note that the chart is shown in log scale so that the impacts at each WWTP may be viewed. Please be aware that this chart shows annual average PFOS concentrations for WWTPs that vary in annual average flow from 180,000 to 494,000,000 GPD and does not reflect loadings discharged. PFOS loadings discharged for a larger number of WWTPs are explored in Figure 11.





Annual average PFOS loadings for WWTPs that have exceeded WQVs have been reduced by 59% from 2019 to 2024 as shown in Figure 11. The number of WWTPs known to be discharging effluent greater than WQVs over that period increased from 24 to 29 as additional data was gathered. Figure 11 shows the impact of additional PFAS data collection, spills, and (most importantly) source reduction efforts over time. WWTPs with only one PFOS exceedance that was not replicated in ongoing monitoring and no source reduction was conducted to explain the exceedance were not included.

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Figure 11. PFOS Loading Reduction at IPP WWTPs Discharging to Surface Waters from 2018 to 2024



ONGOING EFFORTS AND NEXT STEPS

Implementation of IPP PFAS Controls

One tool a WWTP has to control the discharge of industrial wastewater containing PFAS is to develop technically based local limits. Local limits serve as concentration or mass-based effluent limit for various pollutants of concern which applies to the discharge of an industrial user to the sanitary sewer system. The development of a local limit for PFOS allows for a WWTP to determine how much PFOS loading from an industrial source it can receive and be in compliance with the WQV at their effluent discharge point. These local limits ultimately are enacted in an industrial user's discharge permit. Establishing a local limit also provides industrial sources a target level if additional pretreatment controls are needed prior to the discharge into the sanitary sewer. It is important to note that there are some IPP WWTPs which have been unable to pinpoint an industrial source of PFAS but are experiencing periodic exceedances of the PFOS WQV. In these situations, the development of a PFOS local limit is not warranted. These IPP WWTPs will need to continue their investigation of their collection system.

NPDES Permitting Strategy for PFAS

To address PFAS in municipal wastewater, EGLE developed a Municipal NPDES Permitting Strategy for PFAS. The goal of the strategy is to continue to identify, reduce, and eliminate PFAS at WWTPs. This strategy includes requirements for ongoing monitoring, reporting, and regulation of PFAS at WWTPs authorized to discharge under a NPDES permit. Going forward, EGLE will evaluate and adjust the permitting strategy according to ongoing research on this emerging contaminant as treatment technologies are improved and more effective best management practices are developed. The strategy was recently updated in November 2024. Read more about EGLE's <u>Municipal NPDES Permitting</u> <u>Strategy for PFAS</u>.

Land Application of Biosolids containing PFAS Interim Strategy

Through implementation of the IPP PFAS Initiative and additional statewide studies, the WRD was able to identify six WWTPs with high PFOS concentrations in their WWTP discharge and biosolids/sludge and prohibit land application from those facilities until sources of PFOS are controlled and concentrations in the residuals decrease. Screening of agricultural fields that received biosolids applications found significantly lower PFAS concentrations in various environmental matrices (soils, surface waters, etc.) associated with WWTPs with lower levels of PFAS in their biosolids as compared to those with elevated levels. Beginning in 2021, WRD has required WWTPs to sample their biosolids prior to land application and meet certain requirements. The strategy was updated in 2024 to include requirements for sampling prior to land application, notification of results to EGLE and farmers/landowners, and mitigation if necessary, depending on concentrations. Industrially impacted biosolids are prohibited from being land applied. To learn more about this effort and EGLE's statewide studies of municipal wastewater and sludge/biosolids, see the webpage Michigan Biosolids PFAS-related information and links.

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