Determination of PFAS Action Levels for Significant Industrial Users (SIUs)[1]

Maryland Department of the Environment
Wastewater Pollution Prevention and Reclamation Program
Pretreatment Section

[1] Per Protecting State Waters From PFAS Pollution Act - 2024's HB1153 and SB0956

Introduction:

Under the federal Clean Water Act, EPA established the National Pretreatment Program to control pollutants discharged by industrial and commercial facilities into municipal wastewater treatment plants (POTWs). These discharges, if not properly managed, can interfere with treatment processes, contaminate biosolids, or pass through untreated into receiving waters.

In Maryland, the EPA has delegated pretreatment authority to the Maryland Department of the Environment (MDE). MDE, in turn, requires certain local jurisdictions and/or POTWs to develop, implement, and enforce local pretreatment programs whenever they receive wastewater from Significant Industrial Users (SIUs). By definition, SIUs are industries that discharge large volumes of wastewater or release significant amounts of toxic pollutants into a municipal wastewater treatment system. These local programs issue permits to SIUs, set discharge limits, conduct inspections and sampling, and take enforcement action as necessary.

Currently, there are 20 approved pretreatment programs in Maryland, operating under MDE oversight, that directly regulate SIUs within their service areas. For jurisdictions and/or POTWs that do not have approved local programs, MDE itself issues and enforces state discharge permits for SIUs.

As of June 2025, there are 185 SIUs in Maryland. Of these, 182 are regulated under local pretreatment programs, while 3 are directly regulated by MDE.

The General Assembly of Maryland in 2024 passed the Protecting State Waters From PFAS Pollution Act (Senate Bill 0956; cross-filed with House Bill 1153) regarding the regulation of per- and polyfluoroalkyl substances (PFAS) related to significant industrial users (SIUs) operating under pretreatment permits that discharge wastewater into a sanitary sewer system. Per SB0956, MDE has identified SIUs that currently and intentionally use PFAS chemicals (as of 10/1/2024) and established PFAS monitoring and testing protocols for the identified SIUs (as of 1/1/2025). As of June 2025, the data collection from the identified SIUs are actively ongoing.

This document serves to establish PFAS action levels to address potential PFAS contamination from the identified SIUs. As a next step, MDE will coordinate with pretreatment programs and facilities to develop mitigation plans for SIUs that have a reasonable potential to exceed the action levels. Please note that additional and or tiered action levels may be further developed once SIUs have completed all required PFAS sampling.

Approach for Establishing Action Levels:

PFAS is a parameter that consists of several different constituents known as congeners. The two congeners, which are currently the primary focus of standard development, are perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). Establishing an action level for PFOA and PFOS in discharges from SIUs to wastewater treatment plants (WWTPs) is a crucial step in managing the risks posed by these persistent pollutants.

One of the key parameters in this process is the partition coefficient (K_d), which measures the extent to which these compounds partition between the solid phase (such as biosolids) and the aqueous phase (liquid fraction) during wastewater treatment. By integrating K_d values obtained from site-specific studies or relevant literature, regulators can more accurately predict how PFOA and PFOS will distribute within the WWTP environment, considering factors like total suspended solids (TSS) concentrations and sludge handling practices. This data-driven approach allows for calculating influent thresholds for SIUs, ensuring that discharges do not cause biosolids or effluent concentrations to exceed regulatory or health-based limits. Ultimately, setting action levels using partition coefficients fosters a more protective and scientifically sound framework for managing PFAS discharges and safeguarding environmental and public health.

Set the action level for PFOA and PFOS for the influent for the following goals:

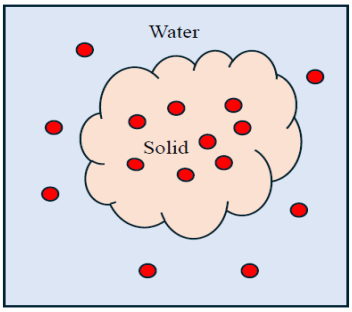
a. Concentrations of PFOA and PFOS in the biosolids should be maintained at levels below 20 ppb - MDE Biosolid Policy
b. Concentrations of PFOA and PFOS in the effluent should be maintained at levels below the NSDWR MCL (4 ppt) - EPA NDWR MCLs

Concept:

Partition Coefficient

$$K_d = \frac{C_s}{C_w}$$

Ratio of chemical distributed between a solid phase and a liquid phase at equilibrium



K_d & TSS Values Used in the Calculations:

$$K_d\,(PFOA) = \ 330\ L/Kg$$

$$K_d\,(PFOS) = 1630\ L/Kg$$

$$TSS\ Conc.in\ the\ Activated\ Sludge\ Unit = 4500\ mg/L$$

The values chosen for K_d were determined based on the median of values provided in various literature sources, as tabulated below (see after for references).

	Kd (L/Kg)	Reference
PFOA	330	*Avanati et al. (2014)*
	329	*Avanati et al. (2014)*
	162	*Avanati et al (2014)*
	545	*Avanati et al.(2012)*
	250	*Zhou et al.(2010)*
	393	Yu et al.(2009)
	357	Yu et al.(2009)
	330	**MEDIAN**
PFOS	1289	*Avanati et al. (2014)*
	2226	*Avanati et al. (2014)*
	1693	*Avanati et al (2014)*
	673	*Avanati et al.(2012)*
	4862	*Avanati et al.(2012)*
	2125	*Zhou et al.(2010)*
	1566	Yu et al.(2009)
	1522	Yu et al.(2009)
	1630	**MEDIAN**

K_d Literature References:

Kd values - PFOA & PFOS

Arvaniti, O. S., Andersen, H. R., Thomaidis, N. S., & Stasinakis, A. S. (2014). Sorption of Perfluorinated Compounds onto different types of sewage sludge and assessment of its importance during wastewater treatment. *Chemosphere*, 111, 405-411.

Arvaniti, O.S., Ventouri, E.I., Stasinakis, A.S., Thomaidis, N.S., 2012. Occurrence of different classes of perfluorinated compounds in Greek wastewater treatment plants and determination of their solid-water distribution coefficients. J. Hazard. Mater. 239-240, 24-31.

Yu, J., Hu, J., Tanaka, S., Fujii, S., 2009. Perfluorooctanesulfonate (PFOS) and perfluorooctanoic acid (PFOA) in sewage treatment plants. Water Res. 43, 2399-2408.

Zhou, Q., Deng, S., Zhang, Q., Fan, Q., Huang, J., Yu,G., 2010. Sorption of perfluorooctanesulfonate and perfluorooctanoate on activated sludge. Chemosphere 81, 453-458.

The values chosen for TSS were determined based on typical ranges of mixed liquor suspended solids (MLSS) for various treatment types commonly found at WWTPs, as tabulated below (see below for references).

Typical Observed TSS in Activated Sludge Units

Treatment Type	Typical MLSS (mg/L)
Conventional Activated Sludge	2,000 – 3,000
Extended Aeration	3,000 – 5,000
Oxidation Ditch	3,000 – 6,000
Sequencing Batch Reactor (SBR)	3,000 – 6,000

MEDIAN: 4500 mg/L

TSS Literature References:

TSS concentration

Metcalf & Eddy / AECOM (2014). *Wastewater Engineering: Treatment and Resource Recovery* (5th ed.).
Tchobanoglous et al. (2003). *Wastewater Engineering: Treatment and Reuse*.
U.S. EPA (2003). *Process Design Manual for Sludge Treatment and Disposal*.
Jenkins et al. (2003). *Manual on the Causes and Control of Activated Sludge Bulking, Foaming, and Other Solids Separation Problems*.

Calculations:

Objective A:

PFOA and PFOS levels in the biosolids should be maintained below 20 ppb (MDE recommended PFOA/PFOS levels in Biosolids)

PFOS :

If the action level for PFOS on the WWTP biosolids is 20 PPB, what would be the maximum concentration of PFOS allowed in the influent of the WWTP?

Approach:

Assume the Kd (PFOS) :1630 L/Kg

$Cs = Kd \times Cw$

$$Cw = \frac{Cs}{Kd} = \frac{20\ \mu g/kg}{1630\ L/kg} = 0.012\ \mu g/L = 12\ ppt$$

PFOA :

If the action level for PFOA on the WWTP biosolids is 20 PPB, what would be the maximum concentration of PFOA allowed in the influent of the WWTP?

Approach:

Assume the Kd (PFOA) :330 L/Kg

$Cs = Kd \times Cw$

$$Cw = \frac{Cs}{Kd} = \frac{20\ \mu g/kg}{330\ L/kg} = 0.0606\ \mu g/L = 61\ ppt$$

Objective B:

PFOA and PFOS levels in the WWTP effluent are to be maintained below 4 ppt (National Primary Drinking Water Regulations, Maximum Contaminant Levels[2])

PFOS :

If the desired level for PFOS in the WWTP effluent is 4 PPT, what would be the maximum concentration of PFOS allowed in the influent of the WWTP?

Approach:

Kd (PFOS): 1630 L/Kg
TSS .: 4500 mg/L = 0.0045 Kg/L

$C_{inf} = C_{eff}\ X\ (1 + Kd \times \mathbf{TSS})$

$$C_{inf} = 4\ ppt \times \left(1 + 1630\ \frac{L}{Kg} \times 0.0045\ \frac{Kg}{L}\right)$$

$$C_{inf} = 4\ ppt \times 8.3 = 33\ ppt$$

PFOA :

If the desired level for PFOA in the WWTP effluent is 4 PPT, what would be the maximum concentration of PFOA allowed in the influent of the WWTP?

Approach:

Kd (PFOA): 330 L/Kg
TSS .: 4500 mg/L = 0.0045 Kg/L

$C_{inf} = C_{eff}\ X(1 + Kd \times \mathbf{TSS})$

$$C_{inf} = 4\ ppt \times \left(1 + 330\ \frac{L}{Kg} \times 0.0045\ \frac{Kg}{L}\right)$$

$$C_{inf} = 4\ ppt \times 2.49 = 10\ ppt$$

[2] Final PFAS National Primary Drinking Water Regulation <https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas>.

Summary:

Maximum PFOS and PFOA allowed in the influent to achieve both objectives:

	PFOS (ppt)	PFOA (ppt)
Objective A	**12**	**61**
Objective B	**33**	**10**
Overall Selection	**12**	**10**

Note that parts per trillion (ppt) are equivalent to nanograms per liter (ng/L).

Conclusion:

To meet both objectives, the action levels for PFOS and PFOA are established for the SIU as follows:

- ☐ PFOS - 12 parts per trillion (ppt), and
- ☐ PFOA - 10 parts per trillion (ppt)

NOTE (1): This methodology is considered conservative because it does not take into account the potential mixing (dilution) that may arise from the introduction of non-industrial wastewater into the WWTP. The Department may consider applying dilution on a case-by-case basis if a facility provides calculations showing its flow and documented values of flows from non-industrial sources.

NOTE (2): The Department may also determine that different and/or additional action levels are appropriate once data collection for SIUs is completed after comparison of values across different facilities.