

INTERIM STRATEGY FOR LAND APPLICATION OF BIOSOLIDS AND INDUSTRIAL SLUDGES CONTAINING PFAS

Revised Version: March 1, 2024

The purpose for the revision is to expand the interim strategy to include industrial sludges in addition to municipal biosolids. This interim strategy does not apply to industrial liquid wastes (wastewaters) or mixed industrial wastes which often include industrial liquid wastes mixed with other wastes or wastewaters including industrial liquid sludges. These mixed wastewaters are often combined by WPDES permitted contractors. Furthermore, this interim strategy does not apply to industrial by-product solids.

1.0 Executive Summary & Goal

The purpose of this document is to provide an overview and interim strategy for municipal and industrial wastewater treatment facility (WWTF) operators handling per- and polyfluoroalkyl substance (PFAS) impacted biosolids and industrial sludges generated at wastewater treatment facilities (WWTF) in Wisconsin.

The Wisconsin Department of Natural Resources (DNR or department) intends to limit land application of municipal biosolids and industrial sludges that are significantly impacted by PFAS compounds through use of this interim strategy.

The department's overall goal is for WWTF operators to continue to reduce PFAS concentrations in biosolids and industrial sludges. PFAS source identification and reduction strategies are vital to reducing PFAS concentrations in biosolids and industrial sludges.

DNR will continue to share findings from Wisconsin's efforts with WWTF operators, the United States Environmental Protection Agency (EPA), and other states to support risk assessment efforts and the efforts related to the development of potential PFAS biosolids limitations and/or strategies both within the state and nationwide.

Implementing this interim strategy reduces risks to human health and the environment through source reduction of PFAS concentrations, thereby allowing the continuance of land application of biosolids and industrial sludges in Wisconsin.

2.0 Brief Background

A brief overview of biosolids, industrial sludges, PFAS, PFAS in municipal and industrial wastewater, and proposed PFAS criteria in Wisconsin is provided below. The intent of the overview is to provide basic information and a high-level summary of issues surrounding this interim strategy document.

2.1 Biosolids

Biosolids are nutrient-rich organic materials that are removed and further treated during the treatment of domestic sewage at WWTFs. Most often, biosolids are land applied for nutrient reuse after undergoing treatment and testing. During biosolids treatment, biosolids are stabilized and undergo significant reduction in pathogens prior to use as a soil amendment, conditioner, and/or fertilizer replacement product. Treatment processes differ at each WWTF, resulting in various forms of biosolids

such as liquids, cakes, or dried pellet-like products. In Wisconsin, approximately 85 percent of biosolids generated are beneficially reused.

DNR operates its biosolids program under delegated federal authority from EPA. Wisconsin's Biosolids Program conforms to 40 CFR Part 503 and is authorized and implemented by chapters 283, Wis. Stats., and NR 204, Wis. Adm. Code. EPA is required to review biosolids regulations biennially to evaluate and identify additional toxic pollutants that occur in sewage sludge and set regulations for those pollutants if sufficient scientific evidence demonstrates that the pollutants may harm human health or the environment. EPA is currently reviewing and conducting a risk assessment for additional pollutants, including specific PFAS compounds that have been identified in biosolids nationwide. DNR will continue to follow EPA's PFAS biosolids risk assessment activities, assist where possible, and follow-up in Wisconsin as necessary.

In general, DNR maintains that beneficial reuse of biosolids not impacted by industries via land application is an appropriate disposal approach. Biosolids from WWTFs not beneficially used as a soil amendment or fertilizer substitute are typically landfilled or incinerated. Landfilling and incinerating biosolids are often costly for ratepayers and eliminates the ability to reuse the nutrients and soil conditioning benefits that biosolids provide.

2.2 Industrial Sludges

Industrial "sludge" is defined in s. NR 214.03 (34), Wis. Adm Code, as the accumulated solids generated during the biological, physical, or chemical treatment, coagulation, or sedimentation of water or wastewater.

Examples of industrial sludges include: fibercake and lime sludges from various papermills, residuals from cheese and butter manufacturing operations, sludge from fish hatcheries, sludge from protein production, sludge from animal rendering operations, sludge from vegetable canneries and natural food production, and many others.

Commonly, industrial sludges permitted to be landspread include food processing sludges, pulp and papermill sludges, and various other sludges from processes that often have minimal metal and/or other pollutants. These industrial sludges are land applied to provide beneficial use to the soils through nutrient, carbon, and lime additions. Nutrient additions are sometimes required to be balanced with nitrogen needs of proposed crop harvest. Lime sludges are often used in place of liming fields with agricultural lime.

In the case of many papermill sludges, the nutrient value of many fiber-cakes and lime sludges is limited in the first and often the second year after application. In fact, many of these sludges require additional nitrogen after application. However, the nitrogen is available in later years as the wood fiber degrades and releases the nitrogen for crop uptake. Often, these types of sludges are studied to determine mineralization rates to predict when the nitrogen will become available. Regardless of when the nitrogen becomes available, these types of industrial sludges provide liming and additional carbon to the soil, improving soil health, and leading to improved harvest. Landfilling and incinerating industrial sludges are often costly for industries where costs are often then passed onto consumers. Landfilling and incinerating also eliminates the ability to reuse the nutrients and soil conditioning benefits that biosolids and industrial sludges provide.

2.3 PFAS

PFAS have been classified by EPA as emerging contaminant(s) at the national level. PFAS are a suite of over 4,000 chemicals historically used in thousands of applications throughout the industrial, food, and textile industries. Some historical uses include: firefighting foams, food packaging, mist suppressants associated with metal finishers and platers, and cleaning products. Materials containing PFAS were and continue to be used by many industries such as: plating, tanneries, or clothing manufacturers, where waterproofing may be required, or a protective film is needed in a manufacturing process.

In the United States, industry voluntarily phased out two of the most studied PFAS chemicals, perfluorooctanoic acid (PFOA) in 2015 and perfluorooctanoic sulfonate (PFOS) in 2002. However, due to the extremely stable nature of PFOA and PFOS, the compounds often continue to be found in materials and in environmental media at the industrial locations where they were once used. The carbon-fluorine bond that exists in PFAS is one of the strongest bonds in nature and is resistant to thermal, chemical, and biological degradation.

2.4 PFAS in Municipal Wastewater and Biosolids

PFAS have been identified at municipal WWTFs since the early 2000s. Some of the most frequently detected PFAS compounds in municipal wastewater and biosolids include PFOA and PFOS.

Widespread use of PFAS in consumer products and manufacturing/industrial processes, in conjunction with extreme resistance of the compounds to degradation, have resulted in the presence of PFAS in municipal wastewater and biosolids. It is important to note that WWTFs are not the source of PFAS, but rather WWTFs are a central point of collection and serve as a key location to control and potentially mitigate the release of PFAS into the environment. Effluents discharged from WWTFs to waters of the state and biosolids applied to the land for beneficial reuse have been identified as potential PFAS release pathways into the environment. This puts municipal WWTF operators in a key position to control the environmental spread of PFAS and an important participant in protecting both human and environmental health.

To date, PFOS has been identified to be the main regulatory driver for municipal WWTFs with elevated PFAS concentrations in the biosolids/sludge from WWTFs with known significant industrial sources. Based on Michigan data, short-chain PFAS are more frequently correlated with aqueous WWTF process flows, while long-chain PFAS were strongly associated with solids process flows. This indicates that long-chain PFAS, such as PFOS, are expected to accumulate in the biosolids/sludge and, if land applied at excessive concentrations, will likely accumulate in soils to some degree.

2.5 PFAS in Industrial Sludges

PFAS compounds have been identified at industrial production WWTFs and in the sludges resulting from wastewater treatment. Industrial wastewaters and sludges have also been a source of PFAS when discharged to municipal WWTFs. Certain industries, depending upon the specific nature of the specialized products manufactured, have larger contributions of PFAS to wastewater. For example, metal platers have been shown to be large contributors of PFAS. Some industries, while not large contributors as a whole, often use or used PFAS containing substances in their manufacturing processes.

Based on Michigan data, long-chain PFAS, such as PFOS, are expected to accumulate in industrial sludge and if land applied at excessive concentrations, will likely accumulate in soils to some degree.

2.6 PFAS Criteria in Wisconsin

Currently, there are no established federal criteria for PFAS in biosolids under 40 CFR Part 503. EPA is in the process of conducting a risk-based assessment of PFAS in biosolids. While DNR is supportive of these efforts, it is unknown whether actual numeric PFAS-biosolids/sludge criteria will be developed and promulgated by EPA in the next few years. Additionally, completion of the risk assessment does not guarantee that federal criteria will be subsequently promulgated.

Wisconsin has developed PFAS criteria for select PFAS compounds (e.g., PFOS and PFOA) in surface water and public drinking water. The department is also in the process of promulgating numeric groundwater quality standards for select PFAS compounds. Section NR 102.04(8)(d)1., Wis. Adm. Code, includes surface water standards for PFOS and PFOA. PFOS is considered a bioaccumulative chemical of concern (BCC), meaning it readily accumulates in living organisms such as people and fish. As a result, water quality criteria for PFOS in surface water are much lower than that for PFOA. This approach is mainly to protect people who may inadvertently ingest PFAS through fish consumption.

3.0 Proposed Interim Strategy for Land Application of Biosolids & Industrial Sludges

Until a fully vetted, EPA risk-based assessment is completed for PFAS in biosolids, DNR, similar to other states, is implementing the following strategy to assist WWTFs and landowners/farmers who make decisions relating to land application of biosolids with detectable concentrations of PFAS. The department anticipates that EPA's risk assessment may also provide instructive information to base future department industrial sludge disposal guidance. Note, the department expects that this interim strategy be used in conjunction with the requirements of chapters NR 204 and NR 214, Wis. Adm. Code.

The strategy primarily focuses on three-parts for success:

- PFAS Biosolids and Industrial Sludge Sampling. Sample and analyze biosolids and industrial sludge suspected to be impacted by PFAS prior to land application.
- PFAS Source Identification and Reduction. PFAS analytical results from biosolids and industrial sludge sampling will dictate the level of source identification and reduction efforts. Note, while PFAS sources are often associated with industrial manufacturing, other sources, including a variety of commercial businesses, have the potential to substantially contribute PFAS loading to WWTFs.
- Farmer and Landowner Communication. It is important that PFAS concentrations in biosolids and industrial sludge along with source reduction efforts are communicated with the landowner and/or farmer receiving the biosolids or industrial sludge. DNR will assist in providing analytical information and additional educational resources specific to PFAS in biosolids and industrial sludges in Wisconsin.

3.1 PFAS Biosolids and Industrial Sludge Sampling

Sampling of WWTF biosolids and industrial sludges for PFAS at those facilities suspected of potentially having elevated PFAS concentrations in their biosolids prior to land application is a key part of this strategy to mitigate risk.

3.2 Source Identification and Reduction

Sampling of biosolids and industrial sludge for PFAS prior to land application will determine if WWTFs should initiate a plan to identify sources of PFAS in their sludge. Reduction strategies can then be employed to reduce and potentially eliminate PFAS in the solids such that WWTF operators can continue to provide a reusable source of nutrients in the form of their biosolids or industrial sludge to landowners and/or farmers. Industries may need to look at product substitution or upstream treatment to prevent PFAS from accumulating in industrial sludge.

3.3 Farmer and Landowner Communication

Landowners and/or farmers may have concerns about accepting biosolids and industrial sludge due to PFAS impacts. See the template letter at the end of this document that may be used by the land applier prior to land application as part of communicating PFOS and/or PFOA concentrations to the owner of the land/farmer. An open dialogue with landowners and farmers is necessary as part of a WWTF's successful land application program. Quickly implementing PFAS reduction strategies will likely contribute to successful relationships with landowners and farmers into the future.

4.0 Proposed PFAS Sampling prior to Land Application

The department has begun to require permittee sampling for PFAS of municipal biosolids and industrial sludges in WPDES permit applications and/or WPDES permits, based on the results of the application sample results.

The department may be able to provide financial assistance for sample analysis for PFAS at municipal WWTFs.

5.0 Analytical Results/Action Items/Source Investigation

The following target thresholds are provided to assist WWTF operators through the decision-making process of how/when land application may occur and whether source reduction measures should be initiated. Collecting PFAS biosolids and industrial sludge samples and determining associated concentrations sooner than later will assist with these types of decisions. Note, these target thresholds are approximate values to be used by the department in conjunction with site-specific knowledge of the characteristics of the biosolids, the proposed disposal option, the characteristics of any proposed land application site (e.g., soil type, depth to groundwater, proximity to sensitive receptors like drinking water wells or surface water, etc.), type of method and equipment used for land application, etc.

Two primary thresholds were selected in developing this interim strategy:

Industrial Impacted Biosolids: From a dataset of municipal biosolids from Michigan WWTFs, data demonstrated that biosolids with PFOS concentrations greater than 150 ug/kg were highly impacted by industrial contributions of PFAS.

Considering Nitrogen Application Calculations. When calculating nitrogen application rates for municipal biosolids and comparing potential PFOS + PFOA concentrations to a variety of soils, it appears that a lower threshold of 50 ug/kg is appropriate at this time. This interim lower threshold will minimize disruptions to biosolids for beneficial reuse until PFAS source reduction measures are further implemented.

While the department is using the concentration of PFOS + PFOA within biosolids and acknowledging in some cases that industrial sludges could be applied at greater rates due to a lack of nitrogen availability in the sludge, the application rate is recommended to be no more than 8 tons per acre. Facilities exceeding an application rate of 8 tons per acre are recommended to discuss PFOS + PFOA concentrations and proposed tons per acre with the department.

The following details the department's approach when PFOS and PFOA impacts are identified in biosolids or industrial sludges at certain levels. Again, implementation of this approach shall also be in conformance with the requirements of chapters NR 204 and NR 214, Wis. Adm. Code.

5.1 Sum of PFOA and PFOS concentrations values generally at or above 150 µg/kg

- Biosolids or industrial sludge generally exceeding a 150 µg/kg PFOA/PFOS combined value are at levels of significant concern. As a result, the department should not approve new or transfer land application sites when combined values are above 150 µg/kg PFOA/PFOS. Future permits may include language prohibiting the authorization of the land application of biosolids and industrial sludges with PFAS concentrations above 150 µg/kg.
- Immediately notify DNR Staff.
- Sample effluent and investigate potential PFAS sources to develop a source reduction program, if the WWTF operators have not already done so.
- Arrange alternative treatment or disposal besides land application.

5.2 Sum of PFOA and PFOS concentration values generally above 50 µg/kg but below 150 µg/kg

- Immediately notify DNR Staff.
- Sample effluent and investigate potential PFAS sources to develop a source reduction program, if the WWTF operators have not already done so.
- To reduce overall loading to a land application site, reduce land application rates to no more than 1.5 dry tons per acre (or submit to the department for an approval of an alternative risk mitigation strategy in an updated sludge management plan prior to land application).
- Prior to initial land application at a site, provide the PFAS analytical results to the landowner/farmer (if different) along with DNR contact information and additional information related to PFAS work in Wisconsin. See template letter at the end of this document for assistance with such communication.
- If land applied, track the cumulative application rates on each land application site and report to the department.
- WWTF operators may decide it appropriate to arrange for alternative treatment or disposal of solids.

5.3 Sum of PFOA and PFOS concentration values generally above 20 µg/kg but below 50 µg/kg

- If over a median concentration of 20 µg/kg but below 50 µg/kg, implement PFAS source investigation and reduction efforts as well as effluent sampling. The 20 µg/kg median value is based on Michigan biosolids data collected from the sludge of approximately 40 municipal WWTF.
- Prior to initial land application at a site, provide the PFAS analytical results to the landowner/farmer (if different) along with DNR contact information and additional information sources related to PFAS work in Wisconsin. See template letter at the end of this document for assistance with such communication.

- Track application rates on each land application site.
- If proposed application rate is greater or equal to eight tons per acre, consult with the department to detail concentrations and recommended tonnages per acre.

5.4 Sum of PFOA and PFOS concentration values generally below 20 µg/kg

- If below 20 µg/kg, land apply per normal approach consistent with chapter NR 204 or NR 214, Wis. Adm. Code.

5.5 Future PFAS Concerns and Activities

Additional actions and activities including addressing other PFAS analytes, sampling requirements, limits, and notifications may be appropriate as new information becomes available.

6.0 Identifying Potential Sources of PFAS Impacting Biosolids and Industrial Sludges

There are potentially many sources of PFAS within biosolids and industrial sludges, so source identification is necessary to ensure biosolids and industrial sludges are protected from industrial and commercial PFAS contamination. The department is willing to partner with WWTF operators wanting to establish a PFAS source identification and reduction program and stands ready to assist if requested.

6.1 Consider PFAS Sources in Biosolids

Common industrial sources of PFAS contributions into biosolids include: metal finishers, landfills (leachate), paper manufacturing, mixed manufacturing, paint manufacturing, leather tannery facilities, commercial industrial laundries, chemical manufacturers, centralized waste treaters, and a variety of miscellaneous sources.

Aqueous film forming foam (AFFF) used as fire-fighting foam can also have lingering impacts as a source of PFAS as residuals within sewers or from infiltration into the sewer collection system.

For small WWTFs, small commercial operations including operations that appear innocuous, such as floor mat cleaning, commercial laundries, and truck washes, may be PFAS sources and identified as potentially impacting PFAS concentrations in biosolids.

6.2 Consider PFAS Sources in Industrial Sludges

Industrial sludges may have several PFAS sources within the industrial facility's production line. There are many potential uses for PFAS within industry, depending on the type of industry and the manufacturing processes employed. Industrial facilities will desire to replace PFAS chemicals and processes (source reduction) to reduce PFAS concentrations in their sludge to reduce overall PFAS discharge to the environment.

7.0 Next Steps

In addition to implementing the measures discussed within this Interim Strategy for the land application of biosolids and industrial sludges containing PFAS, DNR has identified the following next steps as the department expands implementation of the strategy in the future:

- Continue supporting EPA's effort to conduct a robust risk-based evaluation of PFAS in biosolids.
- Collaborate with Michigan and other states on strategies dealing with PFAS in biosolids.

- Review available documentation to identify historical land application sites associated with previous use of PFOS and PFOA.
- Continue to implement PFAS pretreatment initiatives and control strategies at WWTFs.
- Continue the evaluation of PFAS in biosolids and industrial sludges including additional testing at WWTFs and land application sites as appropriate and as resources allow.
 - WPDES permit applications will require biosolids and/or industrial sludge sampling.
 - WPDES permits will include PFAS monitoring requirements for biosolids and industrial sludges, if needed to supplement permit application sampling.
 - The department will offer to work with WPDES permitted municipal WWTFs to collect biosolids samples and assist with the cost of initial PFAS monitoring.
- Continue working with stakeholders to evaluate the fate and transport of PFAS in the environment.
- Update this document as new information becomes available.

8.0 Contacts

For questions related to this interim strategy or other PFAS Water Quality Initiatives please contact:

Fred Hegeman, P.E., Biosolids & Industrial Sludge – Frederick.Hegeman@wisconsin.gov

Amy Garbe, P.E., Compliance & Sampling Techniques – Amy.Garbe@wisconsin.gov

Nate Willis, P.E., Permit Implementation & Treatment Systems – Nathaniel.Willis@wisconsin.gov

9.0 Other Resources

Other resources and data can be found at the following links:

[PFAS | Wisconsin DNR](#)

[Risk Assessment of Pollutants in Biosolids | US EPA](#)

[Michigan Interim Strategy – Land Application of Biosolids Containing PFAS \(2022\)](#)

[Michigan Interim Strategy – Land Application of Biosolids Containing PFAS \(2021\)](#)

[Initiatives to Evaluate the Presence of PFAS in Municipal Wastewater and Associated Residuals \(Sludge/Biosolids\) in Michigan \(2020\)](#)

[Other Michigan Biosolids PFAS Related Information and Links](#)

Biosolids Communication Template Letter

Date:

[Farmer Name / Landowner Name]:

[Address]:

Subject: Biosolids Application Notification

[Generator Name] is preparing to land apply biosolids on land you own and/or farm. Recently there has been a great deal of information in the news about Per- and polyfluoroalkyl substances (PFAS) in our environment. The intent of this letter is to provide a brief update on what is being done to control these substances in biosolids, our recent biosolids sample results, and where additional information can be obtained.

PFAS are a large group of chemicals used for decades in some industrial, commercial, and domestic settings and are found worldwide. Typical materials or processes that use or contain PFAS include firefighting foam, chrome plating, cookware coatings, waterproofing on clothing and carpet, and even food wrappers. Some PFAS, including Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), have been phased out of production in the United States and are no longer approved for use. Even though they have not been used for years, their legacy remains given their strong chemical bonds resistant to degradation in the environment. Wastewater Treatment Facilities (WWTFs) do not generate PFAS chemicals, though they may receive discharges from certain industrial or commercial sources who have used PFAS.

As a result, PFAS may be found in treated wastewater and biosolids. Some of those PFAS are known to travel through water, can linger in the environment, and have the potential to impact the soil, water, and crops. PFAS has been found to build up in the tissue of fish and wildlife. Studies are underway to determine the impact of PFAS on animals, animal products, and crops.

Currently, the United States Environmental Protection Agency is conducting a risk-based assessment of PFAS in biosolids. Until that is completed, the Wisconsin Department of Natural Resources, Water Quality Bureau (which regulates the land application of biosolids) has developed an interim strategy working with WWTFs to implement an approach, focusing on identifying and reducing significant sources of PFAS entering a WWTF and preventing impacted biosolids from being land applied.

Should you have additional questions concerning Wisconsin's strategy to monitor and reduce sources of PFAS in biosolids and industrial sludges, please do not hesitate to reach out to Statewide Residuals Coordinator, Fred Hegeman, via e-mail at Frederick.Hegeman@wisconsin.gov.

Our most recent PFOS plus PFOA testing result is: **[Result number] in parts per billion (ppb)**

Date: _____

Note, presently DNR's threshold concentration for PFOS plus PFOA in biosolids to be considered significantly impacted is 150 ppb.

Industrial Sludge Template Letter

Date:

Farmer Name / Landowner Name:

Address:

Subject: Industrial Sludge Land Application Notification

(Please add generator name) is preparing to apply industrial sludge on land you own and/or farm. Recently there has been a great deal of information in the news about Per- and polyfluoroalkyl substances (PFAS) in our environment. The intent of this letter is to provide a brief update on what is being done to control these substances in industrial sludge, our recent industrial sludge sample results, and where additional information can be obtained.

PFAS are a large group of chemicals used for decades in some industrial, commercial, and domestic settings and are found worldwide. Typical materials or processes that use or contain PFAS include firefighting foam, chrome plating, cookware coatings, waterproofing on clothing and carpet, and even food wrappers. Some PFAS, including Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), which is commonly found in biosolids and in some particular industrial sludges, have been phased out of production in the United States and are no longer approved for use. Even though they have not been used for years, their legacy remains given their strong chemical bonds resistant to degradation in the environment.

Some of those PFAS are known to travel through water, can linger in the environment, and have the potential to impact the soil, water, and crops. PFAS has been found to build up in the tissue of fish and wildlife. Studies are underway to determine the impact of PFAS on animals, animal products, and crops.

Currently, the United States Environmental Protection Agency is conducting a risk-based assessment of PFAS in biosolids and other sludges. Until that is completed, the Wisconsin Department of Natural Resources, Water Quality Bureau (which regulates the land application of biosolid and industrial sludges) has developed an interim strategy working with WWTFs to implement an approach, focusing on identifying and reducing significant sources of PFAS entering a WWTF and preventing industrially impacted biosolids from being land applied.

Should you have additional questions concerning Wisconsin's strategy to monitor and reduce sources of PFAS in industrial sludges, please do not hesitate to reach out to Statewide Wastewater Residuals Coordinator, Fred Hegeman, via e-mail at Frederick.Hegeman@wisconsin.gov

Our most recent PFOS plus PFOA testing result is: **[Result number] in parts per billion (ppb):**

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