Michigan Biosolids Team

Biosolids Facts – Supplement 4

PFAS Testing in Biosolids

Michigan's investigation of PFAS chemicals, from health impacts and testing sites to standards and recommendations, are available and frequently updated at https://www.michigan.gov/pfasresponse. There are many unknowns about PFAS testing, detection, and treatment. Research will need to involve universities, state and federal agencies as work on detection and reduction of PFAS sources continues nationwide.

Quick Facts

- Biosolids are the treated solids from wastewater treatment facilities and are regulated for quality and disposal by the State of Michigan
- Biosolids' nutrient content makes them a beneficial soil amendment for farmland being used for crop production, by recycling nutrients and enhancing soil health
- Land application is a more environmentally friendly disposal option for biosolids than the other two legally permitted disposal methods of incineration or landfill disposal
- PFAS are a class of more than 5,000 chemicals used in many industrial and manufacturing processes, however many of these chemicals including Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) are no longer used in the U.S.
- The U.S. Department of Health and Human Services has measured declining levels of PFOS and PFOA in U.S. human blood samples since 1999 by 80% and 60% respectively, but because there are studies that have linked PFAS chemicals to health concerns, the State of Michigan is taking proactive actions to test for and work to reduce PFAS sources and contamination
- PFAS chemicals are not produced at wastewater treatment facilities but may be sent there from industrial, military, or other domestic and nondomestic sources
- Wastewater treatment facilities are working with the State of Michigan to test for and reduce PFAS chemicals in water and biosolids before they leave the treatment facilities
- Wastewater treatment facilities are working with the State of Michigan to control sources of PFAS entering into sanitary sewer systems
- The State of Michigan is proactively testing farmland where biosolids have been applied and crops grown on those fields to determine if PFAS chemicals are present and whether they pose any risk to drinking water sources, livestock, or crops
- The State of Michigan is also developing standards for PFAS limits in municipal drinking water, surface water, and groundwater, soil cleanup criteria, and interim guidance for land application of biosolids until the EPA establishes a risk-based standard

Note: Biosolids treatment and land application are regulated by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), formerly known as the Department of Environmental Quality (DEQ). More information about requirements for biosolids generators and land appliers can be found at:

Michigan Water Environment Association: All About Land Application of Biosolids (https://www.mi-wea.org/biosolids_-_land_application.php)

Part 31, Natural Resources and Environmental Protection Act (NREPA), Sec. 324.3131 et. seq. (http://legislature.mi.gov/doc.aspx?mcl-451-1994-II-1-31)

Part 24 Rules of the Michigan Administrative Code (http://dmbinternet.state.mi.us/DMB/ORRDocs/AdminCode/312_10290_AdminCode.pdf)

Title 40 of the Code of Federal Regulations (CFR), Part 503 (https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr503_main_02.tpl)

What are PFAS?

Per- and Polyfluoroalkyl substances (PFAS) are a class of more than 5,000 chemicals used for decades in firefighting foam, chrome plating, stain resistance, non-stick cookware, fire retardant and waterproofing on clothing, carpet, textiles, and even food wrappers. These chemicals travel easily through water, do not break down in the environment, and can build up over time in human and animal tissue. According to the Agency for Toxic Substances and Disease Registry, health risks include pregnancy complications, thyroid disease, immune deficiencies, and cancer, though human blood serum levels of Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) tracked in the United States have dropped by 80% and 60% respectively since 1999, suggesting less exposure to those two chemicals as U.S. manufacturers have phased them out.[1]

Because PFAS chemicals have been used in so many products and industrial processes for so long, concentrations can build up in the water that flows through locations where these products end up, such as landfills and wastewater treatment facilities. PFAS chemicals do not originate from these facilities, but because they receive them, EGLE has made landfills and wastewater treatment facilities priorities for testing and actions to reduce human exposure. This factsheet briefly summarizes actions taken by wastewater treatment facilities and many others as the state works to address the emerging concerns about PFAS contamination and associated health risks.

PFAS Testing of Wastewater Treatment Facilities and Biosolids

Wastewater treatment facilities are closely regulated by EGLE. These facilities must adhere to strict standards both for the water quality of their water discharges into water bodies, and the solids they extract and treat, called biosolids. Biosolids are a source of nutrients that can provide beneficial amendments to soil for crop production on farms. EGLE regulates where biosolids can be applied to protect both water quality and human health. Without the ability to

[1] Agency for Toxic Substances and Disease Registry, Department of Health and Human Services, retrieved from www.atsdr.cdc.gov.

land apply biosolids, wastewater treatment facilities' only other disposal options are to send biosolids to landfills or to incinerate them, both of which can present a heavy financial[2] and environmental[3] burden on communities and residents who pay water utility bills. Over the last five years, wastewater treatment facilities in Michigan have land applied an average of 89,000 dry tons of biosolids on approximately 21,000 acres of farmland. This represents only a tiny fraction of Michigan's total farmland area of nearly 10 million acres, but where it is applied, it saves farmers $12 million annually in fertilizer costs, and saves wastewater facilities nearly $8 million annually in disposal costs.[4]

Because PFAS chemicals are easily transported by water, they may also flow into septic tanks and wastewater treatment facilities, where they can be conveyed into the environment through the treated effluent and biosolids. The persistent nature of PFAS chemicals means that normal wastewater treatment does not remove PFAS. This becomes a concern not only because wastewater effluent can transport PFAS chemicals to surface water which may be used as a drinking water source, but also because they can enter the environment through treated biosolids that are land applied for beneficial use as a nutrient source for crop production on farms.

The state of Michigan has organized a multi-agency team to track PFAS levels and movement, called the Michigan PFAS Action Response Team (MPART). The MPART team directed the 95 Michigan municipal wastewater treatment facilities with Industrial Pretreatment Programs (IPPs) to screen their industrial users for PFAS in the wastewater coming into these facilities, sample effluent and biosolids, and begin a monitoring program to reduce and control PFAS in the water and solids exiting these facilities. These IPP programs have shown significant success in detecting and reducing PFAS sources from entering wastewater treatment facilities, and work is continuing to improve their standards and processes for chemical removal.[5]

Most wastewater treatment facilities that tested for PFAS detected levels below the state's new PFAS water quality standards in their effluent (see below, on page 4). Fifteen facilities found PFAS levels higher than state water quality standards in their effluent, so they worked with EGLE staff to reduce industrial sources, set local discharge limits, and continue to monitor PFAS levels on a quarterly basis. An additional seven facilities had high enough concentrations to require them to take further steps for source reduction, including monthly monitoring, biosolids testing, and in some cases restricting biosolids land application until PFAS concentrations were reduced.[6]

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[2] Beecher, N. 2011. Options for Biosolids Use or Disposal in New England and Eastern Canada. North East Biosolids & Residuals Association. Retrieved from: https://static1.squarespace.com/static/54806478e4b0dc44e1698e88/t/54a6ede5e4b039f26ff3fcd6/1420226021916/InfoUpdateBsldsOptionsApr11.pdf.

[3] U.S. Environmental Protection Agency, 1995. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Chapter 2.2: Sewage Sludge Incineration. Retrieved from: https://www3.epa.gov/ttn/chief/ap42/ch02/final/c02s02.pdf.

[4] Summary by Steve Mahoney at the Michigan Department of Agriculture and Rural Development Environmental Stewardship Division, 517-284-5619, mahoneys@michigan.gov.

[5] Michigan's Industrial Pretreatment Program, https://www.michigan.gov/egle/0,9429,7-135-3313_71618_3682_3683_3721---,00.html.

[6] EGLE presentation, February 2019, http://www.viethconsulting.com/projects/presentations.php?pid=517807.

Additionally, to determine whether there were any biosolids land application sites of concern, MPART worked with AECOM, an engineering and lab service firm, to conduct soil, surface water, and groundwater sampling and testing on fields in several locations where biosolids have been land applied to determine whether and where PFAS might stay in the soil and be taken up by crops, or run off or leach into nearby water sources. At the majority of testing sites, PFAS levels were very low or undetectable. At field investigation sites from a wastewater treatment facility with one of the highest concentrations of PFAS detected in the state's testing, a small number of fields had PFOS levels in soil samples above 100 parts per billion (ppb).

Surface water and groundwater testing demonstrated that while PFAS can move from the soil into surface water and shallow groundwater on and near application sites, it has not been shown in MPART's field testing to move to deeper groundwater aquifers where residential and agricultural wells are typically located. MPART and AECOM are continuing site testing through 2019 at locations where biosolids from other wastewater facilities have been land applied, both recently and in past years when concentrations of PFAS chemicals might have been higher before they were phased out from industrial use. The state is also in the process of developing interim guidance for PFAS limits in biosolids to help wastewater treatment facilities better understand how to address the chemicals entering their systems, and what options they have for disposal if high concentrations of PFAS chemicals enter their treated biosolids.

What is the Michigan PFAS Action Response Team doing about other PFAS sources?

Two PFAS chemicals once commonly used in industrial processes, Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), have been found in a wide variety of products and media. The North East Biosolids & Residuals Association (https://www.nebiosolids.org/pfas-biosolids) summarized several studies that found PFAS chemicals in countries around the world:

Cosmetic foundation in Denmark in 2017: up to 2,370 parts per billion (ppb) PFOA[7]
Pork liver in Taiwan in 2010-2011: up to 283 ppb PFOA[8]
Dust in Ohio and North Carolina daycare centers in 2000-2001: 142 ppb PFOA mean[9]
Household food waste in Switzerland in 2003-2004: 6 ppb PFAS mean[10]
U.S. human blood serum in 2012: 2 ppb PFOA and 9 ppb PFOS mean[11]
Garden soil in Minnesota in 2010: 0.36 ppb PFOA mean[12]

The U.S. Environmental Protection Agency (EPA) recommended a lifetime health advisory limit of 70 parts per trillion (ppt) or nanograms per liter (ng/L) in drinking water for two of the most common PFAS chemicals: PFOA and PFOS. Michigan has set surface water quality standards

[7] *Risk Assessment of Fluorinated Substances in Cosmetic Product* (Vol. 169). (Brinch, Anne; Astrup Jensen, Allan; Christensen, Frans, Ed.) Denmark: The Danish Environmental Protection Agency.
[8] Chen, Wen-Ling; Bai, Fang-Yu; Chang, Ying-Chia; Chen, Pau-Chung; Chen, Chia-Yang, *Concentrations of perfluoroalkyl sybstances in foods and the dietary exposure among Taiwan general population and pregnant women*, Journal of Food and Drug Analysis, p. 994-1004.
[9] Strynar, MJ; Lindstrom, AB, *Perfluorinated Compounds in House Dust from Ohio and North Carolina, USA*, Environ Sci Technol, 2008, p. 3751-6.
[10] Brandli, Rahel Christine*, Organic Pollutants in Swiss Compost and Digestate*, 2006.
[11] National Health and Nutrition Examination Survey, 2012.
[12] Scher, D.; Kelly, J.; Souther, K.; Korinek, J.; Messing, R.; Souther, L.; Yingling, V. Levels of perfluorochemicals (PFCs) in residential soil, water and garden produce in communities with contaminated groundwater. Minnesota Department of Health, 2012. Poster.

of 11 ppt for PFOS and 420 ppt for PFOA used for drinking water, and surface water standards for non-drinking water of 12 ppt of PFOS and 12,000 ppt for PFOA.[13] Since PFAS chemicals can bioaccumulate in animal tissues, fish consumed by people from those surface waters can carry higher levels of PFAS than would be safe for frequent consumption. The low surface water standards for non-drinking water are set at a protectively low level to prevent contamination through fish consumption. EGLE has set soil cleanup standards to protect the groundwater-surface water interface at 0.24 ppb for PFOS and 10,000 ppb for PFOA.[14] Enforceable drinking water limits for several PFAS chemicals are being developed for municipal water suppliers.[15]

According to EPA, while U.S. manufacturers have phased out PFOS and PFOA, residues from previous uses and from imported materials where PFOS and PFOA are still used, can be released into the environment. The most significant sources of PFAS chemicals often come from military bases and refineries where firefighting foam has been used, chrome platers and metal finishers, and paint manufacturers and products and materials associated with these PFAS sources may be found in landfills. MPART tested all municipal water supplies in the state for PFAS, plus many private wells, lakes, streams, and land sites. High concentrations have been found at two drinking water sites which were given alternative supplies, and on several lakes and streams where "Do Not Eat Advisories" have been issued for fish consumption (and one for deer consumption). More information about Michigan's testing and results are available at https://www.michigan.gov/pfasresponse.

Addressing Other PFAS Exposure Risks

The primary human health risk for PFAS exposure is through drinking water, which is why the MPART team focused their initial efforts on testing municipal supplies and source waters. However, two dairies in the U.S. – one in Maine and one in New Mexico – found high enough levels of PFAS in their milk that they stopped milk sales and in the case of the New Mexico dairy, depopulated the herd. The New Mexico dairy was located in close proximity to an Air Force base where PFAS firefighting foam was extensively used and where the PFAS had entered the drinking water supply used by the farm family and their cattle. The Maine dairy's exposure was less clear: their fields received land application of both wastewater treatment biosolids and paper mill waste, and Maine officials are still investigating sources and whether the cattle's exposure came through drinking the water near land application sites or eating the forage crops grown on those fields.

The MPART team is communicating with both states to get information about their investigations and research on these exposures, and has requested that the U.S. Department of Agriculture, the Food and Drug Administration, and EPA provide case-by-case assistance if any instance of high PFAS concentration is found where it might cause human health impacts. Additionally, the MPART team and AECOM are working with researchers at Michigan State University to determine how much PFAS chemicals in the soil might be taken up into crops where biosolids applications are typically made, such as field corn.

[13] Michigan PFAS Response, https://www.michigan.gov/pfasresponse/0,9038,7-365-86510_88079-476131--,00.html.
[14] Michigan Generic Cleanup Criteria Table, https://content.govdelivery.com/accounts/MIDEQ/bulletins/1f9448c.
[15] EGLE Press Release, June 27, 2019, https://www.michigan.gov/egle/0,9429,7-135-3308_3323-500772--,00.html.

Currently no regulations exist for food limits on PFAS chemicals, though the European Food Safety Authority (EFSA) has set a human consumption-based "tolerable daily intake" of 150 ng per kg of body weight for PFOS and 1500 ng per kg of body weight of PFOA.[16] The Food Standards Australia New Zealand Authority (FSANZ) published guidelines for investigation of PFAS exposure in a variety of food products:

Fish and seafood: 3.1 – 65 µg PFOS and 25 - 520 µg PFOA per kg body weight
Meat: 3.5 µg PFOS and 28 µg PFOA per kg body weight
Milk: 0.4 µg PFOS and 2.8 µg PFOA per kg body weight
Eggs: 11 µg PFOS and 85 µg PFOA per kg body weight
Fruit: 0.6 µg PFOS and 5.1 µg PFOA per kg body weight
Vegetables: 1.1 µg PFOS and 8.8 µg PFOA per kg body weight[17]

These recommendations are not consumption limits, but rather the point at which health agencies are directed to investigate foods further to determine sources and potential pathways for contamination. FSANZ notes in their report that food consumption is a highly unlikely source of PFAS contamination in humans because most food products are gathered from multiple sites and sources, which would reduce exposure. The Michigan Department of Agriculture and Rural Development (MDARD) has similarly found food is unlikely to be a source of PFAS contamination, but recommends that people who frequently grow, water and eat their own food ensure their water sources do not contain high levels of PFAS, and that pets and livestock should not drink water with higher PFAS levels than that provided for people.

Conclusion

Questions about the MPART team and its actions can be directed to:
The State of Michigan Environmental Assistance Center: (800) 662-9278 or deq-assist@michigan.gov.

If you are concerned about exposure to PFAS in your drinking water, please contact the Michigan Department of Health and Human Services (MDHHS) Toxicology Hotline: (800) 648-6942.

Questions about Michigan's biosolids program and regulation can be directed to:
Mike Person, Michigan Department of Environment, Great Lakes and Energy Biosolids Program, Statewide Program Coordinator: (989) 297-0779, personm@michigan.gov, or www.michigan.gov/biosolids.

To reach regional staff in the Biosolids Program, see:
https://www.michigan.gov/documents/deq/wrd-biosolids-staff_402800_7.pdf.

[16] https://www.efsa.europa.eu/en/press/news/080721.
[17] https://www.health.gov.au/internet/main/publishing.nsf/content/2200FE086D480353CA2580C900817CDC/$File/Consoldiated-report-perflourianted-chemicals-food.pdf.

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