# JOURNAL

OF THE NEW ENGLAND WATER ENVIRONMENT ASSOCIATION

VOLUME 53 NUMBER 4 / ISSN 1077-3002 WINTER 2019

## FEATURES

Two green giants—achieving cost-effective CSO control through green infrastructure

Emerging regulatory controls on PFAS

Tips and tricks for establishing a thrifty culvert management program

On the road to a sustainable infrastructure: Part 1—defining our responsibilities

NEWEA
WORKING FOR WATER QUALITY

# Emerging regulatory controls on PFAS

NED BEECHER, North East Biosolids and Residuals Association, Tamworth, New Hampshire

**ABSTRACT** | Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are contaminants of emerging concern. EPA has developed an Action Plan for PFAS but has not yet set limits under the Safe Drinking Water or Clean Water acts, so several states are establishing preliminary concentration limits that are creating challenges for the wastewater and biosolids industry. The article examines current state regulatory trends and, specifically, limits established by New Hampshire and Maine and the impacts of those regulations. Key concepts are established as essential in assessing these chemicals, including human health impacts as well as feasibility, liability, cost, and benefit aspects. Several examples of unintended impacts to the wastewater and biosolids profession are referenced, and regulatory trends in other states are summarized. Summary data on PFAS levels measured in waters, wastewater, soils, and residuals are also provided.

**KEYWORDS** | Contaminants of emerging concern (CEC), PFAS, regulatory limits, biosolids recycling, land application, health impacts, NEBRA

## INTRODUCTION

Concerns about perfluorinated and polyfluorinated alkyl substances (PFAS) continue to expand in New England and across the world. PFAS are persistent and sometimes bioaccumulative chemicals that provide stain, water, and grease resistance to fabrics and other substrates and that also have surfactant properties beneficial to many products and processes. These substances have been in common use since the 1950s and are found in trace amounts in the environment worldwide. Included in this family of substances are so-called long-chain (more than seven or eight carbons in the chain) chemicals of increasing concern, including perfluorooctane-sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluoroheptanoic acid (PFHpA), perfluorononanoic acid (PFNA), perfluorohexanesulphonic acid (PFHxS), and perfluorodecanoic acid (PFDA). PFOA and PFOS, the two most common, best-researched, and most concerning PFAS chemicals, were phased out in the 2000s. Included in the PFAS family are chemicals that have been introduced to replace PFOA and PFOS: GenX, Adona, and short-chain PFAS such as perfluorobutane sulfonic acid (PFBS) that are considered less toxic and persistent in the human body.

In 2019, regulatory actions in Maine and New Hampshire, aimed at reducing potential human health impacts from PFAS, have directly affected wastewater and biosolids programs. The ripple effects from those actions continue to propagate. Meanwhile, actions in a few other states are also raising concerns for water quality professionals. Municipalities and wastewater utilities and their biosolids programs are facing uncertainties related to potential liability and potential significant unforeseen costs as biosolids reuse practices and disposal alternatives become more restrictive.

Biosolids recycling to soils on farms and other lands has long benefited soils, crops, landowners, communities, and local economies. Based upon the longevity of PFAS in the environment and the growing concerns regarding the long-term health impacts of these substances, the benefits of biosolids recycling sometimes get lost. In the absence of EPA limits, a few states have begun to legislate and aggressively apply conservative standards aimed at reducing human exposures to PFAS. These regulations are having unintended impacts on the biosolids recycling industry. Some states' regulatory agencies, including most New England states, are developing limits for PFAS in drinking water, other waters, and for contaminated site cleanups well in advance of any action by EPA. These local numerical standards are being developed based on conservative human health risk calculations and without consideration of feasibility, costs, and benefits customarily used in developing maximum contaminant levels (MCLs) under safe drinking water programs (and that are required by the federal Safe Drinking Water Act). In Massachusetts, Vermont, and especially New Hampshire, the MCLs being developed for PFAS are within 10 to 20 parts per trillion (ppt) of the analytical method reporting limits (generally 2 ppt) and close to concentrations commonly found in wastewaters and septic systems, often measuring in the singles to tens of parts per trillion. In Maine, regulatory screening levels for PFAS—2.5 parts per billion (ppb) for PFOA and 5.2 ppb for PFOS—are so low that almost all biosolids tested exceeded the Maine target levels. Just to emphasize the minute nature of these limits, 1 ppt is equivalent to 1 second in 31,700 years. A ppb is 1 second in 31.7 years. Analytical abilities to accurately measure such tiny amounts remain challenging, with reporting levels at 2 ppt for clean drinking water. Analyses of wastewater and solids are even more challenging and have higher reporting limits.

This article aims to provide a greater understanding of impacts to inform regulatory decisions for these ubiquitous chemicals while maintaining wastewater and biosolids management options.

## HEALTH IMPACTS STILL DEBATED

Water quality professionals—operators and engineers—must implement protections of public health and the environment. They rely on human health studies, toxicology calculations, risk assessments, and regulations that guide their work. PFAS are the most vexing contaminants of emerging concern (CECs), with health studies indicating "probable" or "possible" links that "may be" associated to negative health outcomes. Widely divergent proposed numerical standards for PFAS in drinking water indicate the levels of uncertainty related to PFAS toxicology. For example, Canada finalized PFOA and PFOS drinking water standards at 200 and 600 ppt this year, while New Hampshire set its at 11 to 18 ppt (Table 1). Massachusetts Department of Environmental Protection (MassDEP), which is considering an MCL of 70 ppt for six PFAS combined, summarizes the health impacts of PFAS this way:

> Studies indicate that exposure to sufficiently elevated levels of certain PFAS may cause a variety of health effects including developmental effects in fetuses and infants, effects on the thyroid, liver, kidneys, certain hormones and the immune system. Some studies suggest a cancer risk may also exist in people exposed to higher levels of some PFAS. Scientists and regulators are still working to study and better understand the health risks posed by exposures to PFAS, and MassDEP is following developments in this burgeoning area closely (MassDEP, 2019).

### Key Concepts

- **Relatively minor amounts of PFAS** are conveyed to the environment by typical municipal wastewater (singles to tens of ppt) and biosolids (singles to tens of ppb). This represents ambient background levels for these persistent, widely used chemicals.
- **PFOA and PFOS—the most concerning—have been phased out** and background levels are now lower in human blood (>70 percent decrease) and are down in wastewater and biosolids. Phasing out uses of concerning PFAS addresses potential concerns most efficiently from such ambient background levels. PFOA and PFOS are becoming legacy issues.
- **Recycling municipal biosolids to soils** has not caused known impacts to food products and has only affected groundwater above EPA's health screening value of 70 ppt in rare cases—and only where there have been large industrial inputs to the sewer
- **Receivers of PFAS**—municipalities and utilities—cannot carry the major burden of addressing PFAS at the end of the pipe. If stringent water quality standards (less than the EPA health advisory level of 70 ppt) are set, funding must be provided, and society will pay more to reduce PFAS to such low levels.
- **Water resource recovery facilities** (WRRFs) can proactively follow and update best practices to cost-effectively reduce potential risks and liability related to PFAS: namely, consider upstream source control and industry best management practices
- **Regulatory agencies** should be aware of unintended impacts on WRRF programs when setting site cleanup and water quality standards for PFAS

This uncertainty around potential health impacts of PFAS is integrated in risk calculations. Toxicologists and risk assessors use routine formulas and protocols to determine appropriate acceptable PFAS levels in drinking water and other matrices, and part of that process is the use of "uncertainty factors"—multipliers that make up for gaps in knowledge about, for example, what the difference in impacts are to a laboratory rat versus a human. The levels of uncertainty around PFAS health impacts have resulted in uncertainty factors of up to 300 times or more. This means that, if research has suggested that a human dose of one unit is acceptable, the final calculated safe level would be 1/300th unit, after use of the uncertainty factors.

Public pressure, politics, and the highly cautious regulatory climate stemming from the Flint, Michigan lead-in-water crisis have combined to drive the accelerated pace to address PFAS with very strict standards layered with large uncertainty factors. This is true in New Hampshire and Maine. These two states provide examples of the challenges of establishing potentially overly conservative PFAS regulations.

## IMPACTS OF SETTING LOW MCLs IN NEW HAMPSHIRE

New Hampshire is home to the former Pease Air Force Base as well as two manufacturers causing significant PFAS-contaminated drinking water sources. In the fall of 2018, the New Hampshire Department of Environmental Services (NHDES) began the regulatory process of setting drinking water MCLs for four PFAS—PFOA, PFOS, PFHxS, and PFNA—as required by a 2018 state law pushed through the legislature by concerned citizens. Initial numerical standards were proposed on December 31, 2018, but additional NHDES risk assessment work during the spring of 2019 led to far lower standards proposed in the final rule in June 2019 and formally approved in the required review by a legislative committee. The new standards took effect on September 30, 2019 (Table 1).

**Table 1. New Hampshire drinking water maximum contaminant levels (MCLs) for four PFAS***

| PFAS | ng/l or parts per trillion (ppt) |
|---|---|
| Perfluorooctanoic Acid (PFOA) | 12 |
| Perfluorooctanesulfonic Acid (PFOS) | 15 |
| Perfluorohexanesulfonic Acid (PFHxS) | 18 |
| Perfluorononanoic Acid (PFNA) | 11 |

*Effective September 30, 2019

Wastewater and biosolids managers have two reasons to be concerned about these New Hampshire drinking water MCLs and identical groundwater standards:

1. **Potential for wastewater effluent and biosolids management to affect drinking water sources and groundwater at such low ppt levels.** Research on Cape Cod (Schaider et al., 2016) showed that septic systems in a purely residential neighborhood have released some PFAS compounds at levels that have affected neighboring drinking water wells at levels in the single to teens of ppt—close to New Hampshire's new standards. Other activities of modern living also likely affect waters at levels close to these New Hampshire regulatory numbers. As part of its rulemaking for setting the new MCLs, NHDES estimated that more than 10 percent of residential wells in the state will show PFAS above the new standards.
2. **Potential for municipalities and utilities to be held liable as "responsible parties" under the concept that is central to federal "Superfund" law (Comprehensive Environmental Response, Compensation, and Liability Act or CERCLA) and is mirrored by some state regulations of contaminated sites.** This is the unnerving question being considered today by public and private wastewater and biosolids management organizations in New Hampshire. If Water Resource Recovery Facility (WRRF) effluent or biosolids, which always (unfortunately) contain some trace amounts of PFAS, are thought to have caused drinking water or groundwater impacts above the new standards, will local utilities be required to pay for all or part of site investigation and remediation costs? So far, the answer in New Hampshire seems to be yes. Concerns are growing with utilities, farmers, landowners, and biosolids management companies. Because of reactions to these potential liability concerns, some 50,000 wet tons (45,000 wet tonnes) of biosolids routinely land-applied each year may have to go elsewhere. But the solids management market has limited capacity and flexibility (Beecher, 2016), which affects feasibility and drives up costs. In the summer of 2019, several WRRFs reported costs for solids management increasing from about $70 to about $130 per wet ton ($77 to $143 per wet tonne)—according to Shelagh Connelly of Resource Management, Inc. And limited local capacity at landfills and incinerators means WRRF managers are checking on options in the Midwest and Southeast, and increasing amounts of biosolids, including from New Hampshire, are being trucked to Canada.

**Comment—estimating costs and weighing benefits...** It is uncomfortable to talk about costs in the face of public health concerns. But cleanup and treatment for PFAS takes money, and municipalities and utilities will have to find that money. Going from 70 ppt (the EPA health advisory screening value for drinking water) to 10 to 20 ppt (as in New Hampshire, New Jersey, and soon maybe California, Michigan, and New York) makes a big difference in likely costs. The health benefits of such a fourfold reduction are uncertain, especially when considering, as noted above, that the uncertainty factors in PFAS human health risk calculations are >300 times. What will society end up paying for addressing PFAS, if regulatory standards are in the 10 to 20 ppt range? Will anyone be able to show benefits to public health that are worth the money spent?

Even as the state has adopted strict MCLs, it has not provided much funding to help municipalities and utilities, let alone homeowners. How and where will the new, low PFAS standards be enforced? What will happen if a community or household does not have the money needed to comply? And what will be the costs to communities, utilities, homeowners, and ratepayers? Many stakeholders believe NHDES failed to adequately include cost and benefit analyses when setting the MCLs.

To address the cost and liability issues, the New Hampshire Municipal Association is working with legislators on a bill to be introduced this fall that would provide at least partial grant funding for local PFAS remediation and enhanced testing at water and wastewater systems to help identify, reduce or remove the current liability concerns. Meanwhile, the state has sued manufacturers of PFAS, as have other states, and is hoping for hundreds of millions of dollars in settlement money to help pay for remediation. But that legal process could unfortunately take a decade or more to resolve, and municipalities and utilities are starting to bear the increased costs now.

In the late summer of 2019, the severity of New Hampshire's PFAS challenges led to legal actions related to wastewater and biosolids management:

- In one case, a private company that NHDES deemed a responsible party went out of business, forcing NHDES to take over PFAS mitigation. For 30 years, the company had managed septage at its southeastern New Hampshire facility under NHDES permits and in general compliance, according to NHDES records prior to this spring. However, this spring, NHDES deemed it to have affected neighbors' wells with PFAS at levels topping out at 175 ppt. NHDES officials are following standard procedures for groundwater contamination and site cleanup. NHDES intends to continue to seek payment from the company for costs incurred. But this is just one septage management program of several in the state that have impacted groundwater. Will other businesses be shut down? What will be the ongoing impacts of further enforcement on management of the state's septage?
- In a second case, a joint suit was filed against NHDES by the Plymouth Village Water & Sewer District, Resource Management Inc. (RMI, a biosolids management company), a farmer and RMI partner Charles Hanson, and 3M, claiming that the MCLs were adopted by a flawed, illegal process. The plaintiffs claim that NHDES is "required not only to analyze the science, but also to consider the costs and benefits to all affected parties that will result from establishing the standard (*The Plymouth Village Water & Sewer District et al. v. Robert R. Scott, 2019*)." The plaintiffs seek an injunction against enforcement of the new MCL regulations and a court ruling requiring NHDES to properly and legally complete the regulatory process with proper notification and public comment.

## PROPOSED FEDERAL LEGISLATION RAISES LIABILITY CONCERNS, TOO

Meanwhile, in the spring and summer of 2019, a score of PFAS-related amendments and bills were moving through Congress. Two House amendments to the National Defense Authorization Act (NDAA) concern water quality professionals, and WEF and the National Association of Clean Water Agencies (NACWA) are leading efforts to amend or defeat those amendments. One, the Dingell amendment (named for Rep. Dingell of Michigan), would require listing of PFAS under CERCLA—the Superfund law. The second, by Rep. Pappas of New Hampshire, would require similar listing under the Clean Water Act. Either amendment could create responsible party liability for wastewater utilities, municipalities, and related wastewater and biosolids management entities.

CERCLA has long had limited exemptions for municipalities, removing liability for waste management, but the proposed legislation does not clearly extend such exemptions. WEF and NACWA maintain it is not appropriate for municipalities and utilities to be liable for any PFAS they receive; they do not use PFAS and are not a contributing source. CERCLA and similar laws are intended to put the responsibility for costs of cleanups on those who profit from chemicals, such as manufacturers and industrial users.

In September and early October, as negotiations continued between the House and Senate on the NDAA amendments, WEF and NACWA urged their organization members to contact their congressional delegations.

## MAINE CONTINUES ITS PARTIAL MORATORIUM ON BIOSOLIDS

On March 22, 2019, Maine DEP imposed a moratorium on biosolids recycling and required testing of all biosolids products prior to any further land application. This sudden regulatory action was in reaction to a news conference at Stoneridge Farm in Arundel, in which the farm had high levels of PFOS in the soil, in cow manure, and in milk. Milk sales were halted immediately upon discovery of the contamination in 2017, and the farm has been addressing the contamination since. Maine DEP's investigation suggested that the excessive PFOS came from an industrial material applied on the land in the late 1980s, not from municipal biosolids that were also applied for several years. But news reports and a lawsuit filed by the farm did not mention the industrial source.

Since the moratorium went into effect, 55 samples of biosolids have been tested, and only two have met the strict screening values that Maine DEP had devised (see Table 2). The North East Biosolids and

Residuals Association (NEBRA) and others have argued for two years that the screening values are not scientifically defensible for use with biosolids. The Maine biosolids test data are similar to data from recent testing of biosolids in other states, such as New Hampshire: single to tens of ppb (also referenced as ng/g). The Maine biosolids tested were almost all from non-industrial communities. These data establish what can be expected to be ambient background levels of PFAS in biosolids deriving from normal daily living environments (see Table 2 below and supplemental tables at the end of this article showing PFAS test results from a variety of media: groundwater, surface water, wastewater, landfill leachate, soils, biosolids, and septage).

**Table 2. PFAS levels in Maine biosolids products***

| Statistical Parameter | PFOA | PFOS |
|---|---|---|
| Max (ppb) | 46 | 120 |
| Min (ppb) | 0.6 | 3.2 |
| Mean (ppb) | 8.5 | 25.4 |
| Median (ppb) | 3.8 | 22.9 |
| n = | 54 | 55 |
| Maine DEP screening limit | 2.5 | 5.2 |

*Maine DEP data; 55 samples tested by Maine WRRFs, April–August 2019, ppb (ng/g)

In late spring, Maine DEP allowed compost products to be marketed and distributed for the rest of 2019, but bulk-applied biosolids applications to land were heavily curtailed. Several WRRFs that have relied on land application have been stockpiling large volumes of solids this summer and fall and seeking disposal options at much higher costs. Presque Isle, which land applied liquid biosolids for many years, was forced into emergency dewatering and transportation to other disposal options—a large cost increase. Several field stockpiles of biosolids at farms were orphaned, some having to be removed and sent to landfill. The new disposal options being used by Maine WRRFs include out-of-state landfills and beneficial use in Canada.

In both Maine and New Hampshire, the biosolids management market has been disrupted because of the regulatory actions related to PFAS, and prices have risen, in some cases nearly doubling.

## THE MAINE PFAS SUMMIT

The Maine Water Environment Association (MEWEA) aims to find compromises with Maine regulatory agencies. On September 13, 2019, as part of its annual fall convention, MEWEA hosted the Maine PFAS Summit, which attracted more than 150 stakeholders from around Maine and New England and included presentations from the Maine DEP commissioner, other DEP leadership, the Department of Agriculture, and the state toxicologist, as well as representatives from EPA, WEF, and NACWA.

The summit began with an update from the director of Maine DEP's Remediation and Waste Management Bureau. He noted the cooperation of a large majority of Maine WRRFs and biosolids recycling and paper mill residuals programs for their timely performance of PFAS testing and data submissions. He emphasized that a large proportion of Maine biosolids continue to be distributed because of the allowance of compost use, and his tone indicated a desire to maintain biosolids recycling.

However, the scrutiny on biosolids as a major PFAS concern continues. Maine DEP has scoured all available past records and compiled all historical data on all sites where biosolids and residuals have been applied. The intent is to prioritize the sites and begin testing them—despite data showing long-term municipal biosolids sites have typical low ppb levels and are not affecting farm products. Discovering more sites with soil PFAS levels above Maine's screening values will likely create confusion. Maine municipal stakeholders argue that the levels associated with biosolids use are generally far lower than the levels at PFAS hot spots at fire-fighting and military sites (via contamination from fire suppression foams), and that, for now, those sites should be the priority for Maine DEP actions.

In addition, Maine DEP is testing compost used in home gardens, closed unlined landfills, reclamation sites, septage, and polymers used at WRRFs. During the summer of 2019, DEP's PFAS actions, and the focus of the Maine PFAS task force, continued to be on wastewater and biosolids facilities, which are simply receivers and conveyors, and not one of the sources of PFAS. The one direct source of PFAS environmental contamination that Maine DEP is testing is Class B firefighting foam sites. MEWEA submitted letters of comment to Maine's PFAS task force contesting what they see as an inappropriately narrow focus on biosolids programs. MEWEA's efforts had effect: In the fall of 2019, the task force's rough draft recommendations included a broader focus.

The Maine Department of Agriculture's presentation to the summit emphasized that "recently conducted statewide retail fluid milk testing" found "all Maine-produced milk below reporting limits" for PFAS (testing was from stores throughout the state and all major milk brands). In addition, in testing of milk from "three dairy farms, with two that spread biosolids, all three showed levels below reporting limits (Maine Department of Agriculture, 2019)." NEBRA independently tested milk at some of the same and an additional long-term biosolids-use farm and obtained non-detect results. The Department of Agriculture also noted that soil levels measured on long-term-biosolids-use farms ranged from 2.6 to 12.9 ppb for PFOA and 5.6 to 20.9 ppb for PFOS. These values are in the range of other land-application sites in other states, and well below the levels at sites affected by fire-fighting and industrial discharges and the Stoneridge Farm in Arundel, where an industrial discharge has likely left up to 878 ppb of PFOS in the soil. The testing results lessened concern of widespread PFAS contamination on farms.

The Department of Agriculture's talk was followed by discussion with a fifth- and sixth-generation farm family directly affected by the biosolids moratorium, forced to dump milk for weeks during testing and realizing unexpected fertilizer costs. They expressed their concern about their reputation and the viability of their product market. Biosolids have been important to their fertilizer and soil management programs for 30 years. From their perspective, their livelihood is threatened by public regulatory actions when they have done nothing wrong and have long complied with Maine DEP and Department of Agriculture standards. They asked for better communications and for state regulators to inform the public further that their products and Maine milk are safe and healthy.

Additional presentations at the summit included the following:

- The state toxicologist explaining the PFAS risk assessment calculations by which numerical standards are set and why there are differences in different jurisdictions
- Northern Tilth summarizing the results of the statewide biosolids and soils PFAS sampling
- Stone Environmental presenting the PFAS leaching modeling they have been working on for NEBRA
- Alpha Analytical discussing PFAS lab analysis challenges

All the presentations are available at mewea.org/fall-convention.

The Maine DEP commissioner spoke to the summit over lunch, reiterating his reliance on the state risk assessors for setting numerical standards. Following questioning, the commissioner stated he does not have the authority to relax the biosolids and soil screening values. Many attendees had the impression that a greater understanding is needed about both the role of biosolids recycling in helping Maine reach its sustainability goals and the negative impacts from the biosolids moratorium.

MEWEA and other presenters emphasized data and science, and the summit culminated with representatives of EPA's Office of Water, WEF, and NACWA emphasizing actions and concerns at the federal level. EPA Office of Water summarized EPA's ongoing work on chemical risk analysis and developing approved analytical methods for PFAS. EPA invited participation in the PFAS problem formulation discussions coming this winter. It will hold an all-states-and-tribes biosolids meeting and training in the spring of 2020. NACWA covered the liability concerns with the proposed federal legislation, and WEF emphasized that states' regulatory activities accelerate one another.

## OTHER STATES' ACTIONS PENDING

While Maine and New Hampshire may be at the forefront of PFAS regulations affecting wastewater and biosolids management, other states are not far behind. In the summer of 2019, California announced drinking water notification levels of 5.1 ppt for PFOA and 6.5 ppt for PFOS. These numbers were chosen because California's water boards were advised that these are the reasonable lowest limits of analytical capability; the health-based standards, they said, would be even lower.

As of the end of the summer of 2019, other states' activities on PFAS regulation included the following:

- **Alaska**—Further action on clean-up standards, etc., were put on hold pending EPA action, in part because of the recognition that state regulation of this issue has uncertainties; however, a major biosolids composting operation has been suspended because of PFAS issues
- **Florida**—Provisional target clean-up levels for PFOA and PFOS are being established, and the state is considering surface water screening values
- **Massachusetts**—Proposed site soil and groundwater clean-up values are in the 20 ppt range for residential groundwater; public comments have been taken; the process of setting state MCLs for drinking water is underway, likely considering about 20 ppt for six PFAS combined
- **Michigan**—Drinking water MCLs were to be proposed by October 1, to be finalized in the spring of 2020; some biosolids programs are on hold
- **New Jersey**—MCLs and groundwater standards recommended for at least two years (PFOA = 13 ppt, PFOS = 14 ppt), but they have not yet been adopted
- **New York**—Comments were due by September 24, 2019, regarding proposed drinking water MCLs: PFOA = 10 ppt, PFOS = 10 ppt
- **Vermont**—May 2019 state law requires the Vermont Department of Environmental Conservation to set MCLs for five PFAS by February 1, 2020 and later to adopt surface water standards
- **Wisconsin**—The state recommended groundwater standards and preventive actions; some biosolids programs are on hold already; the state asked utilities to voluntarily test for PFAS, but most refused, stating that approved analytical methods must come first



| PFAS REGULATORY CONTROLS |

### Interim Considerations & Guidance for WRRFs

**Do you test for PFAS when you do not have to?**

Current issues with testing:

- For public agencies, data are public
- What will you compare data to?
- No EPA-approved analytical method exists except for drinking water
- Comments have been received on the draft method for non-drinking waters SW 846 Method 8327
- The Department of Defense (DoD) provides guidance and encourages use of isotope dilution, "modified Method 537"
- Sampling requires great care to avoid contamination; a formal PFAS sampling and analysis plan is needed

**Look upstream for industries that may use PFAS**

- Consider landfill leachate (generally not a concern, unless it is a high proportion of flow; see the supplemental data tables)
- Apply source control and pollution prevention (P2) strategies to reduce PFAS in influent
- Is formal industrial pretreatment needed? How are small sources differentiated from larger ones?

**Get Involved**

- Be knowledgeable and actively involved in your states' actions on PFAS, including site clean-up standards, drinking water regulations, and groundwater and surface water standards. They need your input to help avoid unintended impacts on wastewater and biosolids management programs. Make sure drinking water, groundwater, and site remediation regulatory staff talk with wastewater and biosolids regulatory staff to find solutions together. Ensure that states know ambient background levels of PFAS in any media they decide to regulate.

**Encourage source control**

- Phase-out of particularly problematic PFAS is a proven solution to reduce exposures

**Support research and best available science to help society understand the relative risk of PFAS**

- This effort includes the relative importance of different pathways of exposure, the role wastewater and biosolids play as receivers and conveyors of PFAS, and the cost-efficiency of source control and phase-outs of the most-concerning PFAS

**Continue to manage wastewater and biosolids with best management practices**

- This includes agronomic rate applications that reduce PFAS inputs and risks

Most states are carefully following the PFAS issues, addressing any industrial and fire-fighting hotspots, and watching for EPA leadership as the science advances further.

## CONCLUSION

In Maine and New Hampshire, some state regulators are evaluating the potential for centralized incineration facilities to destroy PFAS. As drinking water and other materials are cleaned of PFAS, the volume of concentrated PFAS waste is growing, and incineration at temperatures at or above 1,835˚F (1,000˚C) is likely best for destroying these emerging contaminants. Some suggest wastewater solids—biosolids—should all be managed this way in the future. NEBRA and other stakeholders believe such a policy would waste resources such as energy, organic matter, nutrients, and carbon sequestration potential. Northeastern states, along with some in the upper Midwest, are more aggressive on PFAS than most of the rest of the country. This is a crucial time for collaboratively developing policy that is practical, efficient, cost-effective, and environmentally sound.

## ACKOWLEDGMENTS

The author thanks Janine Burke-Wells, executive director of NEBRA, for assistance with this article, as well as MEWEA, Maine DEP, Maine Department of Agriculture, NHDES, biosolids managers, farmers, and NEBRA members who are all figuring out how best to address these challenging PFAS issues.

## REFERENCES

- Beecher, N. 2016. "You have to take my sludge!", *NEWEA Journal*, Volume 50, Number 3
- Maine Dept. of Agriculture, 2019. Slide presentation to the Maine PFAS Summit, September 13, 2109, Northport, ME
- Massachusetts Dept. of Environmental Protection, 2019. https://www.mass.gov/info-details per-and-polyfluoroalkyl-substances-pfas
- Plymouth Village Water & Sewer District, Resource Management, Inc., Charles G. Hanson, and 3M Company, Plaintiffs V. Robert R. Scott, As Commissioner of The New Hampshire Department of Environmental Services, Defendant, complaint filed Sept. 30, 2019, Merrimack Superior Court
- Schaider et al., 2016. Septic systems as sources of organic wastewater compounds in domestic drinking water wells in a shallow sand and gravel aquifer. *Science of the Total Environment*, Volume 547, 15 March 2016

## ABOUT THE AUTHOR

Ned Beecher was executive director of NEBRA from 1998 to 2019. He is now NEBRA's special projects manager and has focused on PFAS in the past three years. Mr. Beecher has led projects and authored articles, papers, and book chapters on biosolids management in the Northeast, eastern Canada, and around North America.





## SUPPLEMENTAL TABLES

**Recent PFAS test results—BIOSOLIDS, RESIDUALS, & SEPTAGE (ng/g, ppb), with soil standards for comparison**

| | PFOA* | PFOS* | PFNA* | PFHxS* | PFHpA* | PFDA | Notes |
|---|---|---|---|---|---|---|---|
| Biosolids products nationwide, 2018 | ~3 – ~15 | ~2 – ~90 | ND – ~4 | | ND – ~4 | <1 – ~17 | Seven composts tested by Lazcano, Lee - Purdue |
| ME biosolids, 2019 | 0.6 – 46 (mean = 8.5) | 3.2 – 120 (mean = 25.4) | | | | | 55 biosolids sampled, cake & composts |
| Food waste & compostable foodware compost, 2018 | ~3 – 12 | ND – ~2 | ND – ~2 | ~0.2 – 1 | ND – ~3 | ~1 – 3 | PFHxA = ~9 – 50 seven composts tested by Choi, Lazcano - Purdue |
| ME septage, 2019 | 15 – 60 | <10 – 121 | | | | | Seven samples; typical levels > biosolids** |
| U. S. sewage sludges, 2001 | 12 – 70 (mean = 34) | 308 – 618 (mean = 403) | | | | | Venkatesan & Halden, 2013; older sludges = higher PFOA & PFOS |
| **STANDARDS** | | | | | | | |
| Modeled PFAS levels in biosolids to avoid impacts to 1 m ground water above 70 ppt (EPA screen) | sum = <40 – 60: 40 PFOA + 0 PFOS *or* 0 PFOA + 60 PFOS | | | | | | Stone Environmental PRZM modeling, 2019, for NEBRA |
| ME DEP screening level developed for non-agronomic residuals, 2018 | 2.5 | 5.2 | | | | | Applied to biosolids & biosolids soils in 2019 |

All data are suspect & variable due to there being no approved analytical method other than for drinking water and different lab protocols in use.

*There were six PFAS included in the U.S. EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3) testing of drinking water; the sixth, not shown here, is PFBS.

** Septage may have higher levels than biosolids because it is older, having sat in septic tanks for up to 10 years, reflecting higher uses of PFOA and PFOS prior to the early-2000s phase-out of these 2 PFAS.

ND = not detected.

**Recent PFAS test results—SOILS (ng/g, ppb), with soil standards for comparison**

| | PFOA* | PFOS* | Notes |
|---|---|---|---|
| Garden control soils, MN, ~2010 | 0.29 – 0.54 | 0.93 – 2.1 | Considered "background" |
| VT "background" soils, 2019 | 0.52 – 4.9 | 0.11 – 9.7 | 66 locations; PFOS found at all |
| NH soils impacted by industrial air emissions, 2016 | ND – 33 | | 160 soil tests in 16 $mi^2$ (41 $km^2$) area downwind of industrial facility |
| Biosolids amended soils, ME, 2019 | 1.1 – 12.9 (mean: 3.1) | 2.1 – 20.9 (mean: 8.8) | Sampling at 29 fields where biosolids were used for ~20+ years |
| Decatur, AL industrially impacted biosolids soils, 2009 | 50 – 320 | 30 – 410 | 3M manufacturer discharged to WRRF for years |
| **STANDARDS** | | | |
| VT DEC, for dermal contact, 2016 | 300 | | Not for leaching to groundwater |
| MI EGLE (DEQ), 2016 | 350 | 0.22 | Groundwater, surface water protection |
| ME DEP screening level developed for non-agronomic residuals, 2018 | 2.5 | 5.2 | Applied to biosolids & biosolids soils in 2019 |

All data are suspect & variable due to there being no approved analytical method other than for drinking water and different lab protocols in use.

**There were six PFAS included in the U.S. EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3) testing of drinking water; the sixth, not shown here, is PFBS.

ND = not detected

**Recent PFAS test results—GROUNDWATER (ng/l, ppt), with water standards for comparison**

| | PFOA* | PFOS* | PFNA* | PFHxS* | PFHpA* | PFDA | Notes |
|---|---|---|---|---|---|---|---|
| Cape Cod residential wells impacted by septic systems | | ~3–9 | | ~0.4–40 | ~0.3–1 | | Schaider et al., 2016 |
| Long-term dewatered biosolids land application sites, VT 2019 | ND–6 | | | | | | VT DEC draft data, three sites |
| NHDES monitoring at sludge monofill, Franklin, NH, 2017 | 47–884 | | | | | | NHDES sludge management site |
| NHDES monitoring at septage lagoons / facilities, 2019 | < 1–399 | < 1–106 | < 1–97 | <1–57 | <1–524 | | Does not include BRC, E. Kingston |
| Arundel, ME farm industrial sludge site groundwater, 2017 | ND–41 | 2–130 | | | | | ME DEP investigation |
| Pease Tradeport, NH, 2014 | 4–350 | 15–2500 | ND–21 | 13–960 | 2–120 | | Firefighting foam |
| Battle Creek ANG Base, MI | ≤ 21,500 | ≤ 55,000 | | ≤ 38,400 | | | Firefighting foam |
| **STANDARDS** | | | | | | | |
| Canada Health (2018) drinking water | 200 | 600 | | | | | |
| U.S. EPA drinking water screening value (2016) & Michigan groundwater | 70 | | | | | | Applies to the sum of two PFAS |
| NHDES MCLs and AGQS (2019) | 12 | 15 | 11 | 18 | | | |
| MA DEP proposed groundwater limit for site cleanup (MCP) (2019) | 20 | | | | | | Applies to the sum of six PFAS |
| VT groundwater limit (2018) | 20 | | | | | | Applies to sum of five PFAS |
| NJ groundwater limit (2018) | 10 | 10 | 13 | | | | 2018 interim limits for PFOA & PFOS |

All data are suspect & variable due to there being no approved analytical method other than for drinking water and different lab protocols in use.

*There were six PFAS included in the U.S. EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3) testing of drinking water; the sixth, not shown here, is PFBS.

ND = not detected. MCL = maximum contaminant level for drinking water, AGQS = ambient groundwater quality standard

**Recent PFAS test results—BIOSOLIDS, RESIDUALS, & SEPTAGE (ng/g, ppb), with soil standards for comparison**

| Location | PFOA | PFOS | Notes |
|---|---|---|---|
| Michigan | 16–3,200 | 9–960 | 32 MI landfills & Mi Waters data (see report*) |
| Vermont | 80–2,800 | 23–300 | 11 analyses of nine samples in 2018 |
| United States | 30–5,000 | 3–800 | |
| Europe | ND–1,000 | ND–1,500 | |
| Australia | 17–7,500 | 13–2,700 | |
| China | 281–214,000 | 1,150–6,020 | |
| **STANDARDS** | | | |
| VT screening levels for landfill leachate, 2018 | 120,000 | 1,000 | Guidance only |
| MI EGLE surface water limit (2015) | 420 | 12 | If source of drinking water; limits are being used to screen wastewater effluent |
| Canada Health (2018) drinking water | 200 | 600 | |
| U.S. EPA drinking water screening value (2016) | 70 | | Applies to the sum of two PFAS |

*Adapted from Michigan Waste & Recycling Association, Table 4.3, (https://www.michiganwasteandrecyclingassociation.com/)

**Conclusion:** Landfill leachate in the U.S. is not a large overall contributor to PFAS in WRRFs, unless the leachate is a very large proportion of the wastewater flow (rarely). Cutting it off is not likely to reduce PFAS levels significantly in most cases.



| PFAS REGULATORY CONTROLS |

**Recent PFAS test results: SURFACE WATER & WASTEWATER (ng/l, ppt), with water standards for comparison**

| | PFOA* | PFOS* | PFNA* | PFHxS* | PFHpA* | PFDA | Notes |
|---|---|---|---|---|---|---|---|
| Van Etten Lake, MI (Dec. 2018) | 131 | 497 | | 531 | | | Contamination from military site/fire fighting |
| NJ DSREH investigation (2019) | 2–34 | < 2–102 | < 2–8 | < 2–96 | 3–15 | < 2 | 14 sites with PFAS sources nearby |
| Arundel, ME farm industrial sludge site, 2017 | ND–249 | 2–476 | | | | | ME DEP investigation |
| Decatur, AL industrially impacted biosolids site, 2009 | ND–11000 | ND–84 | ND–286 | ND–6710 | ND–8250 | ND–838 | U.S. EPA investigation |
| NY paper mill residuals compost site stormwater pond (2017) | 100 | 140 | | | | | Residuals' PFAS levels similar to average biosolids |
| Lapeer, MI WRRF effluent 2017 | | ≤ 2000 | | | | | Metal-finisher discharge = 19,000 |
| NH WRRF influent (3 facilities)<br>NH WRRF effluent (3 facilities) | 6–50<br>6–49 | 4–22<br>< 4–14 | < 4<br>< 4 | < 4–7<br>< 4–8 | < 4–8<br>< 4–19 | | NHDES, 2017 |
| **STANDARDS** | | | | | | | |
| Canada Health (2018) drinking water | 200 | 600 | | | | | |
| U.S. EPA drinking water screening value (2016) | 70 | | | | | Applies to the sum of two PFAS | |
| NHDES MCLs and AGQS (2019) | 12 | 15 | 11 | 18 | | NHDES starts setting surface water standards by Jan. 1, 2020 | |
| MI EGLE surface water limit (2015) | 420 | 12 | | | | If source of drinking water; limits are used to screen ww effluent | |

All data are suspect & variable due to there being no approved analytical method other than for drinking water and different lab protocols in use.

*There were six PFAS included in the U.S. EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3) testing of drinking water; the sixth, not shown here, is PFBS.

ND = not detected MCL = maximum contaminant level for drinking water, AGQS = ambient groundwater quality standard