Summer 2023, Vol. 53, No. 2

New York Water Environment Association, Inc.

ClearWaters

Regulatory and Technological Challenges of PFAS

Also inside:

Highlights of the NYWEA/NEWEA Joint Meeting

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Cover: Outdoor apparel companies have relied on PFAS to make water-resistant, stain-repellant products since the 1950s. Many states, including New York, have passed or are developing bans on selling clothing with intentionally added PFAS. *Kulbabka, Adobe Stock*

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Hello, Friends!

It has been an eventful time since we last spoke. In March, I had the life-changing opportunity to attend the U.N. Water Conference with a group of fellow NYWEA volunteers to learn about and discuss some of the steps being made to combat the world water crisis. Our editor did a wonderful job of compiling all our impressions and I know you will find it an impactful read.

April brought the annual WEF Fly-In to Washington DC. It was thrilling to be invited to listen to our policy-makers and to bring our agenda to the table to make them aware to the issues that are so critical to the clean water sector. Of course, we spoke about funding, which is the life blood of our industry, but also about our staffing crisis, the need for water equity, the WIPPES Act (which finally seems to be gaining momentum) and the big concern on everyone's mind, the new EPA regulations for PFAS and who will be left holding the bag for cleanup costs. If you are not up to date with all things PFAS, read on! This edition of *Clear Waters* is dedicated to ensuring that we have the best, most current information on this rather overwhelming topic.

NYWEA/NEWEA Joint Spring Meeting

The culmination of the second quarter was the Joint Spring Meeting with our colleagues from New England in beautiful Saratoga Springs. A shoutout to everyone who helped with the planning as this conference has so many different facets and collaboration is needed for each of them! As always, our conference committee and program committee did a spectacular job in providing a terrific location (yummy food too!) and fascinating technical sessions. The operations challenge committee, with the leadership of the esteemed William Grandner, worked tirelessly to ensure that all went smoothly. The YPs hosted an awesome reception at the Parting Glass. Our devoted staff made sure that everything ran smoothly. And a special thank you to Jean Malafronte and the group who put together a goodbye bash for our beloved Patricia Cerro-Reehil. It was a magical night full of love and laughter, and we somehow managed to keep the tears to a minimum.

One of the highlights of the meeting for me was getting to speak with you all at the Presidential Plenary (just a fancy phrase for NEWEA President Bob Fisher and I getting to chat about something important to us!). We got to expand on our themes of "One Water" and "Celebrating the Essential Worker." It was an unexpected surprise that we both chose topics that were so in sync. Bob was quite eloquent, and I think I'm going to take some public speaking lessons from him!

Introducing Operation SOS

It was my privilege at the Joint Spring Meeting to unveil the latest mission for NYWEA: Operation SOS (Support Operator Scholarships). As a part of the celebration of our essential worker, I hoped to not only continue our good work with the Lucy Grassano and Brian Romeiser scholarships, but to expand on them to enable operators more access to professional development resources. I was saddened to find that the current balance in our Operator Scholarship fund was seriously depleted and even our current scholarships are in jeopardy!

NYWEA as a group came together two decades ago with a firm commitment to establish a fund to help young people who were interested in joining our industry to achieve their educational goals. We have come to a point that, with over $1 million in that account, we give out $50,000 each year without depleting that account. What an accomplishment!

Now it is time to show that same dedication to our front-line personnel. There is a critical need for staffing in the light of the "silver tsunami," and it is our goal to do our part in giving a leg up to the people who keep our industry afloat! I implore you to join with me to achieve our goal of raising $200,000 this year in a continuing effort to meet our mandate to support and diversify a sustainable water workforce. We will kick off this effort at a special event following the Watershed Conference in September at the scenic Bear Mountain Inn. I hope you will all attend and make this the first of many successful events for Operation SOS! We are accepting individual donations using this QR code. Please donate today!

venmo

Donna Grudier
NYWEA President

L-r: Bob Fischer, Donna Grudier, Khris Dodson, Sana Barakat, Lisa Derrigan and Patricia Cerro-Reehil pose for the camera.

"You Have Big Shoes to Fill!"

Since the decision was made by the State Association Board for me to be Patricia's successor at the Annual Meeting, "You have big shoes to fill!" is probably the one exclamation (or some variation of it) that I've heard. Of course, I received a lot of congratulations and offers of support as well. But it does speak to the enormous legacy that Patricia is leaving behind (although not entirely!).

Patricia has been a driving force and has led NYWEA to new opportunities, developed new programs and enhanced existing ones. One person told me that "Patricia was the only person in that office I ever dealt with." I think that speaks to her presence in the organization and constantly keeping her finger on the pulse of the committees, chapters and the state board, as well as with WEF and other Member Associations.

NYWEA would not be where it is today without her presence as executive director for the past 23 years, and with more than 36 years at NYWEA in total. Her name is synonymous with NYWEA for so many of our members, past and present.

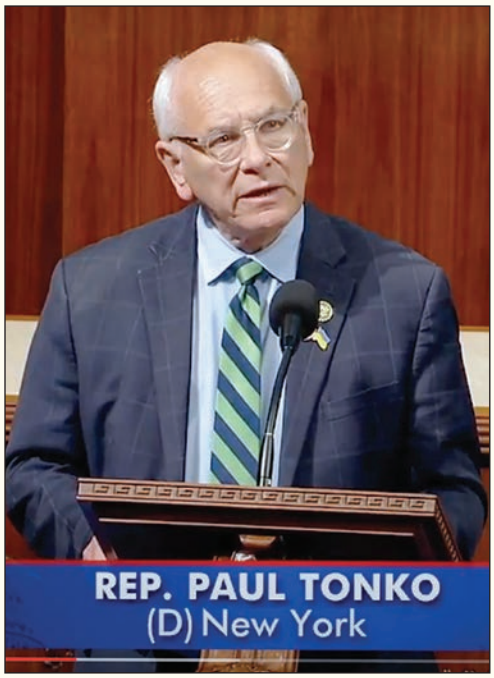
We will miss her but know that she is not far!

So, since this is my first message as executive director, I'd like to more formally introduce myself to those who may not know much about me. For the past 16 years, I have worked at the Environmental Finance Center (EFC) at Syracuse University. The EFC is a U.S. EPA-sponsored program to provide training and technical assistance to local government and utility leaders in the water, wastewater and stormwater realms. So, the work of NYWEA is not foreign to me. In fact, I have been on the State Association Board since 2012. Before serving on the State Association Board, I was the chair of the Public Education committee and have served as committee liaison to the board before becoming an officer in 2019. I served as President in 2022; many of you may recall my focus on the "Year of the JEDI": Justice, Equity, Diversity and Inclusion.

While I am certainly not Patricia, these size 12s are not small and I hope I can fill these shoes as best as I can moving forward, together, with all of you to keep NYWEA strong and relevant to all its members. I am always here to listen, learn and help. I'm excited about the future of this organization, despite the pall that COVID has left on so many of the things that we all have done in the past, and the way we have done them.

Let's learn and grow together and keep this NYWEA family one.

Khristopher Dodson, khris@nywea.org



NY Congressman Paul Tonko spoke on the House floor in June, recognizing Patricia's work at NYWEA and thanking her for her decades of service, and her help in providing New Yorkers with more reliable, more affordable and cleaner water. Here is a transcript of what Rep. Tonko said in the video:

> "I rise today to recognize Patricia Cerro-Reehil on the occasion of her retirement from the New York Water Environment Association. Since 1929, NYWEA has played a leading role in promoting water quality across our state. Patricia's NYWEA career began in 1987 and 14 years later she rose to become the first woman to serve as executive director. Her work over the past 35 years has supported training, education and advocacy for countless utilities, local governments, system operators and water sector businesses. This work has been foundational to protecting and improving water quality throughout New York state. During her time as executive director, Patricia has also embraced NYWEA's educational mission, helping to distribute over $700,000 in scholarships to some 240 students pursuing environmental degrees. Patricia, I sincerely thank you for your decades of service, which have helped provide so many New Yorkers with more reliable, more affordable and certainly cleaner water. Congratulations on your well-deserved retirement."

Celebrating 36 Years of Service: Thank You, Patricia Cerro-Reehil!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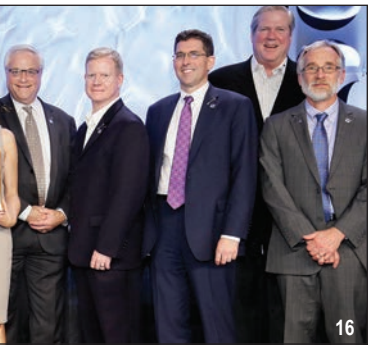


Photo Key:

1. **2006:** Headshot of Executive Director's message in Clear Waters.
2. **2007:** During the 87th annual meeting, President Thomas J. Lauro, recognizes Patricia's service, dedication and contributions to the association members.
3. **2009:** Annual meeting, Bruce Munn to right.
4. **2009:** L-r: Rebecca Martin, Patricia, Jim Hassett and his wife.
5. **2011:** Eileen Reynolds receives the John Chester Brigham Award.
6. **2012:** Anthony Della Valle, Rich Lyons, Congressman Paul Tonko, Patricia, NYWEA President Steve Fangmann.
7. **2012:** L-r: Dave Comerford, Dan Bentivogli, Rich Lyons, Thomas Lauro, James Tierney, Michael Garland, Patricia, and Tom Rhoads.
8. **2013:** Patricia, NYWEA President Mark Koester and Joyette Tyler.
9. **2013:** Build-A-Bike Great Success and a Big Surprise for Kids! After learning about what happens to "used" water and given totes with a message, children from Dr. King Elementary School were presented with new bicycles built on NYWEA teamwork.
10. **2013:** Three Executive Directors, (l-r) Jenny Ingrao, NYSAWWA, Patricia Cerro-Reehil, NYWEA, and William C. Harding, WPPC
11. **2013:** L-r: NYWEA Executive Director, Patricia Cerro-Reehil, Steve Fangmann, Bill Grandner and Anthony Della Valle.
12. **2014:** L-r: President Steve Fangmann, Congressman Tim Bishop, Patricia and Michael Garland.
13. **2014:** L-r: Matt Millea, Michael Garland, Patricia, President Steve Fangmann, U.S. Senator Chuck Schumer (receiving Nelson A. Rockefeller Award), Drew Smith and Robert Kukenberger.
14. **2015:** Jerry Lastihenos and Patricia wrap themselves in NYWEA colors!
15. **2016:** Paul McGarvey, Lisa Melville, Joe Fiegl and Patricia.
16. **2016:** WEF honors NYWEA with the Outstanding Member Association Award: (l-r:) Maggie Hoose, John Fortin, Maureen Kozol, Joe Fiegl, Patricia, Steve Fangmann, Paul McGarvey, Geoffrey Baldwin, Richard Pope and Robert Wither.
17. **2017:** ???, Patricia, NY State Senator John N. DeFrancisco, Bob Kukenberger and Dave Miller.
18. **2017:** Scholarship fundraiser raises $82,000 dollars; (l-r) Paul McGarvey, Bob Butterworth, Patricia, Diane Hammerman, Al Lopez and Fotios Papamichael.
19. **2017:** Patricia and her husband Roy enjoy the gala.
20. **2017:** Patricia shares a moment with Bob Hennigan.
21. **2018:** Spring Meeting, Patricia talks with children from Bolton Elementary School.
22. **2019:** Patricia, left, as Richard Fiedler is presented Service Award by President Robert Wither.
23. **2020:** President Robert Wither and Executive Director Patricia Cerro-Reehil present Fran Sansalone with John Sansalone's Hall of Fame posthumous recognition.
24. **2023:** Patricia and Khris.

Water Views | Summer 2023

New York's Response to PFAS

PFAS comprise a group of chemicals of emerging concern with many uses in industrial processes and consumer products. PFOA and PFOS are the most well-known examples of PFAS chemicals. They are widely distributed in the environment and pose potentially significant issues for water quality and human health. Adding to worries, some PFAS bio-accumulate. So, what is being done in New York state?

Urgent Response. DEC and DOH have engaged in extensive response actions in communities such as Hoosick Falls and Newburgh. We also identify and respond to contamination in drinking water wells serving public and individual water supplies.

Survey for Contamination. DOH now requires public drinking water suppliers to test for certain PFAS and report findings to customers. DEC has been testing legacy landfill and state Superfund sites, many of which have disconcerting levels of PFAS. Due to historic use of PFOS-containing foams, fire training centers have been identified and systematically tested. Nearby wells have been flagged, tested and, if contaminated, addressed.

Treatment. The good news is that effective, yet expensive, treatment systems for PFAS exist. The most widely used is granular activated carbon. Since longer-chain PFAS are generally adsorbed to the carbon more readily than shorter-chain compounds, the frequency of checking treatment systems for breakthrough depends on the type and concentration of PFAS.

Regulation. The DOH maximum contaminant levels (MCLs) in drinking water for PFAS are in the 10 parts per *trillion* (ppt) range. DEC added PFOA and PFOS to the list of hazardous substances and set industrial source water quality guidance values at 2.7 ppt for PFOA and 6.7 ppt for PFOS. DEC will advance more widely applicable water quality guidelines for all dischargers soon. EPA's recently proposed national MCL sets a 4 ppt regulatory limit. These low regulatory levels could go lower as toxicology, detection and treatment science evolve.

Funding. New York, through the Clean Water Infrastructure Act, has allotted hundreds of millions of dollars to public drinking water suppliers to address PFAS (and 1-4 dioxane, another chemical of emerging concern). Much of this funding flows through the Environmental Facilities Corporation, coordinating with DOH. Similarly, DEC has spent enormous sums from its Superfund program to address drinking water contamination.

Source Reduction. Reducing PFAS at the source is critical; we will not "treat" our way out of this problem if more PFAS continue being added to our environment. We must eliminate PFAS from consumer products, including roofing materials, paints, sealants, caulks, adhesives and fabrics. New York law prohibits the intentional addition of PFAS to food packaging. By December 2024 New York will ban the sale of PFAS-treated carpets and may soon ban the sale of any apparel containing intentionally added PFAS. This ban extends to most fire-fighting foams. DEC and its partners are conducting research into the levels of PFAS in biosolids, an issue of concern to NYWEA.

More is to come, but efforts to address PFAS are well underway.

– James Tierney, Deputy Commissioner for Water Resources
New York State Department of Environmental Conservation

Focus on Safety | Summer 2023

$afety Pay$

Workers and employers both benefit from a safe and healthful workplace. When trying to improve workplace safety and health, we tend to argue for reducing or preventing human suffering – but sometimes no one listens. Instead, the focus is on money – how much will this cost us? As we try to drive our workplace's safety culture toward improvements, often the more effective approach is not to drive harder, but to remove obstacles.

When evaluating workplace safety, consider the Culture of Reaction versus the Culture of Prevention. "Reaction" is the traditional notion that illness and injury are an unavoidable part of doing business, and that prevention has a cost, too. Reaction workplaces often don't recognize just how costly this culture is, as there are often large, indirect costs. Costs incurred from unsafe practices include lost workdays, higher insurance premiums, medical expenses, scheduling and overtime, finding and training replacement workers, rehabilitating returning workers, and cleanup, repair or replacing damage from an accident. Don't forget all the administrative costs associated with record-keeping and handling insurance claims.

By contrast, "Culture of Prevention" workplaces recognize that, while prevention may have a cost, many forms of prevention can help an organization save or even earn money (investment versus expense). A Prevention mindset can provide a win-win for both the organization and its employees by understanding that safe practices can both save money and protect worker health. In fact, safety can even make money, especially if you choose to work with contractors who have strong safety records. Compare the costs of unsafe practices with the costs spent on engineering controls, protective equipment, or training and the savings become obvious.

So, how can we make a safety cultural transformation from Reaction to Prevention? First, we need to think comprehensively, and consider the costs as methodically and as broadly as possible. So often organizations consider just the cost of the potential hazard control measure by itself, rather than the indirect costs associated with the uncontrolled hazard. We especially need to think creatively and consider hazard solutions higher up the hierarchy of controls. We need to consider the possibility of finding win-win solutions. For example, the use of a safer chemical may reduce environmental and hazardous waste disposal costs.

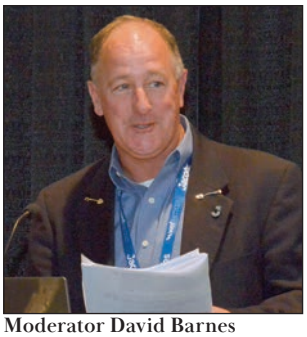
Always remember to engage the workforce. So often the people who do the work have insights as to how their jobs can be done safer and better, but nobody bothers to ask them. In fact, sometimes an outside expert is called in who makes the same recommendations! Also, with employee involvement, we can have better decision-making and commitment to solutions and to change. Some aspects of how safety pays can be measured, but it is hard to measure items such as goodwill, motivation, public relations, innovation, etc. Accidents and injuries have a cost, but safety pays.

– Nellie J. Brown, MS, CIH, ILR School, Cornell University

Highlights of the NYWEA/NEWEA Joint Spring Technical Conference "All for One, One for Water"

Three hundred people attended the June 7-9 joint meeting at the Saratoga Hilton & City Center in Saratoga Springs, NY. The meeting was comprised of 17 technical sessions, an Operations Challenge with 11 teams, a Presidential Plenary, YP reception and a celebration reception for retiring Patricia Cerro-Reehill. Special thanks to our Geyser Sponsors: D&B Engineers and Architects, EDR, GA Fleet, GP Jager, Inc., Koester, and Victaulic.

NYWEA President Donna Grudier and NEWEA President Bob Fischer cut the "ribbon" to open the meeting.



Moderator David Barnes

Julia Manzano speaks to success using SSOAP.

Howard Carter catches up with friends.

Courtney Eaton

Janine Burke-Wells

Session 2 Moderator Wayne Bates

Left, Doug Coppola and James Plummer

Left, Ram Shrivastava and Bill Davignon

Keith Kelly on Great South Bay project

Left, Peter Garvey and Jim Barsanti

Tim Taber and Donna Grudier

The Presidential Plenary meets for breakfast.

Bowery Bay Coyotes begin setting up.

L-r: Rosaleen Nogle, Nadia Mugisha and Regina Harris

L-r: A terrific trio! Maggie Hoose, Maureen Kozol and Patricia Cerro-Reehil

Carolyn Steinhauer and Khris Dodson

John Downey presents to attendees.

Alexandre Remnek of USEPA

Dion Banks of Ecoremedy

George Hawkins at Keynote Luncheon

Don Gallucci during Session 1

Young Professionals Leadership group

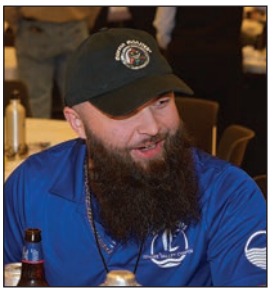
Left, Kathleen O'Connor and Courtney Eaton

Exhibitors are ready!

H2M Exhibitor Ross Hibler

L-r: Taylor Listowski, Angelo DiNottia and Tyler Richardson

Left, Anastasia Rudenko and Scott Lander



Tyler Richardson

L-r: Tom Posella, Michael Garland and Virginia Roach

The Exhibitors are busy.

Above: (l-r) Mike Armes, Matthew Brown and Peter Frick

L-r: Michael Burkett, Raphael Santiago and Wayne Lavair

continued on page 13

L-r: Bob Adamski, Tony Della Valle, Angela Hintz and Joyette Tyler-Della Valle

Left, Dan Gallucci and Kara Keleher

Right: Serdar Umur, left, and Greg Levasseur

L-r: Adam Gowaski, Maegan Thomson, Elaine Yarbrough and Bob Fischer

Photos courtesy of Charlie Tyler and Ken Skibinski

5S Inductions and Operations Challenge

continued from page 11

L-r: Joseph McDonald, Nicholas Sullivan, Michael Orloff, Julie Barown, Angela Delillo, Eric Cushing and Donna Grudier

NEWEA 5S induction, l-r: Jeff Kalmes, James DeLuca, Scott Lander and Eddie Davies, with Charles Tyler at podium.

Jason Swain, left with Bill Grandner

Operator of the Year, Robert Jentz with Donna Grudier

L-r: Kathryn Serra and Julie Barown presented Golden Manhole by Lisa Derrigan.

RI Rising Sludge received the first place lab trophy. L-r: Jason Swain, Shaun Collum, Michelle Hess, Courtney Iava-Savage, Rob Norton, Bob Fischer (holding trophy), Dave Bruno, Max Maher, Eddie Davies, Donna Grudier, Nora Lough and Bill Grandner.

L-r: Alex Beuchner, Claudia Bouchard, Udayarka Karra, Paul Dombrowski (back row), Bill Sedutto and Robert Wither

Operation Challenge winners, Bowery Bay Coyotes!

2023 Operations Challenge teams, event coordinators and judges following the Awards Ceremony at Saratoga Springs. Great job, everyone!

Patricia's Retirement Celebration

Sara Igielski (left) and Kathryn Serra

Michelle Hess (left) and Angel French, right

L-r: E. Tucker Cox, Eric Knudsen and Will Stradling

Ken Skibinski and camera with Michael Lannan

L-r: Matt Oster, Lindsey Wilcox, Courtney Eaton and Zach Henderson

L-r: Mark Koester catches up with Rich and Marlene Lyon.

Rosaleen Nogle and Bob Fischer

Patricia and Jean Malafronte

Takeaways from the U.N. 2023 Water Conference

Edited by Kerry A. Thurston

The United Nations Water Conference was held at the U.N. Headquarters in New York City from March 22 to 24, 2023. The Conference, convened by the U.N. General Assembly, was co-hosted by The Kingdom of the Netherlands and the Republic of Tajikistan. There were also several side events held throughout the city over the course of the whole week. This was the first U.N. Water Conference in 43 years. More information about the conference is available online at *https://sdgs.un.org/conferences/water2023*.

The goal of the conference was to create a watershed moment to bring together stakeholders from all sectors and create a global momentum for accelerated implementation and improved impact to advance the broad challenges surrounding water. Among those gathered stakeholders were members of NYWEA, who have collected their impressions and shared their takeaways from their experiences at the conference. These takeaways are presented following the five themes of the conference, namely:

- Water for Health: Access to safe drinking water, sanitation and hygiene
- Water for Sustainable Development: Valuing Water, Water-Energy-Food Nexus and Sustainable Economic and Urban Development
- Water for Climate, Resilience and Environment: Source to Sea, Biodiversity, Climate, Resilience and Disaster Risk Reduction
- Water for Cooperation: Transboundary and International Water Cooperation, Cross-Sectoral Cooperation and Water Across the 2030 Agenda
- Water Action Decade: Accelerating the implementation of the objectives of the Decade, including through the U.N. Secretary-General's Action Plan

In the weeks following the U.N. Water Conference, I spent a considerable amount of time reflecting on my experience. As you read on, you will learn many heartbreaking facts about the abysmal quality of life endured by many in our world due to climate change and lack of water and sanitation. Hearing about these inequities is difficult and reminds us of the privilege that we enjoy simply by being lucky enough to be born in a country that has public infrastructure. It is incumbent on those of us with a voice to raise it loudly in solidarity with those who have none. I am so grateful to have had the opportunity to hear these stories from the women who have lived them. As you peruse these takeaways, I urge you to consider the millions of lives that make up these stories.

Donna Grudier, NYWEA President

Water for Health

As of today, we have a long way to go in ensuring safe drinking water for health: There are 2.1 million people globally without access to safe drinking water. Globally, 46% of people do not have access to safely managed sanitation. An estimated 494 million people – 6% of the global population – defecate in the open in China, India and Nigeria. More people in the world have a mobile phone than have a toilet.

The Sustainable Development Goal (SDG) 6 initiative aims to ensure availability and sustainable management of water and sanitation for all. SDG 6 not only addresses the issues relating to drinking water, sanitation and hygiene (WASH), but also the quality and sustainability of water resources worldwide. The SDG 6 Global Acceleration Framework, launched by UN-Water in 2020, is a unifying initiative that aims to deliver fast results at an increased scale by mobilizing United Nations agencies, governments, civil society, private sector and other stakeholders toward the goal of ensuring the availability and sustainable management of water and sanitation for all by 2030.

Climate change has resulted in longer distances between water sources. Some women walk up to 2 kilometers (about 1.25 miles) twice a day to fetch water for their families. Men travel with animal herds to find water and are away from their families, leaving unprotected women and children at risk of rape and unplanned pregnancies. Many women have no right over their bodies and bear a heavy burden.

Women are more prone to disease, UTIs and infections from soil contamination. There's not enough education on this topic.

Drinking water gets contaminated by animals that die from drought conditions.

Water is Life and Sanitation is Dignity!

Inequity – There's a 20-year life expectancy gap in London, England, depending on a person's ZIP code or bus stop.

Water for Sustainable Development

Water is the driver for sustainable development. Global freshwater demand would exceed supply by 40% by 2030. Asset management must improve. The private sector must incentivize reuse. Catalytic collaboration between public and private partnerships – we need that 15-30% "activation" energy to start the collaborations.

Israel leads the way with 85% of wastewater reused; 15% in Spain and only 1% in France. Singapore delegates stated that it took them more than 30 years to develop and market the recycled water to the public. According to them, "Think big, start small and learn fast."

Circular Economy: No resource is more perfect for a circular economy than water. It is a reusable asset and growth enabler. Can the clean water industry be the next "mine"? Peru is doing interesting things regarding the circular economy where social and economic opportunities are available. Peru promotes innovation and reduces consumption! Technology exists to reuse wastewater. What gets measured gets done! There are big opportunities for public-private partnerships and sustainable revenue streams. If you set a price that is too low for water, there is no incentive to conserve.

There needs to be more focus on the intersection of water and nutrition. The right to food was identified by the U.N. in 1948, but the right to water was not identified until 2010. Even then, it was a focus on drinking/domestic water, not food and livelihood. In water-scarce areas, there is a need to promote "nutrition-sensitive irrigation," for example, favoring nutrient-dense crops over tobacco.

Water for Climate, Resilience and Environment

Water is at the center of the climate crisis, making the complex water issue a "wicked" complex problem.

Climate change: 90% of the issues revolving around climate change are water related and 74% of natural disasters are due to climate change. Very few countries have policies in place on climate change and a comprehensive credible plan is needed. The actions we take today determine the kind of world our children will inherit. C40 Cities – a global network of mayors of the world's leading cities united in action to confront the climate crisis – have early warning

flood systems. Every city should have a plan. We need regulations that encourage water conservation.

The concept of having people on the ground involved in all phases of planning is critical for making the Early Warning System for weather more effective – classic example of satellites to sandbags – and how to streamline data communication and information systems.

The overall cycle of water use needs to be looked at. This is a called a "Source to Sea" approach. For example, only 20% of the wastewater entering the Mediterranean Sea is treated. Waste entering the oceans is having a negative impact on the Blue Economy (i.e., fishing).

Paradigm shift in water and climate management are what we should be preparing for the next generations. Ecosystem restoration and nature-based approaches to manage the water and climate issues together should be looked at harder. Nature-based approaches are critical to providing integrated solutions that achieve the commitments of the U.N. Water Conference and those of the 27th annual U.N. Convention on Climate Change (COP 27) and the U.N. Biodiversity Conference (COP 15).

Water for Cooperation

Water must be used as an instrument of peace rather than war and the water movement must address diversity, equity and environmental justice.

In Bangladesh, the three major rivers – Padma, Meghna and Jamuna – carry 73,000 tons of plastic waste to the Bay of Bengal every day. Most of this waste comes from its neighboring countries of China and India. This is having a negative impact on its Blue Economy and is affecting the use of farmland. This is an example of why nations need to work together, regardless of political boundaries, to resolve most major water and food supply issues.

A coalition of governments launched the Freshwater Challenge, an initiative to leverage the support needed to restore 300,000 kilometers (approximately 186,400 miles) of rivers and 350 million hectares of inland wetlands by 2030 to enhance water security, tackle climate change and reverse nature loss.

Water Action Decade

We need to breakdown the silos and address the problem holistically. Water cannot be addressed separately; water, biodiversity, pollution, climate change, environmental issues and geo-political issues all have to be considered.

The U.N. is exploring the appointment of a Water Chief who will coordinate the efforts across all U.N. agencies and knit all the efforts together.

We cannot manage what we cannot measure; the initiative of UNESCO's science-based World Water Assessment Program (WWAP) is a game changer in the making. Through the World Water Development Reports and complementary activities, WWAP aims to equip water managers and policy- and decision-makers with knowledge, tools and skills necessary to formulate and implement sustainable water policies.

At the 2023 Water Conference, there was general agreement internationally that there are not enough people going into the water sector and that we need to build capacity by working with universities and their water programs to develop a queue of new engineers, scientists, etc. We also need to value water more as a society and provide high-quality jobs to the members of the local community that work in the water sector.

Women in water have to be a larger footprint as women deal with the water crisis all over the world and sacrifice the most; diversity and equity must be front and center. Having women in positions of leadership in the water sector encourages other women to join the water sector – "you cannot be what you cannot see." WEF indicated that although only 15% of its total membership is women, it is 50/50 for members under 35 years of age. While there was general acknowledgement that there have been huge gains in recent years, those gains have been mostly for white women; we need to raise everyone up.

Asia has about half the Indigenous people in the world. These Indigenous people have been caring for their water and ecosystem sustainably for millennia; water and land use is very intentional and there is reverence toward the resources. These sustainable practices are part of the reason these cultures have remained intact through the modern era. We should learn from Indigenous cultures and develop a more holistic approach toward water, land use and ecosystem management.

It is important to include and center the marginalized when addressing water security and implementing nature-based solutions. Indigenous cultures, especially women and youth, need to be in decision-making roles, not simply consulted.

Conclusion

The mindset that creates a problem cannot solve the problem.

Water cannot and should not be treated as a sector but truly as a life sustaining force; there is no green without blue. Water needs to be addressed along with the other global priorities and there is no life without water.

Contributing authors:

- Donna Grudier, president of NYWEA
- Edmund Lee, Environmental Science Committee chair
- Jamie Ong
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EPA Issues Memorandum Addressing PFAS Discharges in NPDES Permits and Through the Pretreatment Program

by Joshua Kogan and Virginia Wong

This is an important moment in time. On Dec. 5, 2022, the U.S. Environmental Protection Agency (EPA) issued a memorandum that provides states with guidance on how to use the nation's clean water permitting program to protect against per- and polyfluoroalkyl substances (PFAS). This guidance, which outlines how states with permitting authorities can monitor for PFAS discharges and take steps to reduce them where they are detected, is part of the EPA's holistic approach to addressing these harmful forever chemicals under EPA's *PFAS Strategic Roadmap: EPA's Commitment to Action 2021-2024* released in October 2021.

PFAS are a class of thousands of synthetic chemicals that includes perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS) and GenX, which are chemicals used as replacements for PFOA for manufacturing fluoropolymers such as Teflon. These chemicals have been used in consumer products and industrial processes since the 1940s. They are known as "forever chemicals" because they do not dissipate, dissolve or degrade but persist in water, soil and human bodies.

2022 PFAS Guidance Memorandum

The issuance of the December 2022 EPA PFAS guidance memorandum fulfilled a critical step in EPA's efforts to control PFAS at their source, which will reduce the levels of PFAS entering wastewater and stormwater systems and ultimately lower people's exposure to PFAS through swimming, fishing, drinking and other pathways.

"EPA is following through on its commitment to empower states and communities across the nation to address known or suspected discharges of PFAS," said EPA Assistant Administrator for Water, Radhika Fox.

(Nov. 6, 2022, EPA Press Release)

The memorandum, *Addressing PFAS Discharges in National Pollutant Discharge Elimination System (NPDES) Permits and Through the Pretreatment Program and Monitoring Programs,* aligns wastewater and stormwater NPDES permits and pretreatment program implementation activities, and updated EPA's April 2022 guidance, which was targeted at federally issued permits only. In the memorandum, EPA recommends that states use the most current sampling and analysis methods in their NPDES programs to identify known or suspected sources of PFAS and to take actions using their pretreatment and permitting authorities, such as imposing technology-based limits on sources of PFAS discharges. The memorandum will also help the EPA obtain comprehensive information through monitoring the sources and quantities of PFAS discharges, informing other EPA efforts to address PFAS.

The NPDES permit program addresses water pollution by regulating point sources that discharge pollutants to waters of the United States. Created in 1972 by the Clean Water Act, the NPDES permit program can be authorized to state governments by EPA. Anyone discharging wastewater into waters of the United States must obtain a NPDES permit. That permit contains provisions to ensure that pollutants are removed from wastewater discharged directly to rivers or the environment as needed to protect our waters and public health. Many industries discharge wastewater potentially containing PFAS to municipal wastewater treatment plants (WWTPs), rather than directly to rivers or creeks. Municipal WWTPs are not designed to remove PFAS in the waste streams, so reducing the amount of PFAS that industries send to municipal WWTPs is an important part of controlling the amount of PFAS ultimately released into the environment.

The December 2022 memorandum is comprised of four main sections, namely, recommendations for:

(1) Applicable Industrial Direct Dischargers
(2) Publicly Owned Treatment Works
(3) Biosolids Assessment
(4) Public Notice for Draft Permits with PFAS-Specific Conditions

Applicable Industrial Direct Dischargers

EPA's recommendations for industrial discharges start first with applicability, i.e., the industry categories known or suspected to discharge PFAS as identified on Page 14 of the PFAS Strategic Roadmap. These include:

- Organic chemicals, plastics and synthetic fibers (OCPSF)
- Metal finishing
- Electroplating
- Electric and electronic components
- Landfills
- Pulp, paper and paperboard
- Leather tanning and finishing
- Plastics molding and forming
- Textile mills
- Paint formulating
- Airports

This is not a complete list and additional industries may also discharge PFAS. For example, Centralized Waste Treatment facilities may receive waste from the above industries and should be considered for monitoring. There may also be categories of dischargers that do not meet the applicability criteria of any existing effluent limitation guideline (ELG) – for instance, remediation sites, chemical manufacturing not covered by OCPSF, and military bases. For these industries, EPA recommends the use of EPA draft analytical Method 1633 and conduct at least quarterly monitoring for 40 PFAS parameters included in the draft EPA method.

EPA also recommends Best Management Practices (BMPs) be incorporated into NPDES permits for dischargers of PFAS, provides instances for including BMP conditions for pollution prevention and source reduction, and presents examples of permit language. Additionally, to address aqueous film-forming foam specifically, EPA recommends BMPs such as prohibiting the use of aqueous film-forming foam other than for actual firefighting, and to require containment while being used and immediate cleanup after use. The memorandum presents situations where permit limits for PFAS could be applicable.

Publicly Owned Treatment Works

For all Publicly Owned Treatment Works (POTWs) – including POTWs that do not receive industrial discharges and industrial users (IUs) in the applicable industrial categories – EPA similarly recommends the use of EPA draft analytical Method 1633, and a minimum quarterly monitoring for 40 PFAS parameters included in the draft EPA method. EPA recommends that POTW permits should require POTWs to revise their IU inventory, as necessary, to include all IUs

in industry categories expected or suspected of PFAS discharges. As appropriate, POTWs are also recommended to update IU permits to include quarterly PFAS monitoring, develop IU BMPs and local limits, as well as encourage pollution prevention, product substitution and best housekeeping practices.

Biosolids Assessment and Public Notices

For biosolids, EPA recommends that states work closely with their regulated POTWs to reduce the amount of PFAS chemicals in biosolids with emphasis on quarterly monitoring of the 40 PFAS parameters included in draft EPA Method 1633. EPA also recommends public notices of all draft NPDES permits to downstream public water systems, when those permits contain PFAS-specific conditions, including any monitoring or BMP requirements.

State Implementation

Several states have already demonstrated the benefits of leveraging their state-administered NPDES permit programs to identify and reduce sources of PFAS before these forever chemicals enter treatment facilities and surface waters. Michigan, for example, is partnering with municipal wastewater treatment facilities to develop monitoring approaches to help identify upstream sources of PFAS. The state has been able to leverage the monitoring information to work with industries, such as electroplating companies, to substantially reduce PFAS discharges. North Carolina has also successfully leveraged its NPDES program to develop facility-specific, technology-based effluent limits for known industrial dischargers of PFAS. The December 2022 memorandum urges states to replicate these approaches and use others noted in the memorandum to identify and reduce PFAS discharges.

On March 15, 2023, the New York State Department of Environmental Conservation announced the issuance of final water quality guidance values to regulate PFOA, PFOS and 1,4-dioxane. The finalized guidance values support the state's ongoing efforts to protect public health and the environment and prevent exposure to emerging contaminants through the protection of drinking water sources. Additionally, the new guidance values for PFOA, PFOS and 1,4-dioxane also provide protection for aquatic life.

In Summary

EPA's December 2022 memorandum builds upon the agency's April 2022 guidance to EPA regions by expanding the audience to states and including new recommendations related to biosolids, permit limits, and coordination across relevant state agencies. The December 2022 memorandum provides recommendations to NPDES permit writers and pretreatment coordinators, rooted in the successful use of these tools in several states, on monitoring provisions and analytical methods and the use of pollution prevention and best management practices. These provisions will help reduce PFAS pollution in surface waters as the EPA continues work to promulgate ELGs, finalize multi-laboratory validated analytical methods and publish water quality criteria that address PFAS compounds.

We in EPA Region 2 are working to reduce exposure to PFAS compounds to humans and our environment. We are fully committed to achieving these critical goals and look forward to working with our states and the regulated communities to make it so.

Joshua Kogan, PE, is supervisor of the EPA Region 2 NPDES Section and may be reached at Kogan.Joshua@epa.gov. Virginia Wong is supervisor of the Clean Water Regulatory Branch, Water Division, for EPA Region 2 and may be reached at Wong.Virginia@epa.gov.

EPA's December 2022 guidance memorandum aligns wastewater and stormwater NPDES permits and pretreatment program implementation activities. Several states are already leveraging their NPDES permit programs to identify and reduce PFAS before the chemicals enter treatment facilities.

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Keeping Up with the Federal Pursuit to Regulate PFAS and the Potential Impact to Clean Water Utilities

by Emily Remmel

Federal movement to address per- and polyfluoroalkyl substances (PFAS) concerns has been relatively slow compared to various state actions, but this is quickly changing with the U.S. Environmental Protection Agency (EPA) working on myriad regulatory fronts. Most recently, March 29, 2023, EPA published its PFAS National Primary Drinking Water Regulation rulemaking in the Federal Register that will set enforceable standards for drinking water systems under the Safe Drinking Water Act (SDWA). The National Association of Clean Water Agencies (NACWA) is closely monitoring these regulatory actions and is engaging with EPA and the clean water community to help build a strong and sustainable clean water future.

Proposed MCLs under SDWA

Because EPA found PFOA and PFOS are likely to cause cancer, SDWA stipulates that no concentration is safe in drinking water; therefore, EPA set the Maximum Contaminant Level Goal (MCLG) at zero. EPA is also proposing enforceable Maximum Contaminant Levels (MCLs) at 4.0 parts per trillion (ppt) for PFOA and PFOS individually, which reflects a concentration that is currently the most feasible treatment level and analytical quantitation level in finished drinking water.

EPA is also proposing to regulate four other PFAS compounds (GenX, PFBS, PFHxS and PFNA) through a unitless Hazard Index (HI) approach that considers potential public health impacts from mixtures of these chemicals. This HI approach uses a unitless calculation to derive whether a combined mixture poses a potential risk. EPA's rationale is that these four PFAS chemicals have "known and additive toxic effects," and they are likely to co-occur together in drinking water. EPA is proposing to set a unitless HI of 1.0 as the MCLG, which will represent an adequate margin of safety for these four compounds or any mixture containing one or more of these compounds, since they are assumed to "act in a dose-additive manner" with respect to toxicity. EPA notes that additional PFAS compounds might be added to the HI at a later date. While the HI approach has been used in site cleanups under other federal environmental statutes, it has never been used in the context of SDWA drinking water enforceable standards.

How Will These Proposed MCLs Impact Clean Water Utilities?

Future Clean Water Act Standards

The formula used to calculate MCLs under the SDWA is not equivalent to how water quality criteria are formulated or how biosolids risk assessments are calculated under the Clean Water Act (CWA) – meaning that the 4.0 ppt will not correlate exactly, but it will likely drive future compliance values on the clean water side. Specifically, the reference dose (RfD) and the cancer slope factor (CSF) values used in developing the recent MCLGs will be used in the equations to calculate recommended human health ambient water quality criteria and evaluate the risk of PFOA and PFOS in biosolids.

Now that EPA has proposed the MCLGs on the drinking water side, it is likely that EPA will move very quickly to publish its proposed recommended ambient human health criteria under the CWA – which will be based on the RfDs and CSFs used to derive the MCLGs, and thus we expect very low values to be proposed. Unfortunately, without a treatment technology for PFAS that is cost effective and scalable to the extent required for publicly owned treatment works (POTW) flows, it is likely public clean water utilities will need to seek variances, which is its own hurdle.

Before human health criteria are proposed, it is likely EPA will release its final aquatic life criteria soon. These proposed aquatic life criteria set reasonable acute and chronic criteria for freshwaters.

How the EPA Develops Drinking Water Contaminant Regulations

The *Maximum Contaminant Limit Goal* (MCLG) is the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, allowing an adequate margin of safety. MCLGs are non-enforceable public health goals. MCLGs consider only public health and not the limits of detection and treatment technology effectiveness. Therefore, they sometimes are set at levels that water systems cannot meet because of technological limitations.

When determining an MCLG, EPA considers the adverse health risk to sensitive subpopulations (e.g., infants, children, the elderly, and those with compromised immune systems and chronic diseases).

The way EPA determines MCLGs depends on the type of contaminant targeted for regulation:

For **microbial contaminants** that may present public health risk, EPA sets the MCLG at zero. This is because ingesting one protozoan, virus, or bacterium may cause adverse health effects.

For **chemical contaminants** that are carcinogens, EPA sets the MCLG at zero if both of these are the case:

- There is evidence that a chemical may cause cancer.
- There is no dose below which the chemical is considered safe.

If a chemical is carcinogenic and a safe dose can be determined, EPA sets the MCLG at a level above zero that is safe.

For **chemical contaminants that are non-carcinogens but can cause adverse non-cancer health effects** (for example, reproductive effects), the MCLG is based on the reference dose. A *reference dose* (RfD) is an estimate of the amount of a chemical that a person can be exposed to on a daily basis that is not anticipated to cause adverse health effects over a lifetime.

Once the MCLG is determined, EPA sets an enforceable standard. In most cases, the standard is a *maximum contaminant level* (MCL). The MCL is the maximum level allowed of a contaminant in water that is delivered to any user of a public water system.

When there is no reliable method that is economically and technically feasible to measure a contaminant at concentrations to indicate there is not a public health concern, EPA sets a "treatment technique" rather than an MCL. A *treatment technique* is an enforceable procedure or level of technological performance which public water systems must follow to ensure control of a contaminant.

Source: EPA
(https://www.epa.gov/sdwa/how-epa-regulates-drinking-water-contaminants)

Once these recommendations are finalized, states can elect to adopt these into water quality standards.

Future Biosolids Risk Assessment

Over the last several years, growing fears of PFAS contamination have spurred concerns over how clean water utilities manage their biosolids. We have seen instances of several states pushing for land application restrictions, and in one case successfully enacting a complete ban on land application. In other states, concerns have been raised about incineration and the possible air emission impacts of PFAS on local communities. Most of these initiatives result from fear and uncertainty over what concentrations of PFAS in biosolids are safe.

EPA is only now beginning to dig into assessing the risks of PFAS and other currently unregulated potential contaminants in biosolids, recently proposing a standardized framework to screen and assess chemical risks. The Science Advisory Board has scheduled three meetings to vet the merits of EPA's proposed standardized framework for screening biosolids. While the clean water community patiently awaits these meetings and the outcome of the Science Advisory Board review, clean water utilities that land-apply biosolids remain in scientific and operational uncertainty as to whether and what the risks of PFAS are to public health and the environment and whether new pollutant limits will be added to the Part 503 regulations.

EPA's PFAS Strategic Roadmap indicates a timeline for EPA to complete its risk assessment by 2024, but NACWA believes it will not be until early 2025 when the agency possibly proposes a Part 503 rulemaking for PFOA and PFOS, if a risk is found. As noted previously in this article, the RfDs and CSFs used to derive the MCLGs will factor into the biosolids risk assessment. And EPA's running behind on this review only further delays regulatory clarity for the clean water community.

What Other Regulatory Initiatives Can the Clean Water Community Anticipate?

EPA is hard at work on major actions under several federal environmental statutes. The agency is arguably playing "catch up" with the public concern and proactive actions already happening at the local and state levels. Individually and collectively, the agency's federal efforts underway could significantly impact clean water utility management on a national scale in the near future. Following are some of the key actions that NACWA is closely monitoring and engaging with members and EPA on developing.

Designation of PFOA, PFOS (and others) as CERCLA Hazardous Substances

- CERCLA designation
- Method 1633 finalization
- Plan 15 and proposed influent study
- Toxic Release Inventory changes

In what could amount to one of the most significant regulatory initiatives in decades, last fall EPA proposed to designate PFOA and PFOS as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), also known more commonly as Superfund. In doing so, EPA could initiate cleanup actions at highly contaminated sites and seek to hold polluters financially accountable.

Proponents of a broad hazardous substance designation often

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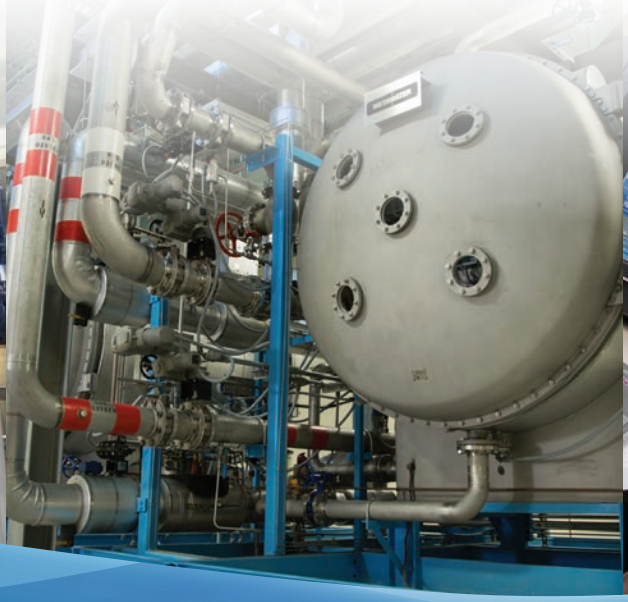


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emphasize the intent of the designation is not to bring cleanup actions against public clean water utilities or public water systems that passively receive PFAS. However, CERCLA's expansive definitions, attribution of liability to "dischargers," and lack of focus on culpability means third parties responsible for contamination can bring in clean water utilities as potentially responsible parties, simply by virtue of their daily CWA treatment operations and the PFAS entering their systems through industrial, commercial and domestic sources. This weakens the intent of a true "polluter pays" policy, instead threatening a "community pays" policy that would place substantial costs on utilities and its ratepayers.

EPA is currently drafting policy guidance on how it plans to use its CERCLA enforcement authorities and discretion. The agency plans to consider various factors – including focusing on PFAS manufacturers and other industries that have released significant amounts of PFAS into the environment – and has stated its intent to not focus on public wastewater or drinking water utilities, public solid waste facilities, municipal airports, or farmers that have land-applied biosolids.

While a positive step in the right direction, NACWA continues to voice major concerns that, regardless of EPA's enforcement discretion and settlement policy, third parties – including those responsible for causing and profiting from PFAS pollution – can drag innocent parties into extremely costly and complex litigation. There is often little EPA can do to stop this from happening, even with its application of enforcement discretion. NACWA, in comments, has urged the agency to clarify that clean water utilities should not be the subject of CERCLA PFAS enforcement actions and to provide instructions to courts grappling with cost allocation and equity considerations in CERCLA litigation. NACWA continues to encourage EPA to support congressional action to pass a true "polluter pays" model for PFAS cleanups and excluding public clean water utilities from liability under a PFAS hazardous substance designation.

Draft Method 1633 Finalization Coming Soon

One of the more challenging aspects for clean water utilities wrestling with concerns over PFAS has been the lack of a CWA-approved analytical method. The last several years, EPA and the Department of Defense have worked to refine Method 1633, a method that can consistently, accurately, and confidently measure up to 40 different PFAS chemicals in various environmental media including wastewater, biosolids, surface water, sediment and landfill leachate. However, up until now, EPA has only issued a single-laboratory validated draft methodology prescribing how clean water utilities should collect and laboratories should analyze samples.

NACWA has voiced concern over EPA's efforts to require federally issued National Pollution Discharge Elimination System permits and to recommend that state permitting authorities include the use of Draft Method 1633 for sampling and monitoring influent, effluent and biosolids, before this method has been finalized and promulgated under CWA Part 136. When measuring PFAS at trace concentrations, it is imperative that the monitoring results are accurate, reliable and confidently measured, especially given the fact that operators are reporting these on discharge monitoring reports that carry legal penalties for providing false or inaccurate information.

EPA has reiterated that the use of Method 1633 is for investigatory monitoring purposes and cannot be used for CWA compliance until promulgated. EPA quietly published an update on its multi-laboratory validation in January 2023, which is the last step before an analytical method moves to promulgation, and continues to recommend the use of this method. It is likely that Method 1633 will be finalized later this year and a formal regulatory promulgation process will begin thereafter.*

Effluent Guidelines Plan 15 Finalized and PFAS Influent Study Proposed

Earlier this year, EPA released its final Effluent Guidelines Program Plan 15 that outlines EPA's planned studies and rulemakings related to effluent limitation guidelines and pretreatment standards for industrial discharges. This plan is published every two years and the most recent follows up on the 2021 Preliminary Effluent Guidelines Program Plan 15, which had a focus on controlling discharges from several industrial categories that discharge PFAS, including the Organic Chemicals, Plastics and Synthetic Fibers (OCPSF) and Metal Finishing categories. In EPA's final Effluent Guidelines Plan 15, EPA announced new rulemakings for PFAS discharges from the Landfill industrial category and plans to expand detailed studies on Textile Mills and monitor Pulp, Paper and Paperboard, Electrical and Electronic Components, Metal Finishing and Airports for PFAS discharges.

Interestingly, the Effluent Guidelines Plan 15 also announces EPA's desire to "initiate a POTW Influent PFAS Study" to focus on industrial discharges to POTWs with the intent to collect samples of PFAS from industrial sources within the collection system before mixing and dilution from other waste streams make it difficult to identify the true sources of PFAS. While EPA's study design is in the initial stages and subject to EPA funding, this effort will attempt to gather more data on upstream industrial sources of PFAS. EPA anticipates partnering with wastewater treatment facilities to conduct this sampling effort but, if this study moves forward, it is likely that the agency will use its authority under the CWA Section 308 to compel utilities to participate in this influent study.

Toxic Release Inventory "de minimus" Exemption Elimination Proposed

EPA recently proposed changing the reporting requirements for PFAS under the Toxic Release Inventory that would add certain PFAS to the list of Lower Thresholds for Chemicals of Certain Concern. This change would effectively eliminate the de minimis exemption that allowed manufacturers of certain PFAS chemicals under a relative concentration threshold to escape reporting their uses and placement in commerce. In proposing this change, EPA acknowledges that even small amounts of PFAS can be concerning. If this rule is finalized, a significant pool of potential industrial sources and commercial users of PFAS will be required to report to EPA their use of PFAS chemicals.

Clean water pretreatment coordinators will benefit from this elimination of the de minimis exemption for certain PFAS because many upstream industrial and commercial entities are unknowingly using products that contain PFAS and are discharging these products to the POTW. Greater transparency of upstream uses will help clean water utilities identify and mitigate PFAS discharges into their systems.

NACWA continues to engage EPA and the clean water community as the federal pursuit to regulate PFAS moves forward. If NYWEA members have any questions on the legislative or regulatory fronts, please do not hesitate to reach out to us at NACWA.

Emily Remmel is the director of Regulatory Affairs for NACWA and may be reached at eremmel@nacwa.org.

*After this article was submitted, a fourth draft of Method 1633 was issued in July 2023. This draft includes aqueous matrices results of the molt-laboratory validation study. (Source: EPA. 2023. Draft Method 1633, *Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS.)*

Monroe County's Pretreatment Program

by Sean Keenan

The Genesee Valley Chapter of NYWEA covers 10 counties of upstate New York within the Genesee River watershed, the Finger Lakes area of the Seneca River watershed, and the Chemung River watershed of the Susquehanna River. This region represents an area of New York state rich in a history of leading technology development in engineering, environmental stewardship, wastewater treatment, watershed protection and facilities management. In the Northern region, along the shore of Lake Ontario, lies Monroe County and the City of Rochester, known for its place in technological advancement through its acclaimed academic institutions, manufacturing facilities and a highly skilled workforce.

Historically, this area of upstate New York has been influenced by industrial giants such as Eastman Kodak, Xerox and Bausch & Lomb, as well as other manufacturing and research institutions. As a result, the region is renowned for its leadership in innovation in the optics sector as well as diverse manufacturing in metal finishing, machining, pharmaceuticals and other chemicals, and the food and beverage sectors. The robust manufacturing economy, which persists to this day, generates tremendous amounts of wastewater. These industrial flows to Monroe County's Pure Waters system are regulated by the county's pretreatment program.

This dissolved air flotation system is one example of available pretreatment technologies. *MCDES*

Regulatory History of Pretreatment

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The Federal Water Pollution Control Act was enacted in 1948, but was significantly reorganized and expanded in 1972 as the CWA. Under the authority vested in it by the CWA, the U.S. Environmental Protection Agency (USEPA) has implemented pollution control programs that have set wastewater standards for industries. Concurrently, USEPA has developed recommended national water quality criteria for pollutants in surface waters.

The National Pretreatment Program requires nondomestic dischargers that introduce pollutants to publicly owned treatment works (POTWs) to comply with pretreatment standards to ensure the goals of the CWA are attained. The program also outlines requirements for POTWs to proactively protect the infrastructure as well as establishing management responsibilities.

The objectives of the National Pretreatment Program are to:

An example of a pretreatment plant at an industrial site. *MCDES*

1. Prevent the introduction of pollutants into a POTW that will interfere with its operation, including interference with its use or disposal of municipal sludge.
2. Prevent the introduction of pollutants into a POTW that will pass through the treatment works or otherwise be incompatible with it.
3. Improve opportunities to recycle and reclaim municipal and industrial wastewaters and sludges.

The National Pretreatment Program identifies specific discharge standards and requirements that apply to sources of nondomestic wastewater discharged to a POTW. By reducing or eliminating waste at the industries (e.g., source reduction), fewer toxic pollutants are discharged to and treated by the POTWs, providing benefits to both the POTWs and the industrial users.

The City of Rochester adopted a Sewer Use Law in 1964 that became the basis of a progressive industrial pretreatment program now run by Monroe County. Monroe County adopted the law in 1972 and has made necessary updates to it over the years to ensure it provides the regulatory framework needed to administer the requirements of the National Pretreatment Program and meet the standards of the national pretreatment requirements. In 1984, Monroe County became an approved Control Authority of the National Pretreatment Program. This provided authority to Monroe County to regulate non-direct discharges from industrial sources to the municipal sewer system. In 1986, Monroe County initiated its industrial pretreatment program. The key to the effective administration of this program has been

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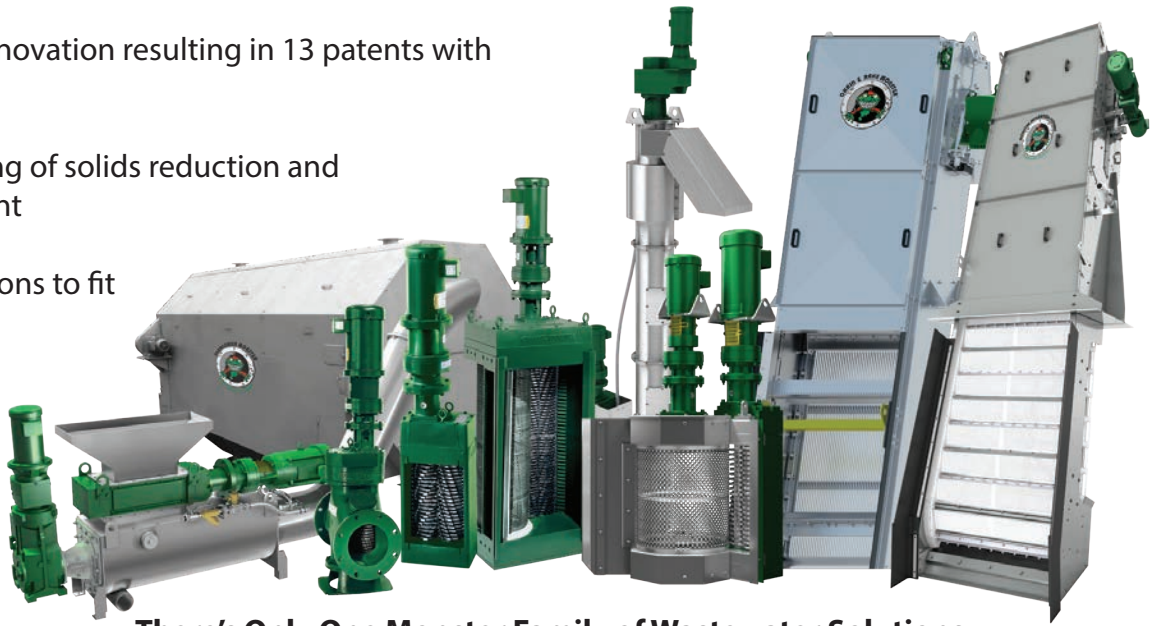

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a high level of cooperation between industry and Monroe County, specifically the Pure Waters Agency, now part of the Monroe County Department of Environmental Services (MCDES) that administers and governs the conveyance and treatment of wastewater.

As an approved Control Authority, Monroe County is committed to ensuring that any wastewater discharged from an industrial, commercial or other source is compliant with the CWA, the National Pretreatment Program requirements, New York State Department of Environmental Conservation regulations and the Sewer Use Law. Under the law, non-residential requirements for users of the sewer system are laid out, which include local, state and federal requirements. Certain liquid or semi-liquid materials (such as concentrated process solutions, flammable or explosive materials and corrosive substances) are prohibited from discharge, while others are conditionally accepted based on a comprehensive review process. Wastewater containing oil and grease, abnormal strength pH, high biochemical oxygen demand (BOD), high total suspended solids (TSS), high total phosphorus (TP), or heavy metals are accepted, but either receive a surcharge (for BOD, TSS and TP), or are regulated by a specific concentration limit. In many cases, these requirements result in the need for pretreatment prior to discharge. The requirements are applied through the issuance of a permit to acceptable industrial users.

Monroe County's Pretreatment Program Today

The Monroe County pretreatment program, one of the largest of its kind in New York state, is coordinated by a staff of six full-time employees in the Environmental Quality Office of MCDES. Over the years, staffing challenges have arisen through retirements and attrition. The roles performed by the staff are diverse, including enforcement, field sampling, facility inspection, permitting (initial applications and renewals), site review, industrial user reporting tracking, data analysis and review, identifying new sources of discharge, regulatory reporting and data management.

Monroe County field sampling crew conducts a flow monitoring study at an industrial site. *MCDES*

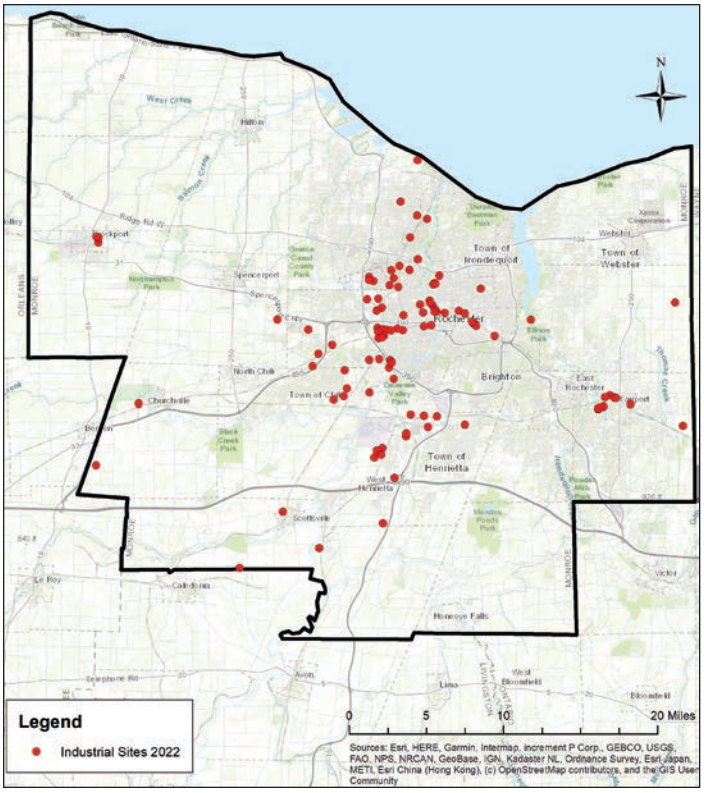

Figure 1. Monroe County Permitted Industrial Users. *MCDES*

The county's pretreatment program currently permits 104 industrial users ***(Figure 1)***, 51 of which are classified as Significant Industrial Users. In any given year, program staff will conduct between 70 and 90 on-site facility inspections (including non-permitted sites), as well as 450 to 550 individual regulatory sampling events at industrial sites, to ensure compliance with the pretreatment requirements. There are 51 waste haulers permitted to discharge at one of three designated waste hauler discharge sites. There are also 12 towns or villages in the region (including outside of Monroe County) that operate municipal treatment facilities and are permitted by the program to haul their biosolids to the Frank E. Van Lare Water Resource Recovery Facility (WRRF) for further treatment and proper sludge disposal.

Monroe County's pretreatment program is dedicated to ensuring the POTW is protected from harmful discharges and also to ensure the safety of all MCDES employees who work in the collection systems and WRRFs. This in turn protects the residents of Monroe County and local watersheds of the Genesee Valley region.

The program has achieved a high degree of compliance through the development of effective working relationships with all industrial sites. This starts with a collaborative regulatory philosophy, focusing on education and outreach to industrial users about the benefits of becoming good environmental stewards. Accommodating the diverse needs of the industrial sites and cooperating where possible, while still adhering to the enforcement requirements of the program, has led to a strong mutual cooperative effort. In our experience, industrial users have been more approachable and communicative, reporting any facility changes or abnormal conditions promptly. This cooperation helps us to maintain a clean environment and sustainable future.

Sean Keenan is the pretreatment coordinator for the Monroe County Department of Environmental Services and may be reached at skeenan@monroecounty.gov.

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It's Time to Pay Attention to PFAS in Biosolids (If You Aren't Already)

by Janine Burke-Wells and Mary Firestone

If you have been hiding under the proverbial rock or simply sticking your head in the sand on the topic of per- and polyfluoroalkyl substances (PFAS), it's time for you to pay attention. PFAS has probably already impacted your work even if you don't realize it.

This thorny and complicated problem of PFAS everywhere in the environment first reared its ugly head for wastewater operators and managers in solids management programs. Although water resource recovery facilities (WRRFs) were not designed to remove PFAS, those PFAS that do get removed end up in the solids, of course. We hope all WRRF managers see that solids management now becomes your biggest liability in addition to one of your biggest expenses. You owe it to your customers to get involved in conversations about PFAS.

The North East Biosolids & Residuals Association (NEBRA) and the Mid-Atlantic Biosolids Association (MABA) are focused on biosolids issues, including PFAS. In this article, we will look at PFAS regulation specific to WRRFs and biosolids, describe how NEBRA and MABA are assisting their members, and provide suggestions for how you can become more proactive in managing for PFAS in your facilities.

April 24, 2023

The Honorable Tom Carper
Chairman
U.S. Senate Committee on Environment and Public Works
410 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable Shelley Moore Capito
Ranking Member
U.S. Senate Committee on Environment and Public Works
410 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Carper and Ranking Member Capito:

The undersigned organizations represent local governments and private entities responsible for safeguarding public health and the environment, including drinking water, wastewater treatment, stormwater management, and water recycling facilities, municipal solid waste landfills, and composting facilities. We write to urge that any legislation on per- and polyfluoroalkyl substances (PFAS) that the U.S. Senate Committee on Environment and Public Works (EPW) considers include a specific provision to ensure that the organizations we represent are explicitly recognized as "passive receivers" of PFAS and afford these essential public services a narrow exemption from liability under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Absent such relief, designation of certain PFAS as CERCLA hazardous substances would shift the "polluter pays" principle of the law to that of a "community pays" model placing the burden of compliance and cleanup onto ratepayers and the public at-large.

The U.S. Environmental Protection Agency (EPA) has stated often, including during Assistant Administrator Rhadika Fox's testimony to EPW, that the agency would use its "discretionary authority" in pursuing CERCLA enforcement actions against certain parties. However, this commitment offers little comfort to our sectors given the expansive rights of Potentially Responsible Parties under CERLCA to bring contribution litigation against other entities that are alleged to be additional sources of hazardous substances at a cleanup site.

EPA has stated that it has insufficient existing legal authority to provide relief to public service providers from the impact of CERCLA contribution litigation. Claims for contribution against passive receiver groups thus would generate significant litigation costs for lawful operations going back decades—costs that would lead to significant cost increases on essential public service providers and the communities and residents they serve.

It is important to highlight that our members deliver essential public services that do not involve the manufacture or use of PFAS. We are passive receivers of media containing PFAS that are ubiquitous in the

Figure 1. Example of a letter to Congress members from the "PFAS Receivers." *NEBRA/MABA and others*

PFAS Liability Under CERCLA

EPA has proposed to designate several PFAS compounds as hazardous under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, more commonly known as the "Superfund" law) and has plans to add more to the list. EPA has stated that it would use its discretionary authority to target the sources of PFAS contamination, but that does not prevent private parties from bringing passive receivers into a CERCLA cleanup action.

The most important issue right now is ensuring that passive receivers of PFAS, such as WRRFs, landfills and composters – are not held liable under ordinary activities involved in managing end-of-life materials containing PFAS. Nationally, a collaboration of "PFAS Receivers" (including MABA and NEBRA) has been effective in getting the attention of Congress ***(Figures 1*** and ***2)***. Narrow exemptions from CERCLA for local utilities' role in handling PFAS materials are needed to ensure the Superfund law's model of "polluter pays" is upheld and communities are not held liable for cleanup costs.

The exemption for PFAS Receivers is not a sure thing so we still need help communicating with Congress. If you are a member of WEF, it will take you five minutes to send a letter to your elected officials in Washington, D.C., using an online tool *Take Action Today! (WEF 2023).*

Regulating Contaminants in Biosolids

The EPA is taking the first steps in the process of eventually establishing additional limits or best management practices for addressing contaminants in biosolids, not just PFAS. There are over 700 chemicals that have been detected in biosolids based on sewage sludge and literature surveys.

With so many chemicals to evaluate, EPA has proposed following a three-step process:

1. Use EPA's Public Information Curation and Synthesis (PICS) process to prioritize the list of chemicals found in biosolids. This approach, similar to one developed to meet EPA's obligations for risk assessments under the Toxics Substances Control Act, is being customized to target the needs of their Biosolids Program.
2. Use the BioSolids Screening Tool (BST) to conduct screening-level risk assessments on chemicals prioritized in Step 1.
3. Conduct refined risk assessments for chemicals that pose the greatest risk as identified in Step 2.

The EPA has convened a Science Advisory Board (SAB) Biosolids Panel, which met virtually April 5 and in person May 2 and 3. The SAB is tasked with reviewing EPA's "Approach to Biosolids Chemical Risk Assessment and Biosolids Tool" *(EPA SAB 2023a).* Details of the meetings are available online *(EPA SAB 2023b).* The SAB Biosolids Panel is charged with providing feedback to EPA on its proposed framework for biosolids risk assessment.

Along with the SAB meeting details, EPA's presentations to the SAB, a white paper on the approach, the BST, and the "charge" questions are also available on the meeting website *(EPA SAB. 2023b).* The SAB Biosolids Panel is just the first step in the process of regulating PFAS and other contaminants in biosolids.

What's Going On in New York State?

Introducing DMM-Draft 7

PFAS in biosolids is becoming a hot topic in the state with the release of the New York State Department of Environmental Conservation (NYSDEC) Division of Materials Management Draft Policy 7 *Biosolids Recycling in New York State - Interim Strategy for the Control of PFAS Compounds* (DMM-Draft 7) for a public comment period that ended July 10, 2023. The NYSDEC is using the State of Michigan's work on evaluating biosolids and industrial PFAS influences as a basis for the agency's interim guidelines.

With DMM-Draft 7, NYSDEC aims to establish interim PFOA and PFOS sampling criteria for recycled biosolids as well as the actions they will take based on results. DMM-Draft 7 does not dictate how a particular WRRF must address potential PFAS sources. The following is an excerpt from DMM-Draft 7 regarding the sampling requirement and guidelines:

> *Within 180 days of the issuance of this policy, all currently permitted 361-2 and 361-3 facilities that accept biosolids must sample each biosolids source (water resource recovery facility) and submit the results to DEC. For proposed facilities that are not yet permitted as of Aug. 1, 2023, analyses must be submitted with the permit application. Prior to sampling, the facility must provide a brief sampling plan to the DMM, including the name of the biosolids source(s) that will be sampled, the timing of the sampling, a description of the sampling technique, the laboratory that will be used and the test method. The required test method is Draft EPA Method 1633 unless an alternative is allowed by DEC. The samples must be analyzed for all the PFAS compounds provided by the test method, not PFOA and PFOS alone.*

The NYSDEC may direct that the samples be sent to a research laboratory under contract with NYSDEC if deemed consistent with the research objectives; in those cases, the cost of the analyses will be covered by NYSDEC. Furthermore, NYSDEC noted that all permitted 361-2 and 361-3 facilities that accept biosolids must sample each biosolids source at a frequency determined by NYSDEC, based on the quantity recycled, potential PFAS sources to the WRRF and previous analytical results.

The DMM-Draft 7 will remain in place until EPA issues risk-based standards, expected by December 2024. The NYSDEC intends to incorporate those standards in a rulemaking based on the data provided for NYSDEC to determine the impacts the EPA standards will have on New York facilities. Until then, the NYSDEC has provided interim guidelines for PFOA and PFOS ***(Table 1)***.

Disposal Options, Sustainability and Costs

Although the majority of New York's biosolids go to landfill *(National Biosolids Data Project 2015; **Figure 3**)*, this is not a sustainable practice for many reasons. Landfill space scarcity is on the rise, with some areas seeing costs exceeding $200 per wet ton, and there is significant potential for additional strain in disposal regulations and options due to potential PFAS regulations. In the Northeast, where landfilling is the only option in Maine, for example, the problems with landfilling wet wastes became apparent quickly. However, landfills are sinks for PFAS and will continue to be a viable short-term option for biosolids generators, but with limits on volumes and even PFAS content of sludges.

continued on page 28

Figure 2. A news headline citing legislation relating PFAS liability claims. *Megan Quinn and Brian Tucker, Waste Dive*

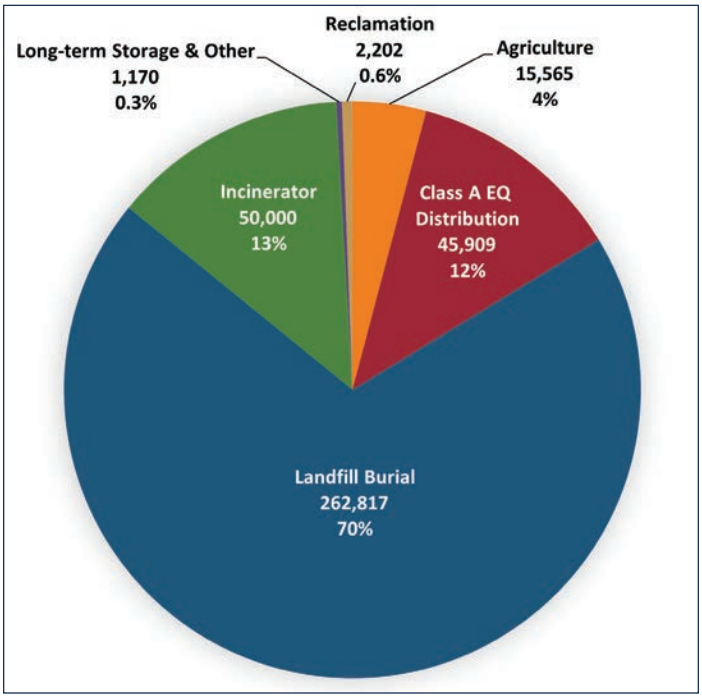

Figure 3. New York biosolids use and disposal in 2015, in dry U.S. tons. Total biosolids approximately 378,000 tons. *National Biosolids Data Project 2015*

Table 1. NYSDEC Interim Guidelines for PFOA and PFOS in Biosolids Recycled.

PFOA or PFOS in Biosolids dry weight (ppb)*	Action Required for Biosolids that are Recycled
20 or less	No action required.
> 20 but < 50	Additional sampling required. NYSDEC will take appropriate steps to restrict recycling after one year if the PFOS or PFOA levels are not reduced to below 20 ppb.
50 or greater	NYSDEC will take action to prohibit recycling until PFOS or PFOA concentration is below 20 ppb.

**In addition to dry weight results, NYSDEC may require analyses using the Synthetic Precipitation Leaching Procedure (SPLP) and use those results to determine whether the biosolids source can be recycled.* Source*: DMM-Draft 7*

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Increasing incineration capacity to dispose of biosolids is unlikely in New York.

Recycling biosolids into soil amendments, with some sort of PFAS limit, is the most sustainable yet the most disparaged of all the options, at least with the press and general public. More and more biosolids generators and managers are coming to see that despite the concerns with PFAS, putting carbon and nutrients back into the soil is important for sustainability.

The rising costs of biosolids disposal and increasingly limited lack of options has been a leading factor for many plants to reevaluate their drying operations to minimize the volume of the biosolids to be managed. There are also new technologies on the horizon that may add needed options and capacity for biosolids end uses in New York.

What Are MABA and NEBRA Doing?

MABA's and NEBRA's leadership have been working to determine how their respective organizations can best assist their members with handling this difficult subject matter and growing issue in the biosolids community.

NEBRA has been tracking PFAS developments since as early as 2017 and has developed a PFAS webpage with numerous resources for its members. NEBRA led a cost impacts study in 2020 *(CDM Smith 2020)* – which is outdated already – and funded a study on fate-and-transport modeling for PFAS in Maine soils.

MABA has created a PFAS Focus Group that worked to build an extensive repository for PFAS-related information on MABA's members-only section of the website. The repository includes research papers and abstracts, studies and statistics, as well as presentations from across the country.

Both NEBRA and MABA have assisted in the funding of PFAS-related research, including work spearheaded by Dr. Ian Pepper and the Water & Energy Sustainable Technology Center at the University of Arizona. The team at the Center is coordinating the PFAS National Collaborative Study on the fate and transport of PFAS following long-term application of biosolids.

The Education and Programming committees of MABA and NEBRA bring the latest research and technologies available, including many related to PFAS elimination, to the association members and biosolids community via webinars and conference sessions *(**Figures 4** and **5**)*. Recent webinars have covered technologies ranging from gasification to pyrolysis, as well as advancements in drying options, dryer operations and opportunities for additional efficiency in drying. The associations are also keeping a watchful eye on regional facilities that are exploring and conducting pilot operations of some of these technologies, including facilities in Schenectady, New York, and Ephrata, Pennsylvania.

The leaders of both MABA and NEBRA are prepared to speak to the press and advocacy groups on behalf of their WRRF members. The associations' leadership continue to encourage an open dialogue with the media and have been featured in local and regional publications. MABA has also issued a press release, as well as a PFAS position statement addressing public and regulatory PFAS concerns. And both organizations are working on materials for their members to use to educate themselves and others about PFAS in biosolids.

Furthermore, MABA's and NEBRA's Regulatory and Legislative committees are keeping an ear to the ground, working to identify, advocate and respond to legislation and regulations that affect the wastewater treatment and biosolids sectors in the region. MABA's and NEBRA's leadership have provided oral and written testimonies and taken part in analyzing proposed general permit revisions, for state and regional regulatory groups from neighboring states to address PFAS and other biosolids-related issues and developments. These committees and the association leadership bring this key information back via frequent communications to their members and the greater biosolids community.

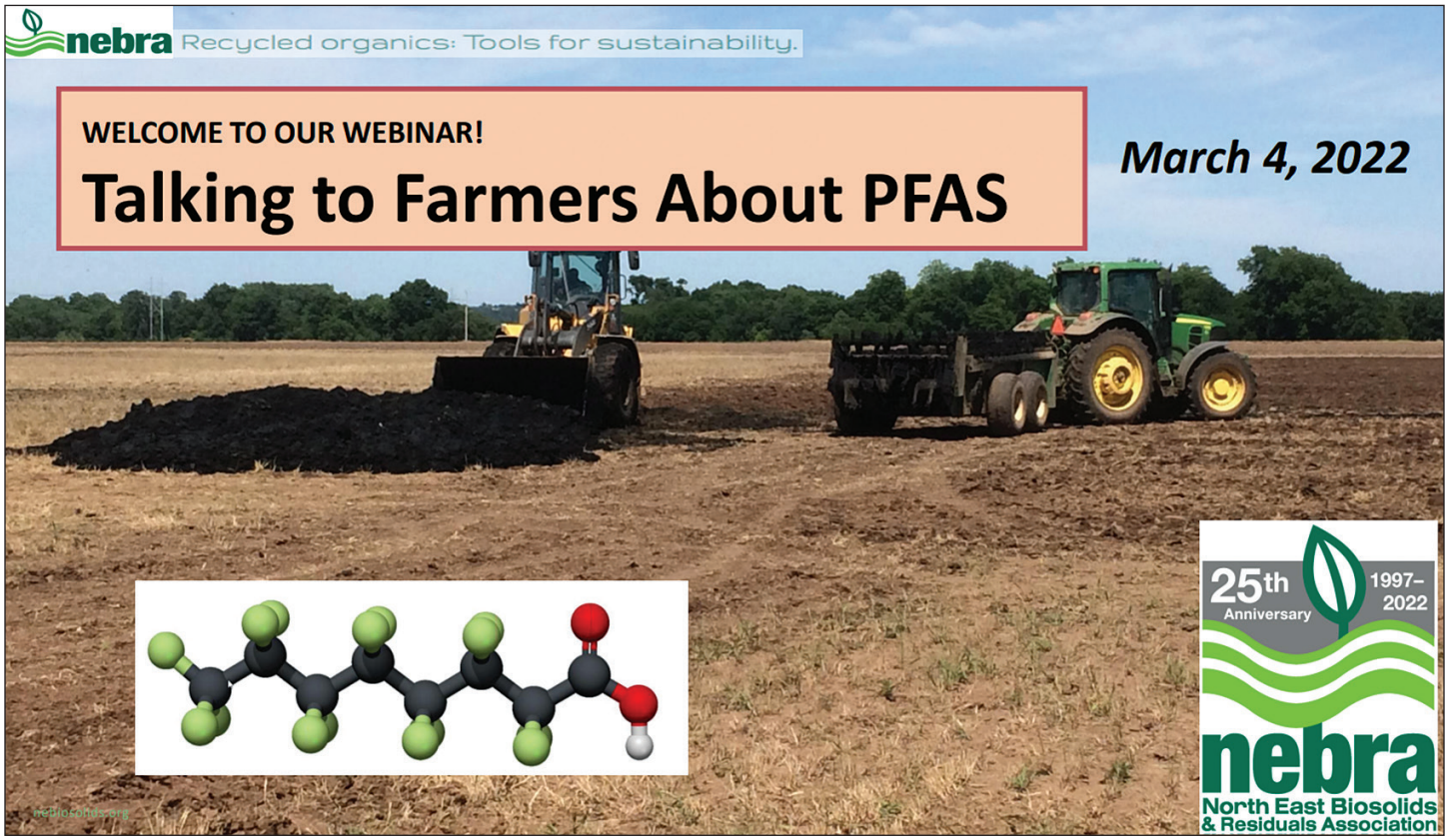

Figure 4. Screen shot of a webinar offered by NEBRA. *NEBRA*

Figure 5. Screen shot of a webinar offered by MABA. *MABA*

What Can You Do?

We certainly recommend you join us at MABA or NEBRA; our organizations are focused just on the solids, and we have been dealing with PFAS in biosolids for some time. MABA and NEBRA have compiled numerous resources for our members to educate themselves and others about PFAS in biosolids.

Find ways to stay informed through NYWEA or your other professional associations. It is important to talk about the PFAS issue as it impacts your operations with local officials and your customers.

You might also more seriously consider that rate increase you have been putting off because we are already seeing significant cost impacts in the Northeast.

Most importantly, get involved with submitting comments on any proposed guidance for PFAS in biosolids in New York state, as well as contacting federal legislators about the exemptions from CERCLA liability for your utility.

Janine Burke-Wells is the executive director of the NEBRA and may be reached at janine@nebiosolids.org. Mary Firestone is the executive director of the MABA and may be reached at mfirestone@mabiosolids.org.

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(See page 60 for more information. Lists as of 8/31/23)

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Complying with New York's Draft Policy for PFAS in Biosolids

by Kyle Thompson, Michelle Young, Rashi Gupta and Eva Steinle-Darling

PFAS is shorthand for per- and polyfluoroalkyl substances, a family of thousands of manufactured chemicals that have been widely used since the 1940s because of their resistance to heat and repellence to water and oil. The toxicity and pervasiveness of certain PFAS have raised concern about their potential health impacts or changes to water and wastewater practices in response. Alongside many other materials and environmental media, PFAS have been widely detected in biosolids *(Thompson et al 2022)*.

As part of their comprehensive PFAS strategy, the U.S. Environmental Protection Agency (USEPA) is conducting a risk assessment of two PFAS – PFOA and PFOS – in land-applied biosolids *(USEPA 2021)*. This assessment will be the basis for any following federal regulation addressing PFAS in biosolids for land application. However, the USEPA does not anticipate completing this risk assessment until December 2024 or later. In the meantime, New York has drafted an interim policy to join the handful of other states – notably Maine, Colorado, Wisconsin and Michigan – that have taken regulatory action about PFAS in biosolids *(Glance 2023)*.

In this article, we will:

1. Summarize New York's draft PFAS in biosolids policy *(Glance 2023)*.
2. Analyze how challenging it will be to comply with this policy based on data.
3. Describe solutions to decrease PFAS in biosolids.

New York's Draft PFAS Biosolids Policy

The New York State Department of Environmental Conservation's (NYSDEC's) draft interim policy follows a framework first pioneered by Michigan ***(Table 1)***. This framework is currently not "risk based." That is, it is not yet based on a comprehensive risk assessment considering the chemical's toxicity and human exposure through various plausible pathways ***(Figure 1)*** because they are awaiting completion of the USEPA risk assessment. Rather, the policy put forth by Michigan is intended to immediately and proactively reduce potential environmental impacts from PFAS by curbing industrial sources to collection systems.

Michigan developed this framework after collecting PFAS data from the influent, effluent, and biosolids of 42 water resource recovery facilities (WRRFs) in their state *(EGLE 2020)*. Michigan concluded that there were levels of PFAS widely detectable in wastewater and biosolids as a domestic baseload. However, there were also several outliers suspected and later confirmed to be caused by industrial

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Table 1. High-level Comparison of Select States' Biosolids PFAS Action Frameworks.

	State				
	Michigan *(EGLE 2021)*	**Wisconsin** *(WIDNR 2021)*	**Colorado** *(CDPHE 2023)*	**New York** *(Glance 2023)*	
Year Implemented	**2021**	**2021**	**2023**	**Draft May 2023**	
Focus PFAS	**PFOS**	**PFOS+PFOA**	**PFOS**	**PFOS**	**PFOA**
	Summary of Requirements at Each Tier (ppb)[a,b]				
Land application not allowed	>125	>150	NA	>50	>50
Source investigation required and limit on application rate	50-125	50-150	NA	NA	NA
Source investigation required	NA	20-50	>50	20-50	20-50
Source investigation recommended	20-50	NA	NA	NA	NA
No change to biosolids applications practices	<20	<20	<50	<20	<20

[a] States generally require informing state regulators and other stakeholders at tiers requiring or recommending source control.
[b] Ongoing monitoring requirements in response to tier levels differ by state.

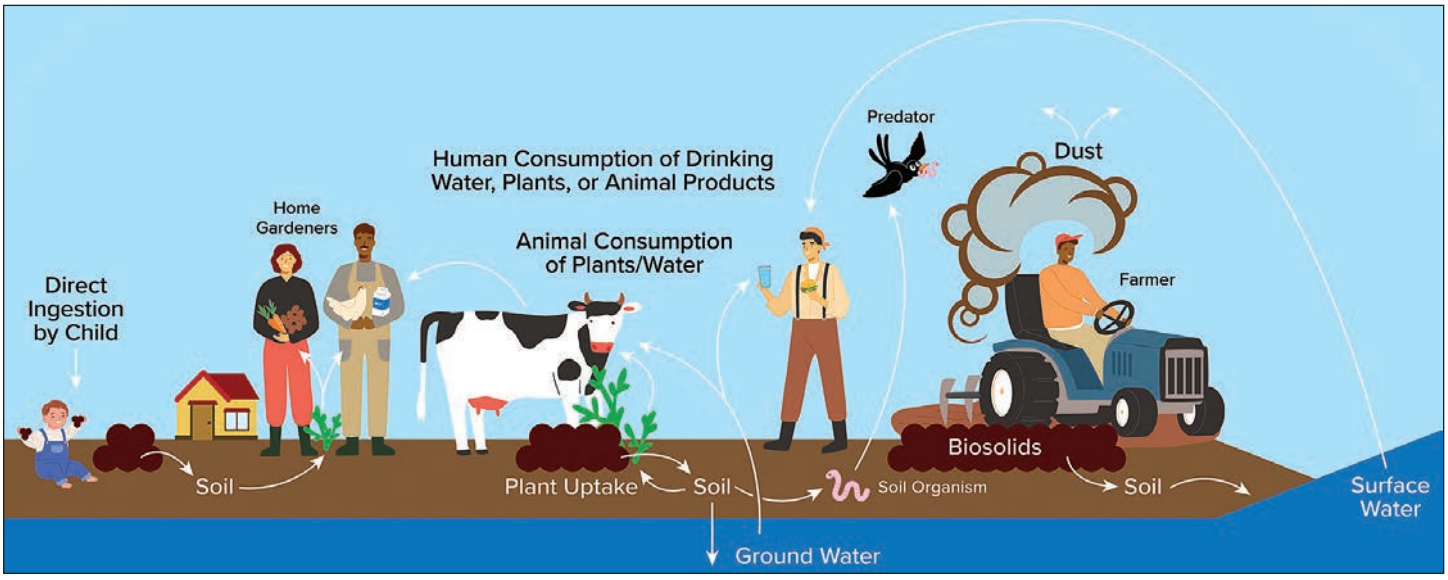

Figure 1. Examples of potential exposure pathways for assessing risks from land-applied biosolids. *Carollo Engineers, Inc.*

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sources. So, the state developed a tiered response framework for different PFOS concentrations in biosolids. This framework requires source control for WRRFs with PFOS concentrations that are very likely influenced by industry. Meanwhile, WRRFs with typical PFOS levels in biosolids could continue their land application practices. Wisconsin and Colorado have since followed suit with similar strategies. This approach stands in stark contrast to the state of Maine, which completely banned biosolids land application in response to PFAS concerns in April 2022.

NYSDEC's draft interim policy differs from Michigan's in a few key ways. Notably, if the interim policy is enacted as is, New York would be the first state to set limits on PFOS and PFOA separately; Michigan and Colorado set limits on PFOS, and Wisconsin set limits on the sum of PFOA and PFOS. Also, NYSDEC would require PFOA or PFOS source control at 20 parts per billion (ppb). In contrast, Michigan recommends source control at 20 ppb and requires source control at 50 ppb.

Compliance Challenges

So, is it feasible to reduce PFOA and PFOS below 20 ppb in biosolids through source control only? Biosolids PFAS data are not readily available for New York, but scientific literature and monitoring surveys of other states provide strong clues.

A meta-analysis of PFAS in biosolids in the U.S. found PFOA and PFOS data available from 1998 through 2020 for 36 individual WRRFs *(Thompson et al. 2022)*. Median PFOA and PFOS were 5.5 ppb and 59 ppb, respectively. So, at first glance, in that study, median biosolids PFOS would have been over 20 ppb. However, much of the biosolids data in that analysis were collected before U.S. PFAS-producing industries phased out PFOA and PFOS (2002-2015). Furthermore, the aggregated studies said that over 20% of the WRRFs had industrial PFAS sources. A lower percentage of WRRFs likely have major PFOA and PFOS industrial sources, especially today, several years after the phaseout.

More recent studies have found lower PFOA and PFOS concentrations in biosolids, suggesting industrial phaseout is having beneficial downstream impacts. In 2018, Michigan sampled PFAS in biosolids in 42 municipal WRRFs *(EGLE 2021)*. All 42 had detectable PFOS, and 60% had detectable PFOA *(Bogdan 2021)*. Six WRRFs (i.e., around 14%) were concluded to be industrially impacted based on measured PFOS concentrations over 150 ppb in the biosolids and identification of a plausible source. The median PFOS concentration was 13 ppb and the median PFOA was 3 ppb, even including the industrially impacted WRRFs.

In 2020, California required WRRFs treating over 1 million gallons per day to measure PFAS in influent, effluent and biosolids. California's public database reports at least one type of PFAS has been detected in solids at 94% of the 156 WRRFs sampled. Nevertheless, for PFOA and PFOS specifically, the majority of California biosolids results were equal to or below their reporting limits of 8 ppb. Median biosolids concentrations were 1.7 ppb PFOA and 6.7 ppb PFOS when including values between the detection and reporting limits. These median concentrations were similar to Michigan's data, indicating similar domestic baseloads state to state. A concentration of 20 ppb would be the 82nd percentile for PFOS and 95th percentile for PFOA in California biosolids ***(Figure 2)***. Given the small percentage of WRRFs above this threshold, it is likely they could come into compliance by using source control to reduce PFAS concentrations to the domestic baseload.

Solutions to Decrease PFAS in Biosolids

So, does this mean smooth sailing? Not necessarily. NYSDEC has proposed to restrict biosolids use for any WRRFs that have not yet reduced PFOA and PFOS below 20 ppb within one year after the first required sample. Michigan has documented multiple cases of successful biosolids PFAS reduction through source control *(Bogdan 2021)*. However, one year is a narrow compliance window given the actions some WRRFs and upstream sources may need to take.

Successful PFAS source control requires seven steps ***(Figure 3)***:

1. Develop a monitoring plan.
2. Carefully sample collection with approved materials.
3. Wait on a commercial lab for PFAS analysis.
4. Interpret geospatial PFAS data.

Figure 3. Steps for PFAS source control. *Adapted from: "Guidebook for Preventing PFAS from Entering Drinking Water Supplies and Wastewater" (Steinle-Darling, Upadhyaya, Thompson, Gonzalez, et al 2023).*

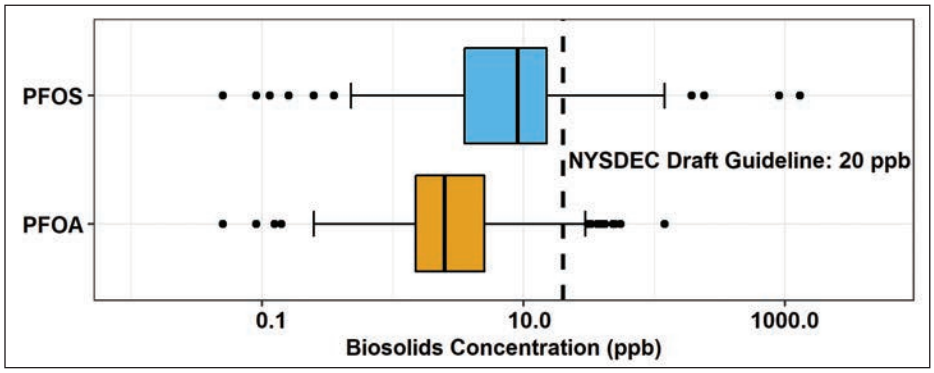

Figure 2. Boxplot of California biosolids PFAS monitoring results for PFOA and PFOS versus the NYSDEC's draft threshold for required source control. Dots represent outliers. Whiskers represent the lowest and highest non-outliers. The colored rectangles represent the 25th percentile to the 75th percentile. The black solid vertical lines represent medians. The dashed vertical black line represents NYSDEC's draft threshold. Values below their detection limit were assumed to be half their detection limit. *Carollo Engineers, Inc.*

5. Potentially conduct additional rounds of planning and sampling to confirm results or if a source was not yet clear from the data.
6. Inform the owner of the suspected source and persuade them to take action.
7. The owner of the suspected source then finds a product substitution or installs treatment or barriers.

Each of these steps could take months, if not years, especially No. 7. Furthermore, PFAS concentrations could decline slowly even after action is taken, particularly if the PFAS enters the collection system gradually (e.g., through contaminated groundwater infiltration). If a WRRF acts

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in good faith to reduce PFAS promptly yet it takes more than one year, this could interrupt biosolids handling. So, it could be advantageous to sample PFAS in biosolids before formally required, to get a head start investigating sources – if needed – and to demonstrate proactiveness to the public.

Another difference between the NYSDEC draft policy and Michigan's strategy is the inclusion of the following footnote:

"In addition to dry weight results, [NYS]DEC may require analyses using the SPLP (Synthetic Precipitation Leaching Procedure) and use those results to determine whether the biosolids source can be recycled." *(Glance 2023)*

SPLP is a USEPA method designed to determine the mobility of a contaminant from a solid such as soil or biosolids *(USEPA 1994)*. The procedure uses a batch equilibrium experiment to desorb a contaminant from a solid to a solution, and the contaminant is then measured in the solution *(NJDEP 2013)*. This footnote creates regulatory uncertainty, because it does not state what PFOA and PFOS concentrations would be acceptable in the extracted solution. However, if the SPLP were an alternative to dry weight concentration tiers – rather than an additional requirement – and if the extract concentration were achievable, this could drive innovation. There is recent and ongoing research on how to reduce PFAS mobility from biosolids *(Zhang, Jiang and Liang 2022; Zhang and Liang 2022)*, which would reduce land application risks without requiring expensive PFAS destruction.

Step-by-step recommendations for PFAS source control will be available in the forthcoming Guidebook for Preventing PFAS from Entering Drinking Water Supplies and Wastewater (***Figure 3***; *Steinle-Darling, Upadhyaya, Thompson, Gonzalez, et al 2023)*. This document was funded by the Water Research Foundation under "Project #5082, Investigation of Alternative Management Strategies to Prevent PFAS from Entering Drinking Water Supplies and Wastewater" *(Steinle-Darling, Upadhyaya, Thompson, Hooper, et al 2023)*.

If future NYSDEC or federal biosolids PFAS regulations are much more stringent than 20 ppb, source control alone may not be enough and WRRFs may need to either landfill biosolids (as allowed) or destroy PFAS. At the same time, landfilling may have limited feasibility due to capacity constraints, greenhouse gas emissions concerns, public pressure, or regulations placed upon the landfills regarding PFAS-laden leachate (which is often sent to WRRFs for treatment and adds to influent PFAS).

Based on the current state-of-the-art, destroying PFAS in biosolids could be highly challenging. Conventional biological processes like aerobic or anaerobic digestion or pre-digestion treatments like thermal hydrolysis have shown no impact on PFAS destruction. In fact, they may increase the PFAS of regulatory concern by transforming polyfluorinated compounds. Long-chain PFAS can decompose at temperatures over 400°C. However, complete mineralization (i.e., full destruction to carbon dioxide and hydrofluoric acid) does not occur until temperatures exceed 1,000°C *(Winchell et al. 2021*).

High-temperature technologies to destroy PFAS have been or will soon be built at the commercial (incineration, pyrolysis, gasification) and demonstration scales (supercritical water oxidation [SCWO], hydrothermal liquefaction [HTL]). Temperatures over 1,000°C can be achieved and maintained with some incineration processes, although conventional sewage sludge incinerators do not operate at those temperatures. Pyrolysis has shown high rates of reduction in some generated products (e.g., biochar), even though they generally operate at temperatures lower than incineration *(Williams et al. 2021)*. Our preliminary estimates indicate pyrolysis for biosolids PFAS destruction capital costs would be around $10 million per dry ton per day.

The potential emission of PFAS or their thermal transformation products into the air or other streams is a key consideration and an ongoing research area for these thermal technologies. Since exhaust may still contain volatilized PFAS, they require high-temperature regenerative thermal oxidizers for full destruction and scrubbers for produced hydrogen fluoride, which is already a regulated compound.

Other demonstration-scale technologies like HTL and SCWO can treat biosolids at somewhat lower temperatures but higher pressures. The Great Lakes Water Authority is testing PFAS destruction with HTL at a pilot-scale. An SCWO demonstration unit is being manufactured for installation at the Orange County Sanitation Districts plant, scheduled for startup later this year.

Due to the relative newness of these high-temperature systems, questions remain regarding capital and operating costs, permitting, long-term operations and maintenance, scalability, reliability and overall system sophistication. All of these characteristics are currently being studied and will continue to be assessed as more installations are built and operating experience is gained. Meanwhile, regulators and researchers continue to study the fate, transport and risks imposed by PFAS in biosolids with a near-term focus on reducing PFAS use in commercial and industrial products.

Kyle Thompson is the national PFAS lead for Carollo Engineers, Inc., and may be reached at kthompson@carollo.com. The co-authors, also with Carollo Engineers, are: Wastewater Lead Technologist Michelle Young, Biosolids Practice Lead Rashi Gupta, and Reuse Technical Practice Director Eva Steinle-Darling.

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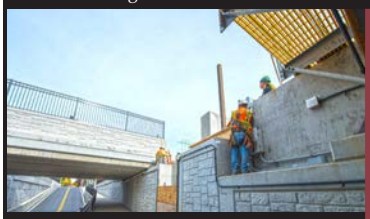
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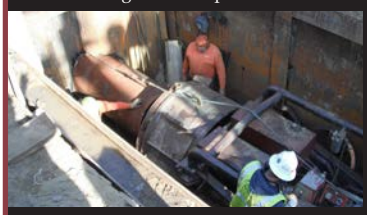
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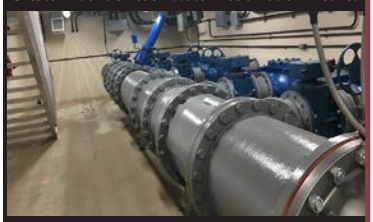
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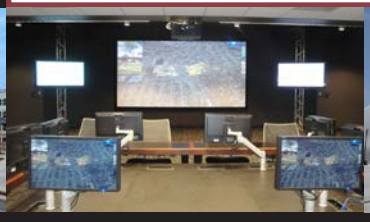
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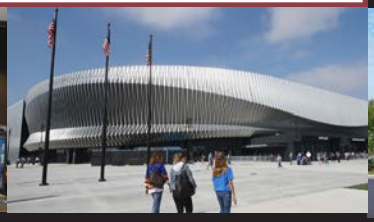
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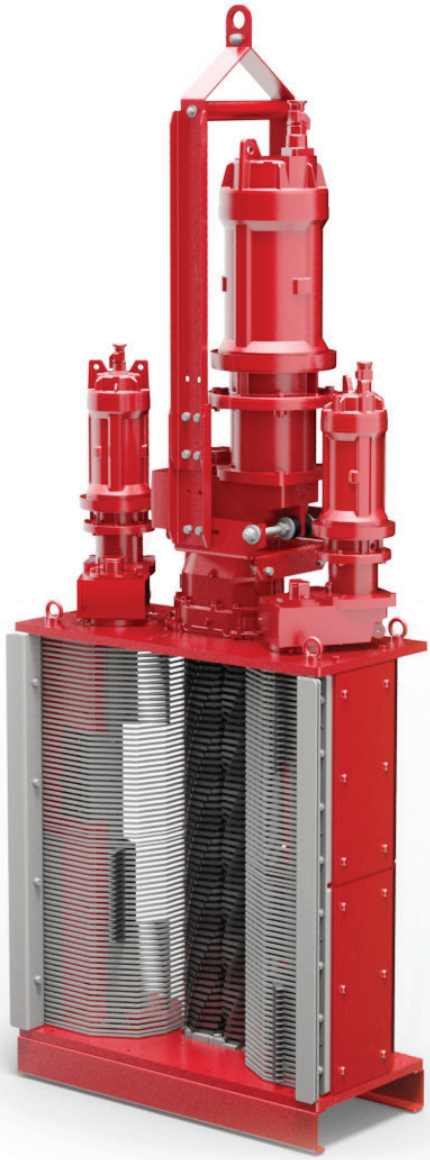

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Summary of The Water Research Foundation's Latest Research into PFAS

by Peter Grevatt and Angelina Dinsmore

Per- and polyfluoroalkyl substances (PFAS) are a very large and complex group of manufactured chemicals that can be found in a remarkable variety of specialty and consumer products such as firefighting foams, food packaging, cosmetics, stain resistant fabric coating, Teflon, water-resistant clothing and more.

A defining feature of PFAS compounds is a carbon backbone that includes multiple carbon-fluorine bonds that are extraordinarily stable in the environment and highly resistant to chemical decomposition. Many PFAS compounds have a strong propensity to bioaccumulate and have been associated with a variety of health effects in humans, including impacts on the thyroid, liver and immune system. PFAS compounds also have associations with several forms of cancer. In 2006, the U.S. Environmental Protection Agency (EPA) classified some PFAS as likely human carcinogens.

The regulatory landscape for PFAS is evolving rapidly, with numerous state level drinking water regulations already in place (including in the state of New York) along with several important actions at the federal level. Some of these actions include:

- The EPA 2022 drinking water health advisory level for PFOA and PFOS that was set orders of magnitude below the current level of detection.
- A proposed maximum contaminant level (MCL) for six PFAS compounds.
- Unregulated Contaminant Monitoring Rule, currently sampling at over 10,000 drinking water systems.
- The proposed hazardous substance designation for PFOA and PFOS, among others.

Each of these regulatory actions has significant potential public health, management and cost implications for the water sector and the communities we serve.

The ubiquitous presence of PFAS in the environment and the extraordinarily large number of potential sources of individual compounds in the PFAS family presents numerous challenges to the water sector. First, the sector requires a clearer understanding of the sources of PFAS in watersheds, including from land-applied biosolids and other solids management strategies, and improved insight into the fate and transport of PFAS from these sources. Second, robust analytical techniques are needed covering a broad diversity of compounds. Third, the sector needs greater clarity on the effectiveness of various treatment options for PFAS compounds, including an understanding of the fate and potential for transformation and release of PFAS during treatment.

The Water Research Foundation (WRF) has been a prominent leader in funding cutting-edge PFAS research. WRF has funded over 20 individual research projects addressing topics such as:

- sampling and analytical methods
- treatment and management of treatment residuals
- management and release of PFAS from solids
- opportunities to reduce the flows of PFAS into water utilities
- One Water risk communications on PFAS

A number of these projects are summarized in this article, and all this information is available in much greater detail to WRF subscribers and partners on our website.

Analytical Techniques

PFAS comprise an extraordinarily large and diverse family of compounds. At present, approved drinking water analytical methods are available for less than 1% of the PFAS compounds known to exist, presenting a significant challenge for utilities seeking to characterize and understand the scope of the PFAS challenge they may be facing.

WRF launched Project 5102, "Application of a Novel Method to Estimate the Total PFAS Content in Water," to provide a strategy that determines the total PFAS content in a sample. This strategy dovetails with current methods that identify the specific concentrations of a relatively small number of compounds of regulatory interest and concern. While this approach will not identify concentrations of additional specific PFAS compounds, it will provide perspective on the broader scope of PFAS content in a water sample.

Treatment of PFAS in Drinking Water

The diversity of PFAS compounds with differing chain lengths, functional groups and chemical structures poses significant treatment challenges for water utilities in addition to the analytical challenges. PFAS compounds of shorter chain lengths frequently behave quite differently from the longer chain compounds when exposed to activated carbon or ion exchange resins. The wide diversity of functional groups that may be present on PFAS compounds further complicates this issue. WRF initiated several projects to address this challenge.

Project 4322, "Treatment Mitigation Strategies for PFAS," provides utilities with a framework to assess potential treatment strategies for addressing contaminated source water.

Project 4344, "Removal of PFAS by PAC Adsorption and Anion Exchange," evaluated the two most readily available treatment approaches to remove PFAS from water sources.

Project 5153, "Evaluation of Bench-Scale Methods to Predict Drinking Water PFAS Removal Performance of Ion Exchange and Novel Adsorbents at Pilot and Full-Scale," builds on the earlier project by providing additional tools to assist water utilities with tailoring their treatment strategies to address the specific PFAS constituents they must treat in source water.

Project 4877, "Concept Development of Chemical Treatment Strategy for PFOS-Contaminated Water," specifically addresses treatment approaches for one of the two PFAS compounds of greatest regulatory concern across the federal government and states.

Project 4913, "Investigation of Treatment Alternatives for Short-Chain PFAS," addresses the significant challenges associated with treatment of short-chain PFAS, which are increasingly being used as substitutes for the longer chain compounds in the PFAS family. While the shorter chain compounds are believed to be less toxic and may be less persistent than the longer chain compounds, some have been found to have greater mobility in the environment and a lower affinity for activated carbon and ion exchange media. As a result, they may be more difficult to remove, further complicating the challenges associated with reducing risk from PFAS compounds in the environment.

The project "Evaluation and Life Cycle Comparison of Ex-Situ Treatment Technologies for PFAS in Groundwater," provides tools to support water utilities in assessing costs and effectiveness of potential PFAS treatment options from a holistic view.

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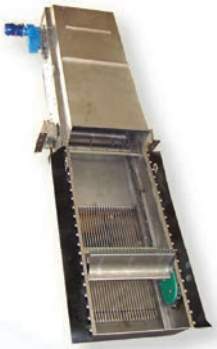

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Project 5103, "Microwave Regeneration of PFAS-Exhausted Granular Activated Carbons," focuses on renewing absorptive media. Ion exchange resins and activated carbon units are readily available PFAS treatment options for many utilities; however, these matrices concentrate PFAS on the absorptive media but do not destroy PFAS compounds. When these media become saturated with PFAS, they must be regenerated or disposed of off-site from the utility. WRF initiated Project 5103 to explore a novel energy-efficient and cost-effective strategy for renewing activated carbon for further treatment.

PFAS Release from Biosolids

To date, federal and most state regulatory activities for PFAS have focused on concerns related to PFAS in drinking water. However, PFAS is of growing interest in water resource recovery facilities (WRRFs), and at least one state has banned land application of treatment solids. WRF has also initiated comprehensive studies to address this growing challenge.

In Project 5031, "Occurrence of PFAS Compounds in U.S. Wastewater Treatment Plants," WRF partnered with over 25 WRRFs in the U.S. to characterize the presence of PFAS in various stages of their treatment process. WRF has built on this work by initiating studies to better understand the fate and transport of PFAS through two of the most frequently utilized management strategies for sewage sludge: land application and incineration.

WRF has conducted multiple projects to characterize factors that affect PFAS release from land-applied biosolids. For example, "Project 5042, Assessing Per- and Polyfluoroalkyl Substance Release from Finished Biosolids," used bench-scale leaching tests of biosolids collected from WRRFs that use differing post-digestion treatment processes to assess PFAS release from finished biosolids. PFAS release was examined as a function of PFAS loading in the finished biosolids, the post-digestion processing of the biosolids and the age of the biosolids to examine the impacts of both biosolids processing and biosolids aging on PFAS release. Together, these tests have helped to quantify PFAS release from land-applied biosolids, elucidate the mechanisms driving the PFAS release, and identify process drivers that may impact PFAS fate and transport from biosolids.

In addition, Project 5002, "Determining the Role of Organic Matter Quality on PFAS Leaching from Sewage Sludge and Biosolids," evaluated the fate and transport of PFAS in secondary sludges and biosolids from multiple treatment processes to determine PFAS sorption and degradation. The project also determined which factors have the greatest effect on PFAS sorption capacity. The research team evaluated the role that the decomposition of biosolids (i.e., weathering) plays in PFAS partitioning to and leaching from biosolids.

The action taken by some states to prohibit land application of biosolids from WRRFs drives a need to better understand the fate of PFAS during thermal treatment of solids. Project 5111 is exploring the fate of PFAS when biosolids are processed through sewage sludge incinerators. The ability of sewage sludge incinerators to fully mineralize PFAS during thermal treatment of PFAS-laden solids is unknown, and there is concern about the generation and release of products of incomplete combustion. This project will include a full-scale test as a critical first step to determine whether sewage sludge incinerators can successfully destroy PFAS and whether products of incomplete combustion are formed.

WRF is also investing in studies to characterize alternative treatment strategies for solids from WRRFs that contain PFAS compounds. Project 5107, "Understanding Pyrolysis for PFAS Removal," is comprehensively studying the performance and feasibility of a full-scale thermal drying and pyrolysis facility to process municipal sludge as the feedstock, with a focus on the ability to remove/destroy PFAS. The research team will:

- determine the fate of selected PFAS compounds through the unit processes
- perform mass balances on metals and organics around the various unit processes

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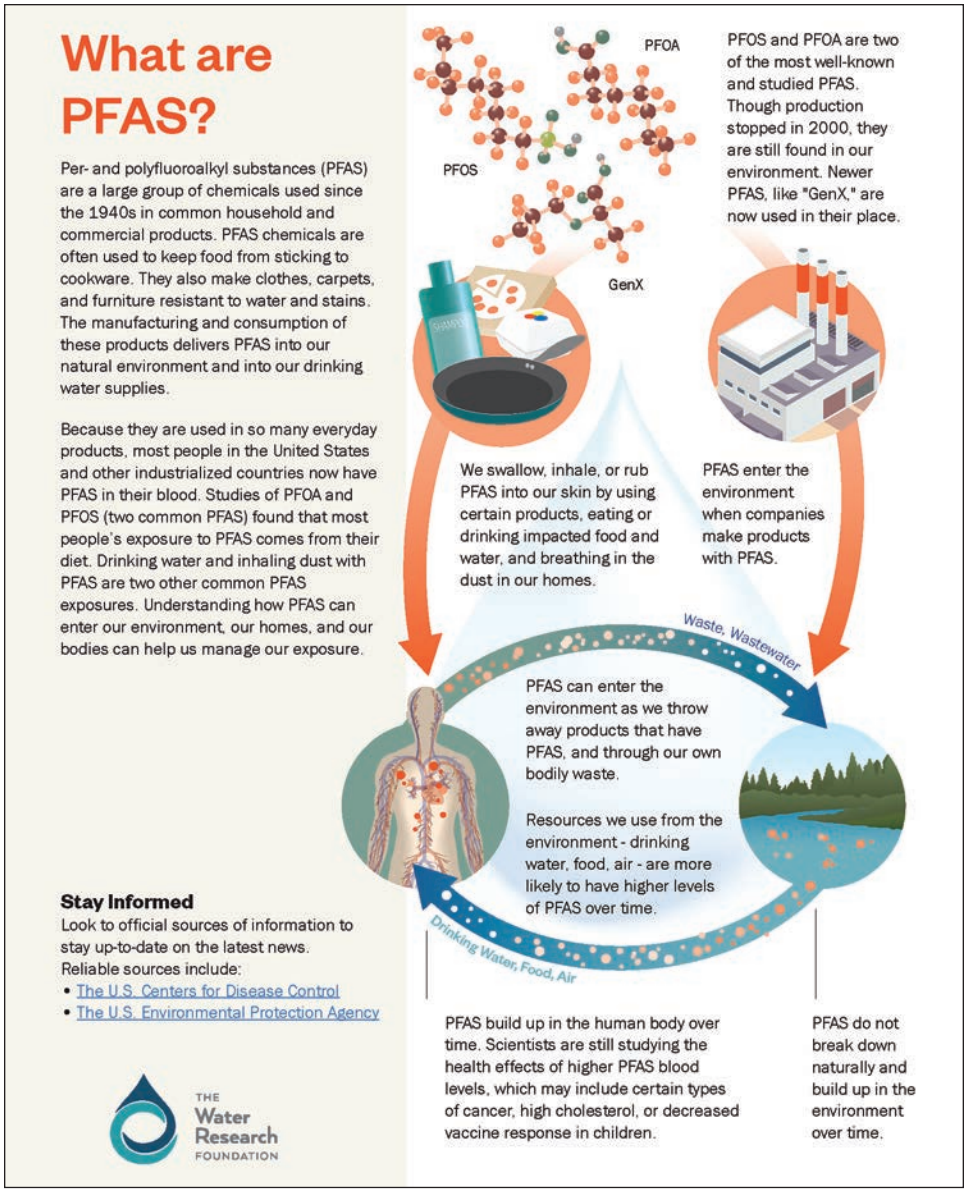

Excerpt from WRF Project 5124's One Water Toolkit Providing Basic Information on PFAS.
Weinrich et al 2022

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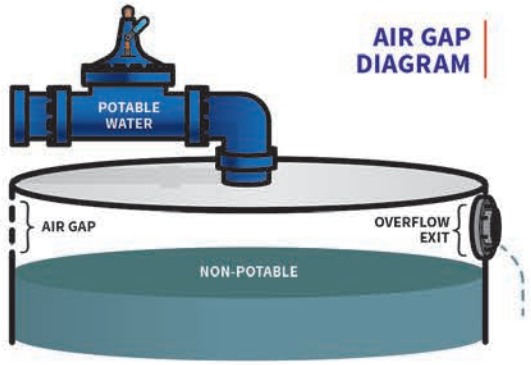

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- develop energy balances around system and unit processes
- determine produced synthetic gas quantity and quality
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Public Risk Communication on PFAS

As we continue to implement our extensive research portfolio on the myriad challenges presented by PFAS in the environment, WRF recognizes that effective public communication has never been of greater importance for every part of the water sector.

In partnership with American Water Works Association, WRF recently published Project 5124, "PFAS One Water Risk Communication Messaging for Water Sector Professionals," which provides water utilities with a variety of communication resources to support interactions with customers, regulators and stakeholders. Through workshops, stakeholder engagement and communications focus groups, two PFAS Risk Communication Toolkits were developed: One Water messaging on PFAS; and messaging to support communications related to the EPA's fifth Unregulated Contaminant Monitoring Rule (UCMR5).

The One Water Toolkit explains the genesis of PFAS – where they come from, how they enter the environment, and how they affect drinking water and wastewater systems. The toolkit sets a solid foundation to raise awareness and educate the public about these complex chemicals.

The UCMR5 Toolkit provides water systems with a "How To" manual to create their own frequently asked questions (FAQs) documents to share with customers and stakeholders. In addition, the FAQs can be used as the basis for other communication materials, including talking points for front-line employees, public information officers and utility leaders. Because every water system faces unique circumstances related to PFAS management and regulatory requirements, the toolkit provides templates for utilities to input their specific system information.

For More Information

Many of the projects presented in this article are ongoing, and WRF will continue to identify opportunities and drive solutions to the many PFAS challenges facing the water sector. For more information about WRF's research on PFAS, please contact WRF Research Program Manager Mary Smith at *msmith@waterrf.org.*

Peter Grevatt, Ph.D., is the chief executive officer of The Water Research Foundation and may be reached at pgrevatt@waterf.org. Angelina Dinsmore is the communications coordinator for The Water Research Foundation and may be reached at adinsmore@waterrf.org.

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PFAS in Our Toilet Paper – What Are the Real Implications?

by Elizabeth (Lily) Young-shim Maio and Eva Steinle-Darling

Toilet paper has made headlines recently after a University of Florida study detected trace amounts of PFAS, a group of emerging chemical contaminants of concern, on toilet paper samples from around the world *(Thompson et al. 2023)*. Articles have appeared in The Guardian and Time magazine, among others, suggesting that toilet paper may be a significant source of PFAS in our waste streams. In this op-ed we try to paint a completer and more nuanced picture of PFAS in our toilet paper and the real implications.

Typical PFAS Exposure Pathways

Toilet paper may seem like an odd product to have PFAS contamination, but the ubiquity of PFAS use in manufacturing, as well as the beneficial properties of intentionally added PFAS such as "stain resistance, water and oil repellency, [among] other properties," means PFAS can pop up almost anywhere (*NYSDEC 2022)*. Typical PFAS exposure pathways for people include *(CWB 2023):*

- grease and water-resistant food packaging
- household products like nonstick cookware and cleaning products
- consumer goods like cosmetics, stain- and water-resistant clothing, upholstery and carpeting
- drinking water

There are also concerns about PFAS in our food supply through agricultural use of sludge from wastewater treatment plants as a cheap fertilizer since the 1980s *(UM n.d.)*.

PFAS exposure through drinking water is considered the most significant, while exposure from consumer products is considered fairly low *(ATSDR 2022)*. However, the PFAS component from consumer goods cannot be ignored. As these products are consumed, PFAS ends up in our waste streams and environment when washed down the sink or – in the case of toilet paper – flushed down the toilet.

> *"Based on the available data, only a small amount of PFAS can get into your body from skin contacting PFAS-contaminated water."*
> (ATSDR 2022)

A U.S. Environmental Protection Agency (EPA) study from the 1980s looking at drinking water supplies at 25 sites across the country found that the water supply "contained between 2% to 16% wastewater discharges from upstream locations (i.e., de facto reuse) under average streamflow conditions" *(Rice, Wutich and Westerhoff 2013)*. And more recent studies have found that the percentage of wastewater in our drinking water supplies has steadily increased since the 1980s *(Rice, Wutich and Westerhoff 2013)*. Therefore, when PFAS ends up in our wastewater it contributes to our drinking water PFAS concentration.

What Are PFAS and Why Is Exposure Significant?

PFAS, which stands for per- and polyfluoroalkyl substances, are a group of manufactured chemicals with a wide range of industrial uses whose defining characteristic is a "chain of linked carbon-fluorine atoms" *(NIEHS 2023)*. The carbon-fluorine bond is one of the strongest in organic chemistry. Since this bond does not occur in nature with evolved natural degradation mechanisms, PFAS can persist and accumulate in the environment, animals and people *(NIEHS 2023)*. That's exactly what PFAS has done since it was first invented in the 1930s and widely adopted in U.S. manufacturing through the 1940s and 1950s *(Brennan et al. 2021)*. There are currently over 9,000 synthetic PFAS chemicals listed on the EPA Chemical Dashboard *(CDC 2022)*.

PFAS has become a household name in recent years, making headlines as it appears in drinking water systems because of concerns about the effects of exposure on human and environmental health. Studies as early as the 2000s have shown potential links of PFAS exposure with adverse health effects in humans. A United Nations hazard assessment of PFOS (a long-chain PFAS) from 2002 "concluded that PFOS is 'persistent, bioaccumulative and toxic to mammalian species,' causing liver and thyroid cancer in rats" *(Brennan et al. 2021)*. Around the same time, in 2003, the U.S. Centers for Disease Control (CDC) published the results of an epidemiological study that estimated that PFOS was present in the blood of 98% of the American population *(Brennan et al. 2021)*.

In 2005, a class-action lawsuit was settled against E.I. DuPont deNemours and Company regarding PFOA contamination (another long-chain PFAS) from one of its factories. The factory, Washington Works in Parkersburg, Virginia, had been using PFOA to manufacture Teflon products and discharged the waste PFOA into the local environment, contaminating the drinking water supply for several communities. This lawsuit highlighted the concerns around PFAS and the lack of federal and state regulation for the discharge of these chemicals into the environment *(C8 n.d.)*.

A condition of the DuPont settlement was the formation of the C8 Science Panel, which conducted research in the communities affected by PFOA contamination from 2005 to 2013 *(C8 2012, C8 2020)*. Through the C8 Science Panel research we now know that PFAS exposure has potential links with "kidney cancer, testicular cancer, ulcerative colitis, thyroid disease, pregnancy-induced hypertension and medically diagnosed high cholesterol" *(HPCBD n.d.)*.

PFAS in Our Toilet Paper – Implications for PFAS Regulation

The University of Florida study *(Thompson et al 2023)* documented the presence of PFAS in 21 toilet paper samples collected around the world from 2021 to 2022. Toilet paper samples were tested for 34 different PFAS and these six PFAS compounds were detected:

- PFHxA
- PFOA
- PFDA
- 6:2 diPAP
- 6:2/8:2 diPAP
- 8:2 diPAP

One compound in particular – 6:2 diPAP – comprised 91% (±8%) on average of the total PFAS mass detected on toilet paper. As 6:2 diPAP has been detected in the waste streams of paper mills, the researchers speculated that PFAS in toilet paper is likely introduced as a byproduct of paper production. The researchers also noted that diPAPs are a large component of PFAS mass detected in typical wastewater treatment plant sludge. Sludges from eight plants in Florida were sampled for the study and diPAPs comprised 54% (±15%) of PFAS mass detected in the sludge.

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When evaluating the contribution of 6:2 diPAP detected in toilet paper to the concentration in wastewater sludge, the researchers assumed that all of the 6:2 diPAP from the toilet paper is partitioned to the sludge from the liquid wastewater. The results indicated that in the U.S. up to 3.7% of the 6:2 diPAP in wastewater sludge could be attributed to toilet paper *(Thompson et al, 2023)*. The researchers concluded that "toilet paper should be considered as a potential significant source of PFAS entering wastewater treatment systems" *(Thompson et al, 2023)*.

Recent wastewater studies investigating the proportion of PFAS mass loading to treatment plants have shown that domestic wastewater from our homes can represent upward of 50% of PFAS mass loading *(Thompson et al. 2022)*. This means that the PFAS leaving our homes is not an insignificant source of PFAS in wastewater and highlights the need to understand what consumer products – such as PFAS-contaminated toilet paper – are contributing to this load.

If PFAS in toilet paper could represent a significant portion of PFAS in sludge generated at wastewater treatment plants, we were curious if removing PFAS from toilet paper entirely could potentially represent a significant reduction in regulated PFAS found in the liquid fraction of wastewater. Of the six PFAS detected on the toilet paper samples from the University of Florida study, only one of them, PFOA, is regulated in New York. The water quality guidance value for PFOA is no more than 6.7 ppt in ambient water sources *(NYSDEC 2023)*.

We conducted a back-of-the-envelope calculation, using the PFAS data from the University of Florida study, to estimate the potential contribution of PFAs-contaminated toilet paper to the liquid fraction of PFOA in wastewater ***(Equations 1*** and ***2)***. From the study, we know that PFOA detected on the toilet paper samples averaged 0.02 nanograms per gram (ng/g; *Thompson et al, 2023)*. We also know that the diPAPs detected on the toilet paper samples are considered precursor species, meaning that they can be transformed into other terminal PFAS such as PFOA under the right chemical and biological conditions at the treatment plant. Therefore, assuming full transformation of the diPAP precursor species detected on the toilet paper into PFOA, the resulting total potential PFOA concentration from toilet paper is 0.13 ng/g ***(Table 1)***.

Using the same toilet paper consumption rate that the University of Florida researchers used – 12.7 kilograms per capita per year – and an average wastewater generated of 230 cubic meters per capita per year ***(Table 1)***, we calculated the potential contribution of PFAS-contaminated toilet paper to the liquid fraction of PFOA in wastewater as only 0.007 nanograms per liter (ng/L) or about 0.05% of the typical wastewater effluent PFOA concentration of 15 ng/L *(Thompson et al. 2022)*.

Thus, toilet paper appears to contribute a negligible amount to regulated PFOA in wastewater effluent. Eliminating PFAS from toilet paper, while still important overall for human health and the environment, would not necessarily bring wastewater treatment plants into regulatory compliance for PFAS concentrations in plant effluent.

Takeaways

The University of Florida study is significant because it helps highlight that PFAS has found its way into countless everyday products, including toilet paper. And while the mass of PFAS found on one product might not be large, the combined mass of PFAS on all our everyday products that gets washed into or flushed into the wastewater system/environment from hundreds of millions of households is significant. And we know that the PFAS that ends up in our wastewater is the same PFAS we end up drinking.

Unfortunately, eliminating PFAS from toilet paper alone is not the silver bullet we were hoping for when we first read the University of Florida study. Our review confirms the need for additional research into domestic sources of regulated PFAS and their precursors. New York state, recognizing the significance of PFAS exposure through consumer goods, both in the home and as a component in wastewater, has taken steps toward banning PFAS in specific consumer goods including food packaging and clothing. For example, Section 37-0209 of New York Environmental Conservation Law prohibits the sale of

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Equation 1: Calculation of estimated toilet paper contribution to wastewater.

$$TP\ Contribution\ to\ Wastewater\ \frac{ng}{L} = \frac{\left[\text{Avg PFOA on TP}\ \left(\frac{ng}{g}\right)\right] * \left[\frac{\text{TP Generated}}{\text{Capita Year}}(g)\right]}{\left[\frac{\text{Wastewater Generated}}{\text{Capita Year}}(L)\right]}$$

Equation 2: Calculation of estimated PFOA percent reduction relative to typical domestic wastewater PFOA concentrations.

$$PFOA\ Percent\ Reduction = \frac{\text{TP Contribution to Wastewater}}{\text{Typical Domestic Wastewater Effluent PFOA Conc}}$$

Table 1. Toilet Paper (TP) Contributions to PFOA Concentrations in Domestic Wastewater, Calculation Input and Results.

Equation 1	Input	Result
Average PFOA on TP*	0.13 ng/g	
TP Generated per Capita per Year*	12.7 kg/cap/yr	
Wastewater Generated Per Capita Per Year*	230 m3	
TP Contribution to Wastewater		0.007 ng/L

Equation 2	Input	Result
TP Contribution to Wastewater	0.007 ng/L	
Typical Domestic Wastewater Effluent PFOA Concentration**	15 ng/L	
PFOA Percent Reduction		0.046%

*Sources: * Thompson et al 2023 ** Thompson et al 2022*

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food packaging with intentionally added PFAS in New York state starting Dec. 31, 2022 *(NYSDEC 2022)*. As of late 2022, at least 10 states, including New York, had enacted bans or restrictions on PFAS in food packaging, with several more states having proposed bans or restrictions *(Havens et al 2022)*. For most of these laws, PFAS restrictions start in 2023 or 2024.

Following the success of the ban on intentionally added PFAS to food packaging products, the New York Legislature passed a bill banning the sale of PFAS in clothing, which was signed into law by Governor Kathy Hochul *(Green and Lee 2023)*. This law, Section 37-0121 of New York Environmental Conservation Law, prohibits the sale of apparel (excluding personal protective equipment and outdoor apparel for severe wet conditions) containing intentionally added PFAS by Jan. 1, 2025. On or after Jan. 1, 2028, the law prohibits the sale of outdoor apparel for severe wet conditions containing PFAS (a) at or above a level that the department shall establish in regulation, or (b) as intentionally added chemicals *(NYSECL 2023)*.

The PFAS problem is complex and touches all corners of the U.S. and likely the world; PFAS has even been detected in trace amounts on top of Mount Everest *(Miner et al. 2021)*. The solution – eliminating sources of PFAS in our domestic products – will likely be equally complex.

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PFAS in Wastewater and Biosolids – An Overview of Background, Cycle in Ecosystem, Remediation and Regulation

by Shyam Sivaprasad, Pooja Sinha, Henry Croll, Vijesh Karatt-Vellatt, Manuel Moncholi and Mehran Andalib

Per- and polyfluoroalkyl substances (PFAS) belong to the class of aliphatic fluorinated compounds with more than 9,000 individual chemicals that consist of perfluoroalkyl moiety of carbon (C) and fluorine (F) *(Sunderland et al 2019; National Institute of Environmental Health Sciences 2022).* PFAS have been prevalently used since the 1950s in a wide range of industries such as aerospace, automotive, construction, electronics, textiles and food packaging, owing to their properties of stain repellency, hydrophobicity, and high thermal and chemical stability. They are highly persistent and ubiquitously present in air, soil and water environments *(Lei et al 2023).*

Since PFAS are characterized by the strong C-F covalent bond that has a high bonding energy of approximately 631.5 kilojoules per mole (kJ/mol), they cannot be degraded easily and have resulted in accumulation in the environment over past few decades *(Wang et al 2021).* These compounds are toxic and have caused a global concern for human and animal health. The U.S. Environmental Protection Agency (EPA) and the Center for Disease Control and Prevention (CDC) have indicated that high-level exposure to PFAS may affect cholesterol levels, decrease female fertility, decrease body weight of offspring, cause neurological effects and some are even considered to be carcinogenic *(Lei et al 2023).*

Classification

At a higher level, PFAS can be categorized into *polymers* and *non-polymers.* Polymers are long-chain molecules characterized by many segments. Polymeric PFAS are less mobile with a higher tendency to bioaccumulation and can transform into other forms of PFAS. Non-polymers are usually in the chain length ranging between two and 13 atoms, much shorter than polymers. The shorter chains are more reactive, mobile and transfer easily into the environment impacting humans and wildlife *(Fidra 2023).*

Non-polymeric PFAS are further classified as *perfluoroalkyl* and *polyfluoroalkyl* substances. Perfluoroalkyl compounds are characterized by one or more carbon atoms bonded to fluorine atoms displacing all the carbon-hydrogen atom bonds. Polyfluoroalkyl compounds contain fluorine atoms where all the hydrogen atoms are not displaced. *Short-chain PFAS* usually refers to non-polymeric compounds with chain length less than or equal to six atoms, while *long-chain PFAS* refers to compounds with chain length ranging between seven and 13 atoms. Some of the FAS non-polymers are used in the production of PFAS polymers, which may again degrade in the environment to yield PFAS non-polymers (*Fidra 2023).*

The classification of PFAS and compounds belonging to different classes are summarized in ***Figure 1*** *(Garg et al 2022).*

PFAS – Sources and Impacts on Water Resource Recovery Facilities

PFAS are produced and utilized in different sources such as textiles, paper/pulp, airports, firefighting in the form of aqueous film-forming foams, and manufacturing industries. It enters the water environment through municipal sources such as wastewater, drinking water, stormwater and landfill leachate and results in air deposition via rain and industrial stack emissions.

In the water resource recovery facilities (WRRFs), the PFAS get transformed and the effluent from the plant gets discharged to surface water, ocean and reuse water. The PFAS cycle is persistent in the environment in different forms. Different residual reduction and handling

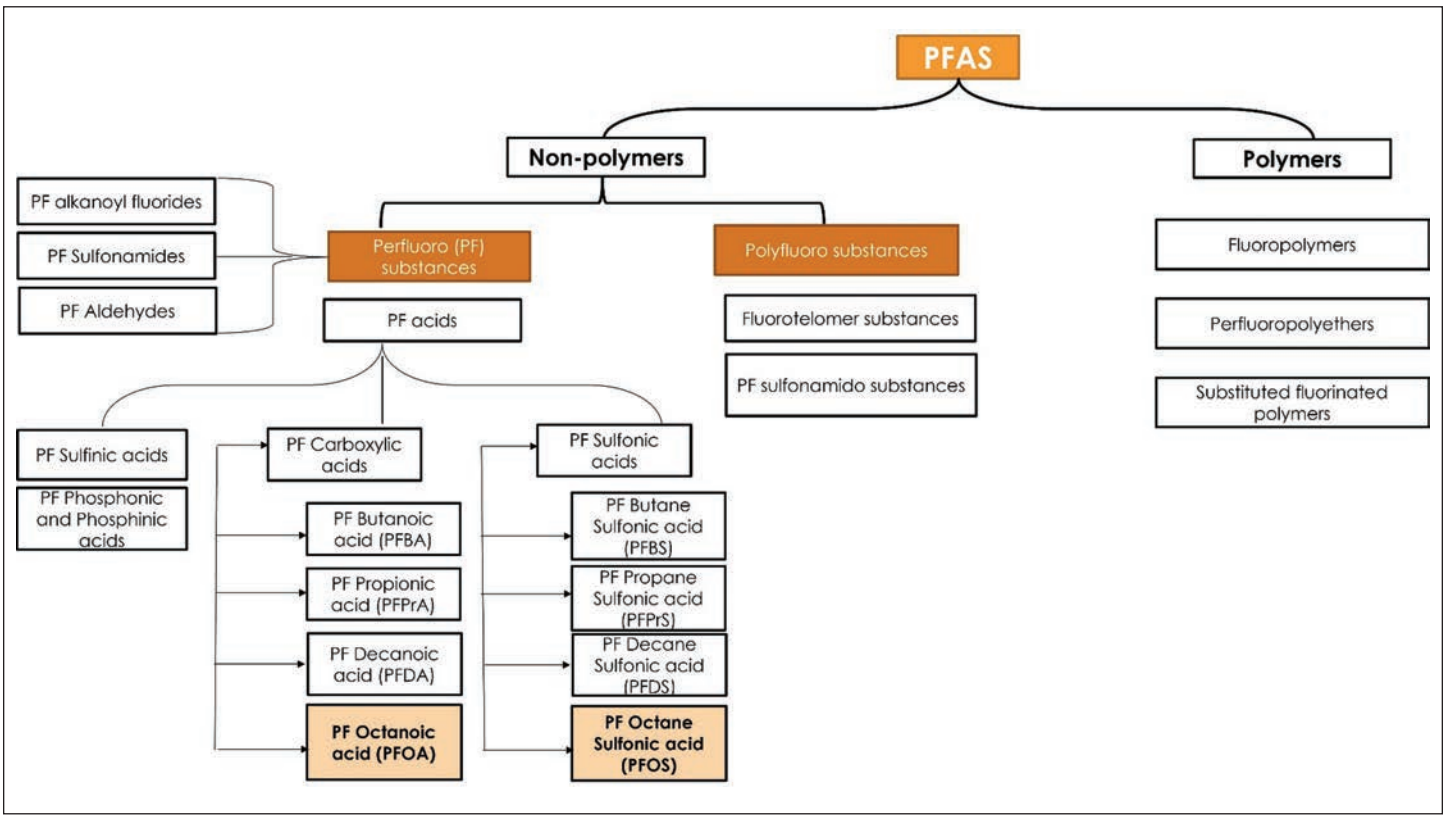

Figure 1. Classification and examples of polymeric and non-polymeric PFAS. *Garg 2022*

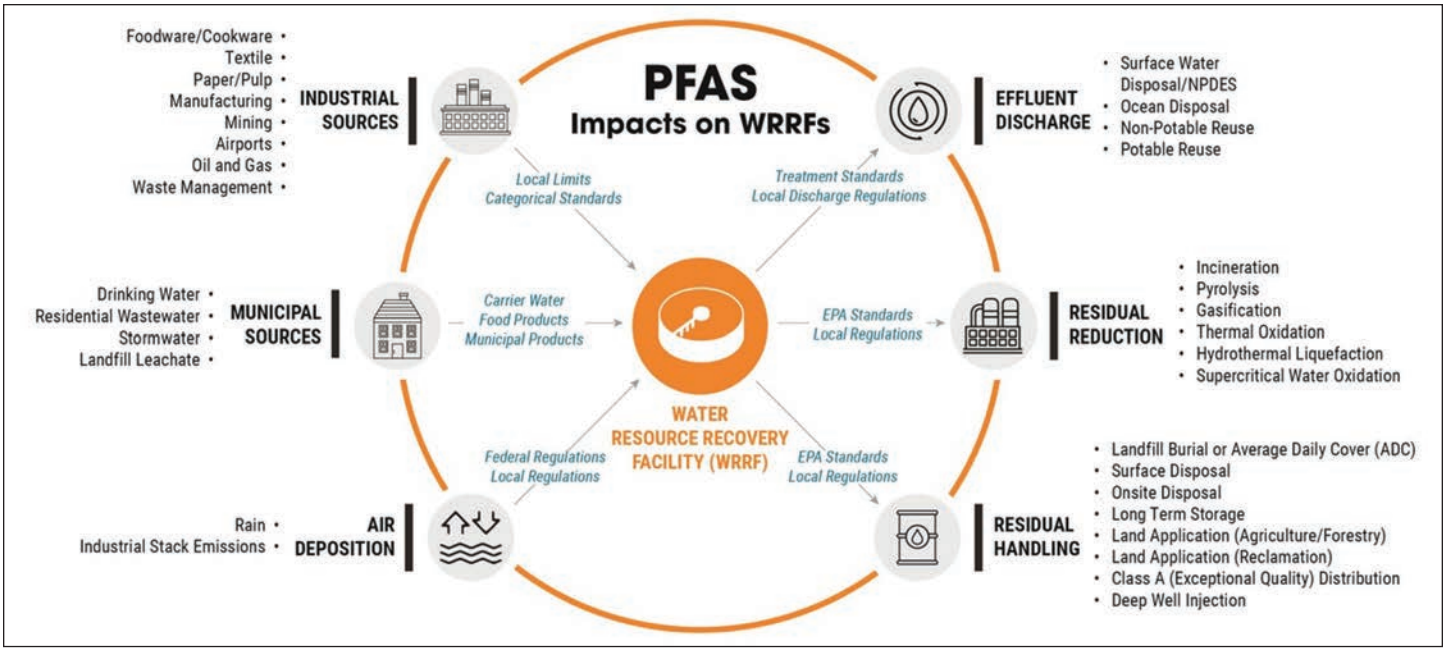

Figure 2. Sources, reduction strategies and impacts of PFAS on WRRFs. *Natioinal Association of Clean Water Agencies*

strategies ***(Figure 2)*** have been identified and are discussed in detail in the following sections.

Prevalence and Fate of PFAS in WRRFs

PFAS in WRRF Influent

The PFAS concentration in WRRF influents is reported to range from less than 5 nanograms per liter (ng/L) to greater than 1,000 ng/L *(Lenka et al 2021)*. For instance, *Jiawei et al (2019)* reported the concentration of PFAS from electroplating industrial plant wastewater ranged from 7.26 ng/L to 6,709 ng/L with an average of 780 ng/L. Primarily, PFOS and PFOA were the major contributors. Similarly, in the studies reported before 2015, PFAS-intensive industries like textile plants have reported concentrations ranging from 232 to 1,115 ng/L *(Bossi et al 2008)*. The highest contributions for PFAS are reported from wastewater drained from firefighting training grounds, on the order of 108 ng/L *(Dauchy et al 2018)*. These high concentrations are from the aqueous film-forming foams, which are used for firefighting purposes.

The wide difference in the range of minimum and maximum values can be attributed to the nature and source of influent wastewater received from different types of industries. In addition, the proximity of heavy PFAS-using industries to the WRRFs and the amount of dilution in the conveyance systems influence the concentrations of influent and effluent from the WRRFs.

PFAS in WRRF Effluent

The quantification of PFAS in effluent wastewater from treatment plants helps in characterizing the discharge from plants into the environment *(Lenka et al 2021)*. The PFOS and PFOA concentrations in WRRF effluent are reported to range from 1 to 187 ng/L for PFOS and less than 3 to 4,300 ng/L for PFOA *(Plumlee et al 2008)*. The effluent discharged from WRRFs plays a vital role as a point source of PFAS for different environmental matrices, such as surface and coastal water, through direct discharge, groundwater and soil (in the form of application of recycled wastewaters). Interestingly, several studies have reported a higher concentration of PFAS in effluent wastewater compared to the influent. This could happen due to the transformation or reduction of precursors, the PFAS compounds that already exist in the environment as contaminants or are co-released with target PFAS. For example, fluorotelomer alcohols are precursors to PFOA *(Chen et al 2017)*.

Optimizing operational process parameters in WRRFs (such as hydraulic/solids retention time, temperature and pH) lowers the concentration of PFAS in effluent; however, it partitions into the solid fraction of sludge *(Lenka et al 2021)*. This clearly indicates that the conventional processes in the WRRFs are not equipped to reduce or remove PFAS completely. Furthermore, it also leads to accumulation of PFAS in biosolids, which affects the soil, and other surface waters due to leaching when the biosolids are land applied or landfilled.

PFAS in Biosolids

The presence of PFAS in biosolids produced as a solid byproduct in WRRFs plays a significant role in PFAS emission into groundwater and soil. PFOS, PFBS, PFOA and fluorinated precursors are some of the PFAS reported to be present in biosolids *(Garg et al 2022)*. *Venkatesan and Halden (2013)* reported the mean annual loading rates for PFAS in the U.S. of 2,749 to 3,450 kilograms per year (kg/yr). The predominant compounds were PFOS (2,052 to 2,575 kg/yr), and PFOA (172 to 215 kg/yr). However, the research specifically focusing on PFAS in biosolids is limited and it needs to be explored further.

PFAS in Landfills

The biosolids from some WRRFs are disposed to landfills. This eventually results in the emission of PFAS-enriched leachate into the environment and contaminates the groundwater and soil. Some of the PFAS compounds reported in landfill leachate are PFOA, PFBS, PFOS, 8:2 fluorotelomer carboxylic acid (FTCA), and other fluorinated compounds. *O'Connor et al (2022)* reported the following concentrations found in landfill leachate:

- PFOA – 49,246 ng/L
- PFBS – 15,236 ng/L
- 5:3 FTCA – 400 to 15,000 ng/L

There is a lack of information on the distribution of the landfill leachate being treated and directly sent to WRRFs.

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Regulations and Policies

The EPA proposed to amend Part 302 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) regulations to include PFOA, PFOS and their isomers to the list of hazardous substances *(The National Law Review 2023)*. The new federal regulation for drinking water PFAS concentration compliance, released in March 2023, is less than 4 parts per trillion. However, currently there are no federal regulations in place for wastewater and biosolids.

In April 2021, EPA Administrator Michael Regan created a council for developing a strategy to protect humans and the environment from PFAS. This was followed in October 2021 by the release of the *PFAS Strategic Roadmap: EPA's Commitment to Action 2021 to 2024*. This document highlights the agency's approach to addressing PFAS and sets timelines for specific short-term actions *(EPA 2021)*. Three central directives were also established:

- Research – Investment in research, development, and innovation to increase the awareness of PFAS exposures and toxicities, human health and ecological effects, and effective interventions incorporating the best-available science.
- Restrict – Pursue a comprehensive approach to proactively prevent PFAS entering the air, water and land at levels that can adversely impact human health and the environment.
- Remediate – Broaden and accelerate the cleanup of PFAS contamination to protect human health and ecological systems.

Some of the key accomplishments achieved in the first year of implementation, as stated in the report, include enhanced chemical safety, safeguarding drinking water, ensuring clean water, cleaning up of PFAS contamination, strengthening scientific foundation and holding polluters accountable *(EPA 2022)*.

In addition, the Bipartisan Infrastructure Law (BIL), signed by President Biden in November 2021, provides more than $50 billion in funding to EPA to bring about a transformation in the nation's drinking water, wastewater and stormwater facilities. The BIL also includes $10 billion dedicated to the communities impacted by emerging contaminants in water, which includes PFAS.

At the state level, regulations on WRRF effluents, biosolids and source control have already been established in Michigan and Wisconsin. Several other states are focusing on monitoring that can be either voluntary, required or proposed ***(Figure 3)***. *(Safer States 2023; Bryan Cave Leighton Paisner LLP 2022)*

PFAS Treatment Strategies

PFAS removal and reduction in effluent and solids are influenced by the method of treatment, application to the solid or liquid train in WRRFs, and the characteristic physical and chemical properties of PFAS.

Primary treatment technologies are mostly transfer technologies (i.e., not destructive) and concentrated spent media still requires PFAS management following treatment. ***Table 1*** and ***Table 2*** summarize

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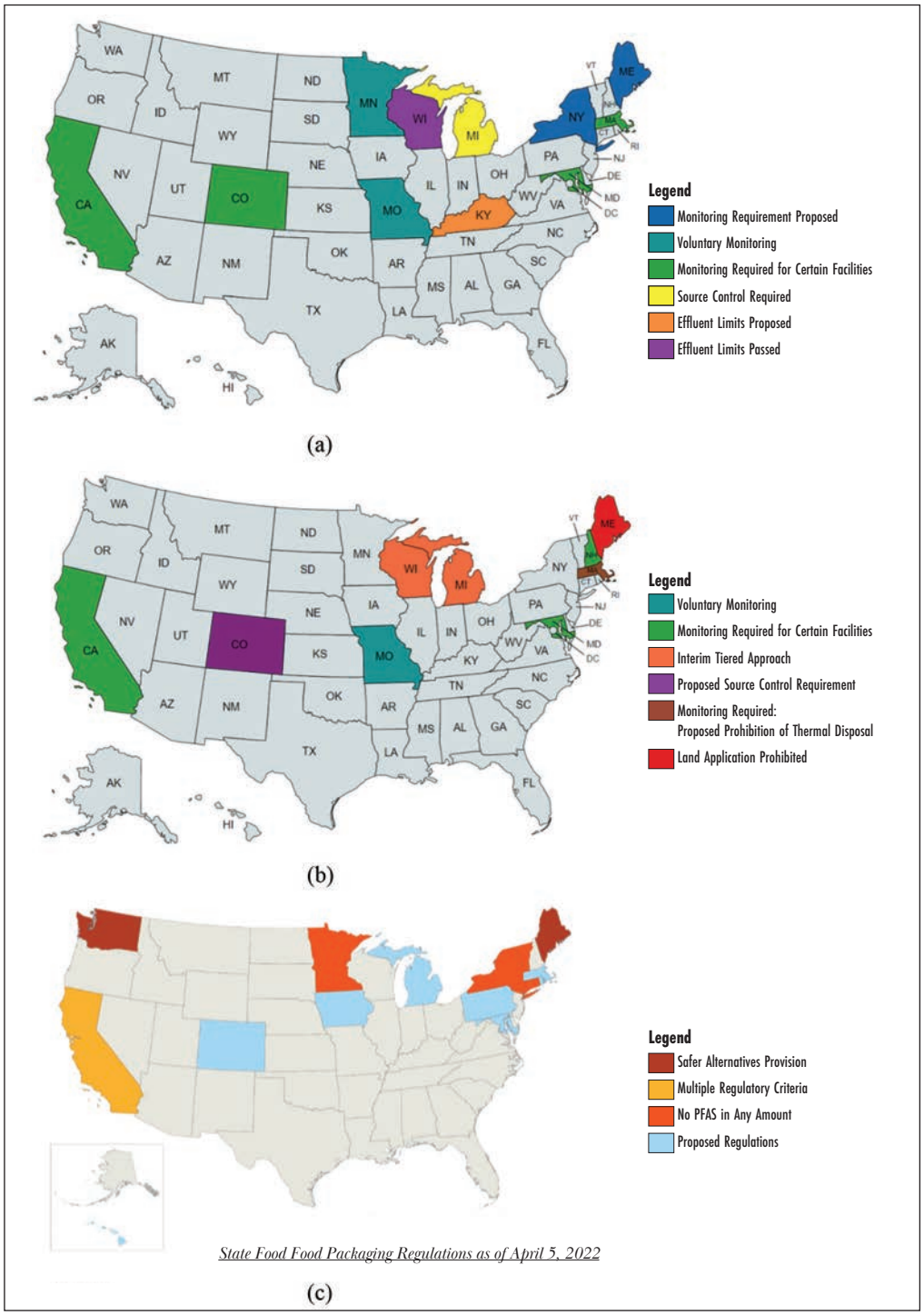

Figure 3. State regulations on (a) wastewater effluent, (b) biosolids and (c) source control.
Safer States 2023; Bryan Cave Leighton Paisner LLP 2022

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some of the PFAS treatment strategies for liquid streams and solids streams, respectively.

Table 1. PFAS Treatment Options in Liquid Trains.

Field Demonstrated	Developing
Granular Activated Carbon	Supercritical Water Oxidation
Ion Exchange	Chemical/Electrochemical Oxidation
Reverse Osmosis*	Chemical Reduction
Nanofiltration	Plasma
Coagulation*	Ultrasound/Sonolysis

*Generally used in combination with Granular Activated Carbon and Ion Exchange.

However, all these strategies are still being researched with preliminary analyses suggesting PFAS destruction in ash/char while the byproducts such as syngas and bio-oil may contain PFAS.

There are several ongoing and completed thermal processing pilot/full-scale facilities in the U.S. focusing on energy recovery and biosolids residual minimization in which PFAS destruction may be an additional benefit ***(Table 3)***.

In addition to the proposed strategies, a strong emphasis should be given to source control. Source control is being carried out in several states such as California, Minnesota and Michigan. The State of Michigan's effort is discussed further in the following Case Studies.

Case Studies

State of Minnesota

In 2017, the Minnesota Department of Health (MDH) issued health-based recommendations for PFOA and PFOS and established a hazard index for PFAS found in drinking water. It was determined that eight out of 11 wells in the City of Cottage Grove became noncompliant. A fast-tracked design and construction schedule was established for interim treatment systems that remove PFAS from water supplies at two critical wells within 90 days of revised guidance *(Croll 2019)*.

An interim solution was designed to help the city of more than 36,000 residents to have continuous access to MDH-compliant drinking water while a long-term solution was being developed. The interim solution utilized two treatment plants with a granular activated carbon system for removal of PFAS to meet MDH standards of drinking water. The raw groundwater is pumped from wells into the granular activated carbon filters. In the filters ***(Figure 4)*** the water passes through a bed of acid-washed bituminous coal (granular activated carbon media) *(Cottage Grove 2020)*. The granular activated carbon system evaluated six perfluoroalkyl carboxylic acids, eight perfluorosulfonic acids and two perfluorosulfonamides with influent concentrations ranging from 0.8 ± 0.4 ng/L to 914.6 ± 92.7 ng/L. All

Table 2. PFAS Treatment Options in Solids Trains.

Technology	Pretreatment	Operating Temperature and Pressure	PFAS Reductions*
Incineration	Dewatering	800°C to 1,300°C	Preliminary research indicated PFAS not found in ash. PFAS release into air needs to be understood.
**Thermal Oxidation	Dewatering	800°C to 1,300°C	Preliminary research indicated PFAS destruction in ash. Other byproducts may contain PFAS.
Pyrolysis	Dewatering and drying	400°C to 900°C	Preliminary research indicated PFAS destruction in biochar. Other byproducts may contain PFAS.
Gasification	Dewatering and drying	600°C to 900°C	Preliminary research indicated PFAS destruction in biochar. Other byproducts may contain PFAS.
Super Critical Water Oxidation (SCWO)	Dewatering	374°C >221 bar	Preliminary research indicated PFAS destruction with no significant emission in air (based on bench/pilot scale studies).
Hydrothermal Liquefaction	Dewatering	260°C to 450°C 70 to 250 bar	PFAS destruction not well understood. Conversion of PFAA precursors to stable PFAAs and the desorption of PFAS from sludge is observed.

* PFAS reduction percentages and the PFAS compounds reduced are not consistently defined in the literature, and hence need to be better understood.
** Similar to incinerator, but with auxiliary fuel fired burner.

Table 3. Pilot/Full-scale Thermal Processing Facilities in the U.S.

Facility and Location	Technology Provider	Type of Technology
Silicon Valley Clean Water, CA	Bioforcetech	Biodry and pyrolysis
Rialto, CA	Anaergia	Thermal dry and pyrolysis
Orange County Sanitation District, CA	374 Water	Super critical water oxidation
Morrisville, PA	Ecoremedy LLC	Thermal dry and gasification
Schenectady, NY	Biowaste Pyrolysis Solutions	Dual thermal dry and pyrolysis
Linden Roselle Sewage Authority, NJ	Aries Clean Energy	Thermal dry and gasification
Fairbanks, AK	Plasma Arc	High temperature incineration
Buffalo, MN	Veolia	Thermal dry and thermal oxidation
Warren, MI	Veolia	Thermal dry and thermal oxidation
City of Edmonds, WA	Ecoremedy LLC	Fluid lift gasification

Figure 4. Granular activated carbon system for removing PFAS from drinking water in the State of Minnesota. *Chow, et. al. 2022*

the treatments were reported to have a full-scale service time of about 142 days before initial breakthrough of short-chain (2-4 CF_2) PFCA *(Chow, et al. 2022).*

State of Michigan

The Michigan PFAS Action Response Team (MPART) is a unique, multiagency approach for coordinating state resources to address PFAS contamination. Agencies responsible for environmental protection, public health, agriculture, military bases, commercial airports, natural resources and fire departments work together to ensure the most efficient and effective response *(State of Michigan 2023).*

The Wastewater Workgroup of MPART includes staff from Michigan Department of Environment, Great Lakes and Energy, Water Resources Division, Emerging Pollutants Section, Field Operations Section, Industrial Pretreatment Program (IPP), Point Source Monitoring Program, Permit Section, Surface Water Assessment Section and Biosolids Program. The objective of the Wastewater Workgroup is to investigate sources of PFAS in wastewater discharged to surface waters or groundwater and implement source-control programs through existing regulatory programs *(State of Michigan 2023).*

A comprehensive evaluation of sources and impacts to the WRRFs in Michigan was established through two different sampling programs:

- IPP's PFAS initiative
- Statewide PFAS assessment of 42 WRRFs

Across Michigan a total of 61 WRRF influents and 95 WRRF effluents were screened for PFOS and PFOA. The observations are summarized in ***Table 4*** *(AECOM 2021).*

Table 4. Summary of WRRF IPP for PFOA and PFOS.

Parameter	PFOA	PFOS
Number of WRRF Influent Detected	54	54
Number of WRRF Effluent Detected	80	80
Influent Detection Frequency (%)	76	76
Effluent Detection Frequency (%)	94	88
Influent Concentration Range (ng/L)	2 - 330	2 - 1,200
Effluent Concentration Range (ng/L)	1 - 660	1 - 4,800

State of Maine

PFAS were initially identified in groundwater at former military installations in Maine. The potential of widespread impacts of PFAS was not realized until it was discovered in a Kennebunk, Kennebunkport and Wells Water District supply well, which led to the discovery of PFAS in dairy farm wells, milk, hay and soil. The Maine Department of Environmental Protection (Maine DEP) and Department of Agriculture, Conservation and Forestry, with the CDC, have continued to investigate public water systems, surface and groundwater, milk supply, agricultural vegetation, sludge and residuals, and fish tissue for PFAS. As of October 2019, the Maine DEP identified more than 30,000 records for 28 different PFAS across 245 locations in the state *(Maine DEP 2019).*

In 2018, the state Legislature and the Board of Environmental Protection approved adoption of Maine DEP's Chapter 418 rule, Beneficial Use of Solid Wastes, containing screening levels for PFOA, PFOS and PFBS in waste materials ***(Table 5).***

Table 5. Screening Levels for Solid Waste Beneficial Use.

Parameter	Screening Level (ng/g, dry weight)
PFBS	1,900
PFOS	5.2
PFOA	2.5

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Table 6. Analytical Methods for Determining PFAS.

Matrix	Method	Sample Preparation	Analytical Method	Revision	PFAS Analytes	Examples
Drinking water	EPA 533	Solid phase extraction	LC-MS/MS	Dec. 2019	25	PFBS, PFDA, PFOS, PFOA, 6:2 FTS
Drinking water	EPA 537.1	Solid phase extraction	LC-MS/MS	June 2020	18	PFBS, PFDA, PFNA, PFOA, PFOS
Groundwater, surface water, wastewater	SW-846 Method 8327	Solid phase extraction and filtration	LC-MS/MS	July 2021	24	PFBS, PFOS, PFBA, PFNS, PFDS
Environmental solids	ASTM D7968-17a	Solvent extraction and filtration	LC-MS/MS	Sep. 2017	30	PFBA, PFBS, PFDA, PFOA, PFOS
Aqueous, soil, biosolids, sediment, tissue	EPA 1633 Draft	Solid phase extraction and filtration	LC-MS/MS	Dec. 2022	40	PFBA, PFBS, PFDA, PFNA, FTS, PFOA,

continued from page 55

In April 2022, the state Legislature passed Bill LD1911 prohibiting all municipal biosolids land application even if screening levels are met. The objective of the legislation is to "prevent further contamination of the soils and waters of the state with so-called forever chemicals."

Analytical Methods for Determining PFAS in Different Matrices

Some of the analytical methods for determining PFAS in different sample matrices are listed in ***Table 6*** *(Millipore Sigma n.d.).*

Conclusion and Future Research Potential

Wastewater effluents and industries that heavily use PFAS act as some of the major point sources for surface water and groundwater contamination due to direct or indirect discharge into these waterbodies.

The conventional WRRF unit operations mostly end up transforming PFAS into precursors leading to higher concentration in the effluent than in the influent. After the ban in use of long-chain PFAS compounds, the usage of short-chain PFAS compounds has increased, and their presence is more prevalent in wastewater sources. Large numbers of precursors are increasingly being identified in water and wastewater indicating that several of them are undetected.

The federal regulations by the EPA and CDC, along with legislative actions by several states, have profoundly increased the awareness of PFAS hazards among the public and numerous efforts have been undertaken to identify, monitor, track and treat PFAS.

There is a huge scope and advancement in the research for remediation of PFAS. Currently, there is a wide range of literature available that focuses on media-based filtration, such as granular activated carbon adsorption, for removal of PFAS from water and wastewater streams. These strategies are effective in removal of PFAS from liquid waste streams but end up accumulating or concentrating PFAS in the solid residuals, which again require treatment for complete destruction and elimination from the environment. However, there is notably limited literature that focuses on complete destruction potential of PFAS, especially from biosolids. This wide research gap provides opportunities for novel, cutting-edge research to explore the technologies focusing on destruction of PFAS from biosolids.

At present, the best approach would be to focus on source reduction of PFAS, decrease the use of PFAS-based products and identify potential alternatives/substitutes for PFAS.

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New York City Department of Environmental Protection Wastewater Operators Receive the Uhl T. Mann Award

In May of this year, the New York Water Environment Association honored Michael Glasgow, Michael Radano, and Malak Shafik of the New York City Department of Environmental Protection (NYCDEP) with the Uhl T. Mann Award. The award is given annually by NYWEA for excellence in treatment plant operations and maintenance.

Michael Glasgow
NYCDEP

Michael Radano
NYCDEP

Malak Shafik
NYCDEP

Michael Glasgow is a devoted wastewater operator, amassing over 32 years of experience with the NYCDEP. He embarked on his professional journey in 1989 as an environmental control technician and has served at various water resource recovery facilities (WRRFs), steadily progressing in his career. In March 2022, Glasgow was promoted to the position of plant chief at the Rockaway WRRF. Since assuming this role, he has demonstrated exceptional efforts in ensuring proper employee training and prioritizing safety as his foremost concern. Glasgow received the Uhl T. Mann Award for operation of a 10.1–50 MGD (million gallons per day) utility.

Michael Radano is a diligent and conscientious wastewater operator with a commendable track record of over seven years at the NYCDEP. He holds a notable certification as a Grade 4A Public Sewage Plant Operator granted by the New York State Department of Environmental Conservation (NYSDEC). Acting as assistant plant chief at the Wards Island WRRF, Radano faces the complex task of overseeing various capital upgrades. In this role, he not only coordinates the construction work associated with these upgrades but also ensures a safe working environment, uninterrupted plant operations and compliance with permits. Radano received the Uhl T. Mann Award for maintenance of a more than 50 MGD utility.

Malak Shafik brings over 21 years of dedicated experience to the NYCDEP. As a certified Grade 4A Public Sewage Plant Operator and NYSDEC Certified Trainer, he has excelled in various roles, starting as a watershed maintainer and progressing to positions such as senior sewage treatment worker and stationary engineer (electric) (SEE). As the deputy plant chief of operations at the Wards Island WRRF, Shafik has implemented standard operating procedures and collaborates effectively with technicians to ensure efficient equipment repairs and minimal operational downtime. Shafik received the Uhl T. Mann Award for operations of a more than 50 MGD utility.

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Lucy Grassano Scholarship invites one Operator from each Chapter to attend the Annual and Spring meetings at no cost as well as provide a stipend to assist with travel expenses.

Lucy Grassano was a Principal Administrative Assistant at NYCDEP. If you were to ask anyone who knew her, Lucy always went out of her way to help any of the operators she engaged with, and their respect and admiration for each other was mutual. She was a mentor, friend, teacher and "mother" to many operations staff throughout the years. Everyone needs a coach; it is in this spirit that this scholarship is granted in her name.

"The Lucy Grassano Scholarship was a fantastic experience that gave me an opportunity to meet operators, vendors and regulators from across the state, and motivated me to become more active in NYWEA. It improved my career by broadening my perspective of wastewater treatment by learning from the presentations and establishing new contacts, and refreshing my passion for protecting our limited water resources."

Craig Hurteau, *Albany County*

The Brian Romeiser Scholarship is awarded to 10 aspiring operators to assist with precertification training. These programs have successfully helped dozens of new members join the NYWEA family, and to be recognized as an integral part of our efforts to maintain the health and safety of our most precious resource, water!

Brian Romeiser was a certified Grade 4A operator who was a selfless and dedicated individual who spent his career helping to advance other operators and encouraging individuals to pursue water resource recovery careers. He served for a long time on the Genesee Valley Chapter Board of Directors.

Special Thanks to the Operation SOS working group:
Co-chairs Donna Grudier and Lisa Derrigan; and members William Grandner, Joe Massaro, Dan O'Sullivan, Cinar Ackman and Matt Oster.

For more information contact Khris at khris@nywea.org
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Operator Quiz Summer 2023 – Test Your Knowledge on Digestion

The following questions are designed for individuals/trainees pursuing certification as they prepare to take the ABC wastewater operator test. It is also designed for existing operators to test their knowledge. Each issue of *Clear Waters* will have more questions from a different process of wastewater treatment. Good luck!

1) When a digester is not being mixed, the solids normally settle to the bottom, leaving a liquid above the sludge known as:
a) Mixed liquor
b) Primary effluent
c) Supernatant
d) Waste-activated sludge

2) Anaerobic digester gas is composed mainly of:
a) Carbon dioxide and hydrogen sulfide
b) Methane and carbon dioxide
c) Methane and carbon monoxide
d) Methane and oxygen

3) Which of the following laboratory tests is most commonly used to determine the calculation for organic loading to a digester?
a) BOD
b) Total suspended solids
c) Percent volatile solids
d) pH

4) What is the desired pH level for an anerobic digester?
a) 5.9 – 6.3
b) 6.8 – 7.2
c) 7.7 – 8.3
d) 9.0 – 10.0

5) What temperature would be best for a mesophilic anerobic digester?
a) 105°F
b) 80°F
c) 120°F
d) 95°F

6) Compared to a mesophilic digester, a thermophilic digester typically requires a:
a) Longer SRT
b) Higher pH
c) Shorter SRT
d) Lower operating temperature

7) A volume of 40,000 gallons/day of waste-activated sludge is pumped to a dissolved air flotation thickener at a total solids concentration of 0.35%. How much digester volume would be saved if the sludge is concentrated to 5.5% before being sent to the digester?
a) 5,007 ft^3
b) 1,168 lbs/day
c) 37,000 gal
d) 5,348 ft^3

8) The raw sludge pumped to an anaerobic digester has a volatile solids content of 70.2%. If the digested sludge leaving the digester has a volatile solids content of 55.5%, what is the percent volatile solids reduction of the digester?
a) 26.5%
b) 47.4%
c) 14.7%
d) 51.3%

9) A digester has a diameter of 60 feet, a side wall depth of 14 feet and a cone depth of 8 feet. What would be the total volume if the liquid level was measured to be 5 feet from the top?
a) 195,883 gal
b) 301,576 gal
c) 246,052 gal
d) 190,246 gal

10) If an anerobic digester has a volume of 1,000,000 gal, what would be an acceptable organic load in volatile solids lbs/day?
a) 67,000 lbs/day
b) 32,000 lbs/day
c) 12,500 lbs/day
d) 150,000 lbs/day

Answers to the lower left.

Answers: **1.** (c) Supernatant **2.** (b) Methane and carbon dioxide
3. (c) Percent volatile solids **4.** (b) 6.8-7.2 **5.** (d) 95 °F
6. (c) Shorter SRT **7.** (a) 5,007 ft^3 **8.** (b) 47.4 %
9. (c) 246,052 gal **10.** (b) 32,000 lbs/day

For those who have questions concerning operator certification requirements and scheduling, please contact Carolyn Steinhauer at 315-422-7811 ext. 4, carolyn@nywea.org or visit www.nywea.org.

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2023-2024 Upcoming Meetings and Seminars

SEPTEMBER

21 **Polymers, P Removal & State of Chemical Industry** (In person, 6 hours)
Binghamton/Johnson City Joint WWTP, 4480 Vestal Rd., Vestal, NY

OCTOBER

19 **Mathematics for Water & Wastewater Operators** (In person, 6 hours)
Bergen Point WWTP, West Babylon, NY

24-25 **Joint Risk & Resiliency Speciality Conference**
The Stamford Hotel, Stamford, CT

26 **Strategic Energy Management**
Mohawk View WPCP, Latham, NY

NOVEMBER

14 **Chlorine Disinfection Soup to Nuts**
TBD

DECEMBER

5 **The Importance of Upfront Project Planning: Leading with Intentional Design Virtual Webinar**

12 **Biosolids Management Virtual Webinar**

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