Title

Legal Extension Strategies to Increase Awareness of Drinking Water Contaminant Regulatory Framework

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Abstract

It is important for stakeholders, scientists, industry, lawyers and decision-makers to understand the varying approaches to regulating drinking water contaminants. To increase awareness and understanding among stakeholder audiences of the legal framework for drinking water protection, the National Sea Grant Law Center (NSGLC) at the University of Mississippi School of Law has developed and implemented research and extension projects for lead, nitrates, and PFAS. The NSGLC's mission is to encourage a well-informed constituency by providing legal information and analysis to the Sea Grant community, policy-makers, and the general public through a variety of products and services. For each contaminant, the NSGLC conducted legal research to identify relevant laws, regulations, policies, and court decisions to gain an in-depth understanding of the existing legal framework. The NSGLC then translated its information on the current legal framework, identified gaps, and potential solutions into a variety of outreach programming. For each of the relevant drinking water contaminants, the NSGLC has taken different outreach approaches. For lead, the NSGLC has worked with an interdisciplinary academic team to conduct community-based research and outreach directly to families. With nitrates, the NSGLC has focused more on professional development for attorneys, natural resource managers, and other policy makers. With PFAS, the NSGLC is proposing a hybrid approach drawing on lessons learned from its previous projects and the COVID-19 pandemic to disseminate information to both professionals and communities. This case study will synthesize key findings on the legal overview, potential legal issues, and outreach efforts for lead, nitrates, and PFAS.

Keywords
Drinking water, lead, nitrates, PFAS, Contaminants of Emerging Concern

Research Implications

- Increased awareness of how drinking water contaminants are regulated in the United States.

- Increased understanding of how contaminants of emerging concern in drinking water can be addressed by the U.S. Environmental Protection Agency and state agencies.
- Increased understanding of the value of legal extension and types of outreach strategies to communicate information on legal and regulatory issues to non-legal audiences.

Introduction

The Safe Drinking Water Act (SDWA) is the primary federal law that ensures the quality of Americans' drinking water. Entities operating Public Water Systems (PWS) must comply with the requirements of the SDWA. PWS are systems with at least 15 service connections or serving at least 25 people for at least 60 days a year (42 U.S.C. § 300f(4)).

The U.S. Environmental Protection Agency (EPA) sets standards for the monitoring and treatment of water for regulated contaminants. Under the SDWA, the EPA adopts regulations for contaminants in drinking water that can adversely affect health and that are known or could occur in public water supplies (42 U.S.C. § 300g(b)(1)). The level at which PWS must take action to address regulated contaminants is known as the Maximum Contaminant Level (MCL). For each contaminant, the PWS must monitor drinking water to ensure that the MCL is not exceeded and take prescribed steps if it is exceeded.

Since Congress passed the SDWA in 1974, the EPA has issued regulations for over 90 drinking water contaminants, including two well-known substances: lead and nitrates (Congressional Research Service, 2021). However, due to regulatory gaps in the SDWA, individuals and communities still face health risks related to their drinking water. For instance, the SDWA does not cover private wells. Further, MCLS are often not health based, but set based on what is technologically feasible, and compliance is determined based on limited sampling.

Gaps also exist with respect to contaminants of emerging concern (CECs). Federal law has not been able to keep up with emerging research on the health risks associated with CECs in drinking water. To regulate a contaminant under the SDWA, the EPA must publish a National Primary Drinking Water Regulation for that contaminant (NPDWR) (42 U.S.C. § 300g-1(a)). To begin this process, EPA must periodically publish a list of unregulated contaminants expected or known to be in PWSs known as the Contaminant Candidate List (CCL). After a research and data collection phase, which can be quite lengthy, the EPA makes a determination whether to develop a NPDWR. In 2016, EPA added two PFAS substances, Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA), to its fourth CCL (U.S. Environmental Protection Agency 2016).

The EPA does not have to regulate a CEC as a listed contaminant under the SDWA in order to provide some protection; rather, it can employ tools like health advisories and unregulated contaminant monitoring rules, as has been done with PFAS (Federal Register 2016). In addition, states can take their own actions in the absence of or in addition to federal regulations. For instance, many states have begun regulating PFAS using a variety of approaches.

It is important for stakeholders, scientists, industry, and decision-makers to understand the varying approaches to regulating drinking water contaminants. To increase awareness and understanding among stakeholder audiences of the regulatory framework for drinking water protection, and the gaps in this regime, this case study will synthesize the National Sea Grant Law Center's (NSGLC) key findings on the legal framework, potential legal issues, and outreach efforts for lead, nitrates, and PFAS.

Methods

This case study provides an overview of the research and extension projects for lead, nitrates, and PFAS implemented by environmental attorneys working for the NSGLC, located at the University of Mississippi School of Law. These three contaminants were selected because they are major issues nationally, have different sources in drinking water (respectively, lead pipes, fertilizers, and industrial manufacturing), and as yet have not been fully addressed through the regulatory process. The NSGLC's mission is to encourage a well-informed constituency by providing legal information and analysis to the Sea Grant community, policy-makers, and the general public through a variety of products and services. Through this mission, the NSGLC has gained vast experience in translating complex legal concepts and analysis into language non-lawyers can understand. Further, due to NOAA Sea Grant's overall efforts to serve as honest brokers of scientific information, the NSGLC is looked to as a trusted source of non-advocacy legal information (Center for Research Evaluation, 2021).

For each contaminant, the NSGLC implemented the following research methodology. First, the NSGLC conducted systematic keyword and subject matter searches of legal databases to identify relevant federal and state regulations, policies, and court decisions. Then, the NSGLC reviewed the compiled provisions to gain an in-depth understanding of the existing legal framework for each jurisdiction. Finally, the NSGLC conducted a comparative analysis of the various frameworks across jurisdictions to identify similarities, inconsistencies, and gaps that may need to be addressed to protect public health. These research findings are summarized in traditional legal memorandum or law review articles.

Upon completion of the legal research, the NSGLC then developed outreach programming to translate its research results for a wider audience. The NSGLC has implemented different outreach approaches for each drinking water contaminant. The NSGLC based these choices on a variety of factors, including the project partners, funding source, and primary audience for the outreach materials.

Lead and Community Engagement

The dangers of lead have long been well-known. Lead exposure in adults can cause hypertension, reproductive problems, and decreased kidney function, and recent research shows an association with heart disease (Neltner, 2021). However, fetuses, infants, and young children are the most vulnerable to lead exposure. The World Health Organization estimates that young children absorb 4-5 times more lead than adults when ingested. At high levels of lead exposure, a child is susceptible to coma, convulsions, and even death. Low levels of lead exposure have been linked to lower IQ, decreased ability to pay attention, and underperformance in school (NIEHS 2021).

There is no safe blood level for lead, and the Centers of Disease Control and Prevention (CDC) states that all sources that can expose children to lead should either be controlled or eliminated. (CDC 2020). Since 1978, when the use of lead-based paint was banned in the United States, environmental and health policy has focused on reducing childhood exposure to lead-based paint and the dust produced as it deteriorates. Lead additives to gasoline were banned in 1996, addressing ambient air exposures. Policy-makers have focused much less attention to lead exposure through other sources like drinking water, despite the fact that in up to 30% of cases of children with elevated blood lead levels (EBLL) there is no immediate lead paint hazard (Mayans 2019).

Legal Overview

The 1986 SDWA banned, starting in June of that year, the use of lead pipes, plumbing fittings and fixtures, solder, and flux in PWSs and any facility, both residential and non-residential, that provides drinking water. It also required that the EPA regulate lead levels in drinking water. The EPA issued regulations under the SDWA in 1991 to address lead and copper contamination in drinking water, known as the Lead and Copper Rule (LCR). The LCR focuses on preventing lead from leaching from plumbing into the drinking supply by requiring PWSs to use optimal corrosion control treatment. Once the appropriate treatment option is determined by the state, the PWS is required to install and operate that corrosion control throughout the distribution system (40 C.F.R. § 141.82).

Unusually, the EPA did not establish an MCL for lead. Instead, the EPA set an action level (AL) for lead at 15 parts per billion (ppb) (.015 mg/L). The 15 ppb AL is not a health-based standard, but rather was chosen due to technical feasibility regarding corrosion control treatment systems. While 0 ppb is ideal to prevent lead health effects since there is no safe level of lead exposure, the EPA determined that it was not technically feasible for PWSs to reach this level when the AL was set in the 1991 LCR.

The monitoring of lead is done through sampling household tap water. Samples are to be collected from sites that are at high risk to have lead in their plumbing materials. For PWSs that serve greater than 100,000 people, the system is required to test the water at 100 sites in two successive six-month periods (40 C.F.R. § 141.81(d)). As the system size decreases, so does the number of required samples. PWSs can reduce the frequency of sampling events and number of sampling sites if they meet certain criteria, such as reporting lead levels below the AL for three consecutive years.

If the results of this monitoring show that more than 10 percent of samples are above the lead AL, the AL is exceeded and certain actions are triggered under the LCR (40 C.F.R. § 141.85-6). These actions include requirements to optimize corrosion control treatment, engage in public education, and, if necessary, replace lead service lines.

Gaps

There are some significant gaps in the SDWA and LCR. While required by the LCR to sample from locations with lead in their plumbing materials, PWSs do not always know the location of lead materials or may not adequately comply during sample site selection (Goovaerts 2017). Further, PWSs are not legally required to sample at schools within their service areas, despite the presence of vulnerable populations. To address some of these gaps, the EPA recently finalized an updated LCR, which is scheduled to become effective in December 2021. The changes focused on the following:

- Requiring a Lead Service Lines (LSL) inventory to identify customers at risk and concentrated areas of LSL.
- Requiring LSL replacement plans to systemically replace LSLs.
- Creating a new trigger level of 10 ppb. The AL remains at 15 ppb, but PWSs that exceed the trigger level must take new steps to address lead levels.
- Increasing sample reliability with an increased focus on having samples come from sites with LSLs.
- Improving risk communication by adding more and faster notice requirements.
- Protecting children in schools by including provisions for testing school and childcare facility drinking water (Federal Register 2021c).

Outreach Strategy: Community Engaged

The University of Mississippi Lead in Drinking Water Project (UM Lead Project) was founded by an interdisciplinary team focused on furthering research and available data on lead exposure through drinking water (NSGLC 2021). Each year more than 200 Mississippi children are diagnosed with lead poisoning (EBLL > 5g/dL) (MSDH 2018). However, research and data on lead exposure from drinking water in Mississippi is limited. The UM Lead Project aims to increase awareness of the risks of lead exposure and access water testing for lead for Mississippi residents. The NSGLC is a member of the UM Lead Project, contributing expertise on environmental law and policy. Other members of the UM Lead Project include professors from the sociology, biomolecular sciences, and engineering departments at the University of Mississippi. The team's range of expertise provides project participants with a multi-layered perspective on how, why, and what happens when a person is exposed to lead in their drinking water.

The UM Lead Project follows a Community-Based Research (CBR) model to incorporate community expertise and concerns into its research as well as to provide resources to address these concerns. CBR seeks to open up the line of communication between researchers and residents. Further, in similar studies where drinking water was tested for toxic metals, community involvement has been established as having benefits such as accelerating research, identifying and meeting social needs, preventing environmental injustices, and enhancing STEM education. (Segev et al. 2020). Community partnerships are essential components of developing relevant research that not only informs scientists, but also increases knowledge of and helps mitigate certain risks for community members.

Community Sampling Events. With funding from the University of Mississippi and the Mississippi Water Resources Research Institute, the UM Lead Project held 11 collection events in the Mississippi Delta over the course of two years (Sept. 2016 – Oct. 2018) (Willett et al. 2021). The Mississippi State Department of Health (MSDH) has classified 20 of Mississippi's 82 counties as high-risk for lead poisoning, nine of which are located in the Mississippi Delta region (MSDH 2017). Further, the drinking water distribution system in Mississippi is incredibly fragmented. For instance, there are 168 PWS in nine Mississippi Delta counties (Bolivar-28, Coahoma-20, Humphreys-11, Leflore-17, Panola-30, Quitman-14, Sunflower-14, Tallahatchie-16, and Washington-18). These PWSs serve over 244,000 customers. However, due to the small size of most PWSs in the region, each PWS is only required to sample a small number of taps – usually just 5 or 10. This means that for many of the PWSs, less than 1% of the homes they served are tested for lead (Otts and Janasie 2017).

These events were hosted in partnership with various community organizations, including community health centers, a hospital-affiliated wellness center, churches, and a Mississippi State University Extension private well program. Working with community partners allowed the team to build on pre-existing relationships, which fostered a strong foundation for the project's research and outreach. This also allowed a high level of trust between the participants and researchers (Fratesi 2018).

The structure of each sampling event varied depending on the community partner, but all incorporated outreach on lead risks. A strength of the project was that it not only engaged the community partners, but students, families, and other community members as well, allowing them to learn more about the dangers of lead. Prior to the distribution of sampling kits, a UM Lead Project team member would give a presentation about the health risks of childhood lead poisoning, how lead gets into our drinking water, and low cost mitigation measures families can take to reduce exposure. Hard copies of informational handouts on lead risks produced by the CDC, EPA, and the MSDH were included with sampling kits. Families who returned water samples for testing received their results via U.S. mail, and those letters also included guidance on how to mitigate exposure.

The UM Lead Project team tested 213 sample bottles for lead concentrations. Of those 213, 184 were from PWSs and 19 from private wells. All of the returned water samples the UM Lead Project tested had lead concentrations below the 15 ppb AL. However, nearly two-thirds of the samples had at least some detectable lead. 41 of the 215 samples (19.2%) had concentrations of 1 ppb or higher. Nine samples exceeded the Food and Drug Administration's bottled water limit of 5 ppb, and those families were provided with a water filter free of charge. Notably, the samples with the highest lead concentrations were from private wells. (Willett et al. 2021).

MSDH Referral Program. Blood lead screening tests are required for all children enrolled in Medicaid in Mississippi at 12 and 24 months (MSDH 2015). Due to limited funding and staff capacity, MSDH only conducts environmental home assessments to identify possible sources of lead for children with an EBLL at or above 15 µg/dL. Doing a home assessment at this EBLL is consistent with CDC recommendations that were released in 1991, though current recommendations urge action at lower EBLL levels (Gilbert and Weiss 2006). To help increase the services provided to families of children with EBLLs, the MSDH and the UM Lead Project are currently partnering to test the drinking water of Mississippi families whose children are diagnosed with lead poisoning but do not qualify for a home assessment.

In 2020, the UM Lead Project sent 53 water sample kits to Mississippi residents in 31 counties. In addition to a water sample bottle and instructions for sample collection, these kits contained outreach materials developed by the team to provide information on lead exposure risks from drinking water and steps families can take to reduce children's exposure. These materials are provided in both English and Spanish. 20 samples were returned to the UM Lead Project for testing, nine of which had detectable levels of lead. Two samples, both from private wells, had lead concentrations significantly higher than the lead AL (approximately 28 ppb and 81 ppb). Families with lead concentrations in drinking water over 5 ppb were provided with water filters free of charge.

SipSafe. The LCR does not currently require lead testing in schools. In 2017, Congress began addressing testing gaps in schools with the passage of the Water Infrastructure Improvement for the Nation (WIIN) Act (Pub. L. No. 114-322 2016)). This legislation provided funds to states to increase voluntary testing in schools and childcare facilities, and to further protect American children from lead exposure.

WIIN grant funds in Mississippi are administered by the Mississippi State University Extension Service through its SipSafe program. The SipSafe program aims to eliminate as many obstacles to lead in water testing as possible by providing testing at no cost, education and training for staff and parents, and low-cost methods of reducing lead exposure should any exposure sources be identified.

The UM Lead Project is a partner in this effort and handles recruitment and sampling for schools and childcare facilities in the Mississippi Delta. SipSafe recruitment involves cold-calling, email and internet advertisement, and community outreach. Sampling is conducted by a UM Lead Project team member who goes to the facility to collect first-draw samples from all water fixtures where children drink from or have access to, and where food is prepared. Sampling results, along with recommendations on mitigation measures, are shared and discussed with facilities.

Nitrogen Pollution and Professional Development

While nitrogen is a nutrient that naturally occurs in aquatic ecosystems, the presence of these nutrients in excessive quantities causes risks to human health and results in substantial economic and environmental harms. In fact, nutrient pollution is one of the most significant and difficult environmental problems in the United States affecting the water quality in over 100,000 miles of rivers and streams and around 2.5 million acres of waterbodies (EPA 2017). Nutrient pollution is primarily caused by human activities such as stormwater runoff, wastewater discharges, septic systems, fertilizer use and improper nutrient disposal in residential areas, and agricultural sources.

Agriculture is one of the largest contributors to nutrient and sediment pollution. Currently, there are over 15,000 distinct water bodies classified as “impaired” due to pollution from agricultural sources (Perez 2017). From 1988-2015, the U.S. Geological Survey’s National Water Quality Assessment (NAWQA) Project sampled the principal groundwater aquifers accessed by public and private drinking water wells. The project found that nitrate levels in groundwater under agricultural land were roughly three times the national background level (Ward et al. 2018). Further, while 6% of private wells exceeded the nitrate MCL, the percentage jumps to 21% in agricultural areas (Ward et al. 2018).

Nitrates can be harmful to human health. Blue baby syndrome, or methemoglobinemia, is a severe risk for infants exposed to drinking water with elevated levels of nitrates. With methemoglobinemia, ingested nitrates are reduced to nitrite, which binds to hemoglobin and forms methemoglobin. Methemoglobin interferes with the blood’s capacity to carry oxygen. When methemoglobin levels exceed roughly 10%, methemoglobinemia can be a life-threatening condition for infants (Ward et al. 2018). Excess nitrates levels have also been linked to certain cancers, such as colorectal, bladder, and breast, thyroid disease, and birth defects (Ward et al. 2018).

Legal Overview

Nitrogen is a regulated contaminant under the SDWA. Under the SDWA, the MCL for nitrate are as follows: nitrate - 10 mg/l; total nitrate and nitrite - 10 mg/l (40 C.F.R. § 141.62(b)). These levels were set to protect against methemoglobinemia, but not the other health risks associated with ingesting excess nitrate levels in drinking water (Federal Register 1991). The FDA has set the same levels for nitrate and total nitrate and nitrite in bottled water (21 C.F.R. § 165.110).

PWS violations of the nitrate MCL are prevalent in the United States. From 1994-2004, nitrate had the most MCL violations in the national Safe Drinking Water Information System (Pennino et al. 2017). Nitrate remains one of the most violated MCLs (Pennino et al. 2017). Treating water to remain below the nitrate MCL can be very costly, and many towns are needing to install upgrades. For instance, the Des Moines Water Works has claimed that it expects to expend between $76 million to $183 million to increase its nitrate removal ability and capacity (Complaint 2015).

Gaps

Under the Clean Water Act (CWA), discharges from point sources require a permit under the National Pollutant Discharge Elimination System (NPDES) program. A point source is a discrete conveyance, like a pipe, ditch, or tunnel (33 U.S.C. § 1362(14)). NPDES permits are not required for nonpoint source discharges. Thus, the regulation of nonpoint source pollution, including runoff, has mostly been left to the states. Further, the CWA expressly excludes "agricultural stormwater discharges and return flows from irrigated agriculture" from the definition of point source (33 U.S.C. § 1362(14)). By regulating point source and nonpoint sources differently, Congress created what some view as a regulatory gap that makes nutrient pollution difficult to control.

The exemption of nonpoint source pollution from the CWA permit program was a driving force behind the Des Moines Water Works (DMWW) litigation (Board of Water Works 2017). DMWW is a PWS that obtains its raw water source from the Raccoon River. DMWW claimed the nitrate levels in the river threaten its ability to deliver safe drinking water despite its implementation of control strategies and construction of a $4.5 million nitrate removal facility (Complaint 2015). DMWW identifies the subsurface drainage system infrastructure operated by the county drainage districts, which drains water from agricultural fields, as a major source of nitrate pollution in the Raccoon River (Complaint 2015). Because the system transports nitrate pollution to open ditches and streams which then convey pollution to the river, the DMWW alleged the drainage districts are point sources under the CWA, rather than diffuse runoff from agriculture (Complaint 2015).

Ultimately, the case was dismissed based on the Iowa Supreme Court's determination that the drainage districts were immune from liability (Board of Water Works 2017). While the case never addressed the merits of DMWW's claims, it is an indicator of how compliance costs for utilities to meet the SDWA's nitrate limits may be a continuing driver of new ways to think about regulating agricultural runoff.

Outreach Strategy: Professional Development

The NSGLC initiated its research and outreach on nutrient pollution as part of its work with the Agricultural and Food Law Consortium, a national, multi-institutional collaboration that operated from 2014 to 2019 (NSGLC 2019). The Consortium was formed to aid in the development and delivery of authoritative, timely, and objective agricultural and food law research and information. In comparison to the interdisciplinary UM Lead Team that was based at the University of Mississippi, the Consortium included attorneys at universities in Arkansas, Mississippi, Ohio, and Pennsylvania. The narrower disciplinary focus and more national scope influenced the projects, audience, and outreach methods chosen by the NSGLC.

The NSGLC's nutrient pollution outreach focused primarily on professionals, attorneys, natural resource managers, and other policy makers interested in the agricultural law field and sought to leverage the pre-existing outreach mechanisms and partnerships of Consortium members. For example, the Consortium organized and hosted a webinar series that had an existing audience base of attorneys and other professionals, such as soil and water conservation professionals. This existing audience base was a driving force in the NSGLC's decision to focus its outreach on professionals in the agricultural field.

Through partnerships with other Consortium partners, the NSGLC submitted abstracts for multiple professional meetings to discuss legal issues regarding nutrient use and management. On July 30, 2017, the NSGLC, the National Agricultural Law Center, and Ohio State University Extension Agriculture & Natural Resources (OSU Extension) hosted a 4-hour workshop on nutrient management at the Soil and Water Conservation Society (SWCS) annual meeting on July 30, 2017. The workshop, titled "Agricultural Nutrient Management and Water Quality: Emerging Solutions and Ongoing Legal Challenges," covered the following topics:

- Balancing agricultural nutrient use with the impacts on water quality;
- An overview of the CWA; and
- State actions

After these informational overviews, the focus of the workshop shifted to a discussion of the issues faced by Des Moines and other cities that are facing rising costs to treat their drinking water. This section of the workshop was meant to be interactive, with the NSGLC facilitating a discussion with the workshop participants on potential solutions for managing agricultural nutrient runoff; however, the participants were reticent in the discussion. Participants noted after the session that they were not interested in brainstorming, but rather, had hoped the workshop would have solutions already laid out for them.

The SWCS workshop was a follow-up to a similar panel discussion by the NSGLC and OSU Extension at the Universities Council of Water Resources (UCOWR) 2017 meeting in Fort Collins. Titled "Beyond dead zones: the impact of agricultural nutrients on drinking water and associated legal policies, planning, and challenges for successful water quality management," the format of the panel was similar, with an overview of the legal framework followed by an interactive panel discussion. The discussion and brainstorming at the UCOWR session was much more robust. Perhaps this can be accounted for by the nature of the forum- the SWCS workshop was designed and advertised as a professional development/continuing education event which may have led participants to expect the presentation of ready-made solutions, while the UCOWR panel was advertised as an interactive event.

PFAS- A Proposed Hybrid Outreach Approach

Per-and polyfluorinated substances (PFAS) are a family of emerging contaminants that includes hundreds of individual compounds. Two common PFAS compounds include Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA). PFAS molecules include strong chains of carbon and fluorine atoms, and this molecular structure makes PFAS resilient and resistant to dissolving or breaking down (Lustgarten 2018). PFAS has been widely used in industrial, commercial, and household products including packaging, water-repellent fabrics, nonstick products, firefighting foam, and cleaning products.

Because PFAS is resistant to breaking down or dissolving, the compounds can accumulate in the environment and in the human body. The EPA reports that PFAS can be found in drinking water, soil, and food (EPA 2020), and humans can ingest PFAS through various ways. According to the National Health and Nutrition Examination Survey, the CDC, and the National Groundwater Association, approximately 95% of the U.S. population has measurable concentrations of PFAS in their blood (National Groundwater Association 2017). Scientists associate elevated levels of PFAS in blood with health concerns and diseases including various types of cancers, liver and kidney disease, hormone disruption, and increased cholesterol levels. Most recently, studies have linked PFAS to reduced vaccine efficiency (Federal Register 2021a).

An increasing number of communities have found PFAS contamination in their drinking water. The Environmental Working Group (EWG) recently published data finding that there was evidence of PFAS contamination in 2,337 sites across 49 states (EWG 2021). As more information is learned about health risks associated with PFAS, there is a greater demand for the federal government and states to meaningfully regulate PFAS compounds.

Legal Overview

Under the SDWA, there are two methods available to regulate PFAS: issuance of a lifetime health advisory or listing as a regulated contaminant with an MCL. A lifetime health advisory is a non-regulatory standard that identifies the concentration of a contaminant in drinking water at or below an anticipated lifetime exposure level with no adverse health effects. (Federal Register 2016). Because a health advisory is non-regulatory, this means the standard is not legally enforceable and PWSs are not required to comply with the set limit (42 U.S.C. § 300g-(1)(b)(1)(F)). Alternatively, the EPA may set enforceable MCL standards that set a threshold limit on the allowable level of a contaminant delivered to water users. Generally, the EPA must balance both the cost and public benefits of regulating a contaminant by setting an MCL that is feasible and takes into consideration health risk reductions (42 U.S.C. § 300g-3).

Federal Regulation of PFAS in Drinking Water

The federal government has not implemented comprehensive PFAS regulatory requirements. Beginning in 2002, EPA initiated a priority review of PFAS and invited eight manufacturing companies to voluntarily phase out all PFOA in their products, which they did. However, the companies replaced PFOA with alternative PFAS compounds. In 2016, the EPA published lifetime health advisories for PFOA and PFOS at 70 parts per trillion (ppt) (Federal Register 2016). More recently, in 2019, EPA published a PFAS Action Plan that explained how the agency planned to address PFAS contamination (EPA 2019). In February 2020, EPA published a proposed notice to set national drinking water standards for both PFOA and PFOS (Federal Register 2021d). The SDWA rules will likely influence state efforts and regulations regarding PFAS as well.

State Action

A growing understanding of PFAS contamination and negative health effects, combined with a lack of comprehensive federal PFAS regulation, has led to limited and inconsistent PFAS regulation. States have taken a variety of approaches to regulating PFAS resulting in a patchwork effect with some chemicals and locations regulated more stringently than others. Normally, federal standards act as a floor and states are free to enact stricter guidelines under state law.

To date, many states have not pursued regulation of PFAS. As Table 1 shows, the approaches of states that have chosen to regulate PFAS vary, as do which PFAS chemicals are regulated. Each approach has strengths and weaknesses. Some states have set non-enforceable advisory levels, while other states have set strict, enforceable MCLs. Others have classified PFAS contaminants as a hazardous substance, prohibiting discharges. States have additionally considered monitoring, reporting, and remediation guidelines and requirements.

(Table 1)

The patchwork PFAS regulatory approach has resulted in hundreds of lawsuits using different legal approaches to recover costs and damages from PFAS contamination. While many parties have successfully recovered damages or reached settlement agreements, some PFAS cases have been dismissed on procedural grounds or failed to establish a legal injury (Golden State Water Co 2021). Additionally, some companies have challenged the regulatory procedure used to set PFAS standards (Complaint 2021). Further, there is a growing recognition of the need for a comprehensive regulatory approach (Bjornlund and Dillon 2020).

Outreach: A Hybrid Approach

Building off lessons learned from the lead and nutrient pollution extension efforts, as well as providing outreach during the COVID-19 pandemic, the NSGLC is implementing a hybrid approach to its PFAS outreach programming. Due in part to the pandemic, the NSGLC's initial focus is on outreach through presentations at scientific conferences. This year, NSGLC has presented virtually on PFAS at the Emerging Contaminants in the Environment Conference hosted by Illinois Sustainable Technology Center and Illinois-Indiana Sea Grant, and at the 2021 UCOWR meeting. NSGLC's presentations help inform conference participants, which include scientists, engineers, educators, extension agents, state agency staff, and other policy makers about the current status of PFAS regulation in order to help identify potential mechanisms to address PFAS contamination, especially as it applies to drinking water.

Community-based outreach projects have been harder to implement during the COVID-19 pandemic. However, due to the impact of its community-based lead project, the NSGLC is continuing to brainstorm ways to inform and work with communities on PFAS issues. In future efforts, the NSGLC plans to work with Sea Grant personnel working on PFAS around the country to share information with their stakeholder communities about the legal framework through fact sheets, webinars, social media, and virtual meetings. These efforts will be aimed at areas with known PFAS contamination (EWG 2021).

Although the COVID-19 pandemic has made it difficult to meet in person, the NSGLC has gained experience in virtual meetings during the pandemic and learned valuable lessons along the way. Based in part on wanting to encourage more audience participation than occurred at its SWCS nutrient pollution workshop, the NSGLC has begun to integrate Poll Everywhere technology (polleverywhere.com) into webinars and virtual meetings. The NSGLC has surveyed webinar participants and have received positive feedback on the Poll Everywhere technology. Poll Everywhere can be integrated into PowerPoint, Keynote, or Google Slides. Once the host shares his or her screen during the presentation, the poll questions appear on a special webpage or through messages on a smartphone. Presenters are able to choose from a variety of activities to engage participants, such as open-ended or multiple-choice questions, or the ability to create word clouds based on participants' answers. Further, the software captures participant answers to help better track the feedback/answers given during the webinar. Finally, while there are paid subscriptions available, users can access Poll Everywhere for free for meetings of up to 25 participants.

To enhance virtual meetings, the NSGLC has also used on-line tools Miro (https://miro.com/) and Mural (mural.co) to create collaborative workshop spaces outside of Zoom. Miro and Mural are both online collaborative whiteboard platforms that enable individuals participating remotely to collaborate as if they were in the same meeting room. The whiteboard spaces mimic many aspects of attending an in-person meeting- posting sticky notes on virtual flipcharts, voting on priorities, and adding ideas to a virtual parking lot. The virtual workspaces also allowed fuller participation by participants whose organizations disallowed the use of Zoom on a computer. Those participants were able to call-in to the meeting on the phone and view the presentation slides through the virtual workspace. Like Poll Everywhere, Miro and Mural do have paid subscription services. However, users can create a limited number of whiteboards- 3 with Miro and 5 with Mural- for free, and educators can apply for free access to further services.

A final lesson learned in hosting meetings in a virtual setting is to work with a professional facilitator on lengthier meetings if financial resources allow. During COVID-19, the NSGLC had two meetings that were originally scheduled to be in-person go virtual. The hired facilitators for both meetings worked extensively with the NSGLC staff to develop the workshop agenda with a particular focus on the needs of a virtual meeting, create the virtual whiteboards, and facilitate the meetings. One meeting also engaged a separate “tech host” facilitator whose specific role was to help participants with any technological issues.

Conclusion

The federal and state governments’ varying approaches to regulating drinking water contaminants are complex and often confusing to non-experts. To increase awareness and understanding among stakeholder audiences of this legal framework, the NSGLC has developed and implemented research and extension projects for lead, nitrates, and PFAS. It is critical that these types of legal outreach programs and strategies provide current and accurate information in a manner that is accessible to both attorneys and non-legal audiences.

These projects have allowed the NSGLC to gain knowledge in the effectiveness of different outreach methods. The NSGLC’s interdisciplinary, community-engaged project on lead has helped families mitigate risks and improved the data available to policy-makers. The project has also enabled the NSGLC to improve its approach for developing outreach materials for the general public and see first-hand how its work benefits communities in Mississippi. With nitrates, the NSGLC has learned more about the expectations and best practices related to the delivery of professional development programming for attorneys, natural resource managers, and other policy makers. While the impacts of this work for reducing exposures to contaminants are less direct than when working with individuals and communities, identifying regulatory gaps to this audience is essential for policy change.

As a result, with PFAS, the NSGLC is proposing a hybrid approach drawing on lessons learned from its previous projects to disseminate information to both professionals and communities with the hope of broadening its impact. While the COVID-19 pandemic has limited community events, the NSGLC will employ outreach methods that it has learned during the pandemic in its future, virtual outreach efforts. These approaches include utilizing audience participant software like Poll Everywhere and virtual whiteboards. While these services offer more advanced options for subscribers, limited use of the technology is available for free. Importantly, educators can apply for additional free services. The NSGLC believes that these outreach techniques can also be employed by other professionals as we continue to work in a mostly virtual space.

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33 U.S.C. § 1251(a).

33 U.S.C. § 1362(14).

40 C.F.R. § 141.62(b).

40 C.F.R. § 141.82.

40 C.F.R. § 141.85-6.

42 U.S.C. § 300f(4).

42 U.S.C. § 300g-1(a).

42 U.S.C. § 300g-1(b)(1).

42 U.S.C. § 300g-1(b)(4).

42 U.S.C. § 300g-3.

Tables

Table 1- Examples of State PFAS Regulatory Actions

State	PFAS Chemical Regulatory Approaches

Michigan	The legislature adopted MCLs for seven PFAS contaminants: PFNA, PFO, PFHxA, PFOS, PFHxS, PFBS, and HFPO-DA. The MCLs took effect in August 2020, and compliance is determined by an annual average sampling point for each compound. The Department of Health and Human Services adopted groundwater standards of 8 ppt for PFOA and 16 ppt for PFOS.
Minnesota	The Department of Health issued advisory values for PFOA at 15 ppt and PFHxS at 47 ppt. The advisory values are a non-binding recommendation set at a limit "that is likely to pose little or no risk to human health." In February 2021, Minnesota's Pollution Control Agency introduced a "PFAS Blueprint" to set health-based guidance values for PFAS drinking water chemicals and include PFAS as a hazardous substance. If implemented into regulation, the PFAS Blueprint would be one of the most comprehensive state regulatory efforts. However, the PFAS standards would continue to be health-based guidance and not enforceable MCLs.
New Jersey	In 2020, the Department of Environmental Protection adopted MCLs for PFOA at 14 ppt and PFOS at 13 ppt. Groundwater standards for PFOA were set at 14 ppt and PFOS at 13 ppt. Beginning in December 2021, private well owners will be required to test for PFOA, PFOS, and PFNA under the New Jersey Private Well Testing Act. PFOA and PFOS are listed as a hazardous substance.
New York	In 2016, New York became the first state to regulate PFOA as a hazardous substance. A hazardous substance designation requires proper storage and limited release of the chemical. State MCLs for PFOA and PFOS are 10 ppt.
Vermont	Vermont Act 21 provided a framework for identifying PFAS water contamination and issued standards for acceptable levels of PFAS in drinking water. The Vermont Water Supply Rule establishes state MCLs for PFOA, PFOS, PFHxS, PFHpA, and PFNA. The sum total of the five PFAS chemicals cannot exceed 1 ppt. Annual Water Quality Sampling is required.

Table 2 - Glossary of Terms

CBR – Community Based Research
CCL – Contaminant Candidate List
CDC – Center for Disease Control and Prevention
CECs – Contaminants of Emerging Concern
CWA – Clean Water Act
DMWW – Des Moines Water Works litigation
EBLL – Elevated Blood Lead Levels
EPA – Environmental Protection Agency
EWG – Environmental Working Group
LCR- Lead and Copper Rule
LSL – Lead Service Lines
MCL – Maximum Contaminant Level
MCLG – Maximum Contaminant Level Goals
MSDH – Mississippi State Department of Health
NALC – National Agricultural Law Center
NAWQA – National Water Quality Assessment
NPDES – National Pollutant Discharge Elimination System
NPDWR – National Primary Drinking Water Regulation
NSGLC – National Sea Grant Law Center
OSU Extension – Ohio State University Extension Agriculture & Natural Resources
PFOA – Perfluorooctanoic acid
PFOS – Perfluorooctanessulfonic acid
PFAS – Per-and polyfluoroalkyl substances
PWS - Public Water System
SDWA – Safe Drinking Water Act
SDWIS – Safe Drinking Water Information System
SWCS – Soil and Water Conservation Society
UCOWR – Universities Council of Water Resources
WIIN – Water Infrastructure Improvement for the Nation
WRVT – Water Resources Visioning Team