Dealing with PFAS in the Water Supply: Creative Solutions to Emerging Threats

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Current regulatory programs are not well adapted to address emerging water supply threats. Collaborative solutions are needed to avoid further loss of water resources and develop new sources of supply.

The U.S. water supply is under threat. Scientists who analyze the implications of a warming planet have found that climate change is increasing the intensity and frequency of droughts — a fact that isn't surprising to many of us, particularly those living in the western U.S. *(1, 2)*. Severe droughts driven by climate change affect the quantity and quality of both surface and groundwater. Droughts increase reliance on groundwater supplies, which can lead to chronic groundwater overdraft and cause groundwater wells to run dry *(3)*. Unfortunately, there are additional factors *(4)* that cause wells to shut down, further reducing our access to usable water.

The presence of poly- and perfluoroalkyl substances (PFAS) in groundwater basins is one such scenario. When PFAS are detected, the lack of regulatory clarity around these substances threatens our ability to effectively utilize critical groundwater resources that are already under stress from drought and climate change. Treating PFAS can be extremely expensive, and commercially available treatment technologies are non-destructive and generate a waste stream that requires disposal, complicating efforts to use PFAS-impacted supplies. Without a clear path toward resolving these issues, wells and other facilities may remain closed indefinitely. Because many U.S. cities and towns rely on these resources for domestic, agricultural, and industrial use, this is a critical issue.

This article describes why current regulatory frameworks are not well adapted to address emerging pollutants such as PFAS, and explains why creative and collaborative solutions are needed to maintain access to water supplies, facilitate the development of new supplies, and increase our resilience to drought and the impacts of climate change.

Introduction to PFAS

PFAS are a group of highly versatile, manmade chemicals that are widely used in many industries and consumer products across the globe. There are thousands of different PFAS, which makes it challenging to draft consistent regulations, given a rulemaking process that typically addresses chemicals individually. Further, regulating PFAS as a "class" will be technically challenging because the thousands of different PFAS have a wide range of chemical and physical properties. For many of these compounds, we lack a clear understanding of the extent and nature of contamination; the sources and behavior of these compounds in the environment; the concentrations that may cause health or environmental effects; and the parties responsible for mitigation and cleanup. These unknowns hinder the detection, cleanup, and management of these chemicals in our water systems, exacerbating the loss of crucial water sources.

When PFAS are found in groundwater wells at levels above evolving guidelines, those wells are typically taken out of service. The groundwater that would have been pumped from those wells must be replaced, often with imported surface water from distant sources, further stressing water supplies. In the western U.S., drought conditions have accelerated the rate at which PFAS are found in groundwater *(5)*. Some water agencies have implemented and others are exploring treatment options to remove PFAS and allow the groundwater resource to be put back into service, but designing and implementing new treatment solutions is expensive and time-consuming.

Why this issue needs consensus among stakeholders. Although there are thousands of PFAS with a wide range of chemical and physical properties, the process of developing regulatory thresholds for chemical compounds typically proceeds one compound at a time — making it nearly impossible for regulations to keep pace with the new compounds being detected and identified in the environment, particularly as analytical methods and detection limits improve. These circumstances make it challenging to take immediate action to keep water sources in service and use impacted groundwater basins to store new sources of supply. Solving this issue will require consensus among various stakeholders that prudent and urgent action must be taken to increase water supply resilience while managing health and environmental risks. Building such a consensus will require active participation from multiple parties and an understanding that inaction could result in a devastating loss of water supply.

Current regulatory approaches

The recent PFAS Strategic Roadmap from the U.S. Environmental Protection Agency (EPA) outlines the commitments that the agency will be delivering on in 2022 and beyond to work toward solutions to this pervasive issue *(6, 7)*. The EPA's PFAS Roadmap outlines a holistic approach to addressing PFAS in the environment and is based on five principles:

- accounting for the full lifecycle of PFAS
- preventing PFAS from entering the environment
- holding polluters responsible for their actions and PFAS remediation efforts
- providing disadvantaged communities with equitable access to solutions
- investing in scientific research to fill data gaps — to improve our understanding of PFAS, identify which PFAS may pose human health or ecological risks, and develop methods to measure, treat, and destroy these compounds.

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Within the EPA's Office of Water, key actions will include nationwide monitoring for PFAS in drinking water systems; establishing primary drinking water regulations and toxicity assessments for select PFAS compounds; and establishing effluent limitation guidelines and technology-based regulatory limits. The Office of Water is also developing ambient water quality criteria, National Pollutant Discharge Elimination System (NPDES) permit requirements, and a biosolids risk assessment for two PFAS — perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS).

In April 2022, the EPA announced progress on three water-related commitments from the Agency's roadmap *(8)*:

- a new analytical screening method for adsorbable organic fluorine in water
- NPDES permitting instructions for monitoring provisions, analytical methods, pollution prevention, and best management practices
- draft ambient water quality criteria for PFOA and PFOS.

In June 2022, EPA released new and updated drinking water health advisory levels for four PFAS chemicals, including updated interim health advisory levels of 0.004 and 0.02 parts per trillion (ppt) for PFOA and PFOS, respectively. These updated levels were established based on potential health impacts and do not consider the feasibility of available treatment technologies to meet these levels; they are also orders of magnitude lower than the analytical detection limits of EPA-approved analytical methods. These factors complicate the process of designing and implementing treatment systems to remove these compounds from contaminated water sources and communicating analytical results to the public.

While these are important developments, it will take time to continue to develop and implement regulatory programs for PFAS. Given the compounding pressures on the water supply system, it is necessary to implement alternative solutions, rather than wait for the completion of the normally lengthy rulemaking process, to save water resources from depletion and to address contamination.

Finding creative solutions to the issue of PFAS is critical for the health of the water supply in the U.S. A revitalized approach is needed to incorporate the best scientific evidence and evolving data and knowledge on PFAS while simultaneously allowing use of groundwater resources. These solutions should continue to adapt over time to incorporate the most up-to-date information available. Solution-seeking will require a consensus between public and private parties on the importance of groundwater basins, which will inform the regulatory process as well as streamline and accelerate the process of finding collaborative approaches to treatment and remediation.

Defining the goals

When designing solutions to allow the use of water supplies impacted by PFAS and other emerging contaminants, it is crucial to first define core goals, such as protecting public health and restoring access to groundwater resources, among other objectives. Defining the ideal outcome will help inform the development of specific solutions and the various steps needed to achieve those solutions.

Protect public health. This goal should be the key component of any solution and must be communicated to the public in a way that promotes confidence in public water supplies. While designing solutions, we must anticipate that regulatory thresholds like health advisory levels and cleanup goals may change over time, and that treatment and monitoring may also need to adapt over time.

Develop new drought-proof sources of water supply. Given the changes in hydrology that are resulting from climate change, it is more urgent than ever to use water efficiently and develop new sources of supply. Investment in stormwater capture infrastructure is needed on a large scale. Water recycling for irrigation, indirect potable supply such as reservoir or groundwater augmentation, and direct potable reuse is driving the development of regulations and new treatment approaches. Desalination may also be an important source of new water supplies. Solutions will need to be regionally tailored, as the feasibility of alternative water supply strategies will depend on local conditions (*e.g.,* storing new supplies in groundwater basins where possible, developing direct potable reuse where storage options are limited, or remediating water supply sources impacted by saltwater intrusion).

Restore access to groundwater resources. Solutions should advance the highest possible beneficial use of groundwater, typically potable supply, and must allow groundwater basins to store new sources of supply, such as captured stormwater and recycled wastewater. Quantifying and recognizing the value of returning groundwater wells to service and using the storage space in groundwater basins to develop and store new water supplies will help improve water system resilience, especially during times of drought.

Designing solutions that will incorporate the best available science. Significant investments are being made to determine how best to treat and regulate PFAS. For example, studies are underway to identify commercially scalable destructive treatment technologies that will eliminate PFAS, rather than simply concentrate them into waste streams that require subsequent disposal. Regulatory approaches to source control have the potential to change the type and quantity of PFAS in water supply sources. Regulatory and technical approaches should incorporate flexibility to respond to and incorporate this information over time.

Who is responsible for implementing solutions?

Groundwater cleanup projects are typically implemented by potentially responsible parties (PRPs) who have caused contamination to occur. However, they may have limited authority and ability to participate in solutions.

For example, consider a remediation and management strategy for a groundwater basin impacted by PFAS and other pollutants. PRPs would potentially be responsible for cleaning up PFAS and other pollutants from industrial or manmade sources. But PRPs would not be responsible for cleaning up pollutants from non-point sources, such as selenium or arsenic from natural sources or nitrate from

historical agricultural practices — yet these pollutants must be addressed to ensure that groundwater can be put to beneficial use.

Public water agencies can be part of water supply solutions, as they may have the ability to access resources or perform services that are not available to PRPs. For example, public agencies have access to public funding sources, as well as the ability to address pollutants from non-PRP sources, assist with operation of treatment systems, and introduce treated water into drinking water distribution systems for potable use.

Regulatory agencies who are responsible for protecting health and permitting drinking water supplies also have a role to play: they must implement the rules and regulations applicable to drinking water quality and treatment and cleanup of contaminated groundwater, issue permits for treatment systems designed to remove pollutants from impaired sources, and establish requirements to protect public health and allow for the incorporation of new information over time.

For example, the Division of Drinking Water (DDW) within California's State Water Resources Control Board has responsibility for implementing the State's Guidance for Direct Domestic Use of Extremely Impaired Sources. California's Guidance establishes the public health principles that guide the evaluation of extremely impaired sources and specifies that these sources can be used only if additional health risks, relative to the use of other available drinking water sources, are known, minimized, and considered acceptable. The Guidance recognizes that coordination and collaboration amongst partner agencies, including the EPA, the Regional Water Quality Control Boards, and the Dept. of Toxic Substances Control, are critical to achieving long-term sustainable water supplies.

Implementing advanced treatment to remove contaminants from groundwater for public drinking use is likely to require consensus and collaboration between public and private parties. Instead of the business-as-usual model where cleanup efforts are delayed or piecemeal and water and storage loss occurs, it may be possible for water agencies, regulatory agencies, and other responsible/interested parties to work together to coordinate a comprehensive cleanup and management strategy.

By implementing this novel approach to address PFAS in groundwater basins, multiple stakeholders may be able to optimize their use of water, return basins to full service, and incorporate groundwater storage as an essential element of developing new water supplies. In addition, these stakeholders can participate in defining a regulatory and remediation strategy that is more comprehensive and beneficial than the conventional regulatory approach.

Given the ever-increasing pressure on our water resources, it is imperative that we develop creative, collaborative solutions to address emerging threats such as PFAS contamination of our water supplies. Rather than wait for regulatory thresholds for individual chemicals, we should develop a new approach with respect to these compounds, as inaction puts our water supply at risk. CEP

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