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DIGDEEP

THE CENTER FOR WATER SECURITY AND COOPERATION

Law and Policies that Address Equitable, Climate-Resilient Water and Sanitation

WATER, SANITATION, AND CLIMATE CHANGE IN THE UNITED STATES SERIES, PART 2

OCTOBER 2024

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SUGGESTED CITATION
Campbell-Ferrari, Alexandra, Shannon McNeeley, Morgan Shimabuku, Luke Wilson, 2024. Law and Policies that Address Water and Sanitation and Climate Change, Water, Sanitation, and Climate Change in the US Series, Part 2, Pacific Institute, Oakland, CA, https://pacinst.org/water-sanitation-climate-change-US-part-2/

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ABOUT CENTER FOR WATER SECURITY AND COOPERATION

The Center for Water Security and Cooperation (CWSC) is a 501(c)(3) nonprofit organization based in Washington, D.C. Founded in 2015, the mission of the CWSC is to advance water security and cultivate cooperation by building a unified body of laws, policies, practices, and standards that ensure the availability of water for current and future generations, and a peaceful, stable, and vibrant global society. Ultimately, the CWSC works to ensure that law and practice guarantee water security and universal access to water and sanitation because without good law those people who have access will lose it, and those who don't, won't ever get it. More information about the CWSC can be found at www.thecwsc.org.

ABOUT THE PACIFIC INSTITUTE

The Pacific Institute envisions a world in which society, the economy, and the environment have the water they need to thrive now and in the future. In pursuit of this vision, the Institute creates and advances solutions to the world's most pressing water challenges, such as unsustainable water management and use; climate change; environmental degradation; food, fiber, and energy production for a growing population; and basic lack of access to fresh water and sanitation. Since 1987, the Pacific Institute has cut across traditional areas of study and actively collaborated with a diverse set of stakeholders, including leading policymakers, scientists, corporate leaders, international organizations such as the United Nations, advocacy groups, and local communities. This interdisciplinary and independent approach helps bring diverse groups together to forge effective real-world solutions. More information about the Institute and our staff, directors, funders, and programs can be found at www.pacinst.org.

ABOUT DIGDEEP

DigDeep is a human rights nonprofit working to ensure every person in the United States has access to clean running water and sanitation at home. The nonprofit has served thousands of families across the country through their award-winning and community-led field projects: the Navajo Water Project (Arizona, New Mexico, and Utah), the Appalachia Water Project (West Virginia), and the Colonias Water Project (Texas). DigDeep is a leading force in US water access research, workforce development, and policy advocacy, underscoring our commitment to addressing the sector's lack of comprehensive data. Notable national reports, including "Closing the Water Access Gap in the United States: A National Action Plan" and "Draining: The Economic Impact of America's Hidden Water Crisis," unveiled the harsh reality that over 2 million people in the US live without a toilet or tap at home, which costs the American economy a staggering $8.6 billion annually. For more information, please visit digdeep.org.

ABOUT THE AUTHORS

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Alexandra Campbell-Ferrari is the Executive Director and Cofounder of the Center for Water Security and Cooperation. As a water lawyer, Alexandra works to create frameworks for understanding whether our laws create the rights and protections we need to achieve water security and universal access to water and sanitation, to evaluate existing laws against those frameworks, and to work with governmental and nongovernmental stakeholders to write for the first time, rewrite, or enforce water laws. Alexandra also teaches water law at the University of Maryland Carey School of Law and American University Washington College of Law as an adjunct professor. Before starting the Center for Water Security and Cooperation, Alexandra was Fulbright Scholar in Spain researching the implementation of the European Union Water Framework directive in Spain. Alexandra holds a bachelor's degree in Political Science and Spanish from Bucknell University, and a juris doctor degree from the George Washington University Law School.

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Shannon McNeeley is a Senior Researcher at the Pacific Institute and the Water and Climate Equity Lead. Her work focuses on water and climate equity and justice for frontline communities. This engages an interdisciplinary and cross-cultural co-production approach, incorporating the social and natural sciences along with different ways of knowing to understand human-environment relationships and how people are impacted by and respond to environmental change. Her research has focused on climate change science and policy, water resources and drought preparedness, and climate planning and action, all with a strong focus on supporting those who are overburdened and under resourced through just and equitable solutions. Dr. McNeeley has worked closely for decades with a multitude of different partners, organizations, decision-makers, Tribes and Indigenous peoples, and frontline communities bridging technical research with applied decision support information and tools. Prior to joining the Pacific Institute, she was at the North Central Climate Adaptation Science Center at Colorado State University and before that at the National Center for Atmospheric Research. Dr. McNeeley holds a master's degree in International Environmental Policy from the Middlebury Institute of International Studies at Monterey and a doctoral degree in Environmental Change and Sustainability Science, which integrated anthropology, ecology, and climatology, from the University of Alaska Fairbanks.

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ACKNOWLEDGEMENTS

Thank you, Kim Lemme, George McGraw, Heather Cooley, Alan Miller, Jessica Dery, Jackie Rigley, Rachel Will, Becky Anderson, and DigDeep staff. Each provided essential guidance, input, feedback, review, and/or support for this report. Also, thanks to California State Water Resources Control Board (SWRCB) staff Christopher Hyun, James Nachbaur, Nicole Williamson, Andrew Altevogt, and Karina Herrera, who reviewed the California sections. All conclusions expressed herein, and any errors or omissions are those of the authors and do not necessarily reflect the views of the SWRCB. We acknowledge the partnership of the Pacific Institute Communications and Outreach team to launch this work and ensure it reaches key decisionmakers, audiences, and other levers of change toward the goal of building a more resilient world. This work was generously supported by Liquid IV and the BHP Foundation.

DEDICATION

We dedicate this report to the communities who feel the impacts of climate change first and most strongly, especially those communities being failed by existing laws.

Water is life.

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Glossary[1]

Acceptable: Water is acceptable if the color, odor, and taste are considered appropriate for personal or domestic use (United Nations 2014), as defined by the user of that water. This standard may vary by a person's culture, gender, and other factors.

Affordable: In general, water service is affordable when a household can afford the cost of essential water and sanitation, including operating and maintaining their own systems, without foregoing other essential goods and services, such as housing, healthcare, food, and other utilities (Teodoro 2019; Feinstein 2018).

Backsliding: Initial use of the term "backsliding" in the water sector comes from the Clean Water Act, where it refers to a prohibition of a state's adoption of less stringent water quality guidelines. More recently, DigDeep and US Water Alliance use it in *Closing the Water Access Gap* (2019) to describe a concerning trend in certain states where the number of homes without water and wastewater access has increased (Roller et al. 2019). In this report we examine how climate change is contributing to that trend. We therefore use backsliding to refer to the process by which a climate phenomenon causes a home or a community to lose access to safe drinking water or a functioning sanitation system (centralized or decentralized/onsite), either temporarily or permanently. We discuss backsliding caused directly or indirectly by climate change through damage or destruction to water and wastewater infrastructure, reduction of water availability at its source in time and quantity, or contamination of water such that it is no longer safe to use.

Centralized drinking water system: Centralized drinking water systems collect, treat, and distribute water to residential, commercial, and industrial customers within a specific geography. These systems can be publicly or privately owned.

Centralized wastewater system: Centralized wastewater systems are made up of a network of pipes that collect and convey household, commercial, and industrial effluents to a wastewater treatment plant (WWTP). The wastewater is treated to reduce and eliminate the presence of contaminants, as required by the Clean Water Act, and discharged into nearby waterbodies.

Climate change: A change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods (United Nations Framework Convention on Climate Change 1994).

Community water system: A public water system that supplies water to the same population year-round (US EPA 2015a).

1 Terms from Part 1 in this series are in white; new terms added specifically for this report are in yellow.

Decentralized or onsite drinking water system: A drinking water system is decentralized when it provides services at the sub-community level, such as to a housing development or individual home. The term onsite indicates that the system is closer to the location where the service is being received, such as on the land where the home is located. Different types of decentralized and onsite drinking water systems include domestic wells, rainwater capture and use, as well as modular drinking water treatment systems (MDWTS) or modular potable water systems.

Decentralized or onsite wastewater system: Decentralized wastewater systems, also known as onsite wastewater systems, provide wastewater services to households separately from a centralized wastewater system. There are several types of onsite wastewater systems, including conventional septic tanks, alternative onsite wastewater treatment systems (AOWTS), which employ alternative treatment techniques compared with conventional septic tanks, cesspools, and pit latrines (US EPA, Office of Water (OW) 2002; US EPA, Office of Wastewater Management (OWM) 2024). Some of these systems use water, while others are dry toilets and do not rely on water.

Disadvantaged communities (DACs): The White House Climate and Economic Justice Screening tool identifies census tracts that are overburdened and underserved. This also includes Federally Recognized Tribes, including Alaska Native Villages. Under the Safe Drinking Water Act, each state is responsible for self-identifying disadvantaged communities. Thus, Clean Water and Drinking Water State Revolving Fund benefits for disadvantaged communities are at the discretion of each state.

Effluent: Liquid waste that is untreated, partially treated, or completely treated (Sudha et al. 2014).

Frontline communities: Communities that are overburdened and under resourced who face disproportionate, “first and worst” impacts of climate change on their water and sanitation systems or access.

Greywater (also graywater, gray water): Water from sources not contaminated with fecal waste, such as showers, bathtubs, handwashing sinks, or washing machines.

Human Right to Water and Sanitation (HR2W): Access to water and sanitation is recognized by the United Nations as human rights—fundamental to everyone’s health, dignity, and prosperity. The **right to water** entitles everyone to have access to sufficient, safe, acceptable, physically accessible, and affordable water for personal and domestic use. The **right to sanitation** entitles everyone to have physical and affordable access to sanitation, in all spheres of life, that is safe, hygienic, secure, socially and culturally acceptable, and provides privacy and ensures dignity (United Nations 2014).

Indigenous peoples: Self-determining societies whose political and cultural foundations pre-exist the formation of the United States, regardless of their recognition status by the US government. Indigenous peoples in the United States include the 574 federally recognized Tribes (as of 2023), Native Hawaiians, Pacific and Caribbean Islanders, State-recognized Tribes, and unrecognized Tribes and peoples. More specific terms will be used where the particular government, legal, cultural, or diplomatic situation is being referenced. Indigenous peoples’ self-determination can be best respected by using terminology that acknowledges Indigenous governance systems and sovereignty (Status of Tribes and Climate Change Working Group (2021).

Indoor plumbing: The presence of hot and cold running water, a shower or bath, and a flush toilet inside the home.

Law: Laws, unlike policies, are adopted by legislatures and are mandatory, enforceable rules.

Legal infrastructure: Legal infrastructure includes the laws, implementing regulations, and institutions established under the law—as well as any policies, programs, and plans that are enforceable mechanisms—that guide, inform, and oftentimes determine or instruct how and whether water and sanitation services can and will be provided.

Modular potable water systems: Modular portable water systems are onsite, pre-engineered, fit-for-purpose systems that treat raw water for potable purposes for a range of situations and communities.

Physically accessible: For water to be physically accessible it must be available in the home, in sufficient volumes to meet domestic needs, at hot and cold temperatures, 24 hours per day. Similarly, accessible sanitation is when toilets are private, located in a home, safe to visit, and available when needed.

Policy: Government policies are developed both after a law is passed to help implement the law, as well as in advance of the development of the law to help formally define political and sector objectives and outcomes used to inform the creation or implementation of a law. Policies are nonmandatory; they represent guidelines, objectives, and strategies adopted by governments to reflect political priorities and a broad, suggested approach to addressing a challenge or achieving a certain outcome. Policies provide insight on the goals and objectives of the government and what steps will help them to achieve those outcomes.

Public water system: A water system that provides drinking water through pipes or other conveyance to at least 15 service connections or an average of 25 people for at least 60 days per year. A public water system may be publicly or privately owned. There are three types of public water systems: community water systems, nontransient noncommunity water systems, and transient noncommunity water systems.

Rainwater harvesting: The collection of precipitation from the roof of a building for the purposes of using the water for a specific purpose, like cleaning, drinking, or cooking.

Regulation: Regulations, like laws, set forth mandatory rules that must be followed and are essential to achieving the goals of law. The law typically provides guidelines for how regulations should be developed and then leaves it to technical experts within the executive agencies to develop the regulations.

Safe: Drinking water that meets or exceeds standards set forth by the federal Safe Drinking Water Act, and by any additional standards established by individual states where geographically applicable. Safe sanitation means that the waste is separated from humans, and transported, treated, and discharged to the environment where it is not a liability or hazard to human, wildlife, or environmental health.

Sanitation: The conveyance, storage, treatment, and disposal of human waste. This includes toilets, pipes that remove wastewater from the home, and treatment measures (Roller et al. 2019).

Sanitation access: Access to sanitation is defined as having in-home availability of sanitation infrastructure to safely collect and transfer solid and liquid domestic waste to a treatment facility or to safely collect and treat solid and liquid waste on site. Sanitation access requires having physical access and economic access (CWSC 2021; US EPA 2016; Williams, Cook, and Smerdon 2022).

Small water systems: Defined under the Safe Drinking Water Act as community water systems serving 10,000 or fewer people.

Sufficient: The World Health Organization considers 50–100 liters (approximately 13–26 gallons) per person per day to be the minimum necessary to ensure most basic needs are met. However, this amount may not be sufficient for broader uses of water that are necessary for healthy, resilient households and communities; this represents the bare minimum for health purposes (Feinstein 2018; Gleick 1996).

Wastewater: Water that has been used and disposed of, which often contains contaminants such as untreated human waste, sewage, or sludge.

Wastewater services (or systems): The provision of centralized sewer systems and treatment plants, individual septic systems, or other forms of decentralized or onsite systems (Roller et al. 2019). Can also be referred to as sewerage services, as sewer systems are often used in wastewater services to transport wastewater to treatment systems and/or disposal outlets.

WASH: The acronym used to refer to water, sanitation, and hygiene, the three basic human requirements for water.

Water access: Access to water is defined as having in-home, reliable availability of sufficient water to meet domestic needs safely. Water access requires having physical access and economic access (CWSC 2021).

Water access gap: The disparity in access to water and sanitation between most Americans and the communities that still lack access (Roller et al. 2019).

Water demand: The amount of water that people take and use from the environment, including for drinking, cooking, bathing, flushing a toilet, and meeting other basic needs.

Water insecurity: Inadequate or inequitable access to clean, safe, and affordable water for drinking, cooking, sanitation, and hygiene. Water insecurity results from a combination of social and physical conditions, including climate change (Schimpf and Cude 2020).

Summary

In the United States, federal, tribal, state, and local laws and policies exist to govern the provision of water and sanitation services to communities and homes. The laws are designed to ensure the protection of public health and the environment; deliver sufficient, safe water for drinking, bathing, cooking, and other household needs; and remove and treat domestic (i.e., household) waste. People without complete plumbing or safe water live within the "water access gap." As explored in the first report in this series, climate change—from extreme temperatures to droughts, floods, extreme storms, and wildfires—is making it hard to close this gap and keep it from growing. Water and sanitation systems in frontline communities already feel the disproportionate "first and worst" impacts of climate change to these systems and to their access to water and sanitation. Laws and policies should help anticipate and plan for the incremental and catastrophic impacts of climate change and protect those most harmed by the effects. Unfortunately, in most cases, the climate is changing faster than the law can respond, thereby leaving frontline communities' water and sanitation systems vulnerable to damage or destruction.

Key messages:

1. The law often **does not proactively manage water resources in the context of climate change**, especially groundwater use, or create a system where uses are weighed against each other or reviewed for their continued appropriateness for a given water source or basin. The basic rules governing water use and water rights are insufficient. As climate change alters precipitation patterns, which subsequently changes our use patterns and the broader availability of water, the laws will be insufficient to ensure there is sufficient water to meet our needs and sustain the environment.

2. Laws provide **insufficient guidance on the design and siting of climate-resilient water and wastewater systems**. Water and wastewater infrastructure is under threat from floods, droughts, saltwater intrusion, and wildfires. As the frequency and severity of natural disasters increases, our infrastructure may be unable to withstand storms and other extreme events, leaving communities without drinking water and/or wastewater services.

3. Access to water and sanitation infrastructure and services is inequitable, and the **laws in the United States do not ensure the human right to water or sanitation**, leaving some households without any safe or regular services and other households under constant threat of shutoffs. This is especially true for households in frontline communities who are affected first and worst by climate change, especially those who may not be able to afford to rebuild or repair their

onsite or decentralized systems. This may leave homes and communities that lose access to their water and/or sanitation without recourse for regaining it, causing backsliding, and widening the water access gap.

In this report, we examine the laws and policies in the US that govern the equitable delivery of water and sanitation in the face of growing climate change impacts. The objective is to identify and understand whether and how laws manage, anticipate, or enable effective responses to climate change impacts on water and sanitation service delivery and infrastructure. This is intended to provide a foundation for a future, more comprehensive evaluation of the gaps and shortcomings that exist in law and policy to ensure the necessary steps can be taken to construct and rehabilitate the legal infrastructure to limit or avoid the impacts of climate change on water and sanitation service delivery. We pay special attention to laws that give visibility to and empower frontline communities and vulnerable households, both those without consistent water and sanitation access and those facing the greatest threat to their access from climate change.

The report is based on two considerations: 1) legal considerations related to climate change impacts on water resources, service delivery, and infrastructure, and 2) the categories of systems that provide drinking water and sanitation services that determine the applicable legal and regulatory requirements. We structured the report based on centralized drinking water systems, centralized wastewater systems, and decentralized, onsite drinking water and sanitation systems. Within each of those, we examine the laws and policies that address three types of climate change impacts on these systems—water scarcity, overabundance of water and flooding, and poor water quality. We also include a section focused on issues of equity in achieving universal, climate-resilient water and sanitation access for all in the US.

The law plays a critical role in anticipating and managing the impact of climate change on water resources, infrastructure, and water and sanitation service delivery.

Water Law and Climate Change

While some laws may not explicitly mention climate change, they can be foundational to adapting to climate change impacts, for example, by providing oversight of water supply availability or setting drinking water quality standards. Having in place the basic laws necessary to manage water resources and service provision can inadvertently, indirectly, and fortuitously protect against climate impacts. There is also an increasing need for water laws to *explicitly* incorporate and consider climate change considerations. Water laws, generally, were developed to provide predictability, yet climate change is making the natural water cycle highly unpredictable. Climate change is already exposing gaps in water law, water quality law, energy law, and environmental law. While better laws for water management and service provision inherently help to address the impacts of climate change on water and sanitation systems, laws increasingly need to intentionally consider the intersection of climate change to ensure that the impacts are properly anticipated and adequately addressed. Existing water laws are ill-equipped to adapt to climate change. Water laws will fall short if the basic structure of water management and service provision reflected in those laws is not based on an intentional consideration of the actual and anticipated impacts of climate change.

Here we summarize key findings and conclusions from our review of federal, tribal, state, and local laws and policies from across the US on whether they help achieve equitable, climate-resilient water and sanitation for frontline communities.

Centralized Drinking Water Systems

Climate change through extreme heat, flooding, drought, rising seas, more extreme storms, wildfires, and other impacts, is already threatening the reliability and safety of drinking water access to frontline communities in the US. In the US there are approximately 300 million people that receive drinking water from centralized drinking water systems, which are the systems that collect, treat, and distribute water to multiple residential, commercial, and/or industrial customers within specifically defined geographical areas called service areas. Most centralized drinking water systems are governed by the Safe Drinking Water Act (SDWA). Changes to water quality from flooding, drought, rising temperatures, saltwater intrusion, wildfires, reductions in snowpack, and other climate events are disrupting and damaging centralized drinking water systems and are making it more challenging to ensure the water they deliver is safe.

In some cases, the way water laws are designed or implemented may exacerbate the challenges created by climate change. For example, Tribes are often legally entitled to more water than they can use, which is inconsistent with the state prior appropriation doctrine approach by which water rights are maintained through actual use ("use it or lose it"). This can create tensions between state and tribal entities, especially where climate change and other factors decrease the volume of available water resources. Also, climate change can exacerbate unsustainable groundwater uses and practices, especially in places where the law either allows for unsustainable groundwater use or does not protect groundwater sustainability. As climate change creates greater dependence on groundwater in some places, laws like California's Sustainable Groundwater Management Act have the potential to provide an important management mechanism for protecting vulnerable groundwater supplies and contributing to more inclusive governance processes, however, implementation of this law has not yet proved to be completely successful in these goals.

In some cases, the way water laws are designed or implemented may exacerbate the challenges created by climate change.

Laws that prioritize available water resources for domestic purposes could become more imperative as climate change shifts precipitation patterns and reduces the availability of water in some geographies. There are examples of states with laws that both create automatic prioritization of domestic uses during droughts and authorize water managers to address emergency water shortages. Together, these provisions can help protect domestic needs when there is insufficient water to meet every demand. In some states, laws where prioritization between water uses is not clear, such as between domestic and agricultural uses, there may be potential for conflict between water uses during times of scarcity.

Some states have laws that mandate water resource management planning, which is a process whereby water managers (including those operating centralized drinking water systems) plan for future investments, like infrastructure upgrades and water supply needs. This is done by analyzing water supply availability, water quality, and use in concert with projected changes in population, the economy, and other factors that impact water demand. Increasingly, water resource management planning processes incorporate climate change considerations, but many do not. Some states have passed laws to create programs that provide technical assistance to small drinking water systems that often lack the capacity for water management planning and planning for climate change. While not specific to climate change, though with implications, drought planning laws and policies are approaches that have been used for requiring or incentivizing consideration of how water systems will function and adapt to water scarcity and supply constraints. Less than half of all states have laws that require drought preparedness plans for water systems.

As climate change alters precipitation patterns, populations continue to grow in urban centers, and costs of delivering water increase, instituting laws and policies that help reduce water use, improve water use efficiency, or permit and regulate using alternative water supplies can help communities adapt to these pressures. Demand management, reducing and making water use more efficient, is often applied through voluntary measures. However, there are several ways that laws and policies have led to long-term water demand reductions and supported adaptation to increasing water scarcity and more intense, prolonged periods of drought. Some key demand management laws and approaches have included: the Energy Policy Act of 1992, state-level laws that set standards for fixture water efficiency in building codes, requirements to upgrade to high-efficiency devices upon change of ownership of a property, and regulations for urban water suppliers to manage water

Flooding in Florida, FWC photo © Stan Kirkland demand. Laws that permit and regulate water reuse and recycling or rainwater and stormwater capture and use may contribute to improved water supply resilience by adding to the community's supply portfolio or by freeing up freshwater to be used for other purposes.

Flooding is among the costliest climate disasters in the US, and climate change is causing the impacts of flooding to grow. Laws that help prevent and reduce the impact of flooding through system design and construction requirements are supposed to help keep centralized drinking water infrastructure safe from these events. The National Flood Insurance Program (NFIP), created by the National Flood Insurance Act, has used historical flood event data for establishing insurance premiums and designating flood risk areas, which may not be applicable under future climate change as catastrophic flooding occurs more frequently. Existing drinking water systems and other infrastructure that were sited and designed based on NFIP's old, outdated maps may be at risk from flooding damage. Drinking water and wastewater systems in communities that are not eligible for the NFIP or are excluded by outdated flood maps that do not account for climate change may lack flood insurance. Even in communities that are participating in the NFIP, protection and disaster recovery have been inequitably distributed with costs disproportionately being placed on low-income neighborhoods. Some states have taken steps to go beyond the federal NFIP requirements, which may provide more protection against flooding events. But even these can fail to explicitly account for future climate change and more extensive flooding.

Centralized Wastewater Systems

Like centralized drinking water systems, centralized wastewater systems are at risk from the impacts of climate change through extreme heat, drought, flooding, damage from extreme storms, sea level rise, and challenges with maintaining their mandated level of treatment in places where water is becoming more contaminated or scarce. In the US, centralized wastewater systems are made up of networks of pipes, pumps, holding tanks, and wastewater treatment plants (WWTPs) that collect, transport, treat, and dispose of waste from approximately 75% to 80% of the population. WWTPs are governed by the Clean Water Act, which regulates the discharges from wastewater treatment plants and requires that the discharges meet certain standards that will protect the quality of the water resources into which the effluent is discharged.

> There are few, if any, legal recourses for homeowners whose sewers back up into their homes during flooding events.

The siting, design, and proper construction of WWTPs can significantly impact the climate resiliency of these systems. Generally, state and local laws and regulations govern these engineering decisions. Once built, it is often many decades before updates or improvements are made to centralized wastewater systems. Due to drought and reductions in per capita water use, some wastewater systems have a mismatch between the volume of influent they were designed for compared to the volume that they now receive, yet there are few legal approaches for addressing this mismatch. While regulations can address the threat of floods and other climate impacts when building new wastewater treatment plants, changing existing plants may be harder.

Centralized wastewater systems that were sited and designed based on historical flood event data also may be at risk from the increased extent and severity of flooding damage. Current federal law exists to ensure new systems are in areas with lower flood risks, but these laws are still based on historical flood maps and do not protect existing wastewater infrastructure. While wastewater treatment systems are taking steps to protect their infrastructure from sea level rise and erosion, many of these changes are made purely voluntarily.


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Current federal law exists to ensure new systems are in areas with lower flood risks, but these laws are still based on historical flood maps and do not protect existing wastewater infrastructure.

In many cities, even small rainstorms can pose problems for aging sewers that were built decades or centuries in the past and are too small or in such poor condition that they cannot effectively transport water. Aging and inadequate infrastructure can lead to homes and businesses experiencing backflows of water from the sewer. This is already occurring in many places like New York City, where sewer backups from rainstorms occur disproportionately in low-income communities and communities of color. But there are few, if any, legal recourses for homeowners whose sewers back up into their homes during flooding events. Climate change and the increase in extreme precipitation and storm events in many parts of the country will only worsen these types of inequities.

Untreated or insufficiently treated wastewater can threaten people's health and wellbeing if it comes into their home, but it can also degrade the quality of surface waters. If inadequately treated, wastewater effluent can degrade drinking water quality, public health, and the environment. The CWA provides a foundation for limiting the impact of wastewater effluent on water resource quality but is inadequate in explicitly requiring considerations of climate change in setting effluent limits. To meet the CWA standards and properly operate, consistently maintain, and periodically rehabilitate and update wastewater infrastructure requires ongoing financial resources and technical capacity. The impacts of climate change, such as degraded water quality and infrastructure damage, compound with these ongoing needs, especially for under resourced communities, exacerbating their efforts to meet regulatory requirements and provide safe, reliable services. Existing legal requirements and regulations were designed to improve pollution control from WWTPs, not to address the impact of extreme weather events and climate change.

State of the State Address.
by Jay Baker at Annapolis, MD.

Decentralized, Onsite Drinking Water and Wastewater Systems

Climate change is also impacting water and sanitation access for US households that rely on decentralized, onsite drinking water and wastewater systems, such as wells and septic systems. Based on the most recent study available (using pre-2010 data), approximately 23 million people-or 17% of the US population at the time-relied on domestic wells for drinking water. More than one in five households in the US use onsite septic systems or small community cluster systems to treat wastewater, and many of those are concentrated in the Northeast and Southeast. The use of septic tanks has continued to grow as more homes are built for people looking to live outside urban centers.

> In regions where sea level is causing the groundwater table to rise, laws may be needed to address potential groundwater contamination from septic systems.

One of the reasons why onsite water and sanitation access is at risk from climate change is because there is limited legal oversight of these systems. Onsite drinking water is largely governed and legislated at the state and local levels. There are often laws that govern the siting and construction of domestic wells, including, for example, a California law that requires domestic wells to be constructed so that flood waters cannot enter through the top and to ensure domestic wells are installed out of historical floodplains. But these types of laws do not always account for changes to flooding severity or frequency due to climate change. At the same time there are few, if any, laws that require ongoing maintenance and inspection of existing domestic wells used for domestic drinking water purposes, let alone preparing for or responding to climate change. Some states or local entities require reinspection of septic systems post-disaster or during resale of a home. Post-disaster inspections may become more critical to ensuring these systems remain functional as more extreme weather events damage and disrupt onsite systems.

From a water resources perspective, state laws that seek to ensure groundwater availability for domestic wells and other users have at times been inadequate for achieving these goals. As climate change adds more water stress, these laws may not be sufficient. Allowing and developing regulations for the installation and use of waterless or greywater systems for onsite sanitation collection, treatment, and disposal will help to encourage their use, and possibly their replacement of water-based household sanitation systems. In regions where sea level is causing the groundwater table to rise, laws may be needed to address potential groundwater contamination from septic systems.

Domestic well quality testing regulations are potentially helpful for improving awareness of water quality in domestic wells, but they do not directly address the increasing risk of water contamination from climate change. Broad groundwater quality protection seeks to provide protection from human activity like agriculture, oil and gas development, or other forms of land use, but it does not offer explicit protection of groundwater from climate change phenomena. Few of the water quality laws governing management of decentralized, onsite drinking water or wastewater systems incorporate climate change.

Laws and Policies for Equitable, Climate-Resilient Systems

Laws can help to ensure that safe, climate-resilient water and sanitation service delivery and infrastructure is available to all by creating rights and protections that enable greater and more equitable access to water and sanitation services. For example, laws can establish that water and sanitation are human rights. While the human right to water and sanitation have yet to be legally recognized at the federal level, some states have amended their constitutions in ways that could serve as a foundation for taking action to protect water resources if climate change causes harm to water quality or reduces water availability, even if not explicitly for the purposes of drinking water access. Furthermore, none of the existing state or local human right to water and sanitation laws or resolutions in the US explicitly address climate change. But when crafted well, these laws create an obligation on state or local governments to take steps to ensure every person has access to safe water and sanitation services now and into the future.

Climate change contributes to rising costs for the drinking water and wastewater utilities, which in turn are passed on to ratepayers, with the greatest impact on low-income households. Laws can create rules that disallow disconnections of water service for households that are unable to pay their bills. As one example, Washington has a law that provides legal protection for households that are struggling to pay their utility bills during hotter weather, ensuring they have access to water when temperatures are extreme and pose a risk to human health.

Laws can create rules that disallow disconnections of water service for households that are unable to pay their bills.

Laws also create funding mechanisms to help ensure that funding is equitably distributed to communities, especially overburdened and under resourced communities. Achieving the standards set out in the CWA and SDWA and ensuring water and wastewater infrastructure is climate-resilient requires federal funding, which is commonly authorized by laws. Two more recent examples of laws that include funding for climate-resilient water and sanitation projects are the Bipartisan

Infrastructure Law and Inflation Reduction Act. Together, these provide historic levels of funding for federal, tribal, state, and local water projects, among other things.

In sum, climate change, by changing the availability of water and the frequency and severity of storms, will continue to make universal water and sanitation access difficult to achieve without legal protections in place. Without explicit consideration of how climate change will impact water availability, the operation of infrastructure, or the quality of surface waters, existing laws leave homes and communities, especially those on the frontlines, exposed and unprepared. Our current laws and policies are insufficient to provide water security, particularly with the significant impacts of climate change on the near horizon. Without changes to the law, more water and wastewater systems will fail and will do so more frequently, leaving entire communities without basic services they need to lead a healthy, dignified life.

Many communities struggling with water and sanitation access face other challenges as well. These include inadequate or unenforced laws, structural and systemic racism, fragmentation of decision making for water and climate change, institutional constraints, and lack of resources to begin and sustain adaptation efforts. A first step to overcoming these challenges and barriers is better understanding the key attributes of equitable, climate-resilient water and sanitation along with the barriers to and opportunities for achieving them. Our next report, Part 3 in this series, will provide a framework for equitable, climate-resilient water and sanitation in the US, as well as an overview of strategies and approaches that frontline communities are taking to create equitable, climate-resilient water and sanitation.

1. Preface

As climate change intensifies and accelerates, many changes and impacts experienced by people and communities will be through water. Droughts are becoming longer, warmer, and more frequent, leading to water supply shortages for homes, businesses, and ecosystems and creating conditions for more intense wildfires. Flooding from extreme storms and more concentrated and intense precipitation events are damaging and destroying water and wastewater infrastructure, taking services offline for hours, days, weeks, or longer. Other events that are only becoming more frequent and intense under climate change, like wildfires and sea level rise, wreak havoc on water quality, leaving homes and communities without access to safe water to drink. And for frontline communities, these events can be devastating and lead to backsliding, i.e., causing a home or community to lose access to safe drinking water or a functioning sanitation system, either temporarily or permanently.

In our first report, Climate Change Impacts to Water and Sanitation for Frontline Communities in the United States, we synthesized the existing knowledge and literature on the effects of climate change on water and sanitation and water resources in the US, especially for frontline communities. The report provided an overview of how communities that lack or struggle to maintain access to water and sanitation are most vulnerable to climate change and how and why climate change poses a challenge to achieving the human right to water, as recognized by the United Nations (Resolution 64/292, United Nations 2014). It provided an in-depth review of literature that address six major climate phenomena and how each will directly and indirectly impact water and sanitation access in the US The six climate phenomena included extreme temperatures, drought, inland flooding, sea level risk, extreme storms, and wildfires. The report was Part 1 in the series, *Water, Sanitation, and Climate Change in the United States*, which continues here.

This report, Part 2 in the series, examines the laws and policies in the US that govern and inform water and sanitation service provision and infrastructure, and whether and how they address the impacts of climate change.[2] In the future, Part 3 in the series will explore the attributes of equitable, climate-resilient water and sanitation systems and identify documented strategies and approaches that frontline communities have tried for achieving this goal in the US.

2 We acknowledge that both wastewater treatment plants and drinking water treatment plants contribute to greenhouse gas emissions. Drinking water and wastewater treatment systems account for approximately two percent of total energy use in the US (US EPA 2023c). Although this is a small percentage, it amounts to the release of over 45 million tons of greenhouse gasses—specifically methane (CH_4) and nitrous oxide (N_2O)—every year. For most municipal governments, drinking water and wastewater plants are often the largest energy consumers, representing thirty to forty percent of the total energy used by the municipality (US EPA 2023c). While we acknowledge this impact, and that there are steps utilities could take to reduce their energy use, this discussion is focused on the impact of climate change on the provision of services, not the impact of providing services on climate change.

2. Introduction

In the US, federal, tribal, state, and local laws and policies exist to govern the provision of water and sanitation services to communities and homes.[3] The laws are designed to ensure the protection of public health and the environment; deliver sufficient, safe water for drinking, bathing, cooking, and other household needs; and remove and treat domestic (i.e., household) waste. Economic, social, political, physical, and legal challenges are still creating significant barriers to the delivery of water and sanitation for millions of people across the country. People who live without complete plumbing or safe water exist within the "water access gap" (Roller et al. 2019). As explored in the first report in this series, climate change—from extreme temperatures to droughts, floods, extreme storms, and wildfires—is making it hard to close this gap and keep it from growing. Water and sanitation systems in frontline communities already feel the disproportionate "first and worst" impacts of climate change to these systems and to their access to water and sanitation. Laws *should* help to anticipate and plan for both the incremental and catastrophic impacts of climate change as well as protect those who are most harmed by the effects. Unfortunately, in most cases, the climate is changing faster than the law can respond, thereby leaving frontline communities' water and sanitation systems vulnerable to damage or destruction.

Economic, social, political, physical, and legal challenges are still creating significant barriers to the delivery of water and sanitation for millions of people across the country.

In this report, we examine the laws and policies in the US that govern the equitable delivery of water and sanitation in the face of growing climate change impacts. The objective of this report is to identify and understand whether and how laws manage, anticipate, or enable effective responses to climate change impacts on water and sanitation service delivery and infrastructure. The report is intended to provide a foundation for a future, more comprehensive evaluation of the gaps and shortcomings that exist in law and policy to ensure the

3 Throughout this report, we use the terms "wastewater" and "sanitation" to differentiate between these two concepts. "Sanitation" is a more inclusive term for processes and approaches to dispose and treat human fecal waste. "Wastewater" is generally used to refer to the liquid that contains fecal waste and other byproducts of household or commercial use, like soaps and cleaning products, that come from showers or sinks. Sanitation includes the process of fecal waste treatment from capture, containment, emptying, and transport through to treatment and either disposal or reuse. Wastewater is collected at a centralized wastewater treatment plant (WWTP), designed to collect and treat wastewater from domestic, commercial, and industrial sources. We use each term throughout this report, as appropriate, to acknowledge that there are different infrastructures and technologies available for treating human waste that may be appropriate depending on the location, community, and circumstances.

necessary steps can be taken to construct and rehabilitate the legal infrastructure to limit or avoid the impacts of climate change on water and sanitation service delivery. We pay special attention to laws that give visibility to and empower frontline communities and vulnerable households, both those without consistent water and sanitation access and those facing the greatest threat to their access from climate change.

The report is structured as follows:

- The overarching structure is shaped by the categories of systems that provide water and sanitation services to households and how the law administers those systems. We have identified three types of systems: 1) centralized drinking water systems, 2) centralized wastewater systems, and 3) decentralized, onsite drinking water and sanitation systems. The type of system largely determines which legal and regulatory requirements apply.
- Within each section we further structure the discussion around climate change's impacts on service delivery and infrastructure. We broadly categorized the climate change impacts described in the first report of the series into three categories—1) water scarcity, 2) flooding, and 3) poor water quality—because this is how the law typically governs water management and service provision and infrastructure.
- Within each category of climate change impact, we examine a sampling of laws and policies that have been adopted by different levels of government—including federal, tribal, state, and local related to water and sanitation provision and climate resilience and adaptation.[4] The way these laws are designed will depend on the different jurisdictional authorities and responsibilities.
- Universal, climate-resilient water access cannot be achieved unless every household is reached. Therefore, the report includes an additional section to explore laws that govern issues of equity, including the human right to water and sanitation, affordability of water and wastewater services, and government funding efforts designed to close access gaps in communities with limited financial resources.
- The reader will also notice that many laws discussed focus on water and do not mention climate change. Laws that better manage water resources and water and sanitation service delivery are the foundation of any legal infrastructure intended to anticipate and reduce climate change impacts. Many laws can be improved or complemented by intentionally and purposefully addressing climate change's impacts on water.

Laws governing water are written at the federal, tribal, state, and local levels. This means that a wide range of approaches can be taken to address water and climate change depending on the authority the government has and their respective policy priorities. Therefore, laws can and often do differ from community to community. Furthermore, some laws may be more prescriptive, while others may provide greater discretion to the implementer. This also leads to different results. For example, a water or wastewater utility may be given the authority to draft regulations or policies but may not be required to exercise that authority. As such, some water and wastewater utilities

4 The term "local" incorporates jurisdictions such as counties, townships, municipalities, towns, cities, villages, hamlets, and unincorporated communities. Different states often use different terms to define local communities. Furthermore, these local communities may or may not have certain governing or legislative authorities or bodies.

will draft regulations, some will not. This contributes to a plethora of different laws, policies, and outcomes across the US, which makes a comprehensive review challenging.

Because of its dynamic and piecemeal nature, water law is constantly evolving. Water law is often developed incrementally and issue-by-issue, leaving an immense number of laws that impact water and sanitation. For this reason, a sampling of existing laws and policies is provided in this report. Some of these examples are representative of broader trends in water law, others represent unique circumstances, and still others are relics of different circumstances and different thinking. Without further comprehensive and exhaustive efforts to research and analyze every relevant law in the US, the picture will always be hazy. To address this gap in research, we have provided examples of various approaches across different jurisdictions and geographies that illustrate what exists. While we attempted to find examples throughout the US, we do draw on relatively more examples from California. This is a result of California's approach to both climate change and water access, which has led to a number of laws and policies that explicitly seek to create equitable, climate-resilient water and sanitation systems. A comprehensive comparative analysis is beyond the scope of this review but is an area identified for future research.

Columbus, Georgia, USA downtown skyline.
©Sean Pavone

3. Background

3.1 WATER LAW

Water laws, policies, and programs are responsible for creating the architecture of rules, institutions, and delivery mechanisms governing the provision of water and sanitation services broadly. Laws—adopted by federal, tribal, state and local legislatures—are responsible for setting forth the rights, rules, requirements, processes, and institutions (including their authorities and responsibilities) necessary for providing safe and climate-resilient water and sanitation services. In the US, laws—as compared to policies—set forth binding rules that must be followed.

Water laws and policies can be adopted outside of the federal, tribal, state and local levels. Laws and institutions can also be established at the regional or river basin level. For example, the US Constitution allows for states to enter interstate compacts to address water issues (US Constitution, art. 1, sec. 10, cl. 3). There are more than forty-five interstate water compacts across the US governing shared river basins (Interstate Council on Water Policy 2020). Through these interstate compacts, states have adopted rules and created institutions to govern shared bodies of water. The Colorado River Compact of 1922 is one example of such a compact and governs the Colorado River across seven states, including Arizona, California, Colorado, New Mexico, Nevada, Utah, and Wyoming. The compact established the Upper and Lower Basins (essentially subbasins within the larger Colorado River Basin) and broadly allotted water to each, which was further clarified in the Boulder Canyon Project Act (1928) and Upper Colorado River Basin Compact of 1948. There is no common formula or format for interstate compacts. Each takes different approaches to governing shared water resources, and they often address different issues in region- or basin-specific ways.

Water laws often require the adoption of regulations for full implementation. The law typically provides general guidelines for how these regulations should be developed, leaving the technical experts within executive agencies—which include all executive offices from mayors to the US president—to develop the regulations. These regulations, like laws, set forth mandatory rules that must be followed and are essential to achieving the goals of the law. For example, the Clean Water Act (CWA) requires the Environmental Protection Agency (EPA) administrator to adopt regulations for the establishment of water quality standards. EPA in turn adopted regulations setting forth the rules to inform the development and adoption of water quality standards by states (CWA 33 USC 1313b; 40 CFR 131). These EPA regulations require states to establish water quality standards, through state-level regulations, which are reviewed and either approved or rejected by the EPA. In this instance, the power to regulate is shared, with the EPA providing greater instruction through its regulation and the state prescribing standards that will be used, as necessary, to modify discharge permits.

Water law is also interpreted and applied by federal and state courts. Questions of state law are interpreted and applied by state courts. Questions of federal law—such as the CWA or Safe Drinking Water Act (SDWA)—are heard by federal courts, including the District and Circuit Courts as well as the Supreme Court of the United States (SCOTUS).[5,6] Court interpretations of law are binding within the jurisdiction of that court and provide important clarifications, especially where there is ambiguity in the law or in previous interpretations. For example, the decision by the SCOTUS in *Hawai'i Wildlife Fund v. County of Maui* addressed a circuit split—or conflicting interpretation of the law—between two federal Appellate courts. The decision determined that a permit *is* required under the CWA when there is a direct discharge from a point source (i.e., a single pipe or point of discharge) into navigable waters (as stated within the CWA) as well as when there is a functional equivalent of a direct discharge. A permit was not explicitly required under these circumstances within the original legislation, but the justices interpreted the legislative language to also apply to discharges that are functionally equivalent to direct discharges to address a lack of clarity. The Supreme Court's interpretation then becomes the understood and applied meaning of that law.

This report focuses on the law related to water and climate change as it has been written. While the law often creates responsibilities for enforcement, it is not guaranteed. This means that the law as written may not reflect reality. For example, the CWA requires that states adopt total maximum daily loads (TMDLs) of nutrients when a water source fails to meet specific water quality standards (CWA § 303(d)). Even though this requirement is set by law, states do not always adopt the TMDLs as required, and the EPA does not always act to enforce this requirement. The law must be executed for it to have impact. Even so, the law as written can empower government and drive change. Law as written is the foundation, but effective application and committed enforcement of the law is also necessary.

This report focuses on the law related to water and climate change as it has been written. The law as written can empower government and drive change. Law as written is the foundation, but effective application and committed enforcement of the law is also necessary.

The purpose of enforcement is to ensure compliance. Inequitable enforcement can lead to denial of rights for groups of people who are already marginalized or left behind by the current system.

5 Federal courts also largely adjudicate tribal water rights, but sometimes decisions are made by State courts.

6 It is important to note that there is not a set path for legal questions to be addressed. Some cases go to District Courts first and then progress through to the Supreme Court. Others can start at the Appellate level and be appealed to the Supreme Court. Depending on the litigants, there may also be recourse directly to the Supreme Court (e.g., when states sue each other) or to other courts that deal with claims against the federal government (which are created by legislation, not the Constitution per se, although this is much less common for various reasons).

Enforcement is necessary where there is noncompliance to ensure that processes and penalties are applied fairly and that there are consequences for failing to comply with the rules and requirements established by the law. Compliance and enforcement of the CWA has historically been challenging. In a 2020 audit conducted by the Office of the Inspector General of the EPA, they discovered that between the fiscal years of 2006 and 2018 enforcement of the CWA declined, which coincided with a decline in dedicated resources for enforcement by the EPA (Butler et al. 2020). During that period, the EPA conducted fewer inspections, initiated fewer enforcement actions, and concluded fewer enforcement actions—including administrative compliance orders, final administrative penalty orders, and civil judicial cases concluded by the Department of Justice. Similarly, the EPA did not complete some enforcement actions such as enforcing payment of financial fines for noncompliance with environmental laws.[7]

Compliance and enforcement of the Clean Water Act has historically been challenging.

Accurate, accessible data is essential to ensuring compliance. Data also helps to provide the necessary transparency to understand how noncompliance impacts frontline communities and other marginalized groups. In a separate report the Government Accountability Office (GAO) found that while the EPA had developed a measure to track progress towards reducing the rate of significant noncompliance, the data being used to track significant noncompliance is incomplete and contains inaccuracies (US GAO 2021). Without the proper data, it is exceptionally difficult to monitor how the law is being enforced.

Government policies, unlike laws, are nonmandatory; they represent guidelines, objectives, and strategies adopted by governments to reflect political priorities and a broad, suggested approach to addressing a challenge or achieving a certain outcome. They may be developed in advance of a law to inform what should be included in the law or after a law has been adopted to help implement the law. They can also be developed to provide guidance where the law does not require action. Policies provide insight on the goals and objectives of the government and what steps will help them to achieve those outcomes. For example, the Clean Water and Drinking Water Infrastructure Sustainability Policy, which was instated by the EPA in 2011, set forth the goal of ensuring that federal investments, policies, and actions would support sustainable water infrastructure (Williams, Cook, and Smerdon 2022; US EPA 2016). Because laws set forth rules that require action or prohibit certain types of action, this report focuses on identifying and understanding the laws governing the relationship between water, sanitation, and climate change.

7 Specifically, the Office of the Inspector General of the EPA stated that the EPA concluded fewer enforcement actions with injunctive relief (action that the EPA orders a regulated entity to take to return to and maintain compliance with environmental laws) and penalties (financial fines a regulated entity pays to the US Treasury in connection with the entity's noncompliance of environmental laws), and that they completed fewer supplemental environmental projects (an additional environmental improvement project that a regulated entity agrees to complete as part of an enforcement action) (Butler et al. 2020).

3.2 THE IMPORTANCE OF WATER LAW FOR DRINKING WATER AND SANITATION IN THE CONTEXT OF CLIMATE CHANGE

Water provision is often thought of in terms of the built infrastructure—such as wells, pipes, and treatment facilities—that capture, move, and treat water and wastewater around a community or household. However, the legal infrastructure—the laws, implementing regulations, and institutions established under the law, as well as any policies and plans that are enforceable mechanisms—also guide, inform, and oftentimes determine, how and whether these services can and will be provided.

One of the challenges with water law is that, generally, it is developed to provide predictability, yet water under a changing climate is highly unpredictable (i.e., what is referred to as "nonstationary") (Milly et al. 2008). Laws are intended to create clear and dependable rules and processes. In being predictable, the law at times can be overly prescriptive and fail to provide the flexibility needed to respond to climate change or other desired changes.

For example, the Colorado River Basin's water was allocated during a much wetter era and did not account for the range of climate extremes now experienced (Wheeler et al. 2022). This has led to the protracted negotiations in the Colorado River Basin to adapt the water allocations considering the ongoing multi-decadal drought (Williams, Cook, and Smerdon 2022). A tentative deal between the states is only emerging after the federal government showed a willingness to take control of the process (Partlow 2023b). While existing laws may not have perfect balancing predictability and flexibility, water law *can* offer both predictability and flexibility if designed well. And for water law to evolve and to allow for adaptation to the ongoing impact of climate change, it will have to provide both predictable and flexible rules and processes.

> Water laws will fall short if the basic structure of water management and service provision reflected in those laws is not based on an intentional consideration of the actual and anticipated impacts of climate change, and existing water laws are ill-equipped to adapt to climate change.

While some laws may not explicitly mention climate change, they are foundational to adapting to climate change impacts. For example, surface water users often turn to groundwater during drought (Petersen-Perlman, Aguilar-Barajas, and Megdal 2022). If groundwater management rules and regulations are not in place to manage this significant uptick in use, existing groundwater users will be affected, groundwater may be overdrawn, and the aquifer's capacity may be permanently diminished (Russo and Lall 2017; Lall et al. 2018). Therefore, having in place the basic laws necessary to manage water resources and service provision can inadvertently, indirectly, and fortuitously protect against climate impacts.

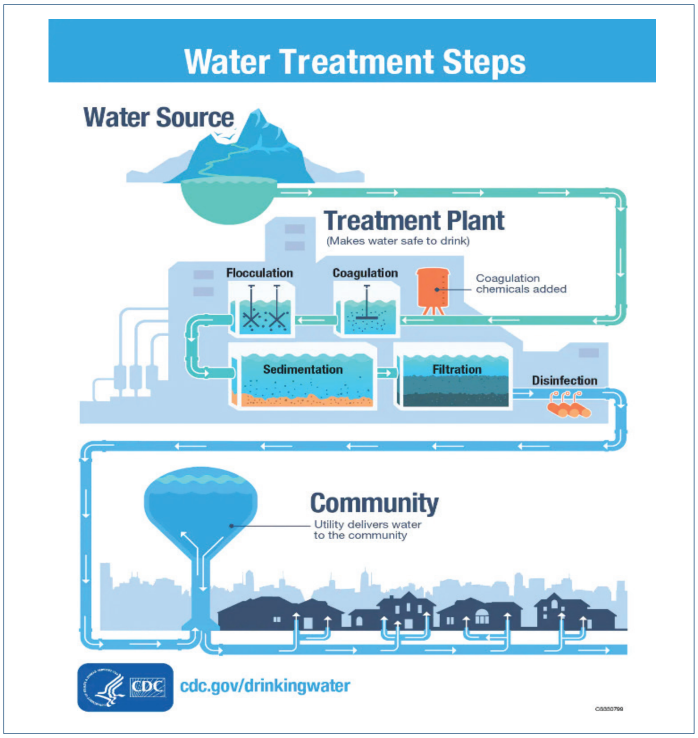
There is an increasing need for water laws to *explicitly* incorporate and consider climate change considerations. While better water management and service provision laws inherently help to address the impacts of climate change on water and sanitation systems, laws should purposefully consider the intersection of climate change and water to ensure that climate change impacts are properly anticipated and adequately addressed. Water laws will fall short if the basic structure of water management and service provision reflected in those laws is not based on an intentional consideration of the actual and anticipated impacts of climate change, and existing water laws are ill-equipped to adapt to climate change. Craig (2020) describes several ways water laws from the Eastern and Western US are ill-equipped for the variability and magnitude of changes to hydrology that are expected under a changed climate. They note that climate change is exposing gaps in water law, water quality law, energy law, and environmental law (Craig 2020). These gaps and inequities will only become more visible and acute as climate change accelerates. In the sections that follow, we examine the existing legal infrastructure governing water and sanitation service delivery and infrastructure in the US, and how it may or may not withstand a changing climate.


Water treatment tanks © Bob Brewer

4. Centralized Drinking Water Systems

Centralized drinking water systems collect, treat, and distribute water fit for human consumption to multiple residential (i.e., single-family and multifamily households) and/or commercial customers within specifically defined geographical areas, also called service areas. Centralized water infrastructure operates above the household level, serving a neighborhood, a community (i.e., a city, town, municipality, county), or more than one community. Centralized treatment and distribution require larger, more complex infrastructure which takes significant funding to construct, operate, maintain, and rehabilitate. Figure 1 shows a schematic from the Centers for Disease Control and Prevention (CDC) of the basic steps and components of a centralized drinking water system.

FIGURE 1. Schematic of a Centralized Drinking Water System



Source: Centers for Disease Control and Prevention 2022

Centralized drinking water systems provide drinking water services to approximately 300 million people living in the US (US EPA, OW 2017). Most centralized drinking water systems are governed by the SDWA, adopted by Congress in 1974. As is typical of laws, the SDWA creates and uses its own legal definitions that may not align with the terms commonly used in the sector. Regulations developed by an agency within the executive branch (such as the EPA), also create definitions, sometimes even modifying legal definitions. This is often done because the law is trying to regulate something very specific based on multiple considerations. The SDWA regulates “public water systems,” defined as “a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves at least twenty-five individuals” for at least 60 days per year (42 USC 300f; 40 CFR 141.2). A public water system is either a community water system or a noncommunity water system. A community water system is a public water system that serves “at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents,” and therefore ranges from being very small to very large.[8] The definition of community water systems largely coincides with the broader term of centralized water systems, only leaving out water systems that have fewer than 15 service connections or serve fewer than 25 people.

Laws and policies that regulate centralized drinking water systems focus on ensuring that systems deliver safe water.

There are approximately 145,000 centralized drinking water systems, commonly called public water systems by government entities, in the US (Humphreys 2022). Of the 145,000 public water systems, nearly 50,000 are community water systems, which provide water year-round to the same population in the US. These systems serve the majority of people in the US, while the rest are served by decentralized, onsite drinking water systems (discussed in Section 6 below) (US EPA 2015a). Approximately 81% of these community water systems serve 3,300 or fewer people (Humphreys 2022). On the other hand, 9% of community water systems serve more than 10,000 people (Humphreys 2022). Notably, small water systems (those that serve 3,300 or fewer) face unique challenges, including limited financial, managerial, and technical capacity, relative to their larger counterparts (Feinstein et al. 2020). These challenges make it more difficult for small systems to meet regulatory requirements, maintain infrastructure, and adapt to climate change in the US.

Laws and policies that regulate centralized drinking water systems focus on ensuring that systems deliver safe water. The SDWA governs the quality of drinking water delivered by community water systems. By requiring the establishment of maximum contaminant levels (MCLs), the federal government sets a floor for what is considered safe drinking water. These MCLs are set by the US Environmental Protection Agency within the National Primary Drinking Water Regulations. States can

8 Public water systems include community water systems, nontransient noncommunity water systems (NTNC), and transient noncommunity (TNC) water systems. Nontransient noncommunity water systems are public water systems that regularly supply water to at least 25 of the same people at least six months per year (e.g., a school, factory, or office building). Transient noncommunity water systems do not provide water services to the same people on a regular basis (e.g., a gas station, campground). This report primarily focuses on community water systems, which are responsible for providing water to the majority of homes and businesses in the US.

adopt more stringent MCLs or MCLs for additional contaminants but cannot adopt less stringent or fewer MCLs than those regulated by the federal government.

For many people, particularly for frontline communities of rural, low-income, and communities of color, these laws, policies, and programs have failed to deliver safe, reliable drinking water. One study found that in 2015, nearly 21 million people in the US were served by community water systems that received a health-based water quality violation that year (Allaire, Wu, and Lall 2018). In other years over the past few decades, upwards of 45 million people received water from systems that violated health-based standards (Allaire, Wu, and Lall 2018). Furthermore, structural racism and underinvestment in predominantly low-income, Black, Indigenous, and other communities of color—exemplified by the water crises in Flint, Michigan, Jackson, Mississippi, Benton Harbor, Michigan, and Toledo, Ohio—threaten the universal safety of centralized drinking water systems.

One study found that in 2015, nearly 21 million people in the US were served by community water systems that received a health-based water quality violation that year.

As detailed in the first report in the series, climate change will further exacerbate the challenge of delivering safe, reliable water for these systems. Climate change can drive water scarcity, reducing the reliability of the lakes and reservoirs, streams, rivers, and groundwater sources on which centralized drinking water systems depend. It has increased contamination of these sources as well, through saltwater intrusion from the sea into groundwater, increased frequency and extent of harmful algal blooms, and growing impacts of severe wildfires on watersheds that feed drinking water reservoirs (Zamuda et al. 2018). Floods and other extreme storms are also happening more frequently and have become more intense. These events can render water infrastructure inoperable, and impact energy supply, energy transmission, and transportation networks that centralized drinking water systems are highly dependent on (Pacific Institute and DigDeep 2024). The rest of this section is focused on how laws, policies, and programs address or fail to address these phenomena, and how they help or hinder the advancement of equitable, climate-resilient centralized drinking water systems for frontline communities.

4.1 WATER SCARCITY AND SUPPLY IMPACTS TO CENTRALIZED DRINKING WATER SYSTEMS

Water scarcity and other supply impacts of climate change will significantly affect water resources needed for centralized water service provision. In the US, drinking water is most commonly supplied from surface water and groundwater sources, like lakes, rivers, and aquifers (Dieter and Maupin 2017). A small fraction of drinking water supplies come from alternative sources such as recycled wastewater, rainwater, and desalinated water. Climate change threatens existing water supplies for drinking water both by creating more water scarcity and by impacting water demand. Climate change is expected to raise water demand in places where there are increasing temperatures or where there are extended periods of time without rain or snow (Pacific Institute and DigDeep 2024). To ensure water provision in the face of climate change, communities need both the baseline legal infrastructure for managing water use and an understanding of climate change actions available to them. In this section, we examine how the law helps to prepare or respond when there is too little water to meet all the water demand, especially when water scarcity threatens basic water services.

Since drinking water quality and availability depend on water resources, the laws that govern water allocation and water resource management are in many ways as important for addressing climate change as the drinking water quality laws. Water laws govern the use and management of water resources by establishing whether, how, when, and by whom water resources can be withdrawn and used. Laws can also incentivize behaviors and actions that help improve efficiency of water use or conserve water, and they can protect certain types of water uses, like water and sanitation service use during times of scarcity. The ability of current laws to support sustainable, equitable water use and management will be tested as climate change impacts continue to grow. In general, water management laws and policies in the US do not explicitly take climate change into account, increasing the likelihood that centralized drinking water systems will face challenges in providing services due to climate change.

4.1.1 Surface Water Rights and Use

Water resource management, including the distribution and allocation of water rights, is largely left to state governments. For example, Congress has not adopted any national laws regarding water management, rights, or allocation.[9] The CWA states that it is a "policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of states to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources, and to consult with the Administrator in the exercise of his authority under this Act," indicating water allocation and use as a state issue (33 USC. 1251 CWA § 101b).

However, there are important exceptions to this. First, the federal government holds "federally reserved water rights." These water rights are intended to be used to achieve the purpose of federally owned or managed lands. As such, when the federal government sets aside land for a particular purpose (for example, the creation of a national park or wildlife refuge), it also reserves water to achieve that purpose. Second, the federal government quantifies tribal water rights and federal agencies, which include the Bureau of Indian Affairs (BIA) and Indian Health Service (IHS), help manage water resources, infrastructure, and services on tribal lands. Lastly, the Army Corp of Engineers (USACE) and Bureau of Reclamation (BOR) (an agency within the Department of Interior) are involved in water management through their congressionally granted authorization to construct and operate water infrastructure such as dams and reservoirs. Through that authorization, Congress states the purpose for which the infrastructure has been authorized and the USACE and BOR construct, operate, and oversee that infrastructure to achieve that purpose, such as irrigation, water supply, and hydroelectric power generation. In fact, the BOR is the largest wholesale water supplier and second largest producer of hydropower in the US (USBR 2023). As a result of these areas of authority, the federal government plays an important role in water management, rights, and allocation.

9 While Congress does approve and write interstate water compacts, these compacts are not nationally applicable. The point here is that Congress is not drafting water resource management or water rights allocation that apply nationally.

States have adopted their own unique approaches to managing water use and allocating water rights. Each state has the authority to determine how water resources are to be allocated and each has adopted its own set of state laws. Generally, states apply either a version of riparianism or prior appropriation when governing surface waters. Riparianism is conventionally a land-based water rights doctrine whereby riparian water rights are available to owners of land adjacent to natural waterbodies. Therefore, landowners next to waterbodies have a right to use and withdraw water from that waterbody, subject to certain limitations. In many states, the riparianism principles that were originally created as common law—law created by judges resolving disputes—have now been codified into state statutes. Where this has occurred, this codified common law system is called "regulated riparianism" (Dellapenna 2011). Regulated riparianism typically requires landowners adjacent to natural waterbodies to apply for water use permits before withdrawing or using any water. People and entities without waterfront property may also apply for water use permits without needing to have riparian land. Permits under this system are typically time-limited and must be renewed periodically with a frequency determined by each state. These periodic permits potentially provide opportunities for states to revisit permit uses and allocations where climate change impacts water flows due to declining precipitation or other factors.

> States have adopted their own unique approaches to managing water use and allocating water rights.

Florida's law codifies the regulated riparianism doctrine. Any person seeking to use water must apply for and receive a permit from one of the five water management districts that cover Florida (Fla. Stat. § 373.219). In their application of a water use permit, the person must demonstrate that the proposed water use: "(a) Is a reasonable-beneficial use as defined in § 373.019; (b) Will not interfere with any presently existing legal use of water; and (c) Is consistent with the public interest" (Fla. Stat. § 373.223). The term "public interest" is not defined within the law, nor has it been defined by the Florida Department of Environmental Protection. If considering climate change impacts is in the public interest, then this term could be used to justify the government's consideration of climate change in making its permitting decisions.

The regulated riparianism statute in Florida includes a few other provisions that provide unique protections for the watershed. For example, the statute requires the establishment of minimum flows and minimum water levels (Fla. Stat. § 373.0421). In establishing those minimum flows, the department or water management district board is required to "consider changes and structural alterations to watersheds, surface waters, and aquifers and the effects such changes or alterations have had, and the constraints such changes or alterations have placed, on the hydrology of an affected watershed, surface water, or aquifer, provided that nothing in this paragraph shall allow significant harm as provided by § 373.042(1) caused by withdrawals" (Fla. Stat. § 373.0421). Minimum flows provide a check on water use and explicitly require the department or the board of a water management district to protect the basin, bearing in mind the reduced flows brought on by climate change. Minimum flows help to protect the sustainability of the river basin, ensuring sufficient water resources for drinking water.

Lastly, the department or water management district board in Florida has the authority to declare a water shortage emergency for a source or sources: “insufficient water is or will be available to meet the present and anticipated requirements of the users or when conditions are such as to require temporary reduction in total use within the area to protect water resources from serious harm” (Fla. Stat. § 373.246). Within the plan to be adopted by the board or department when declaring a water shortage emergency, they can include provisions “for variances and alternative measures to prevent undue hardship and ensure equitable distribution of water resources.” And in accordance with the plan adopted, the board or department can impose restrictions on one or more classes of water uses to “protect the water resources of the area from serious harm and to restore them to their previous condition” (Fla. Stat. § 373.246). Unlike California’s laws presented below, Florida law does not require a two-year waiting period before addressing a water shortage. Additionally, Florida’s water use restrictions can be applied to everyone. This ensures greater equity in sharing the burden of the impact of climate change across all users, rather than being shouldered by just the most junior water users.

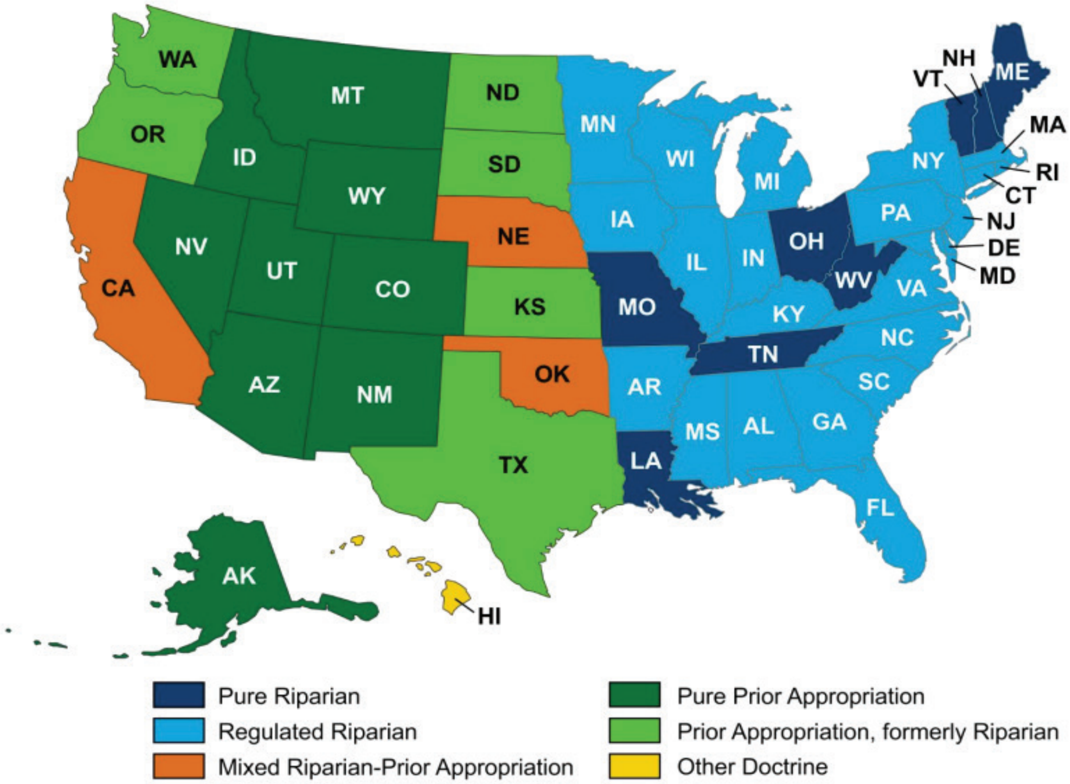
The other approach to water allocation in the US is the prior appropriation doctrine, which is the primary water rights system in Western states, including several states in what is considered the Midwest, like North Dakota, South Dakota, and Kansas (Figure 2). Prior appropriation applies a first-in-time, first-in-right or first-come-first-served approach to the distribution and prioritization of water rights. This approach was developed in part because of a need for a way to allocate scarce water resources between competing users (Benson 2012). Water rights are secured by putting water to a beneficial use.[10] These rights are then prioritized based on the date the right was perfected (i.e., established), creating a formal date-based order, or “seniority,” of water rights.[11] When a water right is not used, it can be lost (Johnson and DuMars 1989). When limited water supply is available, the more senior water rights must be fulfilled first before any water is available for use by junior rights holders. This means that junior rights holders will not always be able to access water resources if water becomes limited (e.g., in times of severe drought that impact water availability). The decision of who gets water and who does not is based only on the date when the water right was perfected and not on the way the water is used. For example, in California in 2021 during an intensifying drought, the state notified 4,300 water rights holders to stop diverting water from the Sacramento-San Joaquin Delta watershed, the largest watershed in the northern part of the state (Becker 2021).

A local journalist reported that the notices to stop diverting were sent to the junior water rights holders, while the 2,300 users with more senior water rights were only sent notices warning that they might face insufficient water supplies (Becker 2021). Among the impacted junior rights holders were municipal water suppliers like Carmichael Water District, which serves a population of about 41,200 people in the Sacramento area. In response, the district switched water sources from their surface water supplies from the local river to groundwater supplies and purchased water from other nearby water districts (Becker 2021).

10 “Beneficial use” is a legal term defined by courts and/or state-level statutes that defines what is considered an allowable use of water. Common beneficial uses include, for example, domestic, agriculture, and industrial uses, among others. In-stream uses—such as environmental flows or recreation—were once not considered a beneficial use.

11 A water right is perfected when unappropriated water is found and put to a beneficial use.

FIGURE 2. **Water Governance in the United States by State**



Source: Department of Energy 2014 (based on data from Beck and Kelley 2009)

This example demonstrates how there can be gaps in the law that do not fully protect drinking water supplies during times of drought. In California, water use can be curtailed under Section 1058.5, "when water is not available under the diverter's priority of right" (Cal. Water Code § 1058.5). However, this only protects the more senior post-1914 water rights holders, which may not include water rights held by drinking water systems.[12] It does not require an equitable or proportional decrease in water usage among all water users that could protect water supply for drinking water. Furthermore, the regulatory agency, the State Water Resources Control Board (SWRCB), can only exercise these rights under Section 1058.5 in a "critically dry year" after at least two consecutive below-normal or drier years, or when the governor has proclaimed a drought state of emergency, potentially disadvantaging water systems while they wait for these powers to be triggered.[13]

12 California is a unique state in that its laws recognize both riparian water rights and appropriative water rights. Both riparian and appropriative rights were recognized by California state law in the 1850s when California became a state. Riparian rights generally have priority above all appropriative rights and cannot be lost due to lack of use. California's Water Commission Act of 1914 is responsible for creating the current appropriative water rights permit structure in place today and establishing a dual water rights system (California 1914). All water rights are limited to the amount of water "reasonably required for the beneficial use to be served" (Cal. Const. art. X, § 2; Cal. Water Code § 100) (Nylen et al. 2023).

13 Water Code Section 1058.5 is a bit broader than suggested here, and states the following: "The emergency regulation is adopted to prevent the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion, of water, to promote water recycling or water conservation, to require curtailment of diversions when water is not available under the diverter's priority of right, or in furtherance of any of the foregoing, to require reporting of diversion or use or the preparation of monitoring reports."

Like riparianism, the prior appropriation doctrine has been codified into state laws. Appropriative water rights are perpetual, meaning there is no expiration date on the permits. However, states now require water users to secure advanced permission before beginning a new water use, which is an important shift from the original doctrine, especially considering climate change and times of water scarcity. By requiring advanced permission, an administrative agency can review the compatibility of the proposed water use, consider the impact on existing uses, anticipate future demand, and—ideally—incorporate projected future water availability. Without an expiration date or other review for appropriative rights, regulators are still making future decisions based on today's information. Still, this pre-use permission process does create a more equitable system that can better address climate change.

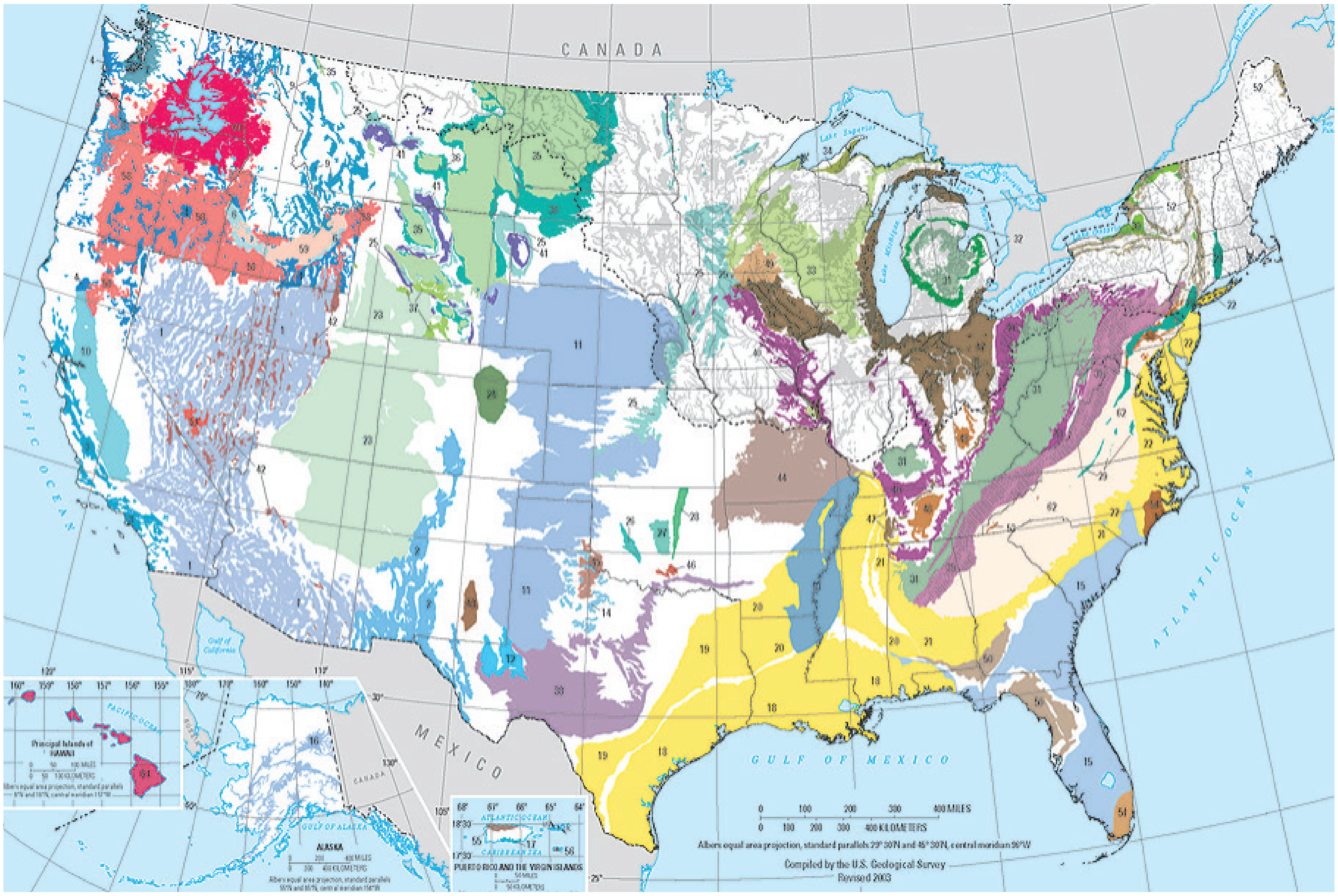
Some state's water laws have provisions to address wasteful or unreasonable use of water, which can create the authority for certain entities to restrict those uses during times of drought or scarcity. Wasteful or unreasonable uses are prohibited by law in California (Nylen et al. 2023). There, "reasonable use" is a flexible concept that can change over time and is based on the circumstances in the basin, which is important in river basins impacted by climate change (Nylen et al. 2023). For example, the California SWRCB adopted emergency regulations under the California Water Code (Cal. Water Code § 1058.5) banning certain uses as unreasonable and wasteful, including the use of water for washing off sidewalks and decorative fountains (unless the water is recirculated). They also ban the application of water to irrigate turf or ornamental landscape within the 48 hours following rainfall of at least one fourth inch of rain when certain emergency conditions have been found by the SWRCB (23 CA Code of Regs 863, 864, 995, 996). In a time of emergency, such as during a drought, these types of laws allow for certain uses to be designated unreasonable and for authorities to restrict those uses.

> While the majority (96%) of states in the US have some law in place to regulate groundwater use and/or quality, the quality and comprehensiveness of those laws is not guaranteed.

4.1.2 Groundwater Rights and Use

In comparison to surface water resources, groundwater resources are relatively difficult to manage (being underground and largely unseen), yet they exist under every state, Washington D.C., and Puerto Rico (Figure 3). While the majority (96%) of states in the US have some law in place to regulate groundwater use and/or quality (Gerlak et al. 2013), the quality and comprehensiveness of those laws is not guaranteed. In many places groundwater use is still unsustainable leading to declining water tables, reductions in surface water availability, subsidence at the ground surface, and groundwater pollution (Smith, Knight, and Fendorf 2018; Russo and Lall 2017, Rojanasakul et al. 2023). Groundwater is generally considered sustainable when it maintains high-quality, long-term storage and flow through inclusive, equitable governance and management (Gleeson et al. 2020; Elshall et al. 2020).

FIGURE 3. Principal Aquifers of the United States



Source: US Geological Survey 2018

In some places, laws allow unsustainable groundwater use. For example, states like Texas apply the "rule of capture" to govern groundwater, which effectively allows a landowner to pump as much water from wells on their property as they wish, with no regard for impacts on other wells (Opiela 2002). Climate change has the potential to exacerbate unsustainable groundwater use and practices, especially in places where the law does not protect groundwater sustainability. In some places, groundwater is used when there is not enough surface water, multiplying the impact of droughts by increasing groundwater use (Flavelle and Rojanasakul 2023). Recharge of groundwater aquifers from surface water sources is also becoming less reliable due to climate change (Döll 2009; Meixner et al. 2016). A growing population combined with a climate that is hotter—and at times much drier in places, such as the Western US—will also drive up existing water demand, likely leading to even greater overuse of dwindling groundwater resources (Lall et al. 2018; Payton et al. 2023).

Two studies, one performed in 2012–2013 and one in 2016 by researchers at the University of Arizona, surveyed representatives within state agencies on the scope of groundwater governance in each state (Gerlak et al. 2013; Megdal et al. 2017).[14] Groundwater is largely managed and regulated at the state level. In nearly half the states, the hydrologic connection between surface water and groundwater is not recognized by the legal system used to manage water (Gerlak et al. 2013). Gerlak and coauthors also found that most states have laws that explicitly address groundwater quality and also water conservation regulations that are applicable to groundwater. However, Megdal and co-authors found that less than half of survey respondents expect their states to meet their groundwater quality management goals (Megdal et al. 2017). Within each state, different agencies at both the state and local levels can be involved with groundwater management and use. Megdal et al. found that in 57% of states, separate agencies are responsible for water quantity and water quality.

State and Local governments have regulated different aspects of groundwater use and water quality. According to Gerlack and co-authors, they have adopted:

1) rules that dictate the amount or timing of groundwater allowed to be used;
2) laws that regulate the construction of new wells;
3) laws that require existing wells to be registered (which can include descriptions of the location, use of the water from the well, etc.);
4) laws that require monitoring and reporting about water use and/or water quality from the well;
5) laws that help protect recharge areas to protect both quantity and quality of groundwater.

These laws also may differentiate between different types of users. The 2012–2013 University of Arizona survey found that only 31 states had groundwater regulations that applied to all water users (the user types included domestic wells, industrial users, privately and publicly owned community water systems, irrigation associations, and "other") (Gerlak et al. 2013). In some states, certain water users are exempt from some restrictions (like households) while others face more stringent restrictions (like industry and community water systems). Broadly, most groundwater laws are insufficient to comprehensively manage groundwater resources from a quality and quantity perspective (Megdal et al. 2015).

In 2014, California pursued changes to groundwater governance in hopes of ensuring longer-term sustainability of groundwater supplies through the adoption of the Sustainable Groundwater Management Act (SGMA) (Cal. Water Code, § 10720 et seq.). SGMA requires California to designate priority levels for groundwater basins and to ensure "sustainable" groundwater use by 2040 (Cal. Water Code § 10722.4; Cal. Water Code § 10933). To identify and achieve the priority levels, all high- and medium-priority basins subject to critical overdraft were required to adopt a groundwater sustainability plan by 2020. The remainder of the high- and medium-priority basins not subject to critical overdraft were required to have a plan by 2022 (Cal. Water Code § 10720.7(a)). The legislature also encouraged low- and very low-priority basins to adopt groundwater sustainability plans,

14 While over a decade old and over eight years old, respectively, and updates needed, Gerlak et al. (2013) and Megdal et al. (2017) are the only 50-state syntheses of groundwater governance. Since their publication, laws governing groundwater have changed in some states, such as the California passage of the Sustainable Groundwater Management Act in 2014, but the general findings summarized here have not changed significantly due to these individual state-level changes. Work by Eckstein and colleagues offer more recent surveys of groundwater laws in 29 states to date in an effort to ultimately compile and compare groundwater laws in all 50 states (Eckstein et al. 2022; Bennett et al. 2020). It is important to note that Gerlak et al. (2013) and Megdal et al. (2017) are based on the results from surveys that were sent out to representatives within state agencies, not research of the relevant laws governing groundwater. Therefore, there is no verification of what is reported through the surveys against the law as written or interpreted by courts or legal analysis about the quality and depth of the law.

although they are not required to (Cal. Water Code § 10720.7(b)). While interim progress is required, at this time, there is still more than a decade until 2040 when the use of groundwater in basins covered by the law must be "sustainable," evidence suggests that SGMA is failing many—but not all—of the most vulnerable groundwater-dependent communities, including domestic well users and small public drinking water systems (Bostic et al. 2020; Bostic 2021).

A reason for this potential failure is that a key criterion for assessing sustainability within each basin—the minimum thresholds for groundwater level (i.e., the deepest groundwater level allowable for basins to be considered in compliance)—was set below the level of thousands of domestic wells and hundreds of wells serving public water systems (Bostic et al. 2020; Bostic 2021; Bostic et al. 2023). Another concern with SGMA is a lack of meaningful, equitable representation of all groundwater users in the regional groundwater planning agencies (Dobbin and Lubell 2021; Perrone et al. 2023). In April 2024, the State Water Resources Control Board placed the Tulare Lake Groundwater Subbasin in probationary status. The State Water Board's decision marks the first time a groundwater basin has been designated as probationary under SGMA. As climate change causes greater dependence on groundwater, laws like SGMA have the potential to provide an important management mechanism for protecting vulnerable groundwater supplies and contributing to more inclusive governance processes.

As climate change causes greater dependence on groundwater, laws like SGMA have the potential to provide an important management mechanism for protecting vulnerable groundwater supplies and contributing to more inclusive governance processes.

4.1.3 Prioritizing Domestic and Municipal Use

In the US, the three largest categories of water use account for 90% of the total water use nationally (USGS 2019). These three uses are thermoelectric power generation, irrigation for agriculture, and public supply (i.e., water withdrawn by centralized drinking water systems and served to homes and businesses) (USGS 2019). Some states have prioritized water use for domestic and municipal purposes against all other uses.[15] These laws are sometimes applicable to water use under all conditions, or they can be specific to times when there is a water shortage, such as during a drought. In both cases, these laws protect homes and communities from losing water access by ensuring that the available water resources will be prioritized for domestic uses, such as drinking water, cooking, hygiene, and sanitation.

Prioritization of water resources for domestic purposes could become more imperative as climate change shifts precipitation patterns, reducing the availability of water in some geographies (Lall et al. 2018; Payton et al. 2023). Climate change is also predicted to contribute to more water quality disruptions (such as during longer, warmer summer months when algal blooms in surface water

15 Municipal purposes include potable water that is treated by a centralized drinking water treatment facility and distributed to be used for domestic purposes, such as drinking, cooking, hygiene, and sanitation.

supplies can cause major water treatment challenges), reducing water availability for those who rely on that source (Pacific Institute and DigDeep 2024; Payton et al. 2023). Where water availability is more of a challenge, prioritizing water use for domestic purposes ensures households get the water they need for drinking, cooking, hygiene, and sanitation.

As an example, California law prioritizes water use by municipalities for domestic purposes. The law states, “The application for a permit by a municipality for the use of water for the municipality or the inhabitants thereof for domestic purposes shall be considered first in right, *irrespective of whether it is first in time*” (Cal. Water Code § 1460; emphasis added). This provision upsets the order of priority established by the prior appropriation doctrine. When water is plentiful, this automatic priority does not affect water allocations. However, when water is scarce, such an automatic grant of seniority to municipal water rights ensures that the limited amount of water available will be made available first for household uses and only thereafter for agriculture and other uses.

California law also grants public water distributors special authorities to protect access to water used for domestic purposes during a water shortage emergency.[16] A public or privately owned water supply distributor can declare an emergency water shortage, defined as insufficient water available for human consumption, sanitation, and fire protection *if* the demands of other water consumers are fulfilled (Cal. Water Code §350, 350). If the shortage is declared, the distributor must adopt regulations and restrictions on the delivery of water for non-domestic purposes to “conserve the water supply for the greatest public benefit with particular regard to domestic use, sanitation, and fire protection” (Cal. Water Code §350, 353). This emergency authority has been exercised by water distributors, including by Marin Municipal Water District which, during a drought in 2021, declared a water shortage emergency pursuant to California Water Code § 350 (Marin Municipal Water District 2021).

In California, a public or privately owned water supply distributor can declare an emergency water shortage, defined as insufficient water available for human consumption, sanitation, and fire protection *if* the demands of other water consumers are fulfilled.

In California, the automatic prioritization of domestic uses and the emergency water shortage authority reflect both proactive protections that prioritize domestic needs and responsive provisions needed to address emergencies. Together, these provisions help protect domestic needs when there is insufficient water to meet every demand.

16 A “distributor of public water supply” is not explicitly defined in California Water Code, however, its definition is referenced in § 10609.28, where it states “...or a distributor of a public water supply, as that term is used in Section 350...” indicating that its use in § 350 is definitional. In this report, the term is understood to mean a water supplier that sells and distributes water to centralized drinking water systems.

Kentucky, like many riparianism-practicing states, has laws that prioritize domestic use.[17] This includes the protection of water for drinking water and for certain purposes such as drinking water for poultry, livestock, and domestic animals (Ky. Rev. Stat. Ann. § 151.210).[18] Kentucky also has adopted a similar provision to the one described above for California. Any person, business, industry, city, county, water district or other political subdivision that wants to withdraw water from a surface water or groundwater source must have a permit issued by the State Cabinet (Ky. Rev. Stat. Ann. § 151.140; 401 Ky. Admin. Regs. 4:010 (2018). However, no permit "shall be required for and nothing herein shall interfere with the use of water for agricultural and domestic purposes including irrigation; and no permit shall be required if the amount withdrawn is less than the amount established by regulation..." (Ky. Admin. Regs. 4:010 (2018). Based on the language of the statute, this protection appears to apply to all agriculture, both subsistence and commercial. In Kentucky, agricultural water use is given the same protection as domestic water use, setting up a potential for conflict between the two uses if there is a water shortage.

4.1.4 Tribal Water Rights and Water Codes

Tens of thousands of Tribal and Indigenous peoples lack access to safe drinking water (Status of Tribes and Climate Change Working Group 2021; Indian Health Service 2020). Climate change will increase the legal and planning complexities involved with securing water rights and building infrastructure on top of the water quality, quantity, and other physical impacts to water resources (Cozzetto, Cooley, and Taylor 2021). In 2020, the IHS found that approximately 38,000 (9.5%) of American Indian and Alaska Native homes lacked adequate sanitation, and 7,100 of these lack access to safe water and/or waste disposal facilities. However, these numbers likely greatly underestimate the number of Indigenous homes that lack safe water and sanitation, in large part because they do not include non-federally recognized Tribes (Status of Tribes and Climate Change Working Group 2021). While tribal water rights and codes apply more broadly than to centralized drinking water systems and water scarcity, we discuss them here because most of this section applies to water delivered through centralized drinking water systems.

> The unique history and legal status of Tribes in the US means that tribal water rights come with many of their own legal structures and governance mechanisms.

The unique history and legal status of Tribes in the US means that tribal water rights come with many of their own legal structures and governance mechanisms. The US government started forcibly removing and displacing Native Americans from their homelands onto reservations in the 1800s, authorized by the 1830 Indian Removal

17 The law uses the term "natural" for domestic uses. Water used for natural purposes is different from water used for "artificial purposes." Artificial purposes include all other water uses not for domestic use, such as water used for commercial and industrial purposes.

18 In Kentucky, "[a]ny owner of land contiguous to public water shall at all times have the right to the use of water therefrom to satisfy his needs for domestic purposes, which shall include water for household purposes, such as drinking water for poultry, livestock and domestic animals. The use of water for such domestic purposes shall have priority and be superior to any and all other uses" (Ky. Rev. Stat. Ann. § 151.210).

Act (Dunbar-Ortiz 2015). The written treaties, agreements, and executive orders that established the reservations, legally known as "Indian Country," generally did not explicitly state whether the land reserved for Native Americans came with water rights. In *Winters v. United States* (1908), the Supreme Court held that when Congress sets aside or reserves land, such as for an Indian reservation,[19] Congress also reserves water sufficient to fulfill the purpose of the reservation (*Winters v. United States*, 207 US 564 (1908)). Therefore, there are implied water rights that attach to each Indian reservation. The Supreme Court based its reasoning on the fact that the government could not have set aside arid land for Native Americans to live on without also reserving enough water for those peoples to survive on that land.[20]

Because the agreements establishing reservations did not *explicitly* include water rights, the *Winters* doctrine was an essential acknowledgement that there are reserved water rights attached to reservations. The *Winters* decision also defined the date of the perfection of the water right as being the date the reservation was established. Because these two dates were linked, most Tribes were given the most senior water rights in their respective basins. While the *Winters* doctrine acknowledged tribal water rights, it did not identify how to calculate the amount of water that Tribes could use. Methods to quantify tribal water rights would be determined in subsequent cases many decades later, starting with the 1963 *Arizona v. California* case (373 US 546, 600-601).[21] Multiple cases were litigated on the issue of quantification for decades thereafter, resulting in different methods of quantification across different reservations and tribal water rights (Anderson 2015).

Federal courts have the authority to adjudicate reserved water rights for Indian reservations or pursue settlements when possible (Bureau of Indian Affairs, n.d.). The 1952 McCarran Amendment—a rider to an appropriations bill—complicated the interpretation of the legal standard by waiving federal sovereign immunity so that the US government can be joined to state lawsuits adjudicating tribal water rights in river systems (McCallister 1976; Blumm, Becker, and Smith 2006). The Supreme Court also subsequently found that state courts can adjudicate Indian reserved water rights (Colo.

19 As described by the Bureau of Indian Affairs, "A federal Indian reservation is an area of land reserved for a Tribe or Tribes under treaty or other agreement with the Unites States, executive order, or federal statute or administrative action as permanent tribal homelands, and where the federal government holds title to the land in trust on behalf of the Tribe" (Bureau of Indian Affairs 2017). Use of this term is appropriate when referring to a federal Indian reservation, or issues related to the jurisdiction of reservations, generally.

20 In justifying their position the Supreme Court wrote, "The lands were arid and, without irrigation, were practically valueless. And yet, it is contended, the means of irrigation were deliberately given up by the Indians and deliberately accepted by the Government. The lands ceded were, it is true, also arid; and some argument may be urged, and is urged, that with their cession there was the cession of the waters, without which they would be valueless, and 'civilized communities could not be established thereon.' And this, it is further contended, the Indians knew, and yet made no reservation of the waters. We realize that there is a conflict of implications, but that which makes for the retention of the waters is of greater force than that which makes for their cession. The Indians had command of the lands and the waters—command of all their beneficial use, whether kept for hunting, 'and grazing roving herds of stock,' or turned to agriculture and the arts of civilization. Did they give up all this? Did they reduce the area of their occupation and give up the waters which made it valuable or adequate?"

21 In the 1963 Arizona v. California case, the Supreme Court approved a Special Master's calculation of water rights using an agriculture-based quantification standard so that "enough water was reserved to irrigate all the practicably irrigable acreage on the reservations" (373 US 546, 600-601). Therefore, the Supreme Court accepted the use of the practicably irrigable acreage standard (PIA) to quantify the water rights held by a reservation. The standard considers the amount of land that can be feasibly and reasonably irrigated and allocates the Tribes the amount of water to irrigate those lands. Even though this standard was accepted by the Supreme Court, it and other courts were not required by this decision to apply this standard in future adjudications. In addition to the water quantified under the PIA standard, if the reservation agreement explicitly included additional purposes of the reservation, then those additional purposes can be used to quantify additional water rights. Although PIA was generally the default in state stream adjudications, courts have used other metrics than the PIA to quantify water allocations (Blumm, Becker, and Smith 2006). The PIA standard can also potentially disadvantage Tribes who do not have irrigable lands, those who utilize technological advances to conserve water, or those where climate change has impacted tribal agriculture (Royster 2013; Zanoni 2010).

River Water Conservation Dist. v. United States, 424 US 800, 809 (1976)). Therefore, both federal and state courts have the authority to adjudicate Indian reserved water rights. This inherently allows for differences in interpretations across the states and likely leads to inequities, depending on what each state court is willing to consider in adjudicating these rights.

Having "paper" rights—or water rights that are legally recognized—is one part of being able to gain access to water resources. The water must also be physically available—meaning the paper rights holder must also have "wet" water rights—along with the necessary infrastructure to deliver the water for the reservations to use. Tribes are often legally entitled to more water than they can use and have used, which is inconsistent with the state prior appropriation doctrine, which requires water rights to be maintained through actual use ("use it or lose it") (Termyn 2019). This can create tensions between state and tribal entities, especially where climate change and other factors decrease the volume of available water resources.

Tribes must also have the legal authority to manage their rights and the waters within their jurisdiction to use the water in accordance with what they see as beneficial and to prepare for climate change. Many Tribes have adopted their own water codes for determining their own priorities, monitoring uses, and dealing with violations, which can also incorporate flexibility the Tribes need for climate adaptation (Royster 2013). For example, the Wind River Reservation's Tribal Water Code recognizes 15 beneficial and equal water uses that include cultural and spiritual uses (McNeeley 2017). In April 2022, the Morton Moratorium was finally rescinded, which was a 1975 memorandum issued by the Secretary of the Interior that required Bureau of Indian Affairs' managers to disapprove any tribal water codes or mechanism that regulated water use on Indian reservations where those regulations required Department of Interior approval under the rules of the Tribal Constitution (US Department of Interior 2022). While many tribal constitutions did not require such approval, for those that did, the Morton Moratorium created confusion and undermined the federal government's stated respect for Tribes' self-determination. In Box 1, we discuss the Water Code of the Navajo Nation and water rights of Tribal Nations as recognized by the Supreme Court.

Many Tribes have adopted their own water codes for determining their own priorities, monitoring uses, and dealing with violations, which can also incorporate flexibility the Tribes need for climate adaptation.

BOX 1. Navajo Nation Water Code and Water Rights

The Navajo Nation Council passed a comprehensive Water Code in 1984 (Navajo Nation Code Ann. tit. 22, § 1101 et seq.). The objectives of the Water Code included to manage and preserve the water resources of the Navajo Nation, "to secure a just and equitable distribution of the use of water within the Navajo Nation through a uniform and coherent system of regulation; and to provide for the exercise of the inherent sovereign powers of self-government by the Navajo Nation" (Navajo Nation Code Ann. tit. 22, § 1101). The Resources Committee and Director of the Division of Natural Resources are charged with overseeing the management and protection of water resources (Navajo Nation Code Ann. tit. 22, §§ 1301, 1401, 1402). The code requires existing water users to file a "Description of Use" within one year of the adoption of the code (Navajo Nation Code Ann. tit. 22, § 1602). After that one-year period, it becomes unlawful to continue existing uses without having filed with the Division of Natural Resources. Any person seeking to initiate any new uses or "take other actions within the jurisdiction of the Navajo Nation affecting the waters therein shall file an Application for Permit" (Navajo Nation Code Ann. tit. 22, § 1603). Like other water rights regimes, it is particularly important to establish water permitting regimes to ensure that water uses are evaluated and considered compatible with existing uses and the environment before they begin their use. Similarly, as climate change affects the availability of water resources, it is important to evaluate uses before they begin.

There are several provisions within the code that provide protections for water resources to ensure that the most important needs are met and to create needed flexibility as water resource availability and demand changes more frequently and rapidly. For example, the resources committee may establish reserved water supplies set aside for a definite or indefinite term of years for future Navajo Nation and other needs (Navajo Nation Code Ann. tit. 22, § 1303). While it is not a requirement, it still provides the committee with the authority to create these reserved waters. The code also allows the resources committee to deduct a fair share of water from individual water users where the Navajo Nation Council determines that there is insufficient water available for a project beneficial to all inhabitants of the Navajo Nation (Navajo Nation Code Ann. tit. 22, §1304). This gives the tribal government flexibility to change water rights when it is for the benefit of the entire community. Lastly, where there is insufficient water for any reason, the following uses are prioritized in the order in which they are listed: "1. Domestic and Municipal Uses, 2. Stock Watering Uses, 3. Agricultural Uses, 4. Instream Needs, for Fish, Wildlife Conservation and Recreational Uses, 5. Economic Development Uses including Industrial and Power Uses, 6. Other Uses" (Navajo Nation Code Ann. tit. 22, § 1501). Notably, domestic and municipal uses are listed first, and instream protections are listed after agricultural uses.

In 2023, the SCOTUS determined, in a 5-4 decision, in *Arizona et al. v. Navajo Nation* that under the 1868 treaty establishing the Navajo Reservation, the US government does not have to take affirmative steps to secure the Navajo Reservation's water rights held in trust by the US for the benefit of the Tribe (Schwartz and Hite 2023).

The Navajo Nation asserted a "breach of trust" claim against the US government, setting forth that the US government had an affirmative responsibility to secure water for the Navajo Nation. The Supreme Court acknowledged that under *Winters v. United States* and *Cappaert* (Schwartz and Hite 2023). The Navajo Nation asserted a "breach of trust" claim against the US government, setting forth that the US government had an affirmative responsibility to secure water for the Navajo Nation. The Supreme Court acknowledged that under *Winters v. United States* and *Cappaert v. United States*, water rights were implicitly reserved with the adoption of the 1868 treaty to achieve the purpose of the Reservation. However, the court ultimately concluded that while the US government holds the water rights of the Navajo in trust, this trust does not require the US government to take affirmative steps—like assessing need, developing a plan to provide water, and building the necessary infrastructure—to "facilitate better access to water on the reservation" (599 US__ (2023)) (Schwartz and Hite 2023, Mullane 2023). The divided SCOTUS determined additionally that the 1868 treaty did not create any specific obligation to provide water. This decision limits the ability of Tribes to force the federal government to enable Tribes to exercise the water rights held in trust.

The four dissenting justices in the case challenged the court's approach to the Navajo's request, highlighting the bleak history leading up to the 1868 treaty before arguing that the majority had misunderstood the Navajo's request. This SCOTUS decision will significantly impact tribal water rights and the federal government's legal responsibilities, especially in the context of the drying West where water resources are overallocated (Mullane 2023).

Changes to federal law have enabled Tribes to advance their sovereignty over water. Through 1987 amendments to the CWA, Tribes can apply for Treatment as States (TAS), which authorizes Tribes to implement certain sections of the CWA, including Section 303, which governs water quality standards (Diver et al. 2019). At the time of publication of this writing, 84 Tribes had been granted TAS status (US EPA 2023d). However, many Tribes have encountered neo-colonial and bureaucratic roadblocks, and the majority of Tribes still do not have TAS status (Diver et al. 2019). Additionally, a 1986 amendment to the SDWA also allowed a grant of TAS status for Public Water System Supervision (PWSS) (US EPA 2015b). To date, the Navajo Nation is the only Tribe that has this TAS status, giving them primacy for 170 public water systems on their lands (US EPA 2015b). Aside from Alaska, where the state has primacy over approximately 200 Alaska Native public water systems, the EPA serves as the primacy agency over the 1,000+ tribal water systems in the US, serving over 1 million people (US EPA 2015b).

Federal law has also created programs to help bring critical water and sanitation infrastructure to Tribal and Indigenous communities. The IHS Sanitation Facilities Construction Division offers the Sanitation Facilities Construction Program for American Indian and Alaska Natives nationwide. This program was authorized in 1959 under Public Law 86-121, The Indian Sanitation Facilities Act (1959). The program provides planning, design, and management services to construct and update water supply, sewage disposal, and solid waste disposal facilities for homes and communities. The division also maintains the Sanitation Deficiency System (SDS), an inventory of projects developed to address existing sanitation deficiencies in American Indian and Alaska Native communities. However, for many Tribal and Indigenous communities who still lack water infrastructure, several factors contribute to the challenge of receiving water and sanitation to their homes and communities, including remote locations, harsh climates, low population densities, poverty, and inaccessible or difficult to access groundwater (Cozzetto, Cooley, and Taylor 2021).

4.1.5 Water Resource Management Planning

Complementing law governing allocation and use is water management planning. Water management planning is a process, either legally mandated, incentivized, or voluntary, whereby water managers (including those operating centralized drinking water systems) plan for future investments, like infrastructure upgrades and water supply needs, by analyzing water supply availability, water quality, and use in concert with projected changes in population, the economy, and other factors that impact water demand (Snyder, Cooley, and Thebo 2023; Abraham, Diringer, and Cooley 2020). Increasingly, these planning processes incorporate climate change considerations (Fleming et al. 2024), but many small and under resourced water management entities, like small public water systems serving frontline communities, often lack the capacity and resources for a comprehensive planning process. In a limited number of cases states have passed laws and policies to support these communities with water management planning (see Box 2 below).

Kentucky law provides broadly for long-term water management planning. The Environmental and Public Protection Cabinet ("Cabinet") is required to develop a "planning process for the long-range management and orderly development of the Commonwealth's resources" (Ky. Rev. Stat. Ann. § 151.112). In 2016, the Kentucky Water Resources Board was created to support the Cabinet's work in developing the planning process (Ky. Rev. Stat. Ann. § 151.113). The Cabinet is also responsible for administering a program to develop long-range water supply plans for each county and its municipalities and public water systems or for a region composed of more than one county (Ky. Rev. Stat. Ann. § 151.114(1)).[22] The plans are required to include: an assessment of existing public and private water resources within the study area, including surface water and groundwater resources; a study of existing water use within the area; projections of future water needs; and a determination of alternative approaches that could be taken to meet future water supply needs (Ky. Rev. Stat. Ann. § 151.114(1)). All plans must be approved by the Cabinet (Ky. Rev. Stat. Ann. § 151.114(3)). Development of these plans enables the government to anticipate rather than react to changes brought on by climate change.

Kentucky also originally provided financial assistance for the development of water supply plans. Under the law, financial assistance to develop water supply plans was provided to communities only until July 15, 1999 (Ky. Rev. Stat. Ann. § 151.118). The county and its municipalities and public water systems were only required to pay up to 20% of the total cost of developing the plan, increasing the number of communities who could benefit from this planning assistance (Ky. Rev. Stat. Ann. § 151.118).

In 2000, the Kentucky legislature required the establishment of water management planning councils for each county, intended to address water management planning through 2020 (Ky. Rev.

22 The plans originally were developed by area development districts together with the counties and their municipalities and public water systems.

Stat. Ann. § 151.601). The councils are required to include representatives from the county, such as a judge or mayor, a person selected by the county health department, a representative of each public water system and from each municipality with populations greater than 1,000. These planning councils were created to replace the planning units established under Ky. Rev. Stat. Ann. §§ 151.114, 151.603(2).[23] Each planning council was required to develop a plan that included a water needs forecast for the county for 5, 10, 15, and 20 years after the year 2000 and a "strategy for delivering potable water as needed into the underserved and unserved areas of the county" (Ky. Rev. Stat. Ann. § 151.603). Plans were to be completed by July 1, 2001, and be consistent with the county long-range water supply plan established under Ky. Rev. Stat. Ann. § 151.114 and the water supply planning process established in Ky. Rev. Stat. Ann. Chapter 151 and Ky. Rev. Stat. Ann. § 224A.300.[24]

The final plan documents were required to discuss many issues, including planning objectives and water supply planning conflicts; water use, forecast, and infrastructure assessment; water supplier source assessment; supply adequacy assessment; supply protection; water resources inventory; water supply alternatives; primary water supply alternatives; and emergency plans (401 Ky. Admin. Regs. 4:220, § 3). The law did not explicitly require the consideration of climate change. If the current supply source was deemed adequate based on the projected need, no information about alternatives water sources needed to be included within the plan (401 Ky. Admin. Regs. 4:220, § 3).

In the same year, the legislature also authorized the Kentucky Infrastructure Authority (KIA) to "implement a program for the provision of water services as authorized in the budget and directed by the General Assembly" (Ky. Rev. Stat. Ann. § 224A.300). A "2020 water service account" was also established within the infrastructure revolving fund to allow the Authority to "assist in making potable water available to all Kentuckians by the year 2020" (Ky. Rev. Stat. Ann. § 224A.304). As can be seen through this example, the law plays a central part in establishing the roles and requirements for using and managing water resources, as well as in creating the institutions, structures and programs used to manage water. Further, this funding mechanism helps to close the water access gap.

While not specific to climate change, although with implications, drought planning laws and policies are approaches that have been used for requiring or incentivizing consideration of how a water system will function and adapt to water scarcity and supply constraints. A 2022 study by the Alliance for Water Efficiency (AWE) found that California was the only state to require utilities to have climate change-related plans, reports, or actions. It also found that 7 states have requirements for water providers to have a stand-alone drought preparedness plan and that 13 states require drought preparedness plans as part of a general plan, emergency plan, or part of permitting processes (Burke et al. 2022). Box 2 describes a 2021 drought planning act in California that was designed to help make drought planning more accessible for small drinking water systems. With small systems often serving frontline communities, it is important to ensure that such systems participate in planning processes.

23 Each area development district was tasked with developing water management areas within twelve months of July 14, 2000 (Ky. Rev. Stat. Ann. § 224A.302). Two or more counties were also allowed to form a multi-county water management planning council (Ky. Rev. Stat. Ann. § 151.601).

24 Per regulation, the planning representative was required to develop two documents: a plan formulation document (describing the details of the planning process) and the final plan (authorizing the Cabinet to develop regulations to shape the implementation of the law) (401 Ky. Admin. Regs. 4:220, § 3; Ky. Rev. Stat. Ann. § 151.116).

BOX 2. **Making Drought Planning Accessible for Small Drinking Water Systems**

Water supply planning is a complex, technical, time-intensive process. Small drinking water systems with limited capacity may need support to ensure proper plans are in place for if/when a drought emergency occurs. In California, S.B. 552 (2021), the Drought Planning for Small Water Suppliers Act, set requirements for small water systems and schools with their own water supply to develop water shortage contingency plans with specific drought elements (S.B. 552, 2021 Reg. Sess. (Cal. 2021)). To address the capacity challenges created by these requirements, the act requires that county governments lead the drought and water shortage planning. To facilitate this role, the state has provided training for counties to learn about their new role, created resources like contingency plan templates, and established an interagency task force to provide better collaboration between stakeholders surrounding drought response. The state also set up the Small Community Drought Relief Program to provide funding and technical assistance for small water systems, which can be used for extending surface water intakes, water hauling, installing water tanks, and other measures (California DWR 2022a; 2022b).

4.1.6 Managing Water Demand

As climate change alters precipitation patterns, populations continue to grow in urban centers, and costs of delivering water increase, instituting laws and policies that help reduce water use or make it more efficient can help communities adapt to these pressures. Often, this type of water management is called “demand management” because it focuses on changing the everyday water demand. Managing demand with conservation and efficiency is often the most cost effective “new supply,” with mounting evidence for its long-term affordability benefits (Cooley, Shimabuku, and DeMyers 2022). This category of water management seeks to reduce and shift water demand to ensure there is enough water supply over the longer term, reducing the need to take emergency measures or use more coercive approaches to manage water use.

While demand management is often applied through voluntary measures, there are several ways that laws and policies have led to long-term water demand reductions and supported adaptation to increasing water scarcity and more intense, prolonged periods of drought. Some of the most effective demand management regulation has been through the Energy Policy Act of 1992, which, among other things, established water and energy efficiency standards for household appliances and fixtures, like toilets, washing machines, and showerheads. The law requires that all appliances and fixtures sold in the US meet an efficiency standard. This means that as homeowners and businesses replace or upgrade water-using fixtures and appliances, the fixtures and appliances on the market are getting more efficient. In 2014, AWE estimated that over the first 20 years of the Energy Policy Act almost 18.2 trillion gallons of water were saved because of the law (Alliance for Water Efficiency 2014).

Toilets are some of the most water wasteful household appliances (DeOreo et al. 2016). In 2022, the US Department of Energy waived federal preemption of national standards for toilet water efficiency, allowing states to adopt more stringent standards (10 C.F.R. 430 (2022)). Fifteen states have gone beyond the Energy Policy Act by enacting higher standards for appliances and fixtures sold in their state (Burke et al. 2022). In many of these states, they set their appliance and efficiency standards to match those certified by the US EPA's WaterSense Program. The WaterSense Program is a voluntary water efficiency device certification program, similar to Energy Star for energy efficiency.[25] WaterSense certifies devices such as toilets, showerheads, and irrigation controllers that use at least 20 percent less water and perform as well or better than regular models. This is important because toilet use accounts for approximately one-quarter of all indoor household uses in the US (DeOreo et al. 2016).

States have also passed laws to update building codes to help ensure that new construction will use efficient appliances and fixtures. As an example, the Georgia State legislature adopted the Georgia Water Stewardship Act in 2010. Under the act, the Department of Community Affairs was required to amend the state minimum standard codes to require the installation of high efficiency toilets and other plumbing fixtures in all new construction issued a permit on or after July 1, 2012 (Ga. Code Ann. § 8-2-3(a)). High efficiency toilets were required to have an average flush volume that did not exceed 1.28 gallons per flush (GPF), in line with the WaterSense standard (Ga. Code Ann. § 8-2-3(c)(1)). Other states, such as Colorado and Texas, have adopted the WaterSense standard for use in new construction as well. Nine states have adopted laws more efficient than the federal standard for toilets, showerheads, and urinals, while six other states have more efficient standards for at least one or two of these fixtures, showing that this is a growing trend (Burke et al. 2022).[26]

There are also examples of states that have adopted laws that require retrofits of inefficient fixtures and appliances upon the sale or change of ownership of a property. For example, in 2009, the California State legislature passed SB 407 to adopt the federal standard of 1.6 GPF for new construction and for retrofits of older properties whenever there is a change in ownership status (S.B. 407, 2009 Reg. Sess. (Cal. 2009)). The law had impacts on real estate sales and applies to residential and commercial properties built on or before January 1, 1994 (Cal. Civ. Code § 1101.2). On or before January 1, 2017, all noncompliant plumbing fixtures in single-family residential properties were to be replaced; any noncompliant plumbing fixtures were to be disclosed in writing to prospective purchasers (Cal. Civ. Code § 1101.4). On or before January 1, 2019, all noncompliant plumbing fixtures in multifamily residential properties and commercial properties were to be replaced (Cal. Civ. Code § 1101.5).[27] Interestingly, the law does not establish civil or administrative penalties that can be assessed for failing to replace a toilet with one that meets the standard. However, the law does establish penalties for selling a toilet that does not comply with the new standard (Cal. Code Regs. tit. 20, §§ 1608-1609).

25 Energy Star is a labeling program administered by the EPA that is used to identify products that are energy efficient. For more information, see https://www.energystar.gov.

26 The nine states with laws that require more efficient toilets, showerheads, and urinals are Washington, California, Colorado, New York, Maryland, New Jersey, Massachusetts, Rhode Island, and Maine. The six other states where there are laws requiring at least one or two of these fixtures to be more efficient are Oregon, Hawaii, Illinois, Texas, Georgia, and Vermont.

27 Noncompliant toilets were defined as any toilet manufactured to use more than 1.6 GPF (Cal. Civ. Code § 1101.3(c)). This standard was updated in 2015 by the California Energy Commission. The new standard required that all water closets sold or offered for sale on or after January 1, 2016, use no more than 1.28 GPF (Cal. Code Regs. tit. 20, § 1605.3(i)). Water closet is defined as, "Water closet means a plumbing fixture having a water-containing receptor that received liquid and solid body waste through an exposed integral trap into a gravity drainage system" (Cal. Code Regs. Tit. 20 § 1602).

Another approach to demand management is through water conservation and efficiency planning, either at the state or local level. Water conservation and efficiency planning—such as California's SB X7-7 (The Water Conservation Act of 2009) and AB1668/SB606 (approved in 2018), which set standards for urban water suppliers—can be used to help prepare for and adapt to increasing water scarcity caused by climate change. AB1668, which added Water Code § 10609.2, requires the SWRCB, in coordination with the Department of Water Resources, to adopt standards by regulation for the efficient use of water and performance measures for commercial, industrial, and institutional water use. These standards, along with others, are then to be used by urban water suppliers to set urban water use objectives. This regulation was adopted by the SWRCB on July 3rd, 2024, and it will go into effect in 2025. As of 2022, there were 22 states that had water conservation planning requirements for municipalities, water suppliers, or managers and 40 states had some type of required water conservation planning focused on reducing long-term water demand (Burke et al. 2022).

4.1.7 Alternative Water Supplies

As climate change alters weather patterns and increases the frequency and intensity of extreme storms, water supplies are becoming less reliable and less predictable than they once were (Lall et al. 2018; Payton et al. 2023). Increasingly, drinking water suppliers are considering alternative water supply options to enhance supply reliability, which includes wastewater reuse, stormwater capture, and other options (Gleick and Cooley 2021). Laws and policies can increase adoption of alternative supply sources and build climate resilience as well as encourage the use of alternative supply sources to help ensure that use is done safely (Burke et al. 2022).

While recycling and reusing wastewater has been happening for several decades, state legislatures have only recently allowed wastewater to be seen as more than just waste.

4.1.7.1 Water Reuse and Recycling

Reuse and recycling of treated wastewater from centralized wastewater treatment plants can increase water supply. Water reuse and recycling are used in some communities for climate adaptation and improved water supply resilience by adding to the community's supply portfolio or by freeing up freshwater to be used for other purposes (Drechsel, Qadir, and Baumann 2022). While water reuse and recycling require collaboration beyond the drinking water sector with wastewater treatment plants and other entities, we include this discussion of water reuse within the drinking water system section because water reuse and recycling can help meet water demands by reducing the pressure on centralized drinking systems (and households through household rainwater harvesting or greywater systems, both discussed below).

While recycling and reusing wastewater has been happening for several decades, state legislatures have only recently allowed wastewater to be seen as more than just waste. Water reuse—where water from different sources is treated to be used for a specific purpose, or end-use, (US EPA 2023a)—can be cost effective, conserve energy, and decrease reliance on water treated to drinking water standards. Wastewater from a centralized wastewater system can be recycled by treating it for direct potable reuse, indirect potable reuse, non-potable reuse, and de-facto reuse. De-facto reuse occurs when a community's drinking water supply is sourced from a river that is downstream from where cleaned, or treated, water is discharged from a treatment facility (e.g., water reclamation facility, wastewater treatment plant) (WateReuse Association 2016). Recycled water could be used for irrigation, agriculture, municipal water supply, industrial reuse, toilet flushing, aquifer recharge, or environmental restoration, depending on the treatment used and the allowable end-use.

Water reuse was historically prohibited or limited in many states. Insufficiently treated wastewater can present a danger to public health and the environment by exposing people to bacteria and other harmful elements. Concerns about these potential exposures, fueled by limited scientific knowledge and political considerations, led many state and local governments to place limits on the ability to reuse water. However, laws and the increased incidence of water scarcity have driven advancements in laws, policies, and technologies that have made wastewater reuse more common, especially in some geographies. At the federal level, the EPA has issued a National Water Reuse Action Plan to identify actions that can be taken by partners to increase the adoption of water reuse (US EPA 2023a). While the plan sets out pathways for water reuse, the EPA has not adopted mandatory standards governing recycled water quality separate from existing drinking water requirements in the SDWA.

Today, many states have adopted or are in the process of adopting regulations to govern and encourage water reuse. Research from 2021 found 56% of the 18 states represented by the Western States Water Council have adopted specific state reuse statutes, 72% have specific state reuse regulations, and 83% have specific state reuse guidance documents (Reimer and Bushman 2021). In 2023, the State of Colorado passed a Direct Potable Reuse Policy (5 CCR 1002-11,DW-016, DW-017), which enables public water systems to implement treat and use wastewater as a drinking water supply. This was the first state-level direct potable reuse policy in the nation.

Research from 2021 found 56% of the 18 states represented by the Western States Water Council have adopted specific state reuse statutes, 72% have specific state reuse regulations, and 83% have specific state reuse guidance documents.

Onsite water reuse is also growing, driven in part by the need to increase water resilience (Snyder, Cooley, and Thebo 2023) Onsite water systems collect water from appliances and fixtures, like sinks, showers, and toilets, as well as from rooftop rainwater and foundation drain water, and then treat it onsite so it can be reused again at the same facility. Minnesota, Colorado, California, Hawaii, and Washington, and several large cities have adopted standards for onsite nonpotable water systems (WateReuse Association, The Water Research Foundation, and US Water Alliance 2021). Each state or municipality has designed their own unique set of standards that dictates what type of water can be collected and reused, the treatment requirements, the specific operations and maintenance protocols, and the allowable end-uses. To protect public health, these standards become increasingly stringent as the likelihood for human contact (with recycled water) also increases.

Water scarcity has driven adoption of laws that incentivize water reuse. For example, the California Water Code defines the use of potable domestic water for nonpotable uses as a waste or unreasonable use of water if recycled water is available for use, thereby incentivizing the adoption of water reuse (Cal. Water Code § 13550). The Code also requires the State Department of Public Health to establish “uniform statewide recycling criteria for each varying type of use of recycled water where the use involves the protection of public health” (Cal. Water Code § 13521). In 2023, California became the second state (after Colorado) to adopt uniform water recycling criteria for direct potable reuse (WateReuse Association 2023).

In states with water rights based on the prior appropriation doctrine, water reuse can require additional permits or processes to ensure that downstream users are not harmed by the project. In California, water reuse is not defined as a beneficial use; therefore, appropriative rights to reclaimed water cannot be granted to that water. If a water reuse project will change the amount of wastewater released into a waterway, then a wastewater change petition must be filed through the State Water Board Division of Water Rights (Reimer and Bushman 2021). The request will be reviewed based on the impact to rights holders caused by the recycled water not being returned to the waterway. In a system of water rights that depends on the return of effluent to the waterway, it is likely that requests to recycle water may interfere with senior appropriative rights (Reimer and Bushman 2021). In Arizona, effluent and recycled water belong to the person who created them until the recycled water takes on the characteristics of groundwater or surface water (Reimer and Bushman 2021). This ownership extends to being able to store and recover the reclaimed water for later use. Therefore, the water rights structure in Arizona does not impede water recycling.

> While stormwater and floodwater are usually considered hazards or nuisances, they are increasingly being recognized as a potential water supply.

Greywater—water from sources not contaminated with fecal waste, such as showers, bathtubs, handwashing sinks, or washing machines—can also be used to replace the use of potable water for purposes that do not need potable water (e.g., toilet flushing). By using greywater, the volume of wastewater that needs to be treated in centralized wastewater system is reduced. Texas allows the use of greywater in certain circumstances. According to Texas State regulations, greywater can be used for landscape irrigation, gardening, composting, and toilet or urinal flushing, and no permit is required to use greywater if you use less than 400 gallons per day (30 Tex. Admin. Code § 210.83). The State of Washington regulates greywater differently. Washington State Department of Health takes a risk-based approach to allowing greywater reuse for subsurface irrigation, creating three tiers of usage. Tier one usage includes the use of no more than 60 gallons per day of light greywater (Wash. Admin. Code § 246-274-100). “Light greywater” is defined as water from bathroom sinks, showers, bathtubs, and washing machines (Wash. Admin. Code § 246-274-009). Tier two usage includes the use of no more than 3,500 gallons per day of light greywater evenly distributed across an irrigated field (Wash. Admin. Code § 246-274-200). Tier three usage includes the use of no more than 350 gallons per day of treated and evenly distributed “dark greywater” (Wash. Admin. Code § 246-274-300). Dark greywater is sourced from non-laundry utility sinks, kitchen sinks, and dishwashers (Wash. Admin. Code § 246-274-009). Permits are required for Tier 2 and Tier 3 systems (Wash. Admin. Code § 246-274-425). These standards are implemented by the local health boards, who also have the authority to adopt more stringent requirements (Wash. Admin. Code § 246-274-007).

Some communities offer financial incentives for installing a greywater system. In Arizona, Tucson Water will reimburse 50% of qualifying costs (up to $1000 for installing a permanent greywater system) after January 1, 2013 (City of Tucson 2023). In California, the City of Glendale offers a rebate of up to $500 for installing a “Laundry to Landscape” greywater system (Glendale Environmental Coalition 2020). The law can play a critical role in incentivizing the use of greywater.

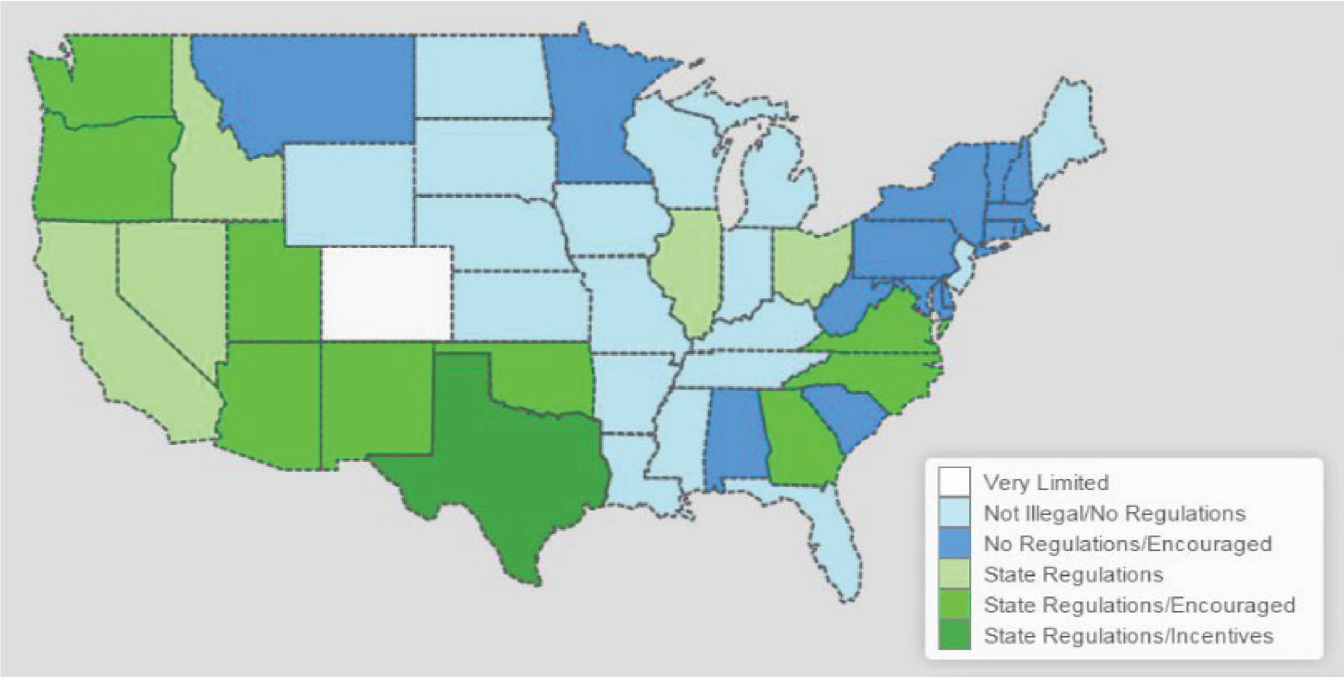
4.1.7.2 Rainwater and Stormwater

While stormwater and floodwater are usually considered hazards or nuisances, they are increasingly being recognized as a potential water supply (US EPA 2022b; Cooley et al. 2022; Berhanu et al. 2024). At the same time that climate change is increasing the need for alternative water supplies like stormwater, it is also altering urban stormwater runoff volumes and timing, necessitating new approaches to capture and manage stormwater (Nodine et al. 2024).

> Laws and regulations that dictate stormwater and floodwater capture and use vary across states.

Laws and regulations that dictate stormwater and floodwater capture and use vary across states. Loper (2015) reviewed laws and regulations from all 50 states on rainwater harvesting—a subset of stormwater capture that typically focuses on stormwater runoff from a roof—and found that the majority of states do not have rainwater harvesting regulations. The US EPA’s 2022 report, *Pure Potential: The Case for Stormwater Capture and Use*, identifies that state water rights, National Pollutant Discharge Elimination System (NPDES) permitting regulations, and water reuse regulations can constrain or support stormwater capture and use (US EPA 2022b). For example, Colorado’s water laws, under prior appropriation, restrict nearly all stormwater and floodwater capture and use because of the potential impact on downstream water rights holders (Loper 2015; Pacific Institute, Wright Water Engineers, and One Water Econ 2024). Rainwater harvesting from a household roof was illegal in Colorado until 2016, when a new law allowed it (Col. HB16-1005). However, harvesting is confined to no more than 110 gallons per household (Cabot et al. 2016). Colorado’s volumetric rainwater harvesting restrictions are the strictest in the country and many other states allow additional rainwater harvesting (Zac 2024; Pacific Institute, Wright Water Engineers, and One Water Econ 2024). Indeed, in much of the Western US—as well as in Texas, Oklahoma, Georgia, North Carolina, and Virginia—rainwater harvesting is encouraged or incentivized (Figure 4) (Loper 2015). In the rest of the country, for the most part, rainwater harvesting is either not regulated or explicitly deemed “not illegal.”

FIGURE 4. Map of State Regulations on Rainwater Harvesting



Source: Loper 2015

In states where laws are permissive of rainwater harvesting, households can collect rainwater from their roofs and use it to water their landscapes, wash their car, or—depending on state laws—apply it to other uses, such as toilet flushing. By using rainwater, households reduce their demand and dependence on drinking water systems. Studies from Texas and Mexico City suggest that rainwater harvesting may be an approach to closing the water access gap for lower-income and more marginalized communities (Aspinwall 2023; Oxfam Mexico 2020; Texas Rainwater Harvesting Evaluation Committee 2006). However, in Australia, where rainwater harvesting is more widespread than in the US, research indicates that climate change will reduce the reliability of rainwater harvesting to meet household water demands (Haque, Rahman, and Samali 2016). Furthermore, where rainwater is used, it is important to ensure that the water quality of the rainwater is appropriate for the use to which it is being applied.

4.2 OVERABUNDANCE OF WATER AND FLOOD IMPACTS ON CENTRALIZED DRINKING WATER SYSTEMS

Too little water can result in no drinking water for a community, but too much water can also mean that a community loses its access to drinking water from damage to infrastructure or from contamination of water supplies from flooding (Pacific Institute and DigDeep 2024). Centralized drinking water treatment and distribution systems are complex systems of hundreds of miles of pipes and infrastructure. Flooding along rivers or from coastal storms can damage and destroy intake and distribution pipes, treatment systems, and cause power outages that disrupt operation (Pacific Institute and DigDeep 2024). Flooding also can lead to contamination of both surface water and groundwater supplies, caused by the mobilization of debris and pollutants from roadways, industrial sites, sewage spills, and from other human sources (Wallender et al. 2014).

Climate change exacerbates the threat of flooding in many parts of the US. Climate changes—such as increasing intensity of precipitation events, more frequent rain-on-snow events, and greater damage from hurricanes exacerbated by sea level rise—all have the potential to increase the risk of damage from flooding to water systems (Hayhoe et al. 2018; Marvel et al. 2023; Payton et al. 2023). In this section, we discuss examples of how the law addresses (and thereby can help reduce or prevent) the impact of flooding on drinking water systems and water resources and how it encourages systems to adapt and rehabilitate after flood events. Often the law does not explicitly consider climate change potentially leaving centralized drinking water systems exposed.

Laws play a role in helping to anticipate, reduce, and at times, prevent the harmful impacts of flooding on drinking water infrastructure. Where the law has been unable to help prepare for anticipated impacts from flooding or prevent harm, it creates structures and processes for responding to the impact of flooding. First, laws set forth requirements for where and how new drinking water infrastructure is developed. Second, laws identify what steps can be taken to reduce the impact of flooding on systems that have already been built. Third, laws can help protect water supplies from contamination from both inland flooding and saltwater intrusion (caused by sea level rise). Fourth, laws also identify post-emergency responses and define requirements for rebuilding after an emergency.

4.2.1 Laws that Help Prevent and Reduce the Impact of Flooding through System Design and Construction Requirements

The Federal Emergency Management Agency (FEMA) has taken steps to minimize the impact of flooding on water supply, buildings, and other infrastructure (including on centralized drinking water systems and wastewater systems) by requiring new and retrofitted infrastructure to meet baseline standards for development in flood zones. Many of the protective requirements are embedded within the National Flood Insurance Program (NIFP). The National Flood Insurance Act establishing the NFIP program was adopted in 1968. After low enrollment, Congress passed the Flood Disaster Protection Act in 1973 (FEMA 2005). The Act required that any buildings constructed in floodplain zones have flood insurance in order to qualify to receive federal financial assistance, loans from federally insured or regulated lenders, and federal disaster assistance (FEMA 2005). These restrictions in accessing funding served to incentivize communities to participate in the program. The Act also prohibited the use of federal dollars toward the purchase or construction of buildings in floodplains located in non-participating communities (FEMA 2005). Since 1973, the largest changes to the program were realized through the National Flood Insurance Reform Act of 1994, including the adoption of the Community Rating System (CRS). Through the CRS, properties located in communities that adopt floodplain management requirements that exceed the minimum requirements of the NFIP qualify for a discount on their flood insurance premiums (FEMA 2005).

The NFIP regulations set forth the minimum requirements for participating in the program (44 C.F.R. § 59-60 (2022)). The minimum requirements applicable to the community depend on the degree of flood hazard and the level of data FEMA has collected and published about the community. Therefore, in communities where FEMA has not provided flood maps, there are fewer requirements to meet. More requirements are demanded in communities where FEMA has provided a Flood Insurance Rate Map (FIRM) with base flood elevations or communities where FEMA has provided a FIRM that shows coastal high hazard areas (44 C.F.R. § 60.3 (2022) (FEMA 2005).

Several gaps in the NFIP exist and can exacerbate vulnerability to flooding for drinking water systems. Homes and businesses, including drinking water systems in communities, outside the NIFP are not eligible for flood insurance from the NFIP and are therefore potentially at a higher degree of financial risk from a flood event. Historical practices of institutionalized racism, such as the redlining that placed housing in flood-prone areas, continue to shape the uneven outcomes from floods and other natural disasters with greater impacts on frontline communities and other marginalized groups (Linscott et al. 2022). For example, Linscott et al. (2022) used geospatial analysis to show how the 2010 Nashville and Davidson County, Tennessee flood event disproportionately impacted communities of color that lived in neighborhoods redlined in the 1930s. Scholars have shown that even in communities that are participating in the NFIP, protections and disaster recovery have been inequitably distributed, with costs disproportionately placed on low-income neighborhoods of these communities (Pralle 2019; Turrentine and Palmer 2022).

Scholars have shown that even in communities that are participating in the NFIP, protections and disaster recovery have been inequitably distributed, with costs disproportionately placed on low-income neighborhoods of these communities.

Another problem is that climate change was not yet considered an issue when the NFIP standards, many of the drinking water systems, and their communities were developed. Climate change alters both the severity and frequency of flooding, and climate change will continue to wreak havoc on these communities and systems through catastrophic flooding events (Pacific Institute and DigDeep 2024). The NFIP standards and maps in many places have not been substantially updated since the 1970s, leaving communities that were developed using the outdated standards at higher risk than they once had been (Turrentine and Palmer 2022). One way that the NFIP was designed to reduce flooding risk was predicated on communities adopting and using the FIRMs to both ensure buildings and other infrastructure in higher-risk areas were appropriately designed and to identify properties that were eligible for federal insurance. These maps show areas with 1% or greater risk of flooding in a year, but in some places climate change is increasing the frequency of these floods and making more severe floods more probable (Yu, Wright, and Li 2020; Payton et al. 2023).[28] More recently, FEMA has begun revising some aspects of NFIP, such as updating their risk rating methodology, which are supposed to help improve their rate setting to make it more equitable and better reflect a property's flood risk (FEMA 2022). Whereas the risk rating methods had previously focused on flood zones and elevations, it now incorporates frequency of flooding, multiple flood types (river overflow, coastal flooding

28 FEMA and other federal agencies like the USGS express flood risk based on the probability of occurrence of a certain magnitude of flood in a single year. A 100-year flood, therefore, has a 1-in-100 times probability (or 1% chance) of happening in a year. In many places, climate change is increasing the probability of a 100-year flood.

including storm surges, and flooding from heavy rainfall), proximity to flood sources, and building characteristics (such as first floor height) (FEMA 2022).

Communities that are able to participate in the NFIP must adopt and enforce "floodplain management requirements that meet or exceed minimum criteria established" by FEMA (44 C.F.R. § 59.2(b) (2022) (FEMA 2017). These requirements apply to new and substantially improved structures in Special Flood Hazard Areas (SFHAs).[29] Communities can achieve these requirements by adopting and enforcing comprehensive floodplain management or by incorporating the responsibilities set forth in the NFIP within existing land use or zoning ordinances. Once a community has adopted the NFIP minimum requirements, property owners within the community qualify for flood insurance, based on the terms set forth. However, historical flood event data used by the NFIP for establishing insurance premiums may not be applicable under future climate change as catastrophic flooding occurs more frequently (Turrentine and Palmer 2022).

The minimum requirements prescribed by the NFIP apply to existing structures. As mentioned above, existing structures to which substantial improvements are made are also required to comply with the minimum requirements established by the NFIP. Substantial improvement is defined as "any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction" of the improvement (44 C.F.R. § 59.1 (2022). Therefore, when any substantial improvements are made to an existing structure, the structure must come into compliance with the NFIP requirements. This includes projects that are completed under multiple permits or over several years.

The National Flood Insurance Act encourages states to adopt more stringent requirements than those identified by the act.

Substantial improvement also includes structures that have incurred substantial damage, regardless of the actual repair work performed (44 C.F.R. § 59.1 (2022). Substantial damage is similarly defined as "damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred" (44 C.F.R. § 59.1 (2022). The cost to repair is required to reflect the full cost of restoring the system to its before-damage condition, even if the owner chooses to do less (FEMA 2005). That cost is then compared to the market value of the structure prior to the damage. In this situation, a system is expected to come into full compliance with the NFIP as if it were new construction or were undergoing substantial improvement.[30]

29 A SFHA is defined by FEMA as "an area having special flood, mudflow or flood-related erosion hazards and shown on a Flood Hazard Boundary Map (FHBM) or a Flood Insurance Rate Map (FIRM)…" (FEMA 2020b)(Federal Emergency Management Agency 2020).

30 Although we recognize that flood insurance plays a significant role while also having limitations, more on this topic is beyond the scope of this report and will be addressed in the third report in this series on strategies and approaches to equitable, climate-resilient water and sanitation in the US.

Some states have taken steps to go beyond FEMA's NFIP requirements. The National Flood Insurance Act encourages states to adopt more stringent requirements than those identified by the act (44 C.F.R. § 60.1(d) (2022)). For example, New Hampshire's Department of Business and Economic Affairs provides model ordinances based on the minimum requirements prescribed by the NFIP and the levels of information made available about the community (New Hampshire Department of Business and Economic Affairs, n.d.).[31] New Hampshire has also adopted a "menu" of more stringent floodplain regulation standards that can and have been adopted by communities (New Hampshire Office of Strategic Initiatives 2020). The menu provides a description of the higher standard, sample model ordinance language, and if a CRS credit (that can contribute to a percent discount on federal flood insurance) is available. Within this menu, water supply and wastewater systems are designated as "critical facilities," which means new systems or those under reconstruction must comply with more strict flooding design and construction regulations.[32] Virginia likewise provides draft ordinances with similar requirements for water supply and sewerage systems (Virginia Department of Conservation and Recreation 2023).

4.2.2 The Role of Nature-Based Solutions in Flood Preparedness

Nature-based solutions (NBS), such as restoring and conserving floodplains, installing rain gardens or swales, and reducing impermeable surfaces, help prevent the impact of stormwater and flood waters on infrastructure, including drinking water systems (Huang et al. 2020).[33] NBS can help to mitigate flood risk and protect infrastructure by absorbing and slowing the flow of water before and during flooding events, although effectiveness of NBS to mitigate flooding has been found to vary by location, storm size, design, and other factors (Huang et al. 2020). In the US, a common NBS approach to stormwater management is through green infrastructure (GI). GI is defined in the CWA as "the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or facilitate the evapotranspiration of stormwater and reduction of flows to sewer systems or to surface waters.'' Whereas gray infrastructure channels water, green infrastructure uses permeable surfaces to allow water to be absorbed. The definition of GI was added by the Water Infrastructure Improvement Act of 2019 to the CWA (Water Infrastructure Improvement Act, Pub. L. 115-436; Clean Water Act,

> In the US, a common nature-based solution approach to stormwater management is through green infrastructure.

31 Within the Model Plans for Communities with no Special Flood Hazard Areas (SFHA) and Communities with Special Flood Hazard Areas (SFHA) and Zone VE, the same requirements apply to water supply and sanitation systems. New and replacement water supply and sewage disposal systems are required to be "designed to minimize or eliminate infiltration of flood waters into the systems" (New Hampshire Office of Strategic Initiatives 2020).

32 The sample ordinance language states that all "new critical facilities are prohibited within a special flood hazard area (or within a special hazard area and the 0.2 percent annual chance (500-year) floodplain)." Furthermore, "critical facilities that are to be replaced, substantially improved, or meet the definition of substantial damage shall be constructed so that the lowest floor, including basement, shall be elevated or dry-floodproofed at least one foot above the elevation of the 0.2% annual flood height or three feet above the base flood elevation, whichever is higher" (New Hampshire Office of Strategic Initiatives 2020).

33 There is no single definition of NBS, but this report adopts the International Union for the Conservation of Nature (IUCN) definition (IUCN 2016) because it is the most established and referenced. The IUCN defines NBS as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits."

33 USC. 1362(27)). Therefore, GI solutions may be available to help communities adapt to changing volumes of stormwater and flood water by mitigating some of the impacts from precipitation events on drinking water infrastructure.

4.3 DRINKING WATER QUALITY FROM CENTRALIZED DRINKING WATER SYSTEMS

Climate change is having many impacts on water quality, making it more challenging and costly for centralized drinking water systems to adhere to legal drinking water quality standards (Payton et al. 2023). For example, extreme heat events lead to cyanobacterial algal blooms in reservoirs, sea level rise causes saltwater contamination of groundwater and surface water supplies, and wildfires leave burn scars that can contribute toxic sediment into drinking water supplies for years following the event (Pacific Institute and DigDeep 2024). Increasing temperatures, flooding, sea level rise, and other climate change phenomena have been directly linked to increasing concentrations of toxic contaminants, like per- and polyfluoroalkyl substances (PFAS) and microplastics in water sources (Gander 2022). Rising costs in the drinking water sector to address these types of challenges create affordability challenges for low-income households (Cardoso and Wichman 2022). In this section, we examine how the law helps to ensure that the water supplied through centralized drinking water systems is safe to drink, considering the additional stress that climate change will put on water resource quality and water infrastructure.

The SDWA applies to all public water systems and sets the foundation for ensuring the provision of safe drinking water by defining safe drinking water to consume and use.[34] This foundation will be critical for protecting households that receive their water from a centralized drinking water system because climate change contributes to water quality degradation. As discussed in Section 3, under the SDWA there are two types of public water systems: community water systems and noncommunity water systems, which includes nontransient water systems (such as a school, factory, office building, or church) and transient noncommunity water systems (such as a campground or gas station). In this report, we are focused mostly on community water systems.

The Safe Drinking Water Act sets national standards for the drinking water supplied by public water systems.

The SDWA sets national standards for the drinking water supplied by public water systems. These National Primary Drinking Water Standards are made up of Maximum Contaminant Level Goals (MCLG) and Maximum Contaminant Levels (MCL). MCLGs are set at "the level at which no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety" (42 USC. § 300g-1(4)(A)), but they are not enforceable. MCLs, which are the highest allowed level of a contaminant in drinking water, are then set as close to the MCLG as is feasible (42 USC.

34 The SDWA defines a public water system as a "system for the provision to the public of water for human consumption through pipes or other constructed conveyances if such system has at least fifteen service connections or regularly serves at least twenty-five individuals. Such term includes (i) any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system, and (ii) any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system" (42 USC. § 300f(4)(a)).

§ 300g-1(4)(B)).[35] Feasibility is based on treatment technologies and techniques, or other means identified by the EPA's administrator (the politically appointed cabinet head of the EPA). While the administrator must identify the treatment technologies and techniques that have been established as feasible, the regulations do not require the use of a specific technology (42 USC. § 300g-1(4)(E)(i)). Along with proposing the MCL, starting in 1996 the SDWA was amended to require the administrator to publish a determination as to whether the benefits of the MCL justify the costs of meeting the MCL (42 USC. § 300g-1(4)(C)). It also required the administrator to identify treatment technologies and techniques that are affordable and available to small systems to ensure that small systems with more limited financial resources can comply with the standards (42 USC. § 300g-1(4)(E)(ii)).

One challenge posed by climate change for centralized drinking water systems is that it is causing increases in the presence and concentration of toxic contaminants, like PFAS (Pacific Institute and DigDeep 2024).[36] PFAS are a class of chemicals that can leach during rain and flooding events from landfills, agricultural lands, biosolids from wastewater treatment plants, and septic systems (Gander 2022). As recently as April 2024 the EPA announced the final National Primary Drinking Water Regulation (NPDWR) for six forms of PFAS (US EPA, OW 2024). The NPDWR establishes a legally enforceable MCLs for these six PFAS in drinking water. This new regulation is expected to prevent PFAS exposure in drinking water for approximately 100 million people, while compliance by drinking water systems and wastewater treatment plants will cost approximately $1.5 billion per year (US EPA, OW 2024).

As recently as April 2024 the EPA announced the final National Primary Drinking Water Regulation (NPDWR) for six forms of PFAS. The NPDWR establishes a legally enforceable MCLs for these six PFAS in drinking water.

Both federal and state laws regulate public water systems that violate the SDWA and allow for interventions like restructuring. At the federal level, a law passed as part of the America's Water Infrastructure Act (AWIA) of 2018 mandates that EPA develop and implement the Water System Restructuring Rule (WSSR) (Landes et al. 2021). The WSSR facilitates the legal process for restructuring ownership and management of public water systems that are struggling to comply with the SDWA. States have also created similar state-level legal options. Box 3 describes a program established by law in the state of California that was created to address issues at water systems that were failing to meet drinking water standards.

35 Feasible is defined as "feasible with the use of the best technology, treatment techniques and other means which the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions, are available (taking cost into consideration)" (42 U.S.C. § 300g-1(4)(D)).

36 PFAS compounds may have toxic health impacts in humans and are found throughout the global water cycle (Gander 2022). Gander explains that PFAS compounds are used to make products resist heat and stains, repel water, and reduce friction. The same study says that PFAS are found in many household and industrial products such as non-stick pans, water-repellent clothing, stain-resistant furniture, and fire-fighting foam.

BOX 3. Policies for Failing Drinking Water Systems and the SAFER Program

Approximately 1,050 drinking water systems that serve almost 12 million people are failing to meet health-based federal drinking water standards.[37] An unknown but likely larger proportion of drinking water systems are at risk of failing to provide safe drinking water to their communities due to low capacity, inadequate funding, increasingly stringent regulations, and climate change (Feinstein et al. 2020). The vast majority (more than 95%) of these failing or at-risk systems are small, serving 10,000 people or less (Feinstein et al. 2020). Mueller and Gasteyer (2021) found that while lack of complete plumbing is primarily a challenge for rural households, unclean and unsafe water is primarily a challenge faced by urban households. They also found that SDWA violations are positively correlated with the poverty rate. This suggests that the communities served by these failing systems are likely not able to shoulder the additional costs necessary to fix the problems.

In 2019, the California State legislature passed Senate Bill 200, establishing the Safe and Affordable Funding for Equity and Resilience (SAFER) program (S.B. 200, 2019 Reg. Sess. (Cal. 2019)). The SAFER program provides an array of resources and tools for failing and at-risk drinking water systems. These include a set of tools (e.g., technical assistance, point-of-use/point-of-entry drinking water treatment systems, maps and data), funding sources, and regulatory authorities with the goal of advancing sustainable solutions to ensure safe, affordable water for all people in California. As of the time of this writing, SAFER had provided 300 projects with technical assistance and $700 million in grants (California State Water Resources Control Board 2024). However, the pace of progress has also been slower than expected. The state auditor found that "over the past five years, the average length of time for water systems to complete their applications and receive funding nearly doubled, from 17 months to 33 months" (Tilden 2022). Nonetheless, this program offers a potential model that could be applied in other states to more proactively and holistically address water quality challenges faced by drinking water systems.

Source water quality—which pertains to water sourced from rivers, lakes, groundwater aquifers and other water bodies and used for supplies for drinking water—is being altered by climate change (Payton et al. 2023).[38] Beyond setting the drinking water standards for centralized drinking water systems, the SDWA also requires states with primary enforcement responsibility to carry

37 Values calculated using Safe Drinking Water Information System (SIDWIS) data exported from ECHO.epa.gov on January 20, 23. Data is for community water systems with at least one health-based violation within the past three years. A single community water system, New York City System (PWSID NY7003493), accounts for 8,271,000 of the 12 million people served by systems with violations.

38 The EPA defines source water as "sources of water (such as rivers, streams, lakes, reservoirs, springs, and groundwater) that provide water to public drinking water supplies and private wells" (US Environmental Protection Agency, Office of Water 2015). .

out a source water assessment program (42 USC. § 300j-13(a)(1)).[39] Source water assessment programs must delineate the boundaries of the assessment areas from which one or more public water systems draw drinking water, inventory possible contaminating activities (PCAs) that may be responsible for releasing regulated contaminants into the source water, and, in such a case, determine how vulnerable the public water system is to the identified PCAs (42 USC. § 300j-13(a)(2)). All assessments were required to be conducted by May 2003. States were also required to submit their programs to the EPA for approval (42 USC. § 300j-13(a)(2)).

Different states included different components for their source assessment programs. For example, the California Drinking Water Source Assessment and Protection Program Plan ("Plan") identified the following as the minimum components of the drinking water source water assessments for surface waters and groundwater: (a) location of the drinking water source, (b) delineation of source area and protection zones, (c) drinking water physical barrier effectiveness checklist, (d) inventory of possible contaminating activities, (e) vulnerability ranking, (f) assessment map, (g) completion of assessment and summary for submission, and (h) public notification through the consumer confidence report (California SWRCB 2021).

Within the Plan, California also identifies voluntary steps communities can take to improve source water protection based on the assessments. The Plan identifies several regulatory management measures as well as non-regulatory management measures for local source water protection programs (California SWRCB 2021). Examples of regulatory measures within the Plan include zoning rules, such as prohibitions on certain land uses and the adoption of growth controls, and land use permit conditions, such as requiring for the review of surface water and groundwater contamination before beginning a new use or regulating underground tank storage. Some examples of nonregulatory measures include conservation easements, watershed restoration efforts, stormwater monitoring, groundwater monitoring, public education, contingency plans, and storm drain labeling. By comparison, the SDWA only requires the conducting of assessments. No additional actions are required under federal law regardless of the results of the assessments. And neither state nor federal programs ensure that climate change impacts to source water quality will be assessed or addressed.

The CWA plays a critical role in protecting source water quality by regulating the release of discharges into rivers and lakes from municipal, commercial, and industrial sources.

The CWA plays a critical role in protecting source water quality by regulating the release of discharges into rivers and lakes from municipal, commercial, and industrial sources. The CWA prohibits the discharge of any pollutant into "waters of the United States" except as allowed by the statute (33 USC. § 1311(a)). The term "Waters of the United States" (WOTUS) is critical to understanding which waters are subject to the requirements of the CWA. Only discharges into

39 Primary enforcement responsibility for public water systems can be given to states and Indian Tribes if they meet certain requirements. For more information see: https://www.epa.gov/dwreginfo/primacy-enforcement-responsibility-public-water-systems.

waters of the US can be regulated under the CWA. The 2023 decision by the Supreme Court in *Sackett v. Environmental Protection Agency* ("*Sackett II*") [40] limited the applicability of the CWA (598 US ____(2023). The Supreme Court concluded that beyond "traditional navigable waters"[41] (such as rivers and lakes), the CWA extends only to wetlands that have a continuous surface connection with a "water of the United States," which is defined as a "relatively permanent body of water connected to traditional interstate navigable waters" (*Sackett*, 598 US at ____). Broadly, the Supreme Court found that the WOTUS include those waterbodies that are relatively permanent and not those that are more frequently dry than flowing. Therefore, intermittent water bodies may be included within the WOTUS, however, ephemeral streams will likely not. While *Sackett II* limits the waters to which the CWA applies, the Supreme Court's 2020 decision in *County of Maui, Hawaii v. Hawaii Wildlife Fund* ensures that when there is a "functional equivalent of a direct discharge" (such as discharges of wastewater into underground injection wells that quickly reach navigable waters), a permit is required under the CWA (590 US ____ (2020)). As climate change alters the flows of water, certain waterbodies may no longer be subject to regulation, unless states adopt broader definitions of waters of the US.

Meeting drinking water standards will only become more difficult due to climate change, increasing the importance of the role that the SDWA and CWA each play in reducing the impact of water quality degradation from droughts, wildfires, extreme storms, and other climate change phenomena.

40 It is referred to as Sackett II to distinguish it from the 2012 Sacket I case.

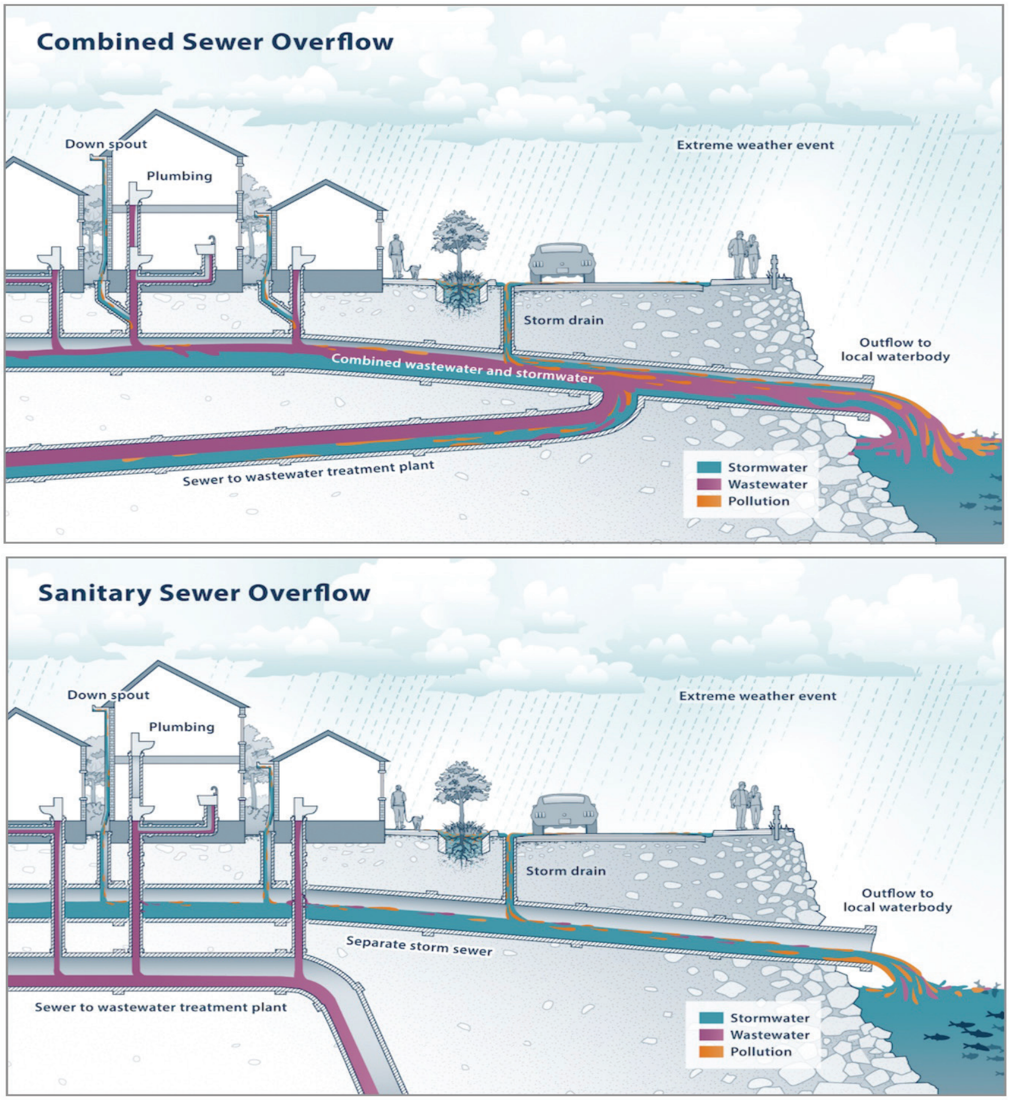
41 Defined as "interstate waters that were either navigable in fact and used in commerce or readily susceptible of being used in this way."

5. Centralized Wastewater Systems

Centralized wastewater systems provide services to the majority of people in the US, with more than 16,000 wastewater treatment providers in the country (American Society of Civil Engineers 2021). These providers serve approximately 75%–80% of the US population, the remaining population served by decentralized, onsite, off-grid sanitation systems, including cesspools and other systems without treatment (decentralized wastewater will be discussed in Section 6) (Maxcy-Brown, Elliott, and Bearden 2023). Centralized wastewater infrastructure is made up of a network of pipes that collect and convey household, commercial, and industrial effluents to a wastewater treatment plant (WWTP). The wastewater is treated to reduce and eliminate the presence of contaminants, as required by the CWA, and typically discharged into nearby streams or waterbodies. Many of the same benefits and challenges with respect to centralized drinking water apply to centralized wastewater treatment. According to the American Society of Civil Engineers (ASCE), 81% of WWTPs are operating at their design capacities, while 15% have reached or exceeded the volume of wastewater the systems can take in and treat (ASCE 2021). As treatment plants and collection networks reach the end of their lifespans, the cost of service will only increase when replacements become necessary. In 2019, the capital investment gap for centralized wastewater systems was calculated at $81 billion (ASCE 2021). Recent investments through the Bipartisan Infrastructure Act and the Inflation Reduction Act may help to close that gap by injecting more financial resources into our nation's water and wastewater systems (discussed more in Section 7.3).

Centralized wastewater systems that are connected to stormwater collection systems are called combined sewer systems (CSSs). Approximately 700 communities are served by CSSs in the US (US GAO 2023). During dry weather or low to moderate rainfall, the wastewater and stormwater is conveyed to the wastewater treatment plant (US GAO 2023). However, heavy rainfall makes the system more likely to become overwhelmed both from the high volumes of stormwater and from infiltration through cracks in the pipes from other sources like groundwater. When CSSs are overwhelmed, the systems are designed to allow untreated wastewater and stormwater to flow directly into rivers, lakes, and the ocean; this is called a combined sewer overflow (CSO) event (Figure 5). During these CSO events there can also be sewage backups in basements and overflows from manholes. As climate change increases the intensity and frequency of rainfall events in certain geographies, CSO events will become more common (Zouboulis and Tolkou 2015). For example, in 2021, Hurricanes Henri and Ida, which made landfall in New York City just a month apart, caused increases in sewer backups in homes and sink holes along streets (Aggarwala 2022).

FIGURE 5. Combined Sewer System During an Overflow Event in Which Stormwater, Wastewater, and Other Pollution Combine in the Sewer System and Flow into the Environment



Source: US Climate Resilience Toolkit 2022

In response to unregulated CSOs, the CWA was amended in 2000, requiring each permit, order, and decree adopted after the amendment enactment date to conform to the 2014 Combined Sewer Overflow Control Policy (CSO Control Policy) (33 USC. § 1342(q)). The CSO Control Policy states that implementation schedules included in Long Term Control Plans (LTCPs) and enforcement mechanisms "may be phased based on the relative importance of adverse impacts upon water quality standards and designated uses, priority projects identified in the long-term plan, and on a permittee's financial capability" (Combined Sewer Overflow Control Policy, 59 Fed. Reg. 18688 (April 19, 1994)) (US EPA 2023b). The EPA developed a Financial Capability Analysis (FCA) to inform how the financial capability of a utility and the community it serves is considered when setting the compliance schedule. The FCA allows systems to extend the timeline for complying with consent decrees (and therefore the requirements of the CWA) based on their communities' income and ability to absorb rate increases). While this allows utilities to keep water rates down, longer compliance schedules expose frontline communities to pollution for longer periods. This undercuts the promise of the CWA to provide fishable, swimmable waters across the country. Therefore, while the FCA may prevent significant rate hikes, it does so at a cost.

Not all wastewater treatment systems are combined sewer systems. Some systems are separate and distinct from the stormwater collection systems, which are called separate sanitary sewer systems (SSSSs), which reduce or eliminate the impact of rainwater on the operation of the wastewater treatment systems. Typically, with SSSSs there are also systems—called municipal separate stormwater systems—whereby stormwater is collected and conveyed separately. These systems are also regulated under the CWA via the EPA's NPDES permits. The permit contains limits on what can be discharged, monitoring and reporting requirements, and other provisions to protect water quality and public health (US EPA, OW 2014).

5.1 WATER SCARCITY AND SUPPLY FOR CENTRALIZED WASTEWATER SYSTEMS

Centralized wastewater systems are designed to function based on water mixing with and conveying waste products from homes and businesses to a treatment facility. In times of drought or scarcity when people are using less water, wastewater flows can become more concentrated (Zouboulis and Tolkou 2015). Concentrated flows can cause deterioration in effluent quality, which leads to challenges for wastewater treatment systems, including increased odors, corrosion of pipes, increased likelihood of blockages, and increased need for system cleaning (Zouboulis and Tolkou 2015; Hughes et al. 2021). Water scarcity also decreases the volume of surface water available to attenuate treated wastewater and other effluents that are discharged into streams, lakes, and rivers. The impacts on downstream ecosystems and communities can include elevated ambient water temperature and higher concentrations of remaining contaminants, such as PFAS and microplastics (Gander 2022). Here we examine how laws and policies help support climate change adaptation for centralized wastewater systems to function when water is scarce to protect frontline communities affected by wastewater discharge (Nguyen and Westerhoff 2019).

5.1.1 Reduced Influent Flow

Both climate change and changes in water demand have contributed to reductions in wastewater volumes leaving from communities and going to centralized wastewater systems (Porse et al. 2023) As discussed in Section 4.1.6 on managing water demand, conservation and efficiency measures help centralized drinking water systems reduce water demands during periods of water scarcity and drought. An outcome from reduced water use is reduced influent flow to centralized wastewater systems. Reduced influent flow can lead to greater concentrations of certain contaminants in wastewater, increased instances of pipe blockages, and reduced availability of treated effluent for recycled water production (Office of Water Programs, California State University, Sacramento et al. 2022). For example, during the 2012–2016 drought in California, reduced influent resulted in an effluent ammonium increase from 35 to 55 milligrams per liter (mg/L) at several case study sites. These types of increases require wastewater systems to use more energy and chemicals and can require increased labor (Office of Water Programs, California State University, Sacramento et al. 2022). The ASCE has claimed that reductions in water use by homes and businesses due to conservation and efficiency measures is one of the factors contributing to increased costs for operating and maintaining wastewater treatment systems (ASCE 2021).

Centralized wastewater systems are designed to ensure the treatment process will adhere to specific water quality regulations. While each system in the US is upheld to relatively consistent standards under the CWA, local conditions, such as climate, geography, and number of customers serviced, create variability in the final design and implementation of these systems. And once they are installed, it is often many decades before updates or improvements are made. Because of drought, climate change, and reductions in per capita water use, some wastewater systems have a mismatch between the volume of influent they were designed for when compared to the volume that they now receive (Porse et al. 2023). A survey of large California urban wastewater system managers found that they were concerned about these changing conditions and the consequences they have on their permit-based discharge requirements (Porse et al. 2023). But this research did not indicate that there were any laws or formal policies in place to address this challenge.

5.2 OVERABUNDANCE OF WATER AND FLOOD IMPACTS ON CENTRALIZED WASTEWATER SYSTEMS

Centralized wastewater systems are commonly located along waterways or the ocean at lower elevations relative to the communities they serve to allow for easy, gravity-driven transport of untreated wastewater from the community to the system and for the flow of treated wastewater back into the environment. This can make them highly susceptible to flooding and sea level rise, both of which are becoming more frequent and intense due to climate change (Zouboulis and Tolkou 2015; Pacific Institute and DigDeep 2024). For example, the severe winds and flooding brought on by Hurricane Harvey in 2017 caused several wastewater treatment systems in Houston to fail, resulting in thousands of gallons of untreated wastewater spilling into the streets of Houston (Stuckey 2017). Flooding can also take electrical systems offline, leading to failure of certain treatment components. In communities that have a CSS—where wastewater and stormwater are both conveyed in the same pipes to the wastewater treatment plant—flooding can lead to CSOs, which contaminate streets and waterways with raw sewage (Figure 5 above).

The law plays an important role in ensuring that wastewater systems, including sewer lines, are properly located, designed, constructed, operated, and maintained. This includes ensuring that they are sited in locations with low flood risk. In most parts of the US, these systems were installed decades ago to manage historical precipitation or around historical understanding of floodplains and are not designed to deal with changes in the volume or intensity of precipitation caused by climate change (Zouboulis and Tolkou 2015). Some legal approaches take into consideration alternative infrastructure designs—such as green infrastructure that uses nature-based approaches like rain gardens—to reduce the amount of stormwater and runoff entering the system. In this section, we examine how the law reduces the risk of too much water on wastewater systems.

5.2.1 Legal Protections for Climate-Resilient Siting, Construction, and Design of Wastewater Treatment

The siting, design, and proper construction of wastewater treatment plants can significantly impact the climate resiliency of these systems. Generally, state and local laws and regulations govern these engineering decisions. Federal regulations under the CWA are limited to regulating outflow point-sources and broader permitting of wastewater discharges, which can impact these decisions at the state and local levels.

State-level regulations often require consideration of a variety of factors for siting and constructing WWTPs, as with many large-scale construction projects. WWTPs may be subject to heightened regulation because of the risk posed to humans by insufficient treatment of wastewater and potential exposure to human fecal matter. In many cases, WWTPs have open-air facilities that may be compromised by a significant flood or heavy precipitation event. While newly adopted regulations can help address the threat of floods and other climate impacts when building new plants, changing existing plants may be harder.

One approach that states can use to try to reduce risk of flooding on new wastewater systems is around regulations on siting. For example, Massachusetts, Florida, and Texas all use the 100-year floodplain as their main determinant for siting of WWTPs and require design and construction of most components to be up to the 100-year flood standard (Fla. Stat. § 403.088; (Massachusetts Department of Environmental Protection 2018); 30 Tex. Admin. Code § 217.35). The Massachusetts Department of Environmental Protection is empowered by the Massachusetts Clean Waters Act to issue regulations for siting, design, and construction. Having suffered severe weather events during winter, with paralyzing record snowfalls in 2015 and in 2022, Massachusetts has felt the impacts of a changing climate (Massachusetts Climate Change Clearinghouse, n.d.; Staff and wire reports 2022). Similarly, Texas and Florida have also experienced significant weather events supercharged by our changing climate (Carter et al. 2018; Kloesel et al. 2018).

There are also federal policies that address siting of various facilities to help reduce risk of flooding and other natural disasters. Under Executive Order 11988, federal agencies must avoid placing critical facilities—such as hospitals and utilities—in the 0.2% (i.e., 500-year) floodplain or must design the facilities to protect against the 0.2% chance flood level (FEMA 2020a).[42] However, in some places as climate change increases the likelihood of these larger flooding events, what are currently referred to as 500-year (or more) events, will become more common, and so regulations need to be updated to protect against the increased severity and larger extent of future flooding (Yu, Wright, and Li 2020; Payton et al. 2023).

As mentioned above, WWTPs are commonly sited near water features at lower elevations than the communities they serve, including ocean and bay shorelines to take advantage of gravity. For these facilities, sea level rise is expected to increase the likelihood of flooding during high tides and storm events, potentially damaging pumps and other equipment, which can lead to untreated sewage discharges (Zouboulis and Tolkou 2015; Pacific Institute and DigDeep 2024). In the San Francisco Bay Area, for example, a Pacific Institute analysis found that a 1.0m to 1.4m sea level rise (the amount projected for that region under medium and high emissions scenarios) would put 8 to 10 WWTPs, respectively, at risk of regular inundation (Heberger et al. 2012). While WWTPs are taking steps to protect their infrastructure from sea level rise and erosion (such as San Francisco's decision to bury a low-level seawall at the aptly-named Oceanside Treatment Plant), many of these changes are made purely voluntarily (Weiser 2018).

42 A 500-year flood has a 1-in-500 times probability (0.2% chance) of happening in any given year. A 500-year flood is larger and more extensive than a 100-year flood. Climate change is altering these flood probabilities (USGS n.d.).

The physical impacts of flooding on centralized wastewater systems can also be felt at the household level, yet there are few legal mechanisms for protecting homeowners and renters from these events. Those impacted by sewer backups are not commonly protected by law from the costs associated with these events, and many insurance companies will not insure against water damage or sewer backups (Bell 2023). In certain cases, it may be possible to file a claim against the wastewater facility (or municipality), but it can be very difficult to prove that the backup event was caused by climate change or negligence on the side of the wastewater system, rather than by issues related to pipes on the homeowner's property.

In many cities, even small rainstorms can pose problems for aging sewers that were built decades or centuries in the past and are too small or in such poor condition that they cannot effectively transport water. Aging and inadequate infrastructure can lead to homes and businesses experiencing backflows of water from the sewer. In New York City, in spite of $20 billion invested in climate resilience measures that included improved stormwater management since Superstorm Sandy in 2012, aged water infrastructure and poorly equipped storm drainage systems have resulted in repeated sewage backups (City of New York 2023; Wilson and Meko 2023). These impacts can disproportionately affect low-income communities and communities of color, such as in South Jamaica, Queens, where the residents are predominantly Black and Latino and some homeowners experience sewer backups every few months (Scott 2022). In September 2023, an extreme rain event caused flash flooding in streets and basements across the city, and the governor declared a state of emergency (Wilson and Meko 2023). In a neighborhood between the border of Brooklyn and Queens that is not connected to a sewer system, a resident reported that her building was collapsing from water damage (Wilson and Meko 2023). A 2021 City of New York report estimated that completely recalibrating their sewers for extreme storms would take decades and could cost $100 billion (dependent on federal funding), and upgrading the system in Southeast Queens alone could cost $2 billion (The City of New York 2021). Climate change and the increase in extreme precipitation and storm events in many parts of the country will only worsen these types of inequities (Marvel et al. 2023; Payton et al. 2023)

5.3 WASTEWATER AND WATER QUALITY IN CENTRALIZED SYSTEMS

Untreated or insufficiently treated wastewater threatens the quality of surface waters, presenting a threat to drinking water, public health, and the environment. There are several ways that climate change impacts the ability of centralized wastewater systems to function properly and maintain protection of water quality. As discussed in Part 1 of this series *Climate Change Impacts to Water and Sanitation for Frontline Communities in the United States*, each of the six climate change phenomena can damage or destroy wastewater infrastructure, disrupt power sources, or cause other challenges for wastewater systems. And damage or destruction can result in untreated water in the environment, homes, and businesses (Pacific Institute and DigDeep 2024). Also, as discussed in Section 5.1, water scarcity and drought contribute to diminished wastewater flows that are often more concentrated and more challenging to treat. In this section, we examine how legal requirements reduce the risk of damage or disruption of centralized wastewater systems and protect water quality and public health.

5.3.1 Effluent Limitations

The CWA sets the standards for what can and cannot be discharged from centralized wastewater treatment plants. The CWA allows for discharges of effluent (i.e., treated wastewater) into rivers and water bodies if the discharger meets the effluent limitations established by regulation and is incorporated into the NPDES permits issued by states or the federal government. The effluent limitations in NPDES permits are determined based on different technology-based standards,[43] however, adoption and use of these "best available" technologies is not required (33 USC. § 1316(a)(1)). Notwithstanding, these technologies and their capacity to control pollution determine the stringency of the effluent limitations set under law.

Discharges from publicly operated treatment works are subject to secondary treatment requirements. "Publicly operated treatment works" is the term used in the US and in the CWA to refer to a wastewater treatment plant owned, and typically operated, by a government agency (typically a local government). To meet the CWA standards and properly operate, consistently maintain, and periodically rehabilitate and update wastewater infrastructure requires ongoing financial resources and technical capacity. The impacts of climate change such as degraded water quality and infrastructure damage compound with these ongoing needs, especially for under resourced communities, exacerbating their efforts to meet regulatory requirements and provide safe, reliable services (Pacific Institute and DigDeep 2024).

The CWA establishes both technology-based standards that govern effluent discharges from point sources and water quality standards based on designated uses and the water quality criteria necessary to achieve those uses. WWTPs must achieve an effluent quality attainable through the application of secondary treatment, which involves a combination of physical and biological treatment requirements (33 USC. § 1311; 33 USC. § 1314(d)(1); 40 C.F.R. 133.102).[44] Where the water quality standards are not being met for a source water into which the wastewater treatment plant is discharging, the effluent standards in an NPDES permit held by the wastewater plant will be amended to achieve those water quality standards.[45] In fact, more widespread adoption of water quality standards used to modify effluent limitations in discharge permits—such as those held by wastewater systems—could enable greater climate change adaptation and ecosystem protection (Craig 2010).

These legal requirements and regulations are the foundation for ensuring WWTPs are not releasing untreated waste into the environment. However, they are designed to improve pollution control, not address the impact of extreme weather events and climate change, which leaves opportunities to improve these laws to achieve more climate-resilient wastewater systems.

43 Such as the best available technology (BAT) that is economically achievable, best practicable technology (BPT), or best conventional technology (BCT). There are also New Source Performance Standards (NSPS) which are based on the "best available demonstrated control technology" (33 USC. § 1316(a)(1)).

44 The minimum standards for wastewater treatment plants are reflected in terms of five-day biological oxygen demand (BOD5), Total Suspended Solids (TSS), and pH (40 C.F.R. 133.102).

45 States also have the authority to adopt more stringent effluent limitations and additional standards for wastewater treatment plants.

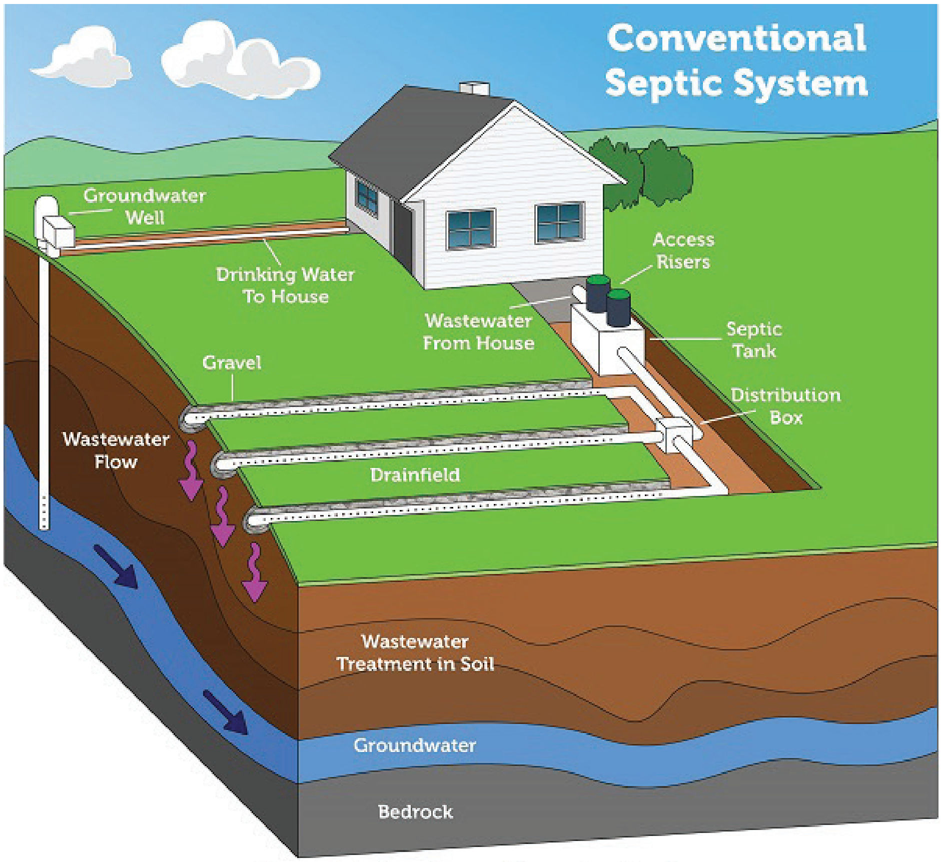
6. Decentralized, Onsite Drinking Water and Wastewater Systems

While most people in the US receive water services from a centralized drinking water provider and send their waste to a centralized wastewater treatment plant, some households rely on decentralized, onsite drinking water and wastewater systems (Figure 6). Decentralized water systems can include domestic wells, rainwater capture and use systems, or modular drinking/potable water treatment systems (MDWTS). Decentralized systems serve households or a small group of households (specifically, fewer than the 15 connections, which would qualify the system as a community water system governed by the SDWA). Murray et al. (2021) estimated that 23 million people-or 17% of the US population at that time-relied on private domestic wells for drinking water. However, this was based on data from pre-2010, and therefore, may be outdated. Neither rainwater nor modular water systems are commonly used in the US for indoor domestic use, such as drinking and bathing, and rainwater capture and use for drinking water purposes is likely not legal in most jurisdictions. Therefore, this section focuses mostly on the laws and regulations related to domestic wells and water use by households.

Decentralized wastewater systems, also known as onsite wastewater systems, include conventional septic tanks, cesspools, pit latrines, and alternative onsite wastewater treatment systems (AOWTS), which employ alternative treatment technologies (e.g., constructed wetlands, aerobic treatments, and recirculating sand filters) to those of conventional methods (US EPA, OW 2002; US EPA, OWM 2024). Some of these systems use water, while others do not rely on water. More than one in five households in the US use onsite septic systems or small community cluster systems to treat wastewater with many of those concentrated in the Northeast and Southeast (US EPA, OWM 2024). The use of septic tanks has continued to grow as more homes are built for people looking to live outside urban centers (Hobson and Hagan 2020; LaFond 2015). Similar to decentralized drinking water, onsite wastewater systems are primarily found in rural parts of the country, but can also be located in peri-urban and even urban environments (Calabretta, Cunningham, and Vedachalam 2022).[46]

46 While there is no one definition, peri-urban areas are those that are generally between urban and rural spaces that are neither completely urban nor rural.

FIGURE 6. Diagram of a Conventional House With Onsite, Decentralized Water and Wastewater System in the Form of a Groundwater Well and Septic System



Source: US EPA, OWM 2024

In addition, like onsite drinking water systems, onsite wastewater systems that serve a small number of people, specifically fewer than 20 people per day, are not directly regulated by the federal government. Federal law under the SDWA requires the EPA to develop regulations for state underground injection control programs (42 USC. § 300(h)). But the law specifies that excluded from the regulations are "individual or single-family residential waste disposal systems such as domestic cesspools or septic tanks" (40 C.F.R. § 144.1(g)(2)).[47] Other than these few federal regulations and restrictions, the regulation of onsite wastewater systems is expected to be regulated at the state and local levels. In most states, the local health departments are responsible for issuing permits for the construction of septic tanks.

Climate change poses many risks to onsite water and wastewater systems. As discussed above in Section 4.1 and in Part 1 in this series, climate change is altering water availability of for all users, including households with their own well or septic tank (Pacific Institute and DigDeep 2024).

47 Per the regulations, any existing large-capacity (serving 20 or more people per day) cesspools were to be closed within five years by April 5, 2005 (40 C.F.R. § 144.88), and construction of new large-capacity cesspools not started before April 5, 2000, is prohibited (40 C.F.R. § 144.88).

Increasing temperatures contribute to increased groundwater pumping, leading to household wells going dry (Flavelle and Rojanasakul 2023). Through wildfires, temperature changes, and other extreme events like hurricanes that cause flooding, climate change affects water quality of surface water and groundwater and can contribute to higher concentrations of contaminants in water supplies, making it unsafe for drinking without treatment (Rowles III et al. 2020). Climate change is expected to have an outsized impact on smaller, more rural, and/or harder to reach communities that rely on domestic wells (Pacific Institute and DigDeep 2024; McNeeley, Rigley, and Will 2024). Septic tanks can be damaged by flooding and sea level rise (Pacific Institute and DigDeep 2024). Flooding can damage septic systems through siltation and debris and oversaturation of leach fields (Calabretta, Cunningham, and Vedachalam 2022). If a septic tank becomes oversaturated, such as from a rising groundwater table due to sea level rise, then it can lead to sewage backups into homes (Calabretta, Cunningham, and Vedachalam 2022). Because many of these systems are underground, changes in ground temperature can also affect their ability to function. In Indiana, where historical snowpack provided an insulating layer, a lack of snow during the winter resulted in frozen drain fields and septic system failures in 2014 (Jones 2014). When these systems are damaged or destroyed untreated wastewater can be released into the environment and contaminate nearby water sources.

Through wildfires, temperature changes, and other extreme events like hurricanes that cause flooding, climate change affects water quality of surface water and groundwater and can contribute to higher concentrations of contaminants in water supplies, making it unsafe for drinking without treatment.

In this section we examine laws related to domestic wells, groundwater resources, and septic tanks. This includes laws that - in the face of climate change - support the use of more efficient waterless toilets, which can reduce the risk of losing access to water or safe sanitation for households that rely on onsite systems.

6.1 WATER SCARCITY AND AVAILABILITY IN ONSITE WATER SYSTEMS AND WASTEWATER SYSTEMS

As described in Section 4.1.2 on groundwater rights and use, each state is responsible for creating and enforcing its own laws that govern how groundwater can be used. But these laws vary by state and not all states have groundwater regulations or protections for domestic wells (Gerlak et al. 2013). In states with groundwater regulations and/or protections for domestic wells, climate change is not always explicitly addressed in these laws.

Florida adopted laws and regulations to govern groundwater use and the listing and construction of wells. The Department of Water Resources is required to develop a Florida Water Plan (Fla. Stat. § 373.036(1)) and included within the plan are the district water management plans (Fla. Stat. § 373.036(2)). District water management plans must include the minimum flows (for surface water sources) and minimum (groundwater) levels, a districtwide water supply assessment, and any completed regional water supply plans, among other components. Minimum levels are defined as "the level of groundwater in an aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources or ecology of the area" (Fla. Stat. § 373.042). Furthermore, the law requires the Department of Water Resources to authorize the water management districts to "implement a program for the issuance of permits for the location, construction, repair, and abandonment of water wells" (Fla. Stat. § 373.308). Once authorized, it is the responsibility of the water management district, local government, or local county health department to issue well permits. These laws are intended to help protect domestic well owners and other groundwater users from losing access to water, but they do not explicitly address climate change.

In states with groundwater regulations and/or protections for domestic wells, climate change is not always explicitly addressed in these laws.

In California, state law requires well owners—including domestic well owners—to obtain a permit from local environmental health agencies or local water districts before any construction, modification, or destruction takes place (California SWRCB 2023).[48] The California Department of Water Resources and the State Water Resources Control Board have established well construction standards that require domestic wells be drilled by a licensed contractor and that any wells must also comply with local and State well standards. These standards are intended to ensure that domestic wells are properly constructed, reducing their chance of failure and risk of contamination. The California Sustainable Groundwater Management Act, discussed in Section 4.1.2, may provide some protection to households with domestic wells by addressing sustainable use of groundwater. However, as noted above, a key criterion for assessing sustainability within each groundwater basin—the minimum thresholds for groundwater levels (i.e., the deepest groundwater level allowable for basins to be considered in compliance)—has been set below the level of thousands of domestic wells and hundreds of wells serving public water systems, leaving them at risk of losing their access to water (Bostic et al. 2020; Bostic 2021; Bostic et al. 2023).

In Arizona, regulations meant to ensure domestic wells have sufficient supplies have already failed to protect some households from losing access to groundwater. Arizona state law requires that developers prove the development will have a 100-year water supply for any housing community with six or more lots that includes domestic wells (Arizona Department of Water Resources, n.d.). However, there is an exemption that allows developers to forego this requirement if they only develop five or fewer lots. This exemption has been attributed as the cause of at least one community near Scottsdale running out of groundwater (Partlow 2023a; Associated Press 2022). In this example, the laws and regulations were inadequate for ensuring sufficient water supply for domestic wells.

48 Well destruction is a process by which a damaged or abandoned well is decommissioned to help prevent contamination of the aquifer (California SWRCB 2023).

Where onsite sanitation systems rely on water, the law plays an important role in ensuring that sufficient water resources are available for domestic household purposes, including to flush toilets. The law can also allow for, and thereby encourage, the use of toilets that do not rely on water to function. In 1999 and 2000, the EPA published informational materials on dry composting toilets, incinerating toilets, and oil recirculating toilets, all of which do not rely on water (US EPA, OW 1999a; 1999b; 2000). Not all states allow the use of composting toilets or have adopted regulations governing their installation. For example, Alaska, California, Delaware, Alabama, Missouri, Oklahoma, and Iowa, have not adopted regulations governing composting toilets (HomeBiogas 2024). Other states allow waterless or greywater toilets and have adopted regulations to govern their use.

The Washington State legislature recognized as an alternative approach to waste disposal the importance of waterless sanitation systems that could reduce the impacts of failing septic systems on public health, the environment, and property values.[49] The Washington Department of Health issued the *Recommended Standards and Guidance for the Performance, Application, Design, and Operation & Maintenance Water Conserving Onsite Wastewater Treatment Systems* in 2012. The recommendations state that four types of waterless toilets have been approved for use within the state, including (1) composting toilets, (2) incinerating toilets, (3) vault toilets, and (4) pit toilets (Washington State Department of Health 2012). For each system type, it explains the type of system and provides recommendations for the standards that should govern their use. Allowing and developing regulations for the installation and use of waterless or greywater systems for onsite sanitation collection, treatment and disposal will help to encourage their use, and possibly their replacement of water-based household sanitation systems.

Allowing and developing regulations for the installation and use of waterless or greywater systems for onsite sanitation collection, treatment and disposal will help to encourage their use.

6.2 OVERABUNDANCE OF WATER AND FLOOD IMPACTS TO ONSITE DRINKING WATER AND WASTEWATER SYSTEMS

Too much water presents similar risks to onsite drinking water and wastewater systems as centralized systems. Large rain events, inundation from sea level rise, and inland flooding threaten contamination of drinking water supplies and the integrity of onsite infrastructure (Pieper et al. 2021). Inundation of a septic tank can cause sewage to back up into a house or to surface through the ground, presenting a significant risk to public health and the environment, damaging the

49 The legislature wrote: "The legislature finds that over one million, two hundred thousand persons in the State are not served by sanitary sewers and that they must rely on septic tank systems. The failure of large numbers of such systems has resulted in significant health hazards, loss of property values, and water quality degradation. The legislature further finds that failure of such systems could be reduced by utilization of non-water-carried sewage disposal systems, or other alternative methods of effluent disposal, as a correctional measure. Wastewater volume diminution and disposal of most of the high bacterial waste through composting or other alternative methods of effluent disposal would result in restorative improvement or correction of existing substandard systems" (Wash. Rev. Code § 70A.105.010). Nonwater-carried sewage disposal systems are defined as "any device that stores and treats non-water-carried human urine and feces" (Wash. Rev. Code § 70A.105.020).

house where it occurs, and requiring costly, time-consuming fixes (Calabretta, Cunningham, and Vedachalam 2022). The risk can range from a temporary disruption to a complete failure of the system that requires replacement. Damaged septic systems can leach untreated waste and cause well-water contamination (Rowles III et al. 2020). Laws that regulate domestic well or septic system siting may help to ensure onsite systems are designed and installed to minimize flooding risk.

Flooding protection for septic systems can also be addressed in state or local law. The Washington State Washington Administrative Code (WAC) sets requirements for local health agencies to ensure decentralized wastewater systems are not installed in areas of high flood risk (WAC 246-272A-0015 1.a.viii). The Mississippi State Department of Health has also set regulations for "onsite wastewater disposal systems," including the requirement that prior to installation, a site evaluation must be performed and include criteria of flooding frequency and the depth to the seasonal high-water table (Mississippi State Department of Health n.d.). While both Washington and Mississippi have laws to regulate the location of newly installed decentralized wastewater systems that consider flooding, neither take climate change into account. In regions where flooding is becoming more frequent, or where sea level is causing the groundwater table to rise, these installation criteria may not be adequate for protecting systems from inundation.

> Flooding protection for septic systems can also be addressed in state or local law.

As noted earlier in Section 6.1, California law regulates well construction, which includes well siting. The regulations state that "[i]f possible, a well should be located outside areas of flooding," with further description of how to construct a well so it is protected from flood water (DWR § 8 Bulletin 74-81). These regulations are from 1991 and do not explicitly mention climate change, so a similar issue as was noted above for siting of septic systems applies here, which is, in regions where flooding is becoming more frequent, these installation criteria may not be adequate for protecting systems from inundation.

6.3 WATER QUALITY IN DECENTRALIZED DRINKING WATER AND WASTEWATER SYSTEMS

The SDWA (which provides regulation of drinking water quality) and the CWA (which sets wastewater treatment requirements for centralized systems) do not apply to decentralized systems serving single or small groups of households. State and local governments provide limited oversight of water quality in domestic wells by establishing guidelines or standards for drinking water quality parameters, such as harmful bacteria, nitrates, heavy metals, and other pollutants. Climate change phenomena, such as floods, droughts, wildfires, and extreme temperatures, contribute to the increase in these pollutants in surface water and groundwater (Pacific Institute and DigDeep 2024). Typically, there is more regulatory oversight for the construction of domestic wells, and some states require regular water quality testing to ensure domestic wells meet certain standards. For septic systems, state and local laws dictate their design and siting to protect the environment, public health, and drinking water sources. In the examples presented below, these types of laws can help prevent or reduce vulnerability to water quality challenges, but all but one example from Virginia (Box 4) fail to directly incorporate climate change.

BOX 4. Climate Change to Wastewater Infrastructure Regulations in Virginia

Many states have not updated their septic tank or onsite sanitation laws or regulations since they were first adopted. Virginia is one state that has. In 2019, the Virginia Secretaries of Natural and Historic Resources, Health and Human Resources, and Commerce and Trade established an interagency Wastewater Infrastructure Work Group to assess the state's wastewater infrastructure needs and to develop recommendations for addressing those needs (Virginia Wastewater Infrastructure Working Group 2021). In 2020, some of the recommendations made by the work group were adopted into law via SB 1396 (Virginia Wastewater Infrastructure Working Group 2021). The bill makes three key amendments to existing law. First, the law adopts a state policy for community and onsite wastewater treatment (Va. Code Ann. § 62.1-223.1).

The law states, "It is the policy of the Commonwealth to prioritize universal access to wastewater treatment that protects public health and the environment and supports local economic growth and stability" (Va. Code Ann. § 62.1-223.1). To advance that policy, the state supports several activities and approaches, including public education about the importance of adequate wastewater treatment, a preference for community and regional projects rather than individual site-by-site projects, and the incorporation of the effects of climate change into wastewater treatment regulatory and funding programs. As part of the policy, the state formally established the work group as an advisory board to the governor's office (Va. Code Ann. § 62.1-223.2).

Furthermore, the Virginia Department of Health, in partnership with a wide range of stakeholders, is required to conduct a needs assessment every four years and estimate the amount of funding necessary to implement the policy beyond what would be funded through grant funding provided under the Virginia Water Quality Improvement Act of 1997 (Va. Code Ann. § 62.1-223.3). The law establishes an "Onsite Sewage Indemnification Law," which created a fund intended to provide compensation to property owners whose septic systems have failed due to negligence of the Department of Health (Va. Code Ann. § 32.1-164.1:01). The fund may also "provide grants and loans to property owners with income at or below 200 percent of the federal poverty guidelines to repair failing onsite sewage systems or install onsite sewage systems on properties that lack adequate sewage disposal" (Va. Code Ann. § 32.1-164.1:01). The new law also declares that the regulations developed to govern onsite sanitation may consider the impacts of climate change on the proposed system (Va. Code Ann. § 32.1-164(B)(16)). The law states that regulations must be designed to be protective of public health and promote public welfare but only may consider climate change impact. Flooding is one impact of climate change and a very real threat to the safety and operation of septic tanks and onsite sanitation. Therefore, any consideration of climate change could help to anticipate the impacts from flooded onsite sanitation and prevent harmful impacts on public health and the environment.

Water contamination is not always detectable by taste, smell, or appearance and households that rely on domestic wells are responsible for ensuring their water is safe to drink and use. Climate change is increasing the presence of some of these difficult-to-detect contaminants, such as PFAS and microplastics (Gander 2022). To ensure domestic well owners are aware of the safety of their water, some states have adopted laws that require domestic well water testing during property transfers or real estate transactions (e.g., N.J.S.A 58:12A-26 et seq. and ORS 448.271). In California, the Groundwater Quality Monitoring Act of 2001 (AB 599) set statutory requirements that include a program for monitoring water quality from domestic wells in specific regions with high dependence on groundwater. Participation in the program is voluntary for those well owners. These laws are potentially helpful for improving awareness of water quality in domestic wells, but they do not directly address the increasing risk of water contamination from climate change.

Some states have adopted regulations that protect groundwater quality broadly, which can offer protection of water quality for domestic wells. In California, there are nine Regional Water Quality Control Boards responsible for setting water quality standards and regulating activities that can impact the beneficial uses of groundwater in the region. In places where groundwater quality is considered adequate for drinking water (a designated beneficial use), activities in that area are regulated to reduce the risk of degrading the groundwater quality for that use (California SWRCB 2018). This approach seeks to provide protection from human activity like agriculture, oil and gas development, or other forms of land use, but it does not offer explicit protection of groundwater from climate change phenomena, like sea level rise or the increasing intensity of wildfires.

Properly constructed and maintained septic tanks do not present a threat to groundwater or surface water. However, if improperly constructed, poorly maintained, or used beyond its lifespan, onsite wastewater infrastructure can cause environmental and groundwater contamination. Impacts from floods, rising sea levels, or extreme temperatures can also threaten the ability onsite wastewater systems to effectively treat waste (Calabretta, Cunningham, and Vedachalam 2022). A report conducted by Miami-Dade County explains how rising sea levels are reducing the distance between septic drain fields and groundwater along Florida's southeastern coastline, reducing these system's ability to treat wastewater and reduce nutrients and pathogens from these households (Miami-Dade County and Florida Department of Health 2018). Large scale rain events or flooding can also cause damage to onsite wastewater systems or overwhelm systems with water causing the release of untreated wastewater into the environment. In many states, onsite wastewater system regulations were created to ensure these systems are installed and designed to adequately process household

In many states, onsite wastewater system regulations were created to ensure these systems are installed and designed to adequately process household wastewater and protect public health and the environment from contamination. But unless they are updated, they may not adequately address anticipated flooding or sea level rise.

wastewater and protect public health and the environment from contamination. But unless they are updated, they may not adequately address anticipated flooding or sea level rise. Ongoing operation and maintenance are commonly the responsibility of the property owner and may not be regulated by any specific laws.

One way that states have tried to regulate onsite wastewater systems to ensure they continue to protect water quality is through reinspection requirements during the point-of-sale or after a natural disaster. In Maryland, for example, onsite wastewater systems must be inspected by a licensed inspector at the point-of-sale (Annotated Code of Maryland, Environment § 9-217.1). In Kentucky, in the jurisdiction of the North Central District Health Department, septic system inspections occur at the point-of-sale, during a remodel, or during a rebuild after a natural disaster (North Central District Health Department, n.d.). Post-disaster inspections may become more critical as more extreme weather events damage and disrupt onsite systems.

7. Laws and Policies for Equitable, Climate-Resilient Water and Wastewater Systems

Laws and policies can play important roles in ensuring that people will have equitable access to climate-resilient water and sanitation services. Here we address the role of laws and policies in ensuring equity in the provision of water and sanitation services in the effort to make them more climate resilient. Laws create rights and protections that enable greater and more equitable access to water and sanitation services. Laws also create funding mechanisms to help ensure that funding is equitably distributed to communities, especially overburdened and under resourced communities. Law should ensure that climate-resilient water access is available to everyone and is not denied based on race, ethnicity, religion, income level, gender, citizenship status, or location.

7.1 THE HUMAN RIGHT TO WATER AND SANITATION[50]

Internationally, the United Nations recognized the human right to water and sanitation in 2010 (Resolution 64/292, United Nations 2014). Many countries voted in support of the resolution and began incorporating a version of the resolution (or other statutes addressing universal water access) into their national laws. The US, however, abstained from the United Nations vote, has repeatedly voiced official opposition to the legal human right to water, and has not codified legal protections for water and sanitation access at the federal level (Gleick 2023). Access to clean water and sanitation is broadly taken for granted in the US, and the continued access to clean water and sanitation is not guaranteed, which leaves frontline communities without legal protections when access is denied (Davis 2015).

While the US federal government has not legally recognized the human right to water and sanitation, as of this writing five states—California, Virginia, Massachusetts, New York, and Pennsylvania—and several local governments have recognized these rights to varying degrees. Each state has taken different approaches and defined the rights differently. However, none of the adopted rights provide the legal protection or regulatory authority necessary to *guarantee* a household or individual will

50 We recognize that the human rights to water and sanitation are legally two distinct rights: the human right to water and the human right to sanitation. Together they are the human rights to water and sanitation. The decoupling is common at the international level in the past five years, in particular. Herein, and in all the reports in the series, we refer to them together as the human right to water and sanitation.

receive water and sanitation services. In establishing human right to water and sanitation, the law can codify and, in theory, mandate that every person has access to water and sanitation (also referred to as "universal access to water and sanitation"). However, the concept of the legal human right to water remains a controversial idea, particularly in the US (Fantini 2020; Murthy 2013). Because of the risk-multiplying threat that climate change poses to access, implementation of the right to water and sanitation will need to be climate-resilient. Further, the increasing impact of climate change on water and sanitation infrastructure requires greater efforts in reinforcing and rehabilitating existing infrastructure to prevent short- and long-term interruptions in access (Pacific Institute and DigDeep 2024).

The first US state to formally adopt the human right to water was California in 2012. California Assembly Bill No. 685 (AB 685) states that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." However, California's law does not create a justiciable right—a right that can be legally enforced in a court of law. The law does not require the state to provide drinking water or to allocate additional financial resources for water infrastructure or water supply development. The law requires all relevant state agencies to "employ all reasonable means to implement this state policy," which is not the same as saying the state *must* realize the state policy. The law further states that it does not create obligations for the state to provide water or to interfere with the decisions made by the public water system in providing water and sanitation services. This law would not, for example, prevent a water system from terminating water service to a household for nonpayment even if they do not have the financial resources to pay. One outcome of AB 685 was to catalyze the creation of the Safe and Affordable Drinking Water Fund through Senate Bill 200 (S.B. 200, 2019 Reg. Sess. (Cal. 2019)). The Fund is used to implement projects that help centralized drinking water systems comply with drinking water quality challenges with the monies coming from a 5% contribution from the Greenhouse Gas Reduction Fund (SB 200).

> While the US federal government has not legally recognized the human right to water and sanitation, as of this writing five states and several local governments have recognized these rights to varying degrees.

Massachusetts, New York, and Pennsylvania have each made amendments to their state constitutions, recognizing the right to clean water, but not necessarily the right to drinking water. The Pennsylvania Constitution states, "The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment" (Pa. Const. art. 1, § 27). Given the context of the provision, it is a right to uncontaminated, unpolluted water resources more than a right to drinking water. The Massachusetts Constitution states, "The people shall have the right to clean air and water, freedom from excessive and unnecessary noise, and the natural, scenic, historic, and esthetic qualities of their environment; and the protection of the people in their right to the conservation, development and utilization of the agricultural, mineral, forest, water, air and other natural resources is hereby declared to be a public purpose" (Mass. Const. art. of amend. XCVII). Similarly, this is a right to uncontaminated water resources. In 2021, New York voters passed an amendment to the state's constitution, stating, "[e]ach person shall have a right to clean air and water, and a healthful environment" (N.Y. Const. art. 1, § 19). Again, based on the language used and the context of the amendment, the provision says more about water resources than drinking water. Furthermore, these amendments do not create explicit rights and obligations for state agencies to take prescribed actions to achieve these protections. However, with the evidence of increasing climate change impacts on both the quality and quantity of water resources, these constitutional amendments could serve as a foundation for taking the climate-informed actions necessary to protect water resources.

The State of Virginia has taken a different approach in their recent adoption of a non-binding human right to water. In 2021, the Virginia Legislature adopted a Joint Resolution recognizing the importance of drinking water (H.J. 538, 2021 Spec. Sess. I (Va. 2021). The resolution states, "Access to clean, potable water in amounts that will ensure an acceptable standard of living is a necessary human right." However, this resolution does not create any rights or obligations and merely represents the "sense of the General Assembly." Therefore, no actions must be taken under the resolution to realize the human right to drinking water. Adopting a resolution represents a formal statement of policy from the legislature but does not represent a legal requirement.

The Virginia Legislature adopted a Joint Resolution recognizing the importance of drinking water. Adopting a resolution represents a formal statement of policy from the legislature but does not represent a legal requirement.

Local governments have also taken steps to provide protection to the human right to water and sanitation. For example, the City of Titusville, Florida passed a referendum adopting a right to clean water (Vazquez 2023). The referendum states, "Residents of the City of Titusville possess the right to clean water, which shall include the right to Waters of Titusville which flow, exist in their natural form, are free of pollution, and which maintain a healthy ecosystem" (City of Titusville v. Speak Up Titusville, Inc., Fla. Cir. Ct. Case No. 2022-CA-038303 (Order on Motions for Summary Judgement) (May 22, 2023)). The referendum prohibits governmental or corporate entities from conducting activities that interfere with these rights. However, this referendum may be overturned by a state law in Florida, the Clean Waterways Act. The Clean Waterways Act, signed into law in 2021, prevents local governments from protecting the rights of nature (Vazquez 2022). The act has already forced the repeal of a referendum passed by Orange County, Florida that contained similar language to Titusville's.

While none of these explicitly address climate change, when crafted well, laws recognizing the human right to water and sanitation create an obligation on states to take steps to ensure every person has access to safe water and sanitation services, consistently, and without climate change-driven interruptions.

7.2 EQUITY THROUGH AFFORDABILITY LAWS AND POLICIES

Climate change contributes to rising costs for drinking water and wastewater utilities, which in turn are passed on to ratepayers, with the greatest impacts on low-income households (Heyman, Mayer, and Alger 2022). Delayed maintenance and emergencies—such as broken water mains—caused by storm events or other triggers, can increase the cost of operating and maintaining these systems, and many utilities respond by raising their rates to cover those costs (Hiller 2022). For example, in 2023, in Lafayette, Colorado (a town of over 30,000 people north of Denver), the local water utility cited climate change as a key driver behind its need to increase rates to pay for water storage infrastructure and other projects that would reduce the risk of water scarcity during future droughts (Drugan 2023). As rates increase, customers who were originally struggling will struggle more to afford their water and wastewater bills, and customers who were on the cusp of water unaffordability will also find themselves unable to pay their water bills.

If a water utility customer does not pay their water bill, many utilities in the US threaten or pursue water service disconnection (also called a "shutoff") to incentivize payment (Holmes et al. 2020). Different legal, policy, and programmatic approaches have been used to help customers remain connected to their water services, even when they are unable to pay. In some states, laws restrict, prevent, or provide conflicting or ambiguous guidance for utilities who wish to offer assistance programs to those who cannot pay (UNC Environmental Finance Center, Corona Environmental, and Abt Associates 2017). For example, Proposition 218, a California State law, prohibits utilities from using water and wastewater service revenue to fund assistance programs. *Bolt v. Lansing*, a Michigan Supreme Court decision interpreting the Headlee Amendment, was also widely accepted as barring the use of ratepayer dollars to subsidize rates for low-income families, though this has been challenged in recent affordability efforts (587 N.W.2d 264 (1998)). Consequently, some utilities must figure out how to fund assistance or affordability programs by other means.

Affordability and assistance programs become even more important where state or local law allows for water shutoffs and water and wastewater costs are on the rise. Communities that permit water shutoffs typically do not establish any exceptions for nonpayment, even if the household does not have the financial resources to pay. The law treats those who cannot pay in the exact same way as those who forget or choose not to pay (CWSC 2019). For example, 87% percent of municipalities and 78% of counties in the state of Maryland allow water services to be terminated for nonpayment (CWSC 2019). Unpaid water bills can be turned into liens on property, commonly the home where the people who have not paid live, and ultimately, these can be foreclosed upon, compounding inequities for households without means to pay their utility bills. In Maryland, 87% of municipalities allow for unpaid water bills to become a lien, and just under 13% of municipalities' laws are silent, leaving open the possibility that liens are allowed (CWSC 2019). These findings are not unique to Maryland as cities throughout the US lack legal protections for low-income households who cannot afford their water and wastewater services, demonstrated through the American Water Access Survey (CWSC 2022).

Cities throughout the US lack legal protections for low-income households who cannot afford their water and wastewater services.

Several recent water assistance laws at the federal and state levels have passed. The American Rescue Plan Act (ARPA) of 2021 established the first-ever federal water assistance program. The Department of Health and Human Services was given funding under ARPA and the Consolidated Appropriations Act of 2021 to launch an emergency water assistance program called the Low-Income Household Water Assistance Program (LIHWAP) (US Department of Health and Human Services 2021). With broad guidance from HHS, states, the District of Columbia, Puerto Rico, US territories, federally and state-recognized Tribes and tribal organizations were given the authority to develop implementation plans and determine the rules and responsibilities informing participation in the program. Funding provided through LIHWAP was available to pay off arrearages (existing debt for water service) up to a designated maximum as well as to reduce future household water costs to prevent the accrual of debt. The LIHWAP program was not reauthorized before the end of 2023; therefore, the program concluded at the end of 2023. However, Senator Padilla introduced the Low-Income Household Water Assistance Program (LIHWAP) Establishment Act at the end of February 2024 to create a permanent nationwide water assistance program.

Under the Bipartisan Infrastructure Law (discussed further in Section 7.3 to follow), Congress authorized the establishment of a pilot water rate assistance program. The Rural and Low-Income Water Assistance Pilot program authorizes the EPA to award grants to forty water service providers of different sizes to trial a water rate assistance program (H.R. Res. 3684, 117th Cong. (2001) (enacted), § 50109). The type of assistance that can be offered includes, but is not limited to, direct financial assistance, lifeline rates, bill discounting, special hardship provisions, percentage of income payment plans, and debt relief. While the program has been authorized, no funding has been appropriated to launch the program. Funding has been allocated for the completion of a needs assessment to study and understand the circumstances of water providers who service communities with a disproportionate percentage of low-income households or providers who have taken on a greater amount of debt because of nonpayment by customers (§ 50108). The needs assessment is currently being conducted by the EPA.

> Federal laws provide water and wastewater funding and financing programs to address aging infrastructure, replace lead water pipes, support water-related climate resilience and safe and clean water projects, restore ecosystems, and support climate and hydrology science and data collection.

Some states have taken alternative approaches to protecting people's access to water. For example, Washington State legislature passed Engrossed Substitute House Bill 1329 in 2023, which will require water and energy utilities and landlords to delay utility shutoffs during extreme heat events. Many state and local laws limit water shutoffs during the colder months because of the use of water in certain heating systems. This law is a unique example of a state's intent to reduce the risk posed by a climate threat by attempting to ensure that households struggling to pay will be able to access water and electricity during hotter weather.

7.3 LAW AND POLICY FOR EQUITABLE FUNDING AND FINANCING

The law plays an important role in authorizing funding for certain programs and for determining how funding is to be distributed. Loans and grants from funding programs, such as the Drinking Water State Revolving Loan Funds (DWSRF) and Clean Water State Revolving Loan Funds (CWSRF), are used by centralized drinking water and wastewater systems to pay for planning and infrastructure projects. Federal laws, like the Bipartisan Infrastructure Law (BIL, also called the Infrastructure Investment and Jobs Act) and the Inflation Reduction Act (IRA), provide water and wastewater funding and financing programs with billions of dollars to address aging infrastructure, replace lead water pipes, support water-related climate resilience and safe and clean water projects, restore ecosystems, and support climate and hydrology science and data collection.

The BIL, signed into law on November 15, 2021, made a once-in-a-generation investment in infrastructure. The BIL authorized a total of $1.2 trillion for rebuilding and replacing failing, aging, and outdated water, energy, transportation, and communications systems with approximately $82.5 billion for a wide range of critical water investments (Gleick, Bielawski, and Cooley 2021). The BIL also includes over $13 billion in direct investments towards tribal governments and entities. Programs funded by the law span several sectors, including water, climate resilience, and energy. Notably, the BIL allocated over $200 million to the Bureau of Indians Affairs' Tribal Climate Resilience Program. Funding for water and sanitation includes $3.5 billion to the Indian Health Service for the Sanitation Facilities Construction Program and set-asides for Tribes under the CWSRF and DWSRF (The White House 2022).

> The Safe Drinking Water Act has allowed each state to define "disadvantaged community," creating 50 unique criteria for qualifying for federal grants.

Achieving the standards set out in the CWA and SDWA and ensuring such infrastructure is climate-resilient requires federal funding. In 1996, a State Revolving Fund (SRF) program was launched under the SDWA (Pub. L. No. 104-182, 110 Stat. 1613 (Act of Aug. 6, 1996)). The CWSRF and DWSRF have since primarily functioned as loan programs, whereby the recipients are responsible for paying loans back, which requires the financing costs to be recuperated from ratepayers. Subsequent amendments to the SDWA and CWA allowed "additional subsidization" for SRFs, which includes "forgiveness of principle, grants, negative interest loans, other loan forgiveness, and ... buying, refinancing, or restructuring debt" (42 USC. §300j-12(d)). In 1996 when the SRF was established as part of the SDWA, Congress authorized states to use up to 30% of their DWSRF capitalization grants to provide additional assistance to disadvantaged communities as defined by the statute.

The SDWA has allowed each state to define "disadvantaged community," creating 50 unique criteria for qualifying for federal grants (US EPA 2022a). Under existing laws, the percentage available for these communities as grants has increased to 35% (42 USC. § 300j-12(d)(2)). Under the SDWA, states are also required to provide a 20% match to the grant funding provided (42 USC. § 300j-12(e)). A similar "additional subsidization" provision was added to the CWA in 2014. States are authorized to use up to 30%, and no less than 10%, of their CWSRF capitalization grants toward additional assistance to eligible communities (33 USC. §1383(i)(3)). The 2021 BIL made a significant investment in both the CWSRF and DWSRF for fiscal years 2022–2026, allocating $11.7 billion to DWSRF and $11.7 billion to CWSRF. Under both programs, 49% of funding is required to be in the form of "additional subsidization" as grants or forgivable loans. Under DWSRF, this additional subsidy is required to be provided to disadvantaged communities (US EPS 2022a).

Other laws help to ensure that funding is equitably distributed. In 2021, the Justice 40 (J40) Initiative (Executive Order 14008) was established. The purpose of J40 is to ensure the *benefits* of funding and programs from these federal laws are more equitably shared and that they reach communities that have historically or are currently marginalized or discriminated against due to race, ethnicity, economic standing, gender, or other forms. The initiative requires certain federal agencies to ensure that "40 percent of the overall benefits of certain federal investments flow to disadvantaged communities that are marginalized, underserved, and overburdened by pollution" (The White House, n.d.). To be clear, J40 is not a new funding program, it is focused on the benefits, or outcomes, of existing federal funding and programs. The requirements of J40 apply to federal programs that invest in climate change and the development of critical clean water and wastewater infrastructure, which include, among others, the EPA's Drinking Water and Clean Water SRFs—the main source of federal, state, and other non-locally derived funds and financing for drinking water, wastewater, and stormwater projects.[51] Through these programs, the federal government is attempting to create more equitable outcomes from federal funding programs.

There are many other related funding policies and programs that we will discuss in more detail in the forthcoming Part 3 of Water, Sanitation, and Climate Change in the United States Series, focusing on achieving equitable, climate-resilient water and sanitation for frontline communities.

51 A list of covered Justice 40 programs can be found in the Interim Implementation Guidance for the Justice 40 Initiative memorandum (M-21-28) (Young, Mallory, and McCarthy 2021).

8. Conclusion

Laws and policies together serve as a critical foundation for achieving equitable, climate-resilient water and sanitation access for frontline communities in the US. Laws set forth the rules, rights, processes, programs, and institutions necessary to inform and guide decision making, especially decision making and action *before* a crisis. Government policies help define political or sector objectives that are used as guidelines to inform the creation or implementation of law. As it stands, the water law frameworks governing the management, distribution, and protection of water resources; the construction, maintenance and financing of water and wastewater infrastructure; and the distribution of drinking water and sanitation services to the public fall short of addressing the impacts of climate change. Many of the laws do not explicitly and intentionally consider or include mentions of climate change nor were they crafted in a way that will sufficiently protect water and sanitation access or systems for everyone, especially for frontline communities. There is also a lack of enforcement of the laws that do exist. And for people who currently lack access to safe, affordable drinking water and sanitation in their homes (a base necessity for being resilient to climate change), existing laws do not ensure that they will ever receive it. These gaps leave drinking water and sanitation systems and the communities they serve more vulnerable to the impacts of climate change and the possibility of backsliding and losing access to water.

Furthermore, as new systems are built to serve frontline communities that currently lack access to water and sanitation, laws are not in place to ensure these systems are built to be resilient in the face of climate change.

Table 1 summarizes the key findings and conclusions from this review of climate change considerations or protections in the laws and policies that govern water and sanitation in the US.

TABLE 1. Key Findings and Conclusions

TOPIC	FOCUS (SECTION)	KEY FINDING OR CONCLUSION
Background	The Importance of Water Law for Drinking Water and Sanitation in the Context of Climate Change (Section 3.2)	One of the challenges with water law is that, generally, it is developed to provide predictability, yet water under a changing climate is highly unpredictable.
		While some laws may not explicitly mention climate change, they can be foundational to adapting to climate change impacts, for example, by providing oversight of water supply availability or setting drinking water quality standards.
		While better water management and service provision laws inherently help to address the impacts of climate change on water and sanitation systems, laws should purposefully consider the intersection of climate change and water to ensure that climate change impacts are properly anticipated and adequately addressed.
Centralized Drinking Water Systems	Water Scarcity and Supply Impacts to Centralized Drinking Water Systems (Section 4.1)	In general, water management laws and policies in the US do not explicitly take climate change into account, increasing the likelihood that centralized drinking water systems will face challenges in providing services due to climate change.
	Surface Water Rights and Use (Section 4.1.1)	Water use permits under regulated-riparianism that must be renewed periodically may provide opportunities for states to revisit permit uses and allocations where climate change is impacting flows, precipitation, or other factors.
		State laws that govern surface water rights and use that require consideration of "the public interest" in making permitting decisions may create an opportunity for considering climate change impacts.
		State-level water use restrictions that are inclusive of all users, often reserved for times when water is scarce, may ensure greater equity in sharing the burden of the impact of climate change rather than being shouldered by just the most junior water users.
		In some states with appropriative water rights, there can be requirements for water users to secure advance permission before using new water, which may allow for future water use permitting decisions to better incorporate climate change.
		In a time of emergency, such as during a drought, some states have laws that allow for certain water uses to be designated as "unreasonable" and for authorities to restrict those uses. This may provide an opportunity for adapting to more intense and/or frequent drought conditions under climate change.
	Groundwater Rights and Use (Section 4.1.2)	Climate change has the potential to exacerbate unsustainable groundwater uses and practices, especially in places where the law either allows for unsustainable groundwater use or does not protect groundwater sustainability.
		As climate change creates greater dependence on groundwater in some places, laws like California's Sustainable Groundwater Management Act have the potential to provide an important management mechanism for protecting vulnerable groundwater supplies and contributing to more inclusive governance processes, however, implementation of this law has not yet proved to be completely successful in these goals.

TOPIC	FOCUS (SECTION)	KEY FINDING OR CONCLUSION
Centralized Drinking Water Systems	Prioritizing Domestic and Municipal Use (Section 4.1.3)	Laws that prioritize available water resources for domestic purposes could become more imperative as climate change shifts precipitation patterns and reduces the availability of water in some geographies.
		There are examples of states with laws that both create automatic prioritization of domestic uses and authorize water managers to address emergency water shortages. Together, these provisions can help protect domestic needs when there is insufficient water to meet every demand.
		In some state laws where prioritization between water uses is not clear, such as between domestic and agricultural uses, there may be potential for conflict between water uses during times of scarcity.
	Tribal Water Rights and Water Codes (Section 4.1.4)	Tribes are often legally entitled to more water than they can use, which is inconsistent with the state prior appropriation doctrine approach by which water rights are maintained through actual use ("use it or lose it"). This can create tensions between state and tribal entities, especially where climate change and other factors decrease the volume of available water resources.
		Many Tribes have adopted their own water codes for determining their own priorities, monitoring uses, and dealing with violations, which can also incorporate flexibility the Tribes need for climate adaptation.
		The 2023 Arizona et al. v. Navajo Nation SCOTUS decision will significantly impact tribal water rights and the federal government's legal responsibilities, especially in the context of the drying West, where water resources are overallocated.
	Water Resource Management Planning (Section 4.1.5)	Some states have laws that mandate water resource management planning, which is a process whereby water managers (including those operating centralized drinking water systems) plan for future investments, like infrastructure upgrades and water supply needs, by analyzing water supply availability, water quality, and use in concert with projected changes in population, the economy, and other factors that impact water demand. Increasingly, water resource management planning processes incorporate climate change considerations, but many do not.
		Some states have passed laws to create programs that provide technical assistance to small drinking water systems that often lack the capacity for water management planning and planning for climate change.
		While not specific to climate change, though with implications, drought planning laws and policies are approaches that have been used for requiring or incentivizing consideration of how water systems will function and adapt to water scarcity and supply constraints. Less than half of all states have laws that require drought preparedness plans for water systems.
	Managing Water Demand (Section 4.1.6)	While demand management is often applied through voluntary measures, there are several ways that laws and policies have led to long-term water demand reductions and supported adaptation to increasing water scarcity and more intense, prolonged periods of drought. Some key demand management laws and approaches have included: the Energy Policy Act of 1992, state-level laws that set standards for fixture water efficiency in building codes, requirements to upgrade to high-efficiency devices upon change of ownership of a property, and regulations for urban water suppliers to manage water demand.

TOPIC	FOCUS (SECTION)	KEY FINDING OR CONCLUSION
Centralized Drinking Water Systems	Alternative Water Supplies (Section 4.1.7)	Laws that permit and regulate water reuse and recycling, both centralized and decentralized, may contribute to improved water supply resilience by adding to the community's supply portfolio or by freeing up freshwater to be used for other purposes.
		Laws that permit and regulate rainwater harvesting and stormwater capture may also contribute to improved water supply resilience, but climate change is altering the timing and volume of rainfall and stormwater runoff.
	Laws that Help Prevent and Reduce the Impact of Flooding through System Design and Construction Requirements (Section 4.2.1)	Historical flood event data used by NFIP for establishing insurance premiums and designating flood risk areas may not be applicable under future climate change as catastrophic flooding occurs more frequently. Existing drinking water systems and other infrastructure that were sited and designed based on NFIP's old, outdated maps may be at risk from flooding damage.
		In communities that are participating in the NFIP, protections and disaster recovery have been inequitably distributed with costs disproportionately being placed on low-income neighborhoods of these communities.
		Drinking water and wastewater systems in communities that are not eligible for the NFIP or are excluded by outdated flood maps that do not account for climate change may lack flood insurance.
		Some states have taken steps to go beyond the federal NFIP requirements, which may provide more protection against flooding events. But even these can fail to explicitly include climate change.
	The Role of Nature-Based Solutions in Flood Preparedness (Section 4.2.2)	Green infrastructure, as authorized in the CWA, may be useful for mitigating some of the impacts from stormwater runoff and floods on drinking water treatment plants.
	Drinking Water Quality from Centralized Drinking Water Systems (Section 4.3)	Meeting drinking water standards will only become more difficult due to climate change, increasing the importance of the role that the SDWA and CWA play in reducing the impact of water quality degradation from droughts, wildfires, extreme storms, and other climate change phenomena.
		Following the 2023 Sackett v. Environmental Protection Agency SCOTUS decision, there is the potential that if climate change alters the flow of water in some waterbodies, they may no longer be subject to regulation, unless states adopt broader definitions for "waters of the United States."
Centralized Wastewater Systems	Water Scarcity and Supply for Centralized Wastewater Systems (Section 5.1)	Once built, it is often many decades before updates or improvements are made to centralized wastewater systems. Due to drought, climate change, and reductions in per capita water use, some wastewater systems have a mismatch between the volume of influent they were designed for compared to the volume that they now receive, yet there are few legal approaches for addressing this mismatch.
		The siting, design, and proper construction of wastewater treatment plants can significantly impact the climate resiliency of these systems. Generally, state and local laws and regulations govern these engineering decisions.
		While regulations can address the threat of floods and other climate impacts when building new wastewater treatment plants, changing existing plants may be harder.

TOPIC	FOCUS (SECTION)	KEY FINDING OR CONCLUSION
Centralized Wastewater Systems	Legal Protections for Climate-Resilient Siting, Construction, and Design of Wastewater Treatment (Section 5.2.1)	Like centralized drinking water systems, centralized wastewater systems that were sited and designed based on historical flood event data may be at risk from flooding damage. Current federal law exists to ensure new systems are in areas with lower flood risks, but these laws are still based on historical flood maps and do not protect existing infrastructure.
		There are few, if any, legal recourses for homeowners whose sewers backup into their homes during flooding events. Climate change and the increase in extreme precipitation and storm events in many parts of the country will only worsen these events, especially for frontline communities.
		While wastewater treatment systems are taking steps to protect their infrastructure from sea level rise and erosion, many of these changes are made purely voluntarily.
	Effluent Limitations (Section 5.3.1)	More widespread adoption of water quality standards, which are then used to modify effluent limitations in discharge permits such as those held by wastewater systems, could enable greater climate change adaptation and ecosystem protection.
		Existing legal requirements and regulations were designed to improve pollution control from wastewater treatment plants, not to address the impact of extreme weather events and climate change.
Decentralized Onsite Drinking Water and Wastewater Systems	Water Scarcity and Availability in Onsite Water Systems (Section 6.1)	Climate change is not always explicitly addressed in state laws that regulate groundwater to protect water supply or well construction for domestic wells.
		State laws that seek to ensure groundwater availability for domestic wells and other users have at times been inadequate for achieving these goals. As climate change adds more water stress, these laws may not be sufficient.
		Allowing and developing regulations for the installation and use of waterless or greywater systems for onsite sanitation collection, treatment, and disposal will help to encourage their use, and possibly their replacement of water-based household sanitation systems.
	Overabundance of Water and Flood Impacts to Onsite Drinking Water and Wastewater Systems (Section 6.2)	Some states have laws that regulate domestic well and/or septic system siting and design that are intended to minimize flooding risk when these systems are being installed or designed. But these laws do not always account for changes to flooding severity or frequency due to climate change.
		In regions where sea level is causing the groundwater table to rise, laws may be needed to address potential groundwater contamination from septic systems.
	Water Quality in Decentralized Drinking Water and Wastewater Systems (Section 6.3)	Few of the water quality laws governing management of decentralized, onsite drinking water or wastewater systems incorporate climate change. Virginia is one exception where they have integrated climate change into wastewater infrastructure regulations.
		Domestic well quality testing regulations are potentially helpful for improving awareness of water quality in domestic wells, but they do not directly address the increasing risk of water contamination from climate change.
		Broad groundwater quality protection seeks to provide protection from human activity like agriculture, oil and gas development, or other forms of land use, but it does not offer explicit protection of groundwater from climate change phenomena.
		Some state or local entities require reinspection of septic systems post-disaster or during resale of a home. Post-disaster inspections may become more critical to ensuring these systems remain functional as more extreme weather events damage and disrupt onsite systems.

TOPIC	FOCUS (SECTION)	KEY FINDING OR CONCLUSION
Equity Considerations	The Human Right to Water and Sanitation (Section 7.1)	While none of the existing state or local human right to water and sanitation laws or resolutions in the US explicitly address climate change, when crafted well, these laws create an obligation on states or local governments to take steps to ensure every person has access to safe water and sanitation services now and into the future.
		While the human right to water and sanitation have yet to be legally recognized at the federal level, some states have amended their constitutions in ways that could serve as a foundation for taking action to protect water resources when climate change causes harm to water quality or reduces water availability, even if not explicitly for the purposes of drinking water access.
	Equity Through Affordability Laws and Policies (Section 7.2)	Climate change contributes to rising costs for drinking water and wastewater utilities, which in turn, are passed on to ratepayers, with the greatest impact on low-income households. One example from Washington intends to reduce the risk of loss of water access posed by extreme heat by providing protections for households that are struggling to pay their utility bills during hotter weather.
	Law and Policy for Equitable Funding and Financing (Section 7.3)	Achieving the standards set out in the CWA and SDWA and ensuring water and wastewater infrastructure is climate-resilient requires federal funding that is commonly authorized by laws.
		The Bipartisan Infrastructure Law and Inflation Reduction Act provide historic levels of funding that can help address climate-resilience of drinking water and wastewater systems.

After reviewing laws and policies from across the US, our main conclusion is that **existing laws are inadequate for preparing and protecting from the impacts of climate change water and wastewater systems and water and sanitation access for frontline communities**. There are several ways that the law leaves communities exposed to the impacts of climate change.

- First, **the law often does not proactively manage water resources in the context of climate change**, especially groundwater use, or create a system where uses are weighed against each other or reviewed for their continued appropriateness for a given water source or basin. The basic rules governing water use and water rights are insufficient. As climate change alters precipitation patterns, which subsequently changes water use patterns and the broader availability of water, the laws will be inadequate to ensure there is sufficient water to meet our needs and sustain the environment.
- Second, **laws provide insufficient requirements or guidance on the design and siting of climate-resilient water and wastewater systems**. Water and wastewater infrastructure is under threat from floods, droughts, saltwater intrusion, wildfires, and other extreme events. As the frequency and severity of natural disasters increases, our infrastructure may be unable to withstand these events, leaving communities without drinking water and/or wastewater services.
- Third, access to water and sanitation infrastructure is inequitable leaving the most overburdened and under resourced communities highly vulnerable to climate change. The **laws in the US do not ensure the human right to water or sanitation**, leaving some households without any safe or regular services and other households under constant threat of shutoffs. This may leave homes and communities that lose access to their water and/or sanitation without recourse for regaining it, causing backsliding, and widening the water access gap.

This is especially true for households in frontline communities affected first and worst by climate change and who may not be able to afford to rebuild or repair their onsite or decentralized systems.

By changing the availability of water and the frequency and severity of storms, climate change will continue to make universal water and sanitation access difficult to achieve without legal protections in place. Without explicit consideration of how climate change will impact water availability, or the operation of infrastructure, or the quality of surface waters, existing laws leave homes and communities, especially those on the frontlines, exposed and unprepared. Our current legal frameworks are insufficient to provide water security, particularly with the significant impacts of climate change on the near horizon. Without changes to the law, more water and wastewater systems will fail and will do so more frequently, leaving entire communities without basic services they need to lead a healthy, dignified life.

Many communities struggling with water and sanitation access face other challenges as well. These include inadequate or unenforced laws, structural and systemic racism, fragmentation of decision making for water and climate change, institutional constraints, and lack of resources to begin and sustain adaptation efforts. A first step to overcoming these challenges and barriers is better understanding the key attributes of and strategies for achieving equitable, climate-resilient water and sanitation. Our next report, Part 3 in this series, will provide a framework for equitable, climate-resilient water and sanitation in the US, as well as an overview of strategies and approaches that frontline communities are taking to overcome barriers and create equitable, climate-resilient water and sanitation.

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