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DIGDEEP

Actionable Criteria for Achieving Equitable, Climate-Resilient Water and Sanitation Laws and Policies

WATER, SANITATION, AND CLIMATE CHANGE IN THE UNITED STATES SERIES, PART 4

NOVEMBER 2025

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SUGGESTED CITATION

Campbell-Ferrari, Alexandra, Morgan Shimabuku, Shannon M. McNeeley, Luke Wilson, 2025. Actionable Criteria for Achieving Equitable, Climate-Resilient Water and Sanitation Laws and Policies, Water, Sanitation, and Climate Change in the US Series, Part 4, Pacific Institute, Oakland, CA, https://pacinst.org/publication/actionable-criteria-for-water-and-sanitation-laws-and-policies/.

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. We have served thousands of families across the country through our award-winning and community-led field projects: the Navajo Water Project (Arizona, New Mexico, and Utah), the Appalachia Water Project (West Virginia and Kentucky), 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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Morgan Shimabuku is a Senior Research Specialist at the Pacific Institute where she researches a wide range of water management issues, including water equity and access challenges, benefits and tradeoffs of water management strategies, water resilience, and more. Prior to joining the Pacific Institute, Morgan was a senior program manager at an environmental nonprofit in Colorado where she ran residential and commercial water conservation program operations in partnership with municipal water providers. Morgan received a bachelor's degree in environmental studies and geology from Whitman College and a master's degree in geography at the University of Colorado Boulder, where she studied climate change, hydrochemical cycling, and snow hydrology at the Institute of Arctic and Alpine Research.

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Shannon McNeeley is Associate Director, Water and Climate Equity at the Pacific Institute. 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 underresourced 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.

Luke Wilson

Luke Wilson is co-founder and Deputy Director of CWSC where he specializes in transboundary water issues and international law including human rights and international criminal law. Professor Wilson also teaches international law at the George Washington University Elliott School of International Affairs. Professor Wilson has worked with The World Bank, The American Bar Association and the US Government in various capacities, with a focus on law systems, dispute resolution, and enforcement issues. Additionally, Professor Wilson was the co-chair of the American Bar Association's International Human Rights Committee, leading one of the Association's largest committees and advancing policy proposals on behalf of the membership, and also served as a law clerk to judges of the International Court of Justice in The Hague. Professor Wilson has been an invited speaker at the Council on Foreign Relations, the American Bar Association, and Bowdoin College, among others, and is a member of international task forces focused on global water affordability and on sanitation policy. Professor Wilson is also a tenor with The Washington Chorus and has performed with the National Symphony Orchestra and the Philip Glass Ensemble.

ACKNOWLEDGEMENTS

Thank you, Becky Anderson, Jessica Dery, Heather Cooley, Peter Gleick, Robin Kundis Craig, and Matthew Bennett. Each provided essential guidance, input, feedback, review, and/or support for this report. We acknowledge the partnership of the Pacific Institute Strategic 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

This report is dedicated to the communities that experience the most immediate and severe impacts of climate change, particularly those that are underserved by current laws and policies.

Water is life.

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Glossary

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, health care, food, and other utilities (Feinstein 2018; Teodoro 2019).

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 water bodies.

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).

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 2002, 2024d). Some of these systems use water, while others are dry toilets that do not rely on water.

Disadvantaged communities (DACs): The 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 (Pacific Institute and DigDeep 2024).

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 US include the 574 federally recognized Tribes (as of 2025), 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 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 enforceable mechanisms such as policies, programs, and plans — that guide, inform, and oftentimes determine or instruct how and whether water and sanitation services can and will be provided.

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 the law. Policies are nonmandatory and 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.

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: 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 onsite. Sanitation access requires having physical as well as economic access (Center for Water Security and Cooperation 2021; US EPA 2016a; 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 amount of water represents the bare minimum for health purposes (Feinstein 2018; Gleick 1996).

Water or Wastewater Utility: Any entity, publicly or privately owned or operated, that provides water and/or wastewater services to customers.

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). Wastewater services can also be referred to as sewerage services because sewer systems are often used in wastewater services to transport wastewater to treatment systems and/or disposal outlets.

Water access: In-home, reliable availability of sufficient water to meet domestic needs safely. Water access requires having physical as well as economic access (Center for Water Security and Cooperation 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).

Water scarcity: When water supplies are not physically available in the quantities needed.

Water shortage: A period when water demand is not met or water rights are not fulfilled.

Summary

This fourth report in the *Water, Sanitation, and Climate Change in the United States* series examines the essential legal and policy attributes needed to protect frontline communities from climate-driven disruptions to water and sanitation infrastructure and services. Climate change is intensifying droughts, floods, wildfires, extreme storms, and sea level rise, which threaten infrastructure, degrade water quality, and create lasting service gaps — impacts that fall disproportionately on frontline communities. While laws at federal, Tribal, state, and local levels could enable equitable, climate-resilient access to water and sanitation services, they often fail to account for these risks, leaving water and wastewater systems and the people they serve underprepared.

Building on earlier reports that reviewed climate impacts, analyzed existing laws, and outlined resilience strategies, this report focuses on identifying actionable legal attributes and criteria that enable equitable, climate-resilient water and sanitation. Attributes include climate-conscious siting and design standards, legal protections for household water use during climate disruptions, climate resilience planning requirements, robust systems for data collection and monitoring, equitable funding distribution, and enforceable compliance mechanisms.

For each attribute, the report outlines several criteria for determining whether it is adequately addressed within the law. Examples of laws from all levels of government and a diverse set of geographies help to illustrate where the laws and policies succeed or fall short.

While laws at federal, Tribal, state, and local levels could enable equitable, climate-resilient access to water and sanitation services, they often fail to account for these risks, leaving water and wastewater systems and the people they serve underprepared.

The attributes and criteria presented are intended as practical decision-support information and tools for frontline communities, policymakers, utilities, and advocates to assess and improve their own legal frameworks. By providing real-world examples and criteria, the report demonstrates how existing legal provisions can be adapted or newly drafted to ensure that water and sanitation infrastructure and services can withstand and recover from climate impacts. While not exhaustive, the findings offer a foundation for developing laws that prioritize equity, climate resilience, and the right to safe, reliable water and sanitation in the face of a changing climate.

This is a report focused on what is possible. Some critics, including some of our reviewers, will say some of these measures are too difficult, expensive, or improbable, especially in the context of extant political polarization and gridlock. To that we say that anything is possible with the right ideas, leadership, and organizing and advocacy behind it. Breakthroughs often begin as impossibilities — until someone with vision chooses to fight for them. Almost nothing worth achieving has ever come easily.

Here we summarize the key strategies and approaches for adapting and drafting laws and policies for equitable, climate-resilient water and sanitation, organized by the six attributes and associated criteria. These criteria are numbered here based on the section in which they appear.

SITING, DESIGN, AND CONSTRUCTION REQUIREMENTS ADDRESS CLIMATE CHANGE

Achieving equitable, climate-resilient water and sanitation for frontline communities in the US will require updating and adding new federal, Tribal, state, and local laws to address requirements and standards for water and wastewater system siting, design, and construction that explicitly incorporate the impacts of climate change. Three criteria that communities and their supporters can use to evaluate whether the laws they have are sufficient, and some strategies and approaches for updating and adopting better laws, include:

Achieving equitable, climate-resilient water and sanitation for frontline communities in the US will require updating and adding new federal, Tribal, state, and local laws to address requirements and standards for water and wastewater system siting, design, and construction that explicitly incorporate the impacts of climate change.

Criterion 3.1: Codes and standards require water and sanitation structures and equipment to be elevated and/or protected from flooding, wildfire, and other climate change disasters.

- State and local laws can require that building codes use the best available science to account for the impacts of climate change on climate risks.
- State and local governments can adopt standards that are more stringent than those currently offered by federal agencies.
- State or local laws governing the post-disaster rehabilitation or rebuilding of water and wastewater infrastructure can incorporate future climate risks.

Criterion 3.2: State law requires drinking water utilities to have adequate storage capacity or be physically connected to at least one backup or alternative source of water supplies.

- State laws can be created to enable interties (physical, piped connections) with neighboring water utilities or update existing laws that may inhibit interties.
- State laws can create incentives or guidance for water utilities to have more than one water source or sufficient backup storage.
- States can create policies that require augmentation plans.
- States can facilitate water availability for domestic supplies during droughts by authorizing rainwater harvesting for domestic use or allowing temporary reallocation of water rights.

Criterion 3.3: Water efficiency is incorporated into building codes for new construction and retrofits.

- States and local jurisdictions can adopt laws that require building and plumbing codes to incorporate higher water efficiency standards than exist at the federal level into new construction.
- State or local laws can require inefficient fixtures or appliances to be replaced upon sale or change of ownership of a property.
- State or local laws can ban nonfunctional turf or set requirements for installing water-efficient landscapes and irrigation systems in new and retrofitted properties.

WATER USES ARE LEGALLY PROTECTED IN FRONTLINE COMMUNITIES DURING CLIMATE DISRUPTIONS

Water governance varies by state and can involve laws from federal, Tribal, state, and local jurisdictions. Therefore, there are no universal approaches to incorporating climate change into laws related to water rights, allocations, and use. The ultimate goal of addressing these gaps in water laws is to create the enabling environment to achieve the human right to water and sanitation, even as climate change makes it more difficult. Four criteria for evaluating if laws have integrated climate change to help water systems manage their resources and protect water and sanitation access in times of water scarcity and drought, and some strategies and approaches for updating and adopting better laws include:

Criterion 4.1: Water laws allow for flexibility in the allocation of water during times of water scarcity.

- State or regional water managers can be given the ability to temporarily alter water allocations and priorities to ensure water remains available for drinking and sanitation during times of drought and scarcity.
- States can define and regulate wasteful or unreasonable uses of water, particularly during times of drought or scarcity.
- States can make water use permits time-limited so that permit holders must periodically renew their license, during which the water management agency can re-evaluate the water use in the context of changes in the hydrologic system, ideally including the most up-to-date projections of climate change.
- States can add flexibility and allow for the redistribution of water use allocations during drought by creating laws that allow for water shortage sharing agreements.

Criterion 4.2: The law protects and prioritizes household water use during times of water scarcity.

- States can make laws that prioritize water for household purposes by prioritizing municipal water use, even if the municipal use has more junior rights than other uses.
- Laws can create the ability for state or regional water managers to temporarily give preference to water rights for human consumption during officially declared droughts.
- States can adopt water laws to support rainwater harvesting for domestic use that do not require water rights.
- States can adapt laws to allow for temporary transfers of water rights to domestic or municipal users during times of drought.
- States can make laws that protect household water use by having more relaxed water permitting requirements for domestic use relative to other forms of use.

Criterion 4.3: The law explicitly requires the impacts of climate change to be considered when administering water rights.

- States can adopt laws that require climate change to be one of the factors considered when renewing or issuing a new water right or water use permit.

Criterion 4.4: Federal, state, and local laws recognize the human right to water and sanitation.

- The federal government can amend the US Constitution and/or codify the human rights to water and sanitation in federal law.
- States can codify the human right to water and sanitation through state constitutional amendments or state legislation.
- Local governments can enact laws or adopt amendments to municipal charters that recognize the human right to water and sanitation**.**
- Resolutions that direct programs, funding, and other resources to communities in need can support the realization of the human right to water and sanitation, especially as climate change threatens the reliability of drinking water and wastewater infrastructure and drinking water sources.

CLIMATE RESILIENCE IS REQUIRED IN PLANNING

Incorporating climate resilience into planning efforts can help to better prepare frontline communities, including their water and sanitation, for climate change impacts. To do this, laws can require state and local governments and utilities to assess and plan for climate change impacts on water and wastewater infrastructure and services. Here we summarize the two criteria that communities or policymakers can use to evaluate whether there are laws that require climate planning to prepare water and wastewater infrastructure and services for increasing risks from climate change, including a summary of examples of existing laws.

Laws can require state and local governments and utilities to assess and plan for climate change impacts on water and wastewater infrastructure and services.

Criterion 5.1: The law requires water and wastewater utilities or government agencies to conduct climate risk and vulnerability assessments, including mapping of critical infrastructure and service areas.

- Federal laws can require states and Tribes to create and submit hazard mitigation plans and integrate climate considerations into related hazard mitigation assistance programs.
- Federal laws can require water utilities serving more than 3,300 people to conduct risk and resilience assessments (RRAs) that evaluate the risk of different (climate) hazards on water utility infrastructure and operations and maintenance.
- State and local laws can require local-level risk and resilience assessments.
- Laws can require climate vulnerability assessments to include mapping of drinking water and wastewater infrastructure.

Criterion 5.2: The law requires states and water and wastewater utilities to adopt climate adaptation and emergency response plans to protect water and wastewater infrastructure and services.

- Federal laws can require water utilities serving more than 3,300 people to develop an emergency response plan. America's Water Infrastructure Act (AWIA) requires that the plan include both emergency measures and measures that proactively reduce the impacts of floods and droughts and other natural hazards on the ability of the utility to provide drinking water.
- State laws can require or encourage state agencies and local governments to conduct climate adaptation assessments and create climate adaptation plans. In California, state law requires city or county governments to adopt a general plan that addresses climate change impacts to critical infrastructure, like water and sanitation.
- State laws can encourage or require utilities to implement climate adaptation strategies, such as water conservation. In California for example, state law required urban water suppliers to develop urban water use targets that resulted in a 20% reduction in water use by 2020 compared to baseline daily per capita water use.
- States can pass laws that create state-level positions, offices, or taskforces dedicated to coordinating climate adaptation and emergency response activities.

WATER AND CLIMATE DATA COLLECTION, MONITORING, AND REPORTING ARE REQUIRED

The law can require that data and information are collected and monitored and that the public has opportunities to weigh into decision making. Laws requiring timely public notices help the public and decision makers stay informed during emergent events, like flooding, that can lead to drinking water contamination and/or sewer overflows. There are also laws in some states and at the federal level that require deeper assessments of different climate phenomena, creating opportunities for the public and decision makers to be informed on the expected impacts of climate change. However, mis- and disinformation are increasingly a challenge for accurate climate change information and may require new laws.

Information and engagement enable transparency, accountability, and responsiveness to challenges faced by water and wastewater utilities in providing safe and reliable services. The law can support engagement by requiring that data and information be published in a publicly accessible manner. Laws can also mandate opportunities for public input, such as through public comment periods. These create opportunities for the public to raise concerns about climate change. However, barriers to equitable public engagement remain, especially for marginalized groups, inhibiting equal opportunity for input and integration of input from all. Some laws support equitable integration of different knowledge systems, such as through the inclusion of Indigenous consultation processes, for example, but more work is needed to expand these types of legal provisions.

Here we summarize two criteria that communities and their supporters can use to evaluate whether the laws they have are sufficient for equitable, climate-resilient monitoring, data, and information on water and sanitation infrastructure and services, and some strategies and approaches for updating and adopting better laws:

Criterion 6.1: The law requires the collection and reporting to the public of relevant, credible climate and water data and information.

- Laws can require information to be provided to the public about the quality of drinking water and wastewater services and their compliance with health-based standards. These reports, however, rarely include information on how climate change is affecting service delivery, which makes it more challenging to plan for and respond to those impacts.
- Federal laws can create opportunities for oversight of critical functions of water and wastewater infrastructure and services that are susceptible to climate impacts, as have been done in the Safe Drinking Water Act (SDWA) and Clean Water Act (CWA).
- Laws can require public notices of higher risk drinking water and wastewater violations so that the public can take measures to protect themselves.
- Laws can require studies and assessments to be conducted through which data and information are collected and evaluated to inform recommendations for future action related to climate risks.

Criterion 6.2: The law facilitates the participation and engagement of the public in decision making about water-related climate adaptations.

- The law can require publication of data and information related to climate risks to water or wastewater infrastructure or services online to facilitate public access to the information.
- The law can require administrative agencies to offer the public the opportunity to provide feedback on draft regulations and guidance they issue. Diverse types of public engagement, including written comments and listening sessions, may ensure that more members of the public can provide feedback.
- The law can mandate consultation processes with historically marginalized groups such as Tribal Nations. For example, the US Global Change Research Act (1990) mandated an Indigenous consultation process as part of the National Climate Assessment.

LAWS GOVERN EQUITABLE DISTRIBUTION OF CLIMATE-RESILIENT INFRASTRUCTURE FUNDING

Laws help fund drinking water and wastewater infrastructure projects and rehabilitation efforts. Laws direct government funding to water and wastewater infrastructure as well as provide certain guidelines for how and on what the funding can be spent. Beyond appropriating greater funding to support the rehabilitation of water and wastewater infrastructure, laws could provide greater direction on how the funding should be used to ensure more funding is dedicated to enabling water and wastewater utilities to prepare for climate change impacts. By ensuring that investment in infrastructure considers climate change impacts, investments go further and have a long-term impact.

By ensuring that investment in infrastructure considers climate change impacts, investments go further and have a long-term impact.

Here we summarize three criteria that communities and their supporters can use to evaluate whether the laws they have are sufficient, and some strategies and approaches for updating and adopting better laws:

Criterion 7.1: Laws appropriate funding and create loan programs to enable climate-resilient access to water and wastewater services and to create and extend water and wastewater infrastructure to communities that currently lack access.

- Federal lawmakers can pass laws, such as America's Water Infrastructure Act of 2018, the CWA, and the SDWA, to create funding mechanisms and appropriate funding for specific types of projects that help water and wastewater utilities to provide safer, more resilient services.
- Federal and state legislatures can appropriate funding or provide supplemental funding for climate-resilient water and sanitation using laws.
- Federal lawmakers can create mechanisms that make climate disaster funding easier to access, such as by appropriating disaster relief through State Revolving Funds (SRFs).
- Lawmakers and government agencies can create laws and policies to more equitably distribute climate resilience funding.
- SRF intended use plans (IUPs) can prioritize funding for improving the climate resilience of water and wastewater infrastructure.
- State laws can authorize state governments to issue bonds to fund projects that help water and wastewater systems adapt to climate change.
- Laws can include provisions to prioritize funding for frontline communities. For example, the Texas Flood Infrastructure Fund was adopted through laws that specifically require prioritization of funds for low-income communities.

Criterion 7.2: Laws create economic incentives to consider the water and climate risks of new development and ensure proactive rehabilitation and responsible redevelopment in flood-prone areas.

- Federal and state lawmakers can pass laws that restrict the use of government funding from supporting development in certain flood-prone areas. For example, the Coastal Barrier Resources Act of 1982 restricted the use of Federal funding in coastal barriers.
- Federal lawmakers can encourage state and county governments to adopt more climate-resilient land-use practices by making federal flood insurance contingent on implementing and enforcing these practices.

- Federal law can incentivize states and Tribes to take proactive steps to improve disaster readiness and resilience by offering a higher share of assistance for these types of activities, as has been done under the Stafford Act.
- Laws can authorize funding to buy properties from people who choose to move after repeated climate disasters.

Criterion 7.3: Laws can mandate the tracking and reporting of climate disaster relief funding.

- Federal law can require governments to track funding obligations and expenditures to provide greater transparency on disaster assistance and preparedness.
- Laws can require nonfunding agencies, like the Government Accountability Office, to review and report on government funding expenditures.

LAWS TO MINIMIZE CLIMATE DISRUPTIONS ARE ENFORCEABLE AND ENFORCED

The law not only establishes the rules that must be followed, but the terms of enforcement and permitted actions. Enforcement of the rules is critical to ensuring that the law is followed. It puts the rules into practice, creating consequences if and when the laws are violated. The EPA and states have discretion in determining which enforcement actions they want to bring, depending on a variety of factors. Some states allow citizens to enforce the law as a backstop to the government. Having effective penalties and consequences increases the likelihood that people will stay in compliance with the law, including taking steps to anticipate how climate change threatens their compliance.

Here we summarize five criteria that communities and their supporters can use to evaluate whether the water laws are both enforceable and enforced, and some strategies and approaches for improved enforcement:

Criterion 8.1: The law establishes consequences for noncompliance with drinking water and wastewater standards that protect public health, water quality, and the environment and considers the equity and fairness of those consequences.

- Laws can establish penalties for noncompliance with regulations and determine who is responsible for enforcing specific regulations.
- Enforcement action settlement can require that utilities that fail to comply with regulations make specific updates to their systems on a certain timeline.
- The SDWA allows for water systems that are struggling to comply to explore consolidation or regionalization to address water quality issues.
- Monetary fines as consequences can create an additional burden on less well-resourced communities and their ability to come into compliance. Alternative penalties — like Supplemental Environmental Projects — can better support compliance.

Criterion 8.2: The law establishes enforcement tools that sufficiently deter behaviors that violate the law and increase the risks of climate disruptions to water and wastewater service.

- Federal laws can set priorities for how agencies determine enforcement penalties. For example, the EPA's General Enforcement Policy (1984) identifies three enforcement priorities that guide the agency in setting penalties for EPA regulations.
- Laws can set the maximum fine allowed but allow the courts to decide the level of penalty under that maximum. For example, the CWA identifies factors for the court to consider when calculating penalties under the law.
- States may adopt different maximum financial penalties for noncompliance with the CWA and SDWA, creating different incentives across the US for complying with the same laws.
- Government agencies can set policy that directs enforcement departments to incorporate climate change into their enforcement efforts. For example, EPA policy provided guidance to its enforcement arm to consider climate change in its efforts to bring violators into compliance with the SDWA and CWA.

Criterion 8.3: Enforcement actions are taken by governmental bodies responsible for implementing and enforcing the law.

- State and federal enforcement agencies can choose to enforce existing laws. While compliance with the law is mandatory, enforcement is discretionary.

Criterion 8.4: The law creates opportunities for the public to enforce implementation of and compliance with the law.

- Because federal laws allow it, citizens can bring lawsuits to enforce the CWA and SDWA against the government and other actors.
- State laws can allow citizens to bring lawsuits to enforce environmental laws. Citizen suit provisions are particularly important in states that have broader waterbody protections than covered by a post-Sackett Clean Water Act.

Criterion 8.5: Permits explicitly anticipate and address climate change impacts and do not undermine compliance and environmental protection.

- EPA Regions can issue National Pollution Discharge Elimination System (NPDES) permits to wastewater utilities that require the utilities to develop climate adaptation plans as part of the permitting process. EPA Region 1 issued three permits with this requirement in 2023.

CONCLUSION

The analysis in this report confirms a simple but powerful truth: without an explicit, enforceable legal foundation, the US will struggle to deliver safe, reliable water and sanitation to every community as the climate warms and extremes intensify. We reviewed hundreds of federal, state, and local statutes and distilled them into six core attributes — siting, design, and construction requirements; legal protections for household water use during climate disruptions; climate-resilience planning; monitoring, data collection and reporting; equitable funding; and enforcement — that together define an enabling environment for equitable, climate-resilient water and sanitation infrastructure and services. We identified 64 legal strategies that can be used to operationalize each attribute, demonstrating that workable language already exists in some jurisdictions and can be adapted elsewhere.

We reviewed hundreds of federal, state, and local statutes and distilled them into six core attributes that together define an enabling environment for equitable, climate-resilient water and sanitation infrastructure and services.

The 19 actionable criteria catalogued herein should not be construed as a uniform model code, but rather as a diagnostic checklist. Policymakers may employ it to benchmark existing statutes; regulators can integrate the criteria into guidance and permitting; utilities may use it to align capital plans; and communities and their supporters can use the criteria to drive change and improve the climate resilience of their water and sanitation systems.

Our review also identified three areas where there remain critical gaps in developing laws and policies that support equitable, climate-resilient water and sanitation.

- **Decentralized and onsite systems.** While most US households are served by centralized water and wastewater systems, millions who rely on decentralized and onsite systems are typically less protected legally from climate impacts.
- **Integration of climate science.** Many statutes still rely on historic understanding of climate patterns, and methods for regularly updating design storms (i.e., the intensity and/or frequency of a storm event to which infrastructure systems are designed to withstand), flood maps, and water rights require new laws and policies at all levels of government.
- **Effectiveness of enforcement.** New quantitative studies linking specific enforcement tools to improved climate outcomes for water systems are needed.

Addressing these gaps will require collaboration among legal scholars, policymakers, water resource managers, scientists, utilities, Tribal governments, and community organizers.

Water is life, and the obligation to secure it for current and future generations is, at its root, a matter of justice. Climate change is already testing the physical limits of the US's water and sanitation infrastructure along with the limits of the legal and policy frameworks that guide this infrastructure and services it provides. The attributes set forth in this report demonstrate that the law — when well-crafted, resourced, and enforced — can help create more equitable, climate-resilient water and sanitation for frontline communities.

1. Introduction

As climate change intensifies and accelerates, frontline communities experience many of its impacts through water. Droughts are becoming longer, hotter, and more frequent, increasing the risk of water shortages for homes, businesses, and ecosystems and creating conditions for more intense wildfires. Flooding from extreme storms and more intense precipitation events are taking lives and damaging or destroying water and wastewater infrastructure, taking services offline for hours, days, weeks, or longer. Other events that are worsening under climate change, like wildfires and sea level rise, can wreak havoc on water quality, leaving homes and communities without access to safe drinking water. These climate events can lead to backsliding, i.e., loss of access to safe drinking water or a functioning sanitation system, either temporarily or permanently, with the first and worst impacts often being felt by frontline communities (Pacific Institute and DigDeep 2024). Already, more than two million people in the US live in the water access gap without running water and basic plumbing in their homes, and millions more are served by public water systems[1] with Safe Drinking Water Act (SDWA) violations or face water and wastewater utility bills they cannot afford (Roller et al. 2019).

Laws can provide critical parameters and enabling conditions for water and sanitation managers, operators, and staff to continue providing safe, reliable services as the frequency and strength of extreme temperatures, droughts, and floods and other climate-change disruptions grow.

Despite these threats, the federal, Tribal,[2] state, and local laws and policies across the US largely fail to help protect communities from the impacts of climate change on water and wastewater infrastructure and services (Campbell-Ferrari et al. 2024). This is true for laws that protect and steward water resources to those that govern the construction and operation of water and wastewater infrastructure. Laws can provide critical parameters and enabling conditions for water and sanitation managers, operators, and staff to continue providing safe, reliable services as the frequency and strength of extreme temperatures, droughts, and floods and other climate-change disruptions grow. However, these laws often do not explicitly take climate change into account (Campbell-Ferrari et al. 2024). This gap leaves water and sanitation infrastructure and services at greater risk of damage or worse during climate emergencies. And the frontline communities served by these unprotected and underprepared systems often bear the greatest risks and financial burdens (Pacific Institute and DigDeep 2024).

The lack of consideration of climate change impacts extends to regulation and operation of water and wastewater infrastructure. Often, laws do not require communities to consider climate impacts as part of the construction or rehabilitation of water and sanitation systems. This means infrastructure will be left vulnerable to climate change impacts, leading to short-term, long-term, and, in some cases, permanent service disruptions (Pacific Institute and DigDeep 2024). Further, federal and state laws do not guarantee access to water and sanitation by recognizing a human right to water and sanitation (aside from a few examples we discuss in Section 4). The failure to recognize the right to water and sanitation leaves governments with no legal responsibility and little impetus to ensure communities have safe and reliable access to water and sanitation.

This report is the fourth in the Water, Sanitation, and Climate Change in the United States Series. This series aims to synthesize the state of knowledge and identify gaps at the intersection of climate change, water, and equity in the US. While these topics have received substantial attention individually, more work is needed to elucidate how and where they intersect. The first report of the series, *Climate Change Impacts to Water and Sanitation for Frontline Communities in the United States*, reviewed the literature on the effects of six climate change phenomena on water resources and water and sanitation in the US — extreme temperatures, drought, flooding, sea level rise, storms, and wildfires, especially in frontline communities (Pacific Institute and DigDeep 2024). Part 2, *Law and Policies that Address Equitable, Climate-Resilient Water and Sanitation*, examined how laws and policies that govern and inform water and sanitation service provision and infrastructure in the US address the impacts of climate change (Campbell-Ferrari et al. 2024). Part 3, *Achieving Equitable, Climate-Resilient Water and Sanitation for Frontline Communities*, highlighted strategies and approaches for achieving equitable, climate-resilient water and sanitation in the US (McNeeley et al. 2025).

This fourth report in the series is a continuation of part 3 and outlines the essential or necessary characteristics of equitable, climate-resilient water and sanitation laws and policies (i.e., attributes). It also presents actionable criteria for evaluating the legal principles, provisions, or sections within the laws that help achieve the associated attribute. These criteria are a unique component of this report that were not used in the previous report in this series. While existing laws and policies are largely inadequate to protect water and sanitation infrastructure and services from the impacts of climate change, they can be adapted to meet this challenge.

While existing laws and policies are largely inadequate to protect water and sanitation infrastructure and services from the impacts of climate change, they can be adapted to meet this challenge.

This is a report focused on what is possible. Some critics, including some of our reviewers, will say some of these measures are too difficult, expensive, or improbable, especially in the context of extant political polarization and gridlock. To that we say that anything is possible with the right ideas, leadership, and organizing and advocacy behind it. Breakthroughs often begin as impossibilities — until someone with vision chooses to fight for them. Almost nothing worth achieving has ever come easily.

The attributes and criteria identified in this report are intended for frontline communities and their supporters to assess their own legal infrastructures for shortfalls. This report documents dozens of examples of existing laws and policies that either meet or fall short of the criteria, demonstrating how legal provisions can be more effectively drafted to manage climate change impacts. Ultimately, this report aims to identify legal provisions that can be adopted, and in many cases have been adopted, so that frontline communities in the US can draft and adopt laws that help them create more equitable, climate-resilient water and sanitation infrastructure and services.

This report is structured as follows:

- Section 2 presents the organizing framework with categories and attributes of equitable, climate-resilient water and sanitation laws and policies.
- Sections 3 through 8 describe each of the law and policy attributes and associated criteria for achieving them, including its importance, the barriers and challenges to its achievement, and examples for how existing laws or policies have integrated the associated criteria (or not).
- Section 9 is the conclusion and includes knowledge gaps and recommendations for future research.

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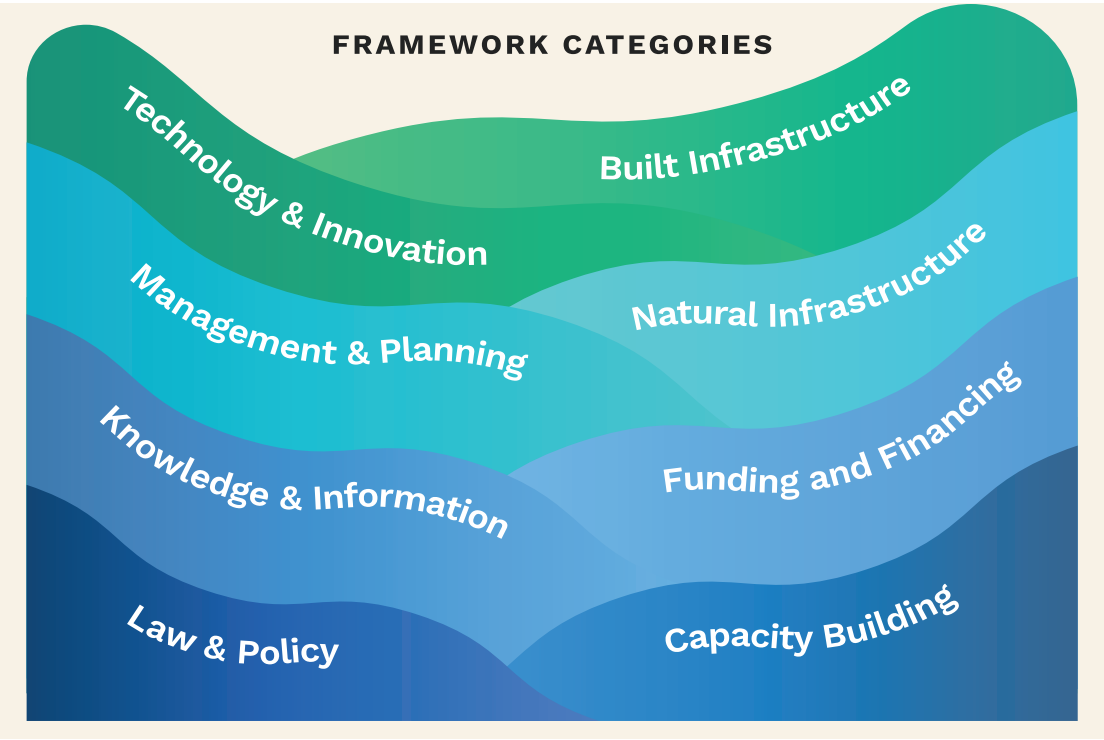
2. Approach

2.1 FRAMEWORK FOR ACHIEVING EQUITABLE, CLIMATE-RESILIENT WATER AND SANITATION

McNeeley and co-authors (2025) provided a literature-informed framework to categorize and communicate the major components of equitable, climate-resilient water and sanitation (Figure 1). The categories include (1) built infrastructure, (2) technology and innovation, (3) natural infrastructure, (4) management and planning, (5) funding and financing, (6) knowledge and information, (7) capacity building, and (8) law and policy. The report addressed seven of the eight categories, providing more than 100 documented strategies and approaches frontline communities and their supporters have applied to make water and sanitation systems more resilient to climate change. This report takes a similar approach, focusing on the eighth category: law and policy.

FIGURE 1. Framework for Achieving Equitable, Climate-Resilient Water and Sanitation



Note: The figure depicts the eight categories of climate-resilient and equitable water and sanitation, which serves as the organizing framework for the attributes and corresponding strategies in McNeeley et al. (2025). This report focuses on the legal and policy attributes and corresponding strategies.

To develop the framework and attributes, we reviewed academic literature, government and NGO reports, and online tools. We primarily focused on literature, resources, and case examples from the US but drew on literature from non-US contexts when relevant. We also solicited input from practitioners at conferences and through online and in-person forums.

Although extensive, additional effort is needed to fill gaps in available data and documented information. As one example, we do not address strategies for reducing greenhouse gas emissions. We also did not do a deep review of Tribal laws and policies. The conclusions provide some areas for additional research.

2.2 ATTRIBUTES AND CRITERIA OF EQUITABLE, CLIMATE-RESILIENT WATER AND SANITATION LAWS AND POLICIES

We identified and synthesized a diverse set of attributes and criteria of laws and policies from federal, state, and local levels (Table 1). These attributes outline the essential characteristics of laws and policies that enable equitable, climate-resilient water and sanitation in the US.

TABLE 1. Law and Policy Attributes of Equitable, Climate-Resilient Water and Sanitation in the US

ATTRIBUTE	ATTRIBUTE DESCRIPTION
Siting, design, and construction requirements address climate change	Federal, state, and local governments adopt siting, design, and construction requirements and standards for water and wastewater infrastructure that explicitly address the impacts of climate change.
Water uses are legally protected in frontline communities during climate disruptions	Legal frameworks are established and enforced that safeguard priority water uses, including domestic, subsistence, cultural, and livelihood needs in frontline communities during water scarcity, shortages, and other climate disruptions.
Climate resilience is required in planning	The law requires water and wastewater utilities and government agencies to adopt climate resilience plans to guide water resource and asset management.
Water and climate data collection, monitoring, and reporting are required	Laws across all jurisdictions create requirements to monitor and collect data and information critical to preparing water and sanitation infrastructure and services for climate change.
Laws govern equitable distribution of climate-resilient infrastructure funding	Federal and state laws equitably appropriate and distribute financial resources to fund and finance the rehabilitation of existing and construction of new climate-resilient water and wastewater infrastructure.
Laws to minimize climate disruptions are enforceable and enforced	Federal, Tribal, state, and local laws create enforcement mechanisms for ensuring that drinking water and sanitation systems serving frontline communities meet legal and regulatory standards to reduce risk of harm from climate change impacts to water and sanitation infrastructure and services.

Along with attributes, we identified criteria for determining whether each attribute is adequately addressed within the law. The criteria can be used to assess whether specific legal principles, provisions, sections in the law, rules, rights, responsibilities, and authorities help stakeholders prepare and respond to climate impacts on water and wastewater service delivery and infrastructure. Along with each criterion, we offer examples of law and policy strategies and approaches to meet them.

We developed these attributes and the criteria for frontline communities and their supporters to apply to the laws and policies relevant to them. These supporting entities include community-based organizations, nonprofits, federal, Tribal, state, and local lawmakers, water and wastewater utilities,[3] and regulators.

In developing these attributes and criteria, there were a few considerations that informed the scope. The law treats centralized and decentralized services differently, as discussed in *Law and Policies that Address Equitable, Climate-Resilient Water and Sanitation* (Campbell-Ferrari et al. 2024).

Because approximately 90% of the US population is served by centralized drinking water systems and 75% is served by centralized wastewater systems (US EPA 2025a, 2015a), we concentrated this research on the laws and policies that govern centralized water and wastewater infrastructure and services.

An important caveat that applies to the entire report is that the laws and policies cited herein may change or be repealed. This risk is especially high for federal laws and policies with the dramatic policy shifts in the White House as of 2025. The administration is aggressively reversing many of the previous administration's actions along with long-standing laws, policies, programs, and funding designed to protect water, ecosystems, people, and property from climate change and injustice. The administration is explicitly targeting climate change and equity measures, many of which have already been eliminated or severely gutted, bringing many legal issues covered in this report into question — both in the near and long terms. We made efforts to keep up with these changes as we prepared this report for publication, however, inevitably there will continue to be changes after this report is published.

Finally, the aim of this report was not to identify *everything* that could be addressed by and included within the law. Rather, we sought to identify the most critical attributes and criteria for creating a strong legal foundation for preparing for and responding to climate change disruptions to water and sanitation infrastructure and services affecting frontline communities. Different states and localities often have different laws and policies, and therefore, may have different starting points in adapting their laws and policies to climate change. We also did not do a comprehensive review of all legal examples across the US. Instead, we included a diverse set of examples from different geographies and levels of governments. 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. As such, applying the attributes and criteria will likely require tailoring to the context in which they are being implemented and in close partnership with the communities they are meant to serve to ensure they are responsive to their needs and challenges.

3. Siting, Design, and Construction Requirements Address Climate Change

Attribute description: Federal, state, and local governments adopt siting, design, and construction requirements and standards for water and wastewater infrastructure that explicitly address the impacts of climate change.

As climate change intensifies, more extreme droughts, floods, and other weather events will disrupt, damage, or destroy water and wastewater infrastructure. When infrastructure is damaged or destroyed, services from water and wastewater systems can fail, leaving people without access to running water. This attribute addresses the need to update standards and codes to reflect the increased risks associated with climate change so that water and wastewater infrastructure is sited, designed, and constructed in ways that has the best chance to withstand these impacts and remain functional.

Water and wastewater infrastructure built without considering the increased risks from climate change leaves communities at greater risk of backsliding (losing access) when a climate disaster occurs. For example, in 2024 Hurricane Helene caused unprecedented flooding in western North Carolina that damaged a drinking water distribution system and reservoir. This left hundreds of thousands of homes without safe running water for more than 50 days (City of Asheville 2024; Lahr 2024). Similarly, in August of 2022, historic flooding in Jackson, Mississippi further damaged the already failing water system. This resulted in approximately 160,000 people without safe drinking water for weeks (Southern Poverty Law Center 2023).

During a severe drought in California in the mid-2010s, an analysis of state agency records found that 52 public water systems applied for and received emergency drought funding to haul in water via truck or deliver bottled water to customers (Feinstein et al. 2017). The systems either lacked backup water supply options such as deeper wells or connections to other public water systems or only had access to water supplies with degraded water quality that they were unable to treat with their existing treatment technology. The majority of these systems served 1,000 or fewer customers and were predominantly low-income and state-designated “disadvantaged” communities,[4] highlighting the inequity in the impacts of the drought (Feinstein et al. 2017).

There are economic benefits to ensuring infrastructure standards and codes incorporate climate change. Compared to no adaptation, proactive adaptation measures can save lives and billions of dollars in infrastructure repair and replacement costs post-climate disaster (Melvin et al. 2017; Neumann et al. 2021). For example, one estimate found that every $1 spent on making homes, businesses, and infrastructure more disaster-ready can save $7 in damage, cleanup costs, and lost jobs. With the acceleration of costly climate change disasters, adapting infrastructure to climate change can provide significant economic value.

> Water and wastewater infrastructure built without considering the increased risks from climate change leaves communities at greater risk of backsliding (losing access) when a climate disaster occurs.

While floods, wildfire, and droughts will always pose some risk to water and wastewater infrastructure, improved climate-resilient siting, design, and construction standards can help protect water and sanitation infrastructure and services. Laws can be enacted to change existing rules so that as infrastructure is updated, expanded, or rebuilt after a disaster, it is built following more climate-resilient practices. Laws can also incentivize utilities to physically connect to other neighboring systems or install infrastructure to maintain backup water supplies to reduce risks during drought or other climate disasters. Building codes can legally require new construction to have flood and wildfire mitigation features and water augmentation plans or to use water-efficient fixtures, appliances, and landscaping. They can also require that older buildings be retrofitted with more efficient devices, helping communities with retrofitted buildings collectively lower water demand and reduce broader community vulnerability to drought.

We identified three criteria that can be used to help communities incorporate climate change into the design, siting, and construction of water and sanitation infrastructure.

1. Codes and standards require water and sanitation structures and equipment to be elevated and/or protected from flooding, wildfire, or other climate change disasters.
2. State law requires drinking water utilities to have adequate storage capacity or be physically connected to at least one backup or alternative source of water supplies.
3. Water efficiency is incorporated into building codes for new construction and retrofits.

3.1 CRITERION 1: CLIMATE DISASTER PROTECTION FOR WATER AND SANITATION INFRASTRUCTURE

Codes and standards require water and sanitation structures and equipment to be elevated and/or protected from flooding, wildfire, and other climate change disasters.

Building codes and standards address a wide range of requirements to ensure safety, functionality, durability, and resilience in building design and equipment placement. There are multiple ways that these codes and standards can incorporate the growing risk of flooding, wildfire, sea level rise, and other climate change phenomena. One way is to require use of the best available science on climate change risks. Another is for Tribal, state, and local governments to adopt standards more stringent than used by state and federal agencies like the Federal Emergency Management Agency (FEMA). A third is to ensure rules governing the rehabilitation or rebuilding of water and wastewater infrastructure post-disaster incorporate future climate risks. With these approaches, new water and wastewater infrastructure, as well as those needing to be reconstructed or repaired, will be better prepared for future impacts of climate change.

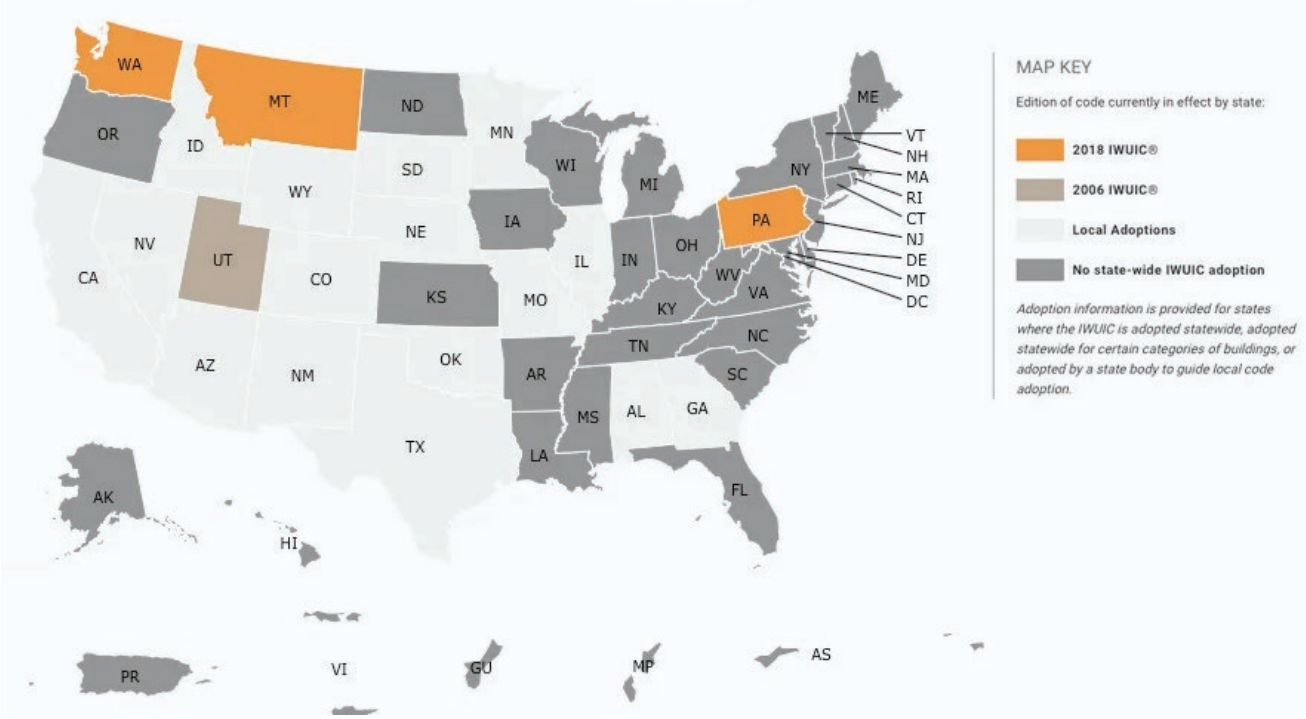
Building codes and standards already address some components of fire safety, but they typically reduce risks of harm and destruction of a structural fire or fire that ignites inside a building rather than a wildfire. For example, building codes may dictate that smoke alarms are installed in a certain number of rooms within a building. While important safety measures, they do not address wildfire risk. Beginning in 2003, the International Code Council[5] developed the International Wildland-Urban Interface Code (IWUIC), providing minimum regulations for land use and the built environment in wildfire-prone areas (International Code Council 2024a).[6] The IWUIC addresses several key areas:

- defensible space and vegetation management,
- fire-resistant construction materials,
- access and egress for fire response (e.g., road widths and signage),
- water supply requirements for firefighting,
- structure siting and lot configuration, and
- hazard severity classifications (low, moderate, high, extreme).

The IWUIC model code is something that local governments and states can use and adapt to their specific needs. The IWUIC is not mandatory at the federal level, but it has been adopted by at least

200 local jurisdictions in 24 different states and at the state level by California, Montana, Nevada, Pennsylvania, Utah, and Washington (Figure 2) (International Code Council 2024b, 2025). On the island of Kauai, Hawaii, the County Council and Mayor passed an ordinance (Bill 2961) to embed fire mitigation, fire-resistant home improvements, and defensible-space standards into building codes for areas known as plantation camps, which are residential communities in place with historical and cultural significance to the local people (Kauai Now 2025). This law was the first in the state to formally require wildfire safety in zoning and permitting processes. By adopting the IWUIC or other wildfire safety measures in building codes, local governments can require new construction and renovated buildings in the wildland-urban interface to be more prepared for wildfire. This can help to reduce the risk that people will lose their homes and that community assets like water and wastewater infrastructure will be destroyed when exposed to wildfire (International Code Council 2020; Pacific Institute and DigDeep 2024).

FIGURE 2. International Wildland-Urban Interface Code Adoption Map



Note: Additional sources report that California and Nevada have also adopted IWUIC statewide (International Code Council 2025, 2025).

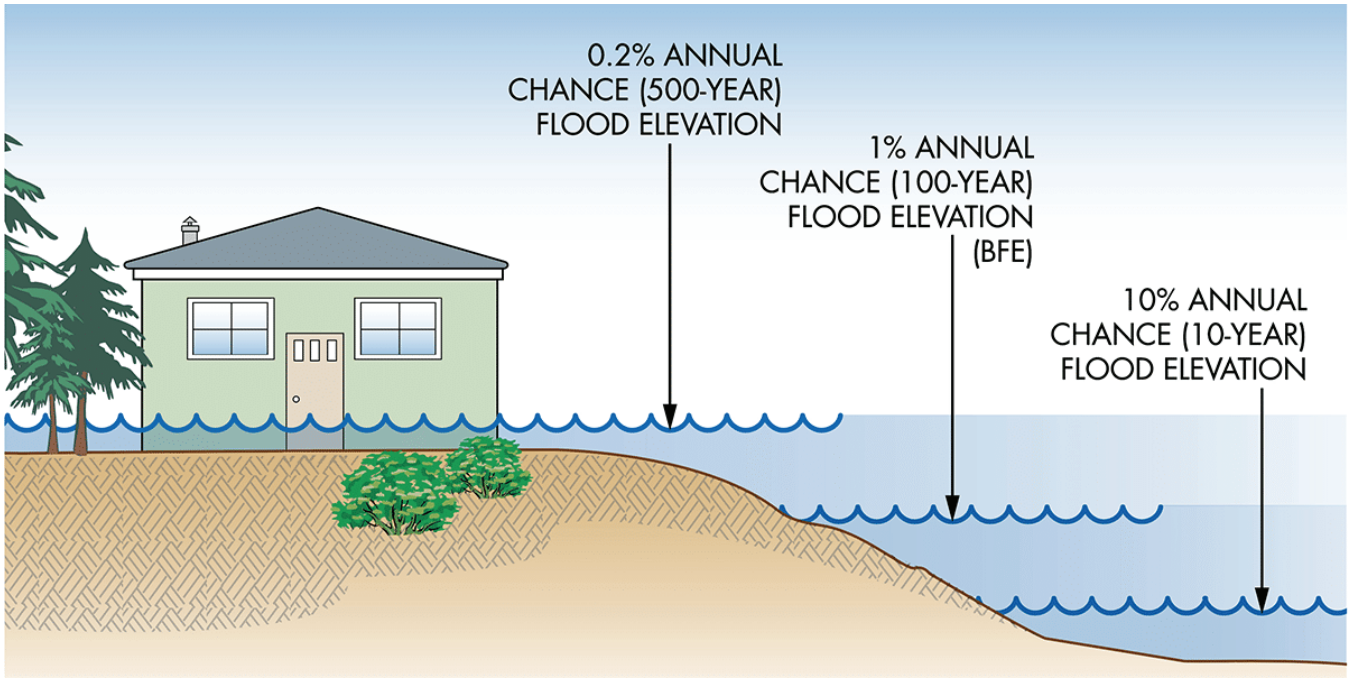
Source: International Code Council 2024b

Building codes and standards to address flooding are used by floodplain managers, city planners, civil engineers, developers, and communities nationwide to plan and design infrastructure. The NOAA Atlas Precipitation-Frequency Atlas of the United States ("Atlas") helps inform the elevation and design of critical infrastructure (including water and wastewater infrastructure) to withstand flooding. For example, municipalities use rainfall frequency and precipitation estimates ("IDF curves") from the Atlas when sizing roof drainage systems or site grading. However, the most current version, Atlas 14, assumes a stationary climate (i.e., the climate of the past would be the climate of the future) (NOAA 2024). Yet, in 2022, US Congress passed the Providing Research and Estimates

of Changes in Precipitation (PRECIP) Act that required the National Oceanic and Atmospheric Administration (NOAA) to update its precipitation estimates and the methods it uses to prepare them so that it considers the non-stationarity of the climate. The Bipartisan Infrastructure Law included a provision for funding this work, to be published as Atlas 15 in 2026 and 2027 (NOAA 2024). However, funding for NOAA's climate research, including for the sections in Atlas 15 that are designed to incorporate climate change, were paused indefinitely in July 2025 because of orders from the White House administration (Kaplan 2025).

Another way Tribal, state, and local governments can prepare for increased risks of flooding from climate change is by adopting floodplain standards that exceed those provided by FEMA and the National Flood Insurance Program (NFIP). The NFIP is the most extensive flood insurance program in the US. It makes flood insurance available to homeowners and businesses within the approximately 23,000 participating NFIP communities (FEMA 2024d). The NFIP uses FEMA's Flood Insurance Rate Maps (FIRMs) to delineate flood risk and determine eligibility and insurance rates. The FIRMs show the areas within the community that have a 1% chance of being flooded any given year (i.e., the 100-year flood), also known as the Base Flood Elevation (BEF) (Association of State Floodplain Managers 2020) (Figure 3).[7]

FIGURE 3. The Percentage Chance of Different Flood Elevations at a Single Location



Note: The least likely flood elevation shown is the 0.2% annual chance of flood elevation (i.e., 500-year flood). The 1% annual chance elevation, also known as the Base Flood Elevation (BFE) (100-year flood), is the level used in FIRMs to determine flood insurance eligibility.

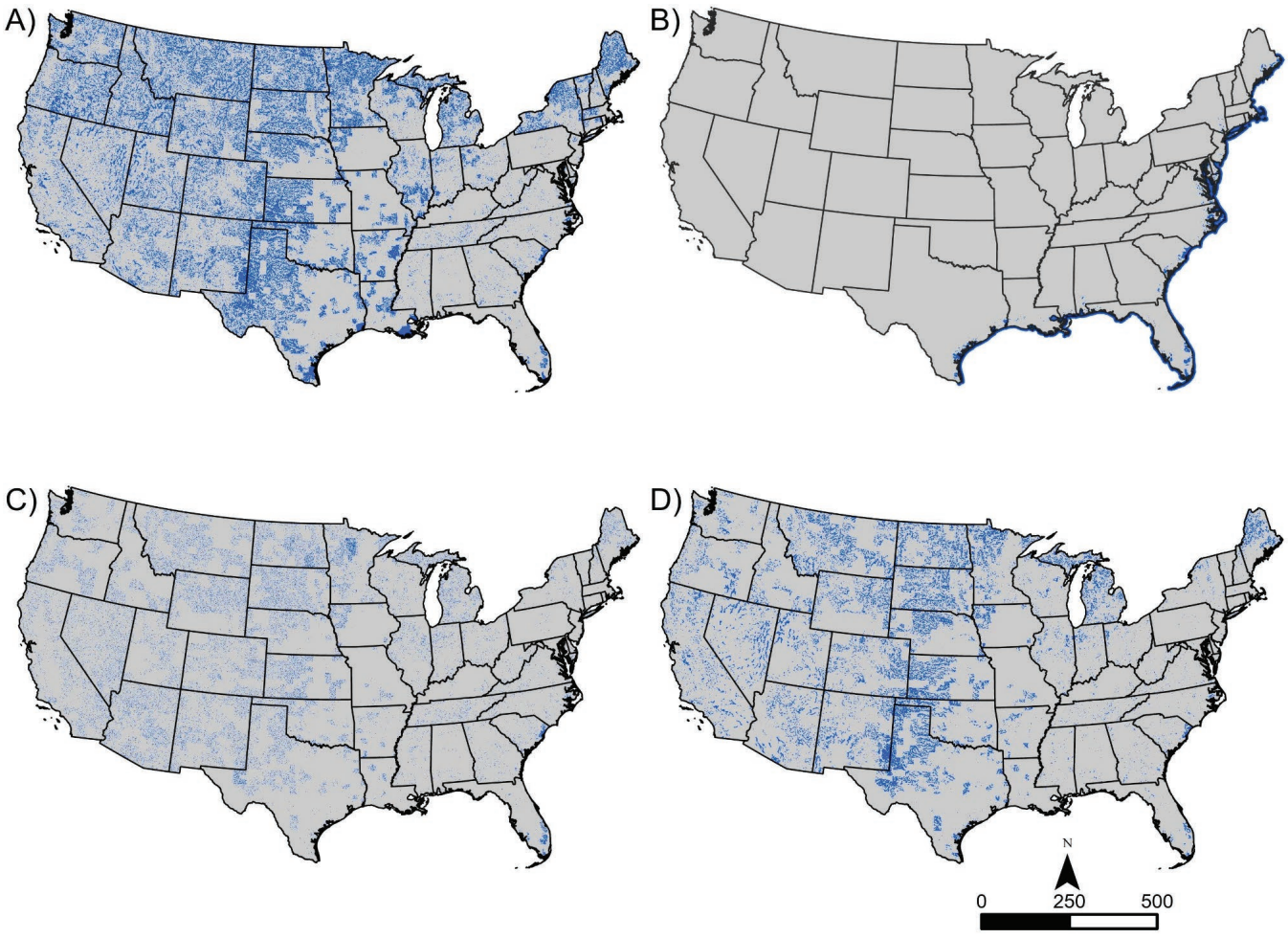
Source: Association of State Floodplain Managers 2020

Importantly, the BFEs used in the FIRMs are set using historical data and do not account for increasing flood risks with climate change (for example, an area with increased risk of the historical 500-year flood level). Within the base flood zone, communities that wish to participate in the NFIP so that their homes and businesses can obtain flood insurance are required to adopt and

enforce floodplain management regulations to help reduce the risk of flooding impacts. Drinking water and wastewater utilities in these communities are subject to these regulations and can be insured by NFIP.

However, the NFIP regulations are increasingly inadequate in the face of climate change, leaving communities and their water and sanitation facilities outside of the insured zone vulnerable to increasing flood risks (Campbell-Ferrari et al. 2024). First, the minimum requirements for participating in the NFIP vary because, under the law, these requirements are dictated by a community's flood hazard and the level of data FEMA has collected and published. Places where FEMA has not provided flood maps have few requirements not necessarily because there is no or low risk of flooding, but because their community has not been officially mapped by FEMA (US Government Accountability Office 2013). Flores et al. (2025) found that approximately 26 million people in the conterminous US live in unmapped flood hazard zones and that these unmapped zones contain a higher proportion of low-income households. Figure 4 shows federally overlooked flood risk in the conterminous US.

FIGURE 4. Federally Overlooked (A) Combined, (B) Coastal, (C) Pluvial (Rainfall), and (D) Fluvial (River) 100-Year Floodplains in the Conterminous US



Source: Flores et al. 2025

Second, FEMA's old flood maps focus on riverine flooding and coastal high-hazard areas. They do not capture pluvial (rainfall) floods, nor the risk of multiple forms of flooding occurring at one time, as was the case in New York and Texas after Hurricane Sandy in 2012 and Hurricane Harvey in 2017, respectively (Flavelle et al. 2020). FEMA's Risk Rating 2.0, a major change in the way the NFIP calculates flood insurance premiums, addresses this issue, but it will take time for communities to adopt the new standards. Under the new approach, NFIP premiums will be based on geographical variables, such as the distance to water as well as a broader range of flood frequencies and sources than the current system. However, in January 2025, the new White House administration's Executive Orders eliminated numerous programs and funding, leaving the future of this effort uncertain (The White House 2025).[8]

Because the FIRMs are outdated and do not incorporate climate change in many places, water and wastewater infrastructure may lack insurance and other protection measures for increased risks. Yet, changing FEMA flood maps is very contentious and challenging because it puts more properties in flood risk zones, which can drive up insurance costs and can make some places less desirable to live or build new housing developments (Flavelle et al. 2020; Pralle 2019; Horn 2022).

To address gaps in the NFIP, some states and local governments have adopted more stringent building and siting standards to protect homes, businesses, and critical infrastructure like hospitals, fire stations, or water and wastewater infrastructure. The NFIP only requires critical facilities to be located or protected against the 500-year flood level (where there is a 0.2% chance of flooding in any given year) (FEMA 2005). Following Hurricane Sandy, however, the state of New York adopted more rigorous standards for critical equipment and other storm-related measures funded under an SRF program (Hanson and Piper 2016). The standards require critical equipment in areas subject to tidal change or sea level rise be placed above the highest of either the 100-year flood level plus five feet, the Sandy high-water mark plus four feet, or the 500-year flood level. Likewise, any facility that has flooded or may flood due to sea level rise must be designed for whichever is the most protective: the 100-year flood level plus two feet, the Sandy high-water mark plus one foot, or the 500-year flood level.

Even with these improvements, the New York state building code may not be sufficient to protect water and wastewater infrastructure from increased flood risk. First, it only applies to facilities obtaining a loan from the SRF program. Additionally, while more stringent relative to NFIP standards, it is still based on a historical event (in this case Hurricane Sandy) and therefore may still be inadequate for addressing flood risk given more intense storms.

Another approach to incorporate future flood risk into building codes and standards is through rules governing the rehabilitation or rebuilding of water and wastewater infrastructure post-disaster. In 2024, FEMA published their Final Rule on the Federal Flood Risk Management Standard (FFRMS) (FEMA 2024a). The rule amended Title 44, Part 9 of the Code of Federal Regulations and became effective in September 2024, however it was rescinded by the new White House administration in early 2025 (The White House 2025). The new rule sought to give FEMA more flexibility in funding projects involving new construction, major improvements, or repairs to substantial damage.[9] This would have allowed FEMA to use updated projections of flooding based on climate science when funding these projects. The FFRMS was meant to increase the flood elevation (how high) and floodplain (how wide) used when reconstructing infrastructure to reflect future as well as current

flood risks (FEMA 2024a). The FFRMS rule would have increased the flood elevation and floodplain standards to reflect future risk and required consideration of natural features and nature-based solutions, such as floodplain restoration, floodplain health, recharging flows, and providing other benefits (Turner et al. 2022; Vigerstol et al. 2023).

One challenge created by the update of the Final Rule was that it would have increased project costs for developers. However, FEMA would have paid for a portion of the costs to implement the FFRMS, often 75% or more (FEMA 2024a). In addition, FEMA found that incorporating two feet of elevation into a new building design on average adds only 1.91% to the total project cost (FEMA 2024a). Another barrier to the future application of this rule (should the next administration decide to reenact it) is that it does not apply to reconstruction after non-federally declared disasters nor to projects that are not funded by FEMA.[10]

Laws and policies can help utilities to better plan for droughts and lower reservoir levels by requiring climate change and drought to be considered when constructing intake structures.

Building codes and standards can also guide water and wastewater infrastructure design and siting to manage drought impacts. And laws or policies can help utilities to better plan for droughts and lower reservoir levels by requiring climate change and drought risk to be considered when constructing intake structures. Without considering climate change when utilities build new infrastructure, they can be left with major retrofits that are expensive and challenging to implement. For example, the Southern Nevada Water Authority had to add a third intake structure in Lake Mead in anticipation of worsening drought in the Colorado River Basin that can withdraw at reservoir elevations below 1000 feet above sea level (Southern Nevada Water Authority 2025b). The project cost approximately $1.35 billion (Southern Nevada Water Authority 2025a). In this case, Southern Nevada Water Authority proceeded without a governing law in place, but having established standards and codes could help utilities avoid such costly infrastructure upgrades. The third intake was also intended to provide municipal water customers with better water quality than otherwise could have resulted without the new infrastructure improvement to address declining water levels.

These are just a few ways that building codes and standards can be written or updated so that the increased risks of climate change are better incorporated into new construction of buildings and infrastructure. Adopting and enforcing these codes and standards may help to keep communities connected to water and sanitation services, even as floods and wildfires become more frequent and intense. Another approach to protecting water access despite growing risks of extreme climate events is to make sure that water utilities are connected to backup water supplies.

3.2 CRITERION 2: BACKUP WATER SUPPLY REQUIRED

State law requires drinking water utilities to have adequate storage capacity or be physically connected to at least one backup or alternative source of water supplies.

As climate change intensifies droughts, drinking water utilities ("water utilities") will become more challenged to ensure they have sufficient, safe water for serving their communities (Pacific Institute and DigDeep 2024). This is especially true for small water utilities that are geographically isolated from a diversity of water sources. The cost of constructing and maintaining backup sources and additional storage are barriers for many of these communities. Some states, like California, Texas, Colorado, Arizona, and Florida, already require certain types of water suppliers, like water utilities, to have a drought plan to prepare them for droughts and water shortages. As part of these plans or as additional regulation, states can also adopt laws that require water utilities to physically connect to backup water supplies and/or to have storage specifically for drought and other emergency situations. One legal approach to this can be laws that enable interties (physical, pipped connections) with neighboring water supply systems or other water utilities. Or they can ensure that existing laws do not inhibit interties. Another approach is to use laws to create incentives or guidance for water utilities to have more than one water source or sufficient backup storage. Laws that require water augmentation plans are another strategy for ensuring that there will be sufficient water supplies to meet new demand in water scarce regions. These laws will help to ensure water utilities are constructed to be more resilient to climate change.

While some states promote interties and physical connections between water utilities (e.g., Kentucky, California), other states limit or even prohibit physical connections or interties between water systems (Landes et al. 2021). This was the case in New Mexico until 2023 when the state passed the Regional Water System Resiliency Act (SB 1). This Act created a legal framework for small water (and wastewater) utilities to voluntarily form regional water authorities, giving them more flexibility in how they address challenges like water supply reliability (Rural Community Assistance Corporation 2023).

Another way that the state of New Mexico has encouraged water utilities to have more than one water source is by including a reference to it in the guidelines used by the New Mexico Environment Department for reviewing water supply system permits (including for water utilities). Specifically, in the "Recommended Standards for Water Facilities" guidance, Section 3.2.1.2 "Number of Sources," it states: "A minimum of two sources of groundwater should be provided" (p. 3-4) (New Mexico Environment Department 2006). This recommendation is directed at groundwater-dependent water supply systems, and it is not enforceable. It is also unclear whether this guidance has influenced water utilities to install additional wells; a resilience assessment for the New Mexico Interstate Stream Commission in 2023 found that 34% of public water systems in the state had only one well

(Lewis 2023). The assessment also found that aquifer resilience was linked to how the surrounding river basin was managed. Basins governed by interstate stream compacts showed greater resilience to climate change than those without interstate stream compacts. Lewis (2023) explained that this was because the aquifers in river basins with interstate compacts are managed to ensure that there is sufficient water in the river to meet the requirements of those compacts. Furthermore, the Supreme Court has interpreted older interstate compacts (with no explicit reference to groundwater) to include hydrologically connected groundwater.[11]

At the federal level, legislation has also been passed that can help smooth the process for water utilities to physically connect to other utilities, thereby adding a second or backup water source. The American Water Infrastructure Act of 2018 directed the US EPA to promulgate a rule that implements a provision of the SDWA that helps provide a structure for states and public water systems[12] to identify, evaluate, and implement restructuring alternatives (see Section 1414(h)). Called the Water System Restructuring Assessment Rule, this would allow for restructuring to include interconnections with another system, as well as operation changes, upgrades to or replacement of water system infrastructure, consolidation,[13] or transfer of ownership (US EPA 2024c). This rule would also allow states to require an assessment of a water system and would establish incentives for water systems to identify options and submit restructuring plans. The rule is focused on systems that regularly fail to meet the requirements of the SDWA. The proposed regulation also comes with incentives for water systems to restructure, including eligibility to use Drinking Water State Revolving Funds for restructuring, protection under the SDWA from enforcement actions on past violations for up to two years, and protection from fines or penalties for the water systems that acquire non-compliant water systems (US EPA 2024c).

Requiring water augmentation plans is another approach that some states have codified to create more flexibility in water-scarce basins. In Colorado, for example, augmentation approaches include water-court approved plans established by water users to designate the alternative water supplies they can use to meet specific demands. Water augmentation can be done, for example, by transferring water from one river to another, treating and reusing wastewater, drilling new groundwater wells, or capturing and using stormwater runoff from impervious surfaces in urban areas. Augmentation plans allow water users with junior water rights, who may otherwise not have access to water during times of scarcity, to use water if they are able to replace it with an alternative source (Colorado Department of Natural Resources, Division of Water Resources 2025). In Colorado, policy by the State Engineer's Office in 1995 created a formal, legal process for the state's water courts to decree (i.e., legally establish) augmentation plans (Simpson 1995).

Per Simpson, the policy was created to "attempt to ensure a reliable supply of augmentation water, especially when dealing with domestic uses."

Even with these laws, several barriers remain for water systems seeking to create physical connections to other systems, supplies, or extra water storage. One of the main barriers is obtaining water rights that would allow access to new water supplies during drought. Each state has adopted its own unique approach to managing water use and allocating water rights. In states with prior appropriation water rights, which is the primary water rights system in the western US and in several midwestern states like North Dakota, South Dakota, and Kansas, water rights can be difficult and expensive to acquire. Furthermore, newly secured water rights are junior rights, meaning that when water is scarce such as during a drought, the more senior water rights holders may end up using all the available water before junior water rights are fulfilled. This prior appropriation, "first in time, first in right," system was designed in part as a way to allocate scarce water resources among competing users (Benson 2012), but it offers little flexibility in the face of a changing climate (Campbell-Ferrari et al. 2024).

There are some ways that state laws can facilitate water availability for domestic supplies during droughts. One option is adopting state laws regarding harvesting rainwater. For example, Colorado passed state law to allow rainwater to be harvested from residential households without a water right (Colorado HB 16-1005). The law allows single family households to have no more than two 55-gallon rain barrels (i.e., 110 gallons maximum) captured at any given time, and it requires that the water be used outdoors for nonpotable uses such as watering plants. Other states tend to either have more permissive laws for harvesting rainwater, or no explicit legal provisions allowing or prohibiting rainwater harvesting at all (Zac 2025).

There are some ways that state laws can facilitate water availability for domestic supplies during droughts.

A second option is adopting state laws that allow for the temporary reallocation of water rights, such as temporary transfers, or water banking during droughts. Water banking is defined differently by each state, however, it is generally the practice of storing water from one source, either in surface water reservoirs or aquifers, in exchange for water from another source or for later use.

California allows for temporary water rights under Section 1725 and 1735 of the California Water Code (Szeptycki et al. 2015). States can also modify transfers to privilege certain kinds of transfers (e.g., for domestic use) and forbid others (e.g., filling swimming pools) (Craig 2025b). California has experimented with this in places like the San Joaquine Valley by enabling water rights transfers from agricultural water users to municipal users (California State Water Resources Control Board 2014). Beyond voluntary water rights transfers, mandatory reallocations of substantial amounts would likely demand major state investment, particularly if such transfers are viewed as a government seizure of property. (Water rights are addressed more completely in Section 4.)

The high cost of digging additional wells or constructing reservoirs is another barrier that water utilities face when constructing new infrastructure for back up supplies like new interties. For example, DC Water — which serves approximately 700,000 residents and nearly 30 million annual

visitors to the Washington, D.C. area — is vulnerable to drought because of its dependence on the Potomac River (Interstate Commission on the Potomac River Basin 2024). According to the Interstate Commission on the Potomac River Basin (ICPRB), a congressionally authorized advisory interstate compact agency of the Potomac Basin states (Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia), a shutdown of Potomac River intakes would cause a loss of water for some areas served by DC Water after just one day. This suggests that DC Water is insufficiently resilient to climate change or other potential emergencies (ICPRB 2024). The ICPRB reported that the cost to improve DC Water's resilience would be approximately $800 million to create interties by converting an existing quarry into a regional raw water storage reservoir with tunnels to carry the water to the DC metro area.

Similarly, small water utilities face high costs when evaluating options for physically connecting to another system. For example, a 2021 California State Water Resources Control Board Drinking Water Needs Assessment report estimated that physical consolidation costs for water utilities in California would cost hundreds of thousands to millions of dollars per system (California State Water Resources Control Board 2021a). These costs are for service lines to individual houses, pipelines to connect to another system, legal and administrative costs for system acquisition, and environmental permits (California State Water Resources Control Board 2021a). The report noted that the cost of physically consolidating systems can vary widely and is highly system dependent. These examples from Washington, D.C. and California demonstrate the high costs for improving climate resilience by building new reservoirs or interties between water systems. These projects are also difficult because they can take many years or decades to complete, depending on political and bureaucratic complexities, time for constructing new infrastructure, and barriers due to geographic location.

Laws can enable interties with neighboring water systems or ensure that existing laws do not inhibit interties.

In summary, laws can enable interties with neighboring water systems or ensure that existing laws do not inhibit interties. These help water utilities to physically connect to other systems that may be able to provide additional water supplies during times of drought or other emergencies. Another approach is to use laws to create incentives or guidance for water utilities to have more than one water source or sufficient backup storage. Incentives and guidance can help overcome cost and capacity barriers that water utilities face when trying to implement interties or backup storage projects. Requiring augmentation plans is another legal approach to increase the likelihood that water systems will have backup supply options. Finally, states can facilitate water availability for domestic supplies during droughts by legally allowing rainwater harvesting or temporary reallocation of water rights. These types of laws can help water systems to build resilience against droughts or other climate disasters, but the projects this approach requires can be costly and difficult to implement.

3.3 CRITERION 3: WATER EFFICIENCY IN BUILDING CODES

Water efficiency is incorporated into building codes for new construction and retrofits.

Water-efficiency standards for common fixtures and appliances have saved trillions of gallons of water (and substantial amounts of energy) in the US. Twenty years after the implementation of the Energy Policy Act of 1992 that set the standard flush volume for toilets at 1.6 gallons (from the 3.5 gallons used by toilets prior to the Act), estimated water savings from this standard were 18.2 trillion gallons (Alliance for Water Efficiency 2019). The EPA's WaterSense Program is a voluntary water-efficiency program that certifies devices such as faucet aerators, showerheads, toilets, pre-rinse spray valves, and irrigation controllers that use at least 20% less water and perform as well or better than regular models. The program has helped homes and businesses in the US save another estimated 9.1 trillion gallons of water since 2006 (US EPA 2024g, 2025b).[14] States like Maine, Georgia, and Illinois have adopted various WaterSense fixture standards, or stronger, into their plumbing codes, further accelerating adoption of the most water-efficient devices (Burke et al. 2022). These savings mean that homes and businesses need less water to do the same tasks, helping to reduce the water demand from water utilities, whose supplies are increasingly at risk from worsening droughts, extreme heat, sea level rise, and flooding events.

Water-efficiency improvements — such as replacing inefficient devices with more efficient models, replacing lawns with climate-resilient grass and plants, and improving irrigation efficiency — can help frontline communities and households adapt and build resilience to climate change. However, these measures can be expensive and possibly leave out the communities who need it the most. When implemented through programs that specifically target frontline communities and households, water efficiency and conservation[15] help to contribute to water and climate resilience by decreasing water demand, freeing up potable water supplies, increasing resilience to drought, and decreasing water and energy costs (Cooley, Shimabuku, and DeMyers 2022; McNeeley et al. 2025). Water efficiency and conservation programs that are free, address household leaks, and are available to more than just single-family, owner-occupied households are effective at reaching frontline communities (Cooley, Shimabuku, and DeMyers 2022; Clements et al. 2017). In addition, implementing water efficiency measures can help improve affordability and support equity for low-income households (US EPA 2025b; Cooley, Shimabuku, and DeMyers 2022).

Creating standards and rules that incentivize or require builders and others to use more water-efficient fixtures and appliances in homes and businesses not only helps communities adapt to climate change, but it can also improve water affordability. Installing more efficient fixtures and appliances upfront helps households use less water, therefore reducing their utility bills. These changes also help keep water demand lower for the entire community, reducing the need for new water supplies (Cooley, Shimabuku, and DeMyers 2022). And therefore, over the long term, water efficiency and conservation are often the most cost-effective "new supply" because they reduce the need for costly infrastructure upgrades and expansions (Beecher, Chesnutt, and Pekelney 2001; Chesnutt, Pekelney, and Spacht 2018; Cooley, Phurisamban, and Gleick 2019; Mayer 2017). At the community level, water and wastewater systems that incorporate efficiency gains into their long-term planning can better anticipate future demand, allowing them to right-size infrastructure and avoid overbuilding treatment plants, storage capacity, distribution networks, and other costly projects that can leave systems with decades of debt (Heberger, Donnelly, and Cooley 2016).

States can adopt laws that require building and plumbing codes to incorporate water efficiency into new construction. For example, Georgia passed a law in 2010 that amended the state's building code to read: "On or before July 1, 2012, the department, with the approval of the board, shall amend applicable state minimum standard codes to require the installation of high efficiency plumbing fixtures in all new construction" (GA Code § 8-2-3 (2024)). The code includes water-efficiency specifications for toilets, showerheads, and bathroom and kitchen faucets or faucet aerators. In 2021 the state of Massachusetts enacted "An Act Creating a Next Generation Roadmap for Massachusetts Climate Policy", which updated plumbing fixture standards and codes such that all new construction would be required to meet the minimum standards set out by the bill (Mass. Acts ch. 8 (2021)).

Creating standards and rules that incentivize or require builders and others to use more water-efficient fixtures and appliances in homes and businesses not only helps communities adapt to climate change, but it can also improve water affordability.

These standards were in line with the EPA's WaterSense labeled products and included things like a maximum required flow rate of 1.5 gallons per minute for household bathroom faucets and faucet aerators, 2.0 gallons per minute for showerheads, and a maximum flush volume of 1.28 gallons for household toilets (Mass. Acts ch. 8 (2021); US EPA 2017a). Texas has also adopted regulations for the use of water-efficient products in building codes, but they only apply to a specific subset of buildings or conditions (Burke et al. 2022).

Municipal laws can also require high efficiency appliances in hotels, motels, public bathrooms, and apartments. For example, Miami Gardens, Florida local building code requires all new residential and commercial structures to include high efficiency plumbing fixtures, fixture fittings, and appliances. The fixtures, fixture fittings, and appliances must comply with specifications outlined in the code or have received a US EPA WaterSense Label (Miami Gardens, FL, Code of Ordinances § 28 - 46 (2019).

As of 2025 there were six states (California, Georgia, Massachusetts, Nevada, New York, and Utah) with laws that required building or plumbing codes to specify the use of water-efficient products during construction (Burke et al. 2022; Alliance for Water Efficiency 2025). And there are 11 other states and the District of Columbia that have passed standards stronger than the federal standards for one or more plumbing fixture (Alliance for Water Efficiency 2025).

In California, SB 407 requires retrofits of inefficient fixtures and appliances upon the sale or change of ownership of a property (S.B. 407, 2009 Reg. Sess. (Cal 2009)). The regulations apply to real estate sales of residential and commercial properties built on or before January 1, 1994 (Cal. Civ. Code § 1101.2). However, this law did not establish civil or administrative penalties for failing to follow this part of the law (Campbell-Ferrari et al. 2024).

As of 2025 there were six states with laws that required building or plumbing codes to specify the use of water-efficient products during construction.

Outdoor landscape, especially in arid areas, can also be water intensive, and strategies to reduce inefficiencies in landscape water use can help improve resilience to climate change. In Nevada, AB 356 (2021) created a law that effectively bans "nonfunctional turf" in the Las Vegas Valley. Nonfunctional turf is turf grass that "provides no recreational value, is largely decorative, or not safe to access and use" (Southern Nevada Water Authority 2025c). The law prevents the installation of new nonfunctional turf and requires the removal of nonfunctional turf in the Las Vegas Valley by the end of 2026. It does not apply to grass in a homeowner's yard, or to grass used for recreation at schools or parks but it will apply to grass on commercial, multifamily, government, and other properties. This law is expected to save about 9.5 billion gallons of water, or about 29,150 acre-feet, per year from being extracted from the Colorado River (Nonfunctional Turf Removal Advisory Committee 2021). This savings is nearly 10% of Nevada's total legal water allocation from the Colorado River (Hite, Sheikh, and Stern 2025).

Other states and local governments have taken different approaches to reducing inefficient use of water outdoors. In California, through a law originally passed in 1990, the state has implemented a Model Water Efficiency Landscape Ordinance that sets requirements for new and rehabilitated landscapes to meet water efficiency requirements and produce other environmental benefits (AB 325, Water Conservation in Landscaping Act, 1990). Enforcement of the law was placed in the hands of regional agencies which have had variable success to implementation (Matthews, Fujino, and Hollett 2022). Outdoor water efficiency laws at the local level have not been systematically evaluated. However, research by the Alliance for Water Efficiency suggests that, if enforced, local municipal codes that target water waste, such as irrigation runoff, and violations of water restrictions can be effective at saving water during drought (Alliance for Water Efficiency 2020). While local jurisdictions can also adopt building and plumbing codes that specify the use of water-efficient products during construction, the Alliance for Water Efficiency has found this rarely occurs and argues that state requirements are important (Burke et al. 2022). If local jurisdictions want to pursue changes in states where building and plumbing codes have not yet incorporated water efficiency, the Net Blue Initiative offers language for crafting local ordinances to make community

growth more water efficient, or even net zero (Alliance for Water Efficiency, Environmental Law Institute, and River Network, n.d.).

3.4 SUMMARY

To build equitable and climate-resilient water and sanitation systems for frontline communities in the U.S., federal, Tribal, state, and local laws must be updated to reflect the growing risks posed by climate change. This includes revising standards for the siting, design, and construction of water and wastewater infrastructure to ensure they are equipped to handle threats such as flooding, wildfires, and other climate-related disasters. State and local governments can lead by adopting building codes that incorporate the best available climate science and by setting standards that go beyond existing federal requirements. Laws governing post-disaster rebuilding should also consider future climate risks to avoid repeated infrastructure failure.

In addition to climate protections, laws can require water utilities to improve resilience by ensuring backup water supplies through adequate storage or connections to alternative sources. This can be supported by enabling or incentivizing interconnections between neighboring utilities and requiring water supply augmentation plans. Improving long-term sustainability also involves integrating water efficiency into building codes. States and local jurisdictions can adopt more stringent water efficiency standards for new construction and retrofits, mandate replacement of inefficient fixtures at the point of property sale, and restrict water-wasting landscaping in favor of drought-tolerant and efficient irrigation systems. These strategies collectively help to ensure that water infrastructure can better withstand the impacts of climate change while at the same time promoting sustainable water use.

4. Water Uses in Frontline Communities during Climate Disruptions Are Legally Protected

Attribute description: Legal frameworks are established and enforced that safeguard priority water uses, including domestic, subsistence, cultural, and livelihood needs in frontline communities during water scarcity, shortages, and other climate disruptions.

Many existing water laws were designed for more predictable past climatic conditions and fail to protect domestic, subsistence, cultural, and livelihood uses in frontline communities during times of water scarcity. This section examines legal approaches that strengthen protections, prioritize equitable allocation, and integrate climate change into water management, thereby advancing the human right to water and sanitation for those most at risk.

The human right to water and sanitation is at the core of this attribute, especially for communities that have historically lacked adequate water rights or have been left out of water management decision-making. Access to water and sanitation are not only necessary for human survival but also critical for climate resilience. Yet in the US, frontline communities are more commonly located in "hotspots of plumbing poverty" where households that suffer from limited to no water access and sanitation services are clustered (Deitz and Meehan 2019). Laws are needed to ensure that frontline communities in these hotspots (for example, California's Central Valley, the Navajo Nation, and Central Appalachia) have sufficient, safe, acceptable, physically accessible, and affordable water for drinking, sanitation, firefighting, cooling during extreme heat, and other household purposes (Campbell-Ferrari et al. 2024). Ensuring this access will also help improve public health, protect the environment, and provide economic benefits to individuals and the broader economy.

We identified four criteria that can be used to evaluate whether the law helps protect water access for priority purposes in frontline communities during times of water scarcity and water shortages.

1. Water laws allow for flexibility in the allocation of water during times of water scarcity.
2. The law protects and prioritizes household water use during times of water scarcity.
3. The law explicitly requires the impacts of climate change to be considered when administering water rights.
4. Federal, state, and local laws recognize the human right to water and sanitation.

4.1 CRITERION 1: FLEXIBLE WATER ALLOCATION DURING SCARCITY AND SHORTAGE

Water laws allow for flexibility in the allocation of water during times of water scarcity.

One purpose of water law is to create a framework for managing the allocation and use of water. Water laws were designed, in part, to provide predictability and help water users feel secure in their ability to access and use water despite natural fluctuations in water availability combined with a growing number of water users within the watershed over time. By design, therefore, water laws can be inflexible and unadaptable. This is particularly true of water laws under the prior appropriation doctrine, primarily used in the more arid western states, which prioritizes water rights based on the date the right was perfected (i.e., established) and on whether that right has been put to a beneficial use (i.e., "use it or lose it") (Craig 2020). In states that use the prior appropriation doctrine[16] and in times of scarcity, water users with older, "senior" water rights get to use water before those with younger, "junior" rights. This is referred to as "first in time, first in right."

Water laws can fall short of ensuring water availability to meet household needs in frontline communities. This is especially true with the impacts of climate change increasing the likelihood and severity of water scarcity (Payton et al. 2023). In this section, we highlight legal approaches that can help provide equity and flexibility in existing water rights systems. One approach is to give state or regional water managers the ability to temporarily alter water allocation during times of scarcity so that water remains available for drinking and sanitation. Another approach is to define and regulate wasteful uses of water, particularly during times of extreme drought and scarcity. A third approach is to make water use permits time-limited so that permit holders must periodically renew their license, during which the water management agency can re-evaluate water use in the context of changes in the hydrologic system. This would require the inclusion of the most up-to-date climate change projections. The final approach involves water shortage sharing agreements, which can be an alternative strategy to prevent loss of water access during droughts.

Water laws can fall short of ensuring water availability to meet household needs in frontline communities. This is especially true with the impacts of climate change increasing the likelihood and severity of water scarcity.

One approach to improve flexibility is to give state or regional water managers the ability to temporarily alter water allocations to ensure water is available for drinking and sanitation.[17] In Florida, regional water management entities (called governing boards or departments) have the authority to declare a water shortage emergency (Fla. Stat. § 373.246). This declaration triggers the requirement for a plan to be adopted by the regional management entity. Within the plan, the law states that these entities 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 regional management entity can impose restrictions on one or more classes of

water use to “protect the water resources of the area from serious harm and to restore them to their previous condition” (Fla. Stat. § 373.246). These authorities, if acted on, can enable water systems to have sufficient water supplies to deliver to their customers during drought conditions. These legal provisions also help to ensure that the burden of the water shortage is shared more equitably across all users, rather than being shouldered by specific groups of water users.

Another way to improve flexibility in the allocation of water during times of drought is to create laws to limit wasteful, unreasonable, and lower priority uses of water. Laws can give states the authority to restrict certain uses during times of drought or scarcity. For example, during a declared drought in 2022, the California State Water Resources Control Board designated residential and commercial irrigation less than 48 hours after a rainfall of at least one-quarter inch as an “unreasonable water use” (23 CA Code of Regs § 995) (California State Water Resources Control Board 2022). Cities have adopted other demand-focused policies that limit lower priority uses, including mandatory outdoor use restrictions that establish watering schedules and prohibit certain water uses, such as washing cars and filling swimming pools (Dilling et al. 2019). Cities may also charge drought surcharges to incentivize customers to use less water, but this can have affordability implications, especially for households with lower incomes (Feinstein et al. 2017). For example, in 2015 during a major state-wide drought in California, Feinstein and co-authors used state data to evaluate how drought surcharges across three utilities raised water costs for customers. They found that drought surcharges “had a much larger impact on the lowest-income households” even though these chargers were overall small compared to the baseline cost of water.

A third way laws have created greater flexibility in water allocation and use is by putting expiration dates on water use permits. This allows for permitted uses to be re-evaluated as climatic conditions change, the river or broader watershed changes, and as uses shift over time. For example, the New

York Department of Environmental Conservation requires a water withdrawal permit for water users who withdraw 100,000 gallons per day or more of surface water or groundwater (6 CRR-NY 601.2). Water withdrawal permits can be issued for a fixed term of no more than ten years, and permittees are required to reapply before the expiration date (6 CRR-NY 601.11). During the renewal process, the state collects information on the permittee's approved sources, total approved withdrawal quantity, and water withdrawal system modifications (6 CCR-NY 601.10; New York State Department of Environmental Conservation 2020). Public water systems are also required to submit a map of the service area boundaries and possible sources of contamination (6 CCR-NY 601.10). Permits are evaluated based on several considerations that include: 1) whether the quantity of supply will be adequate for the proposed use, 2) the proposed withdrawal is limited to what is reasonably necessary, and 3) the proposed withdrawal will be implemented in a way that causes limited impacts on the quantity and quality of water, among other factors (6 CCR-NY 601.11). This process allows the state to assess and re-assess each permitted water use within the context of factors that change over time. However, there is not a specific requirement to consider climate change. As such, the permitting rules could be updated to require that climate change and other factors affecting water availability are considered during the permit issuance and renewal process.

Another way to improve flexibility in the allocation of water during times of drought is to create laws to limit wasteful, unreasonable, and lower priority uses of water. Laws can give states the authority to restrict certain uses during times of drought or scarcity.

A fourth approach for improving the flexibility of water allocations during droughts is to allow for water shortage sharing agreements. Water shortage sharing agreements, such as those practiced in New Mexico, provide an alternative approach to distributing water during droughts, offering an alternative to strict priority administration under the prior appropriation doctrine. Instead, this alternative approach allows all users to access at least some water, even during times of drought (The Utton Transboundary Resources Center 2025; Russo Baca et al. 2025). According to experts at the University of New Mexico's School of Law, water shortage sharing has been practiced in New Mexico for centuries, long before statehood and the administration of water rights by the Office of the State Engineer (Russo Baca et al. 2025). In 2004, New Mexico codified water shortage sharing agreements as a form of "alternative administration" of water allocations (NMAC 19.25.13.3 and NMAC 19.25.13.7 C(4) 2004). Under New Mexico law, alternative administration is described as:

> Administration that is based on water sharing agreement among affected water right owners, and that is acceptable to the state engineer. Such administration may include voluntary shortage sharing such as, but not limited to, percentage division or pro rata allocation, rotation of water use, and reduced diversions (NMAC, 19.25.13.7 C(4) 2004).

A key provision of the law is that shortage sharing agreements are mutually agreed upon by "affected water rights owners," in addition to complying with the New Mexico water laws administered by the Office of the State Engineer. In practice, Russo Baca and co-authors (2025) documented how this approach has resulted in equitable water management during times of

drought. For example, in the Rio Chama basin, lower basin water users have more senior water rights compared to the upper Rio Chama basin users under the prior appropriation doctrine. In 2020, drought conditions led to unusually low water levels in the river, triggering the shortage sharing agreement established cooperatively by both upper and lower basin water rights holders. Under this agreement, both senior and junior users shared in the water shortage, where senior rights holders reduced their use, allowing junior rights holders to continue accessing water from the river (The Utton Transboundary Resources Center 2025).

As climate change intensifies droughts and makes water scarcer at times, new legal strategies are emerging to allow more equitable and adaptive water allocation.

In sum, water laws often lack the necessary flexibility to respond to climate change. However, as climate change intensifies droughts and makes water scarcer at times, new legal strategies are emerging to allow more equitable and adaptive water allocation. These include empowering state or regional authorities to temporarily adjust allocations, prohibiting wasteful water uses during droughts, requiring periodic water permit renewals to assess current conditions, and enabling water shortage sharing agreements. Such mechanisms aim to ensure water remains available for basic household water use while also distributing the impacts of climate change and water scarcity more equitably among users. Water users and managers rely on water laws to provide a system for water allocation with a sense of predictability. However, as climate change introduces greater uncertainty and unpredictability in weather patterns and water availability, there is a growing need for laws to provide both stability and flexibility during times of water scarcity. This will be extremely challenging and expensive, especially in the western US where water is often already overallocated. But pursuit of the legal adaptations discussed could help provide greater assurances that domestic and municipal water needs can still be met under changing conditions.

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4.2 CRITERION 2: PROTECTION OF HOUSEHOLD WATER DURING SCARCITY

The law protects and prioritizes household water use during times of water scarcity.

In the US, the three largest types of water use are irrigation for crops, public supply,[18] and thermoelectric power generation, which account for 90% of the total water use nationally (Medalie et al. 2025). Of the total water withdrawn across these three categories, public supply, which includes water use by water utilities serving households, accounts for approximately 14.5%, while irrigation for crops and thermoelectric power generation account for 43% and 42.5% on average, respectively[19] (Medalie et al. 2025). In this section we discuss examples of state law that prioritize water use for households above all other uses. These laws are sometimes applicable to water use under any condition, or they can be specific to water shortage events, such as during a drought. In any case, these laws protect homes and communities from losing water access by prioritizing the available water for household use, such as drinking water, cooking, hygiene, and sanitation.

In California, the law prioritizes water for household purposes by prioritizing municipal water use (i.e., water supplied by a city or town for households and businesses). 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).

This provision upsets the order of priority established by senior and junior water users under the prior appropriation doctrine and grants the municipal water use priority regardless of when the use began. When water is plentiful, this does not affect water allocations. However, when water is scarce, the automatic granting of priority to municipal water use ensures that the limited amount of water will be made available first for household use and only thereafter for agriculture and other uses. It is worth noting, however, that California has a strong public trust doctrine — a legal principle that asserts that certain natural resources, like water, are preserved for public use — and some other built-in legal rules that already make its version of prior appropriation more flexible than most western states.

When water is scarce, the automatic granting of priority to municipal water use ensures that the limited amount of water will be made available first for household use.

The California Supreme Court has also embraced the "pueblo rights doctrine," which stipulates that municipalities that were established by Mexico or Spain prior to the US accession of territory from Mexico in 1848 have the right to take as much water from local waterways as they need for municipal purposes (Saxer 2023). While this sounds like a promising opportunity for ensuring water for domestic purposes, Saxer argues that in practice it has allowed large urban areas like Los Angeles to claim water rights over less powerful groups. No other states where this would apply, such as Nevada, Utah, New Mexico, Arizona, or Texas, have embraced this doctrine.

Water rights reprioritizations are allowed in other state laws. In Oregon, the Water Resources Commission has the authority to grant a temporary preference to water rights for human

consumption and/or stock watering uses once a drought declaration has been made by the governor for a county (Oregon Water Resources Department 2025).

However, there have been few tests in the real world as to whether these laws, in practice, ensure water supplies remain available for domestic use during times of drought (Craig 2018). One that occurred in Texas showed that, in practice, even explicit legal protections of domestic and municipal use may not be upheld in court. The Texas Water Code reads, "the appropriation of water for domestic and municipal uses shall be and remain superior to the rights of the state to appropriate the same for all other purposes" (Texas Water Code § 11.024(1)). However, Craig illustrates how the Bravo River Decision by the Texas Court of Appeals in 2015 effectively nullified the power of this legal provision by determining that the governing agencies could not "exempt junior preferred water rights from suspension based on public health, safety, and welfare concerns" (Texas Commission on Environmental Quality v. Texas Farm Bureau, 460 S.W.3d 264, 273).

States where the riparian doctrine is used — a framework of law that bases water rights on land ownership adjacent to a water source — often prioritize domestic use during times of scarcity. However, protecting water for "domestic" use does not necessarily provide a broad enough protection to ensure that water is available to fulfill household water needs supplied by water utilities. In Kentucky, for example, there are laws that prioritize water for household use.[20] This includes the prioritized right to always be able to withdraw water from waterbodies adjacent to riparian property for drinking and for certain purposes such as drinking water for poultry, livestock, and domestic animals (Ky. Rev. Stat. Ann. § 151.210).[21] 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 applies to individual household uses and agricultural uses. While the law protects individuals who withdraw water from waterbodies for household purposes, municipal water suppliers responsible for meeting household needs for drinking water and other uses are subject to permit requirements and are not afforded any unique protections. Per the regulations, permits are required for withdrawals of 10,000 or more gallons per day unless exempted under the law discussed earlier (401 KAR 4:010). Furthermore, Kentucky law gives agricultural water use the same protection as household water use. This creates a potential for conflict between the two uses when there is a water shortage. While the eastern portion of the country is typically considered less vulnerable to drought than the west, changes in temperatures and the variability of precipitation due to climate change are increasing the extent, severity, and frequency of droughts in the east as well (Hoffman et al. 2023).

States have adopted a range of legal strategies to prioritize household water use during times of scarcity. Some laws give household or municipal water uses legal priority over other water uses, even if those uses would otherwise have seniority under existing water rights systems. In some cases, states allow temporary reprioritization during officially declared droughts to ensure access for human consumption and basic needs. Other states extend equal legal protection to both household and agricultural uses, which may lead to competition during shortages. These variable approaches reflect efforts to balance competing demands while safeguarding essential household water access in the face of growing climate-related drought risk.

4.3 CRITERION 3: INTEGRATING CLIMATE CHANGE SCIENCES INTO THE ADMINISTRATION OF WATER RIGHTS

The law explicitly requires the impacts of climate change to be considered when administering water rights.

Each state has its own processes in place for administering water rights or permitting new water uses (i.e., ways that water rights arise).[22] In states where a formal permitting process is in place, these processes require the applicant to detail basic information such as the source where water will be withdrawn, the timing of withdrawals, the amount, and the intended purpose or use. In some states there are additional steps required to ensure other downstream water users will not be "injured" by the new water use. A new law can add requirements that applications for water rights and the proposed water use be considered in light of the anticipated impacts of climate change on available water resources. To date, no states have directly taken on the political challenges of passing new laws to adjust water rights or use permitting processes to formally incorporate climate change (Craig 2025a).

To date, no states have directly taken on the political challenges of passing new laws to adjust water rights or use permitting processes to formally incorporate climate change.

In California, the State Water Resources Control Board ("State Water Board") has taken some early steps toward incorporating climate change into their water rights processes. In a report published in 2021, the state described the data needs, opportunities, and potential approaches for how to effectively incorporate climate change into their water rights process (California State Water Resources Control Board 2021b). California has been proactive in measuring and projecting the impacts of climate change on water resources, however the report highlights the need for more downscaled, local data for the purposes of water rights. The report also discusses the need to change from relying only on historical flow, precipitation, and runoff data to projected data that incorporate climate change, because using only historical data assumes the range of climate variability and extremes is stationary, which is no longer reliable under climate change (referred to as "nonstationarity") (Lall et al. 2018; Milly et al. 2008). The end of the report lists 12 recommendations to help the State Water Board incorporate climate change into the state's water permitting processes. These recommendations include several items, such as leveraging existing climate change data in permitting water availability analyses, strengthening the minimum period of record requirement for streamflow data, and planning for droughts.

While this undertaking has not led to a revision of the California Water Code to date, many of its components can be executed without requiring new statutory authority. Incorporating climate change into permitting processes and water management planning can help to ensure waterbodies are not overallocated and avoid endangering the availability of water for drinking water and sanitation needs.

4.4 CRITERION 4: HUMAN RIGHT TO WATER AND SANITATION

Federal, state, and local laws recognize the human right to water and sanitation.

Access to safe and affordable water and sanitation is recognized internationally as a fundamental human right. This right is essential for public health, environmental protection, and human dignity. Although the United Nations formally recognized the human right to water and sanitation in 2010, the United States has not codified this right at the federal level. Recognition and implementation vary across states and municipalities, with legal frameworks often lacking enforceable provisions or clear responsibilities. Given the intensifying impacts of climate change, legal and policy structures must evolve to ensure climate-resilient, universal access to water and sanitation services (Campbell-Ferrari et al. 2024).

In 2010, the United Nations General Assembly adopted a resolution formally recognizing the human right to water and sanitation (United Nations 2014). This right requires water and sanitation services to be sufficient, safe, physically accessible, acceptable, and affordable. Although many countries supported and adopted the resolution into national law, the United States abstained and has consistently opposed formal international recognition of the right (Gleick 2023). Consequently, there is no federal law guaranteeing universal access to water and sanitation.

While existing statutes such as the SDWA and the CWA regulate water quality and wastewater discharge, they do not guarantee service provision or affordability. Federal programs and funding mechanisms exist to support water infrastructure but are not designed to ensure universal access. Some states have independently taken steps to recognize the human right to water. However, implementation varies widely, and most state efforts fall short of establishing enforceable legal obligations.

Some states have independently taken steps to recognize the human right to water. However, implementation varies widely, and most state efforts fall short of establishing enforceable legal obligations.

California became the first state to recognize the human right to water through Assembly Bill No. 685 (2012). The law states that every human being has the right to “safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes.” However, the law does not create a legally enforceable right. It requires state agencies to consider this policy but does not obligate them to provide service or allocate funding. The law did, however, catalyze the creation of the Safe and Affordable Drinking Water Fund via Senate Bill 200 (S.B. 200, 2019 Reg. Sess. (Cal. 2019)), which supports projects addressing water access gaps using revenue from California’s Greenhouse Gas Reduction Fund.

Virginia passed a nonbinding joint resolution in 2021 declaring access to potable water a necessary human right (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, while this does include household drinking water, 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.

New York, Massachusetts, and Pennsylvania have amended their state constitutions to include the right to clean water. These provisions primarily protect environmental resources rather than guarantee household-level drinking water or sanitation services. They do not establish specific obligations or mechanisms for enforcement.

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 clean water sources more than a right to household 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).

Similar to Pennsylvania, 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 and household drinking water.

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 and household drinking water.

Local governments have also explored ways to address the human right to water and sanitation. In Titusville, Florida, residents passed a referendum sponsored by Speak Up Titusville that established the right to clean water. The referendum prohibited actions that would pollute or degrade local water bodies. After it was passed, the city sued Speak Up Titusville, which sponsored the ballot measure. The city challenged

the measure on the basis that it was preempted by state law that prohibited local ordinances or charters that granted legal rights to a plant, animal, body of water, or other part of the natural environment. The trial court ruled in favor of Speak Up Titusville, requesting that the city certify the charter amendment (Duerig 2023). The measure was ultimately overturned by a state appellate court in 2025, citing the Clean Waterways Act (2021), which preempts local governments from granting rights to nature or adopting similar environmental protections (Vazquez 2022). The act previously forced the repeal of a referendum passed by Orange County, Florida that contained similar language to Titusville's. The advocates are currently seeking a rehearing because the amendment does not create a right for nature, but rather, a right to water.

In cities such as Detroit, Boston, and Pittsburgh, coalitions have formed to advocate for local adoption of the human right to water, motivated by contaminated water resources, water shutoffs, or discriminatory practices in water services (Murray and Kominers 2014). Some cities, such as New York City, Los Angeles, and Pittsburgh, have produced Voluntary Local Reviews to assess their progress toward the United Nations Sustainable Development Goals, including water access (Ziegenhagen 2021). However, these efforts have not yet resulted in binding legal recognition of water and sanitation rights.

Ultimately, adopting an actionable law requires having a clearly defined goal. The Center for Water Security and Cooperation (CWSC) defined universal "access to water and sanitation" to create a measurable way to track and determine whether progress is being made in ensuring households have access to water and wastewater services (Center for Water Security and Cooperation 2021). According to CWSC, access requires physical access, economic access, and equity.

- Physical Access: Reliable, in-home availability of sufficient water for domestic needs and in-home sanitation systems capable of safe waste collection and treatment.
- Economic Access: The ability to afford essential water and sanitation services without sacrificing other basic needs.
- Equity: Non-discriminatory access for all individuals and communities.

CWSC further outlines the components of access to include sufficient source waterto meet basic household uses, including drinking, cooking, cleaning, and sanitation. Another component is adequate infrastructure. Households must have access to functional plumbing and sanitation systems that connect to either centralized utilities or safe onsite solutions. Lastly, services must meet safety standards and effectively prevent harm to human health and the environment.

Climate change significantly threatens water availability, safety, and infrastructure integrity. Rising temperatures, extreme weather events, and prolonged droughts place additional strain on already-vulnerable systems. Despite these risks, none of these laws explicitly integrate climate change considerations into their recognition of the human right to water and sanitation. Legal recognition of the human right to water must evolve to include climate-informed obligations and planning mechanisms to remain effective.

In sum, the United States has yet to fully realize the human right to water and sanitation. While some states and localities have taken initial steps toward recognition, current legal frameworks remain fragmented, largely symbolic, and insufficient for ensuring universal, equitable, and climate-resilient access.

4.5 SUMMARY

Water rights and governance in the United States are highly fragmented across federal, Tribal, state, and local jurisdictions, leaving no single framework that consistently protects household water access during scarcity. Many existing laws were built for historical climate conditions and rigid allocation systems that can fail frontline communities when drought or other shortages occur. Climate change is making these challenges more acute by increasing the frequency and severity of water scarcity, especially in communities already facing systemic inequities in water access.

This section outlined legal strategies that can make water allocation more equitable and climate responsive. These include granting state or regional authorities the necessary flexibility to adjust allocations during shortages, prohibiting wasteful uses in drought conditions, requiring regular permit renewals that account for climate projections, and enabling shortage-sharing agreements that distribute limited supplies more fairly. It also highlights state laws that prioritize household water use over other sectors, opportunities to integrate climate change into water rights administration, and the need for enforceable recognition of the human right to water and sanitation.

Achieving climate-resilient water governance will require codifying clear, enforceable protections at all levels of government; ensuring affordability and access for all households; and embedding equity and climate science into legal frameworks.

Achieving climate-resilient water governance will require codifying clear, enforceable protections at all levels of government; ensuring affordability and access for all households; and embedding equity and climate science into legal frameworks. Without these measures, climate change will deepen existing disparities in access to safe, sufficient, and affordable water, undermining both public health and climate resilience in frontline communities.

5. Climate Resilience Is Required in Planning

Attribute description: The law requires water and wastewater utilities and government agencies to adopt climate resilience plans to guide water resource and asset management.

Climate resilience planning is required to anticipate and prepare for climate change impacts on water and sanitation infrastructure and services. Legislatures can establish laws that require water and wastewater utilities or federal, state, and local government agencies to adopt water resource management plans or other climate planning initiatives and documents. Laws not only require the creation of planning documents but also set forth guidelines for what should be considered as part of the planning process and what should be included within the plan. These guidelines typically provide a set of minimum expectations for what topics a plan should address and leave room for the plan to include additional material. It is through the planning process that climate risks and vulnerabilities can be identified and approaches can be developed to reduce those risks. Without those processes, water and sanitation infrastructure and services may be vulnerable to climate disasters.

We identified two criteria that can be used to evaluate whether laws require water and wastewater utilities or federal, state, and local government agencies to incorporate climate resilience into water resource and asset management planning.

1. The law requires water and wastewater utilities or government agencies to conduct climate risk and vulnerability assessments, including mapping of critical infrastructure and service areas.
2. The law requires states and water and wastewater utilities to adopt climate adaptation and emergency response plans to protect water and wastewater infrastructure and services.

5.1 CRITERION 1: REQUIRED CLIMATE RISK AND VULNERABILITY ASSESSMENTS

The law requires water and wastewater utilities or government agencies to conduct climate risk and vulnerability assessments,[23] including mapping of critical infrastructure and service areas.

Developing climate-resilient water and wastewater infrastructure and services requires understanding the threats created by climate change and who or what is most vulnerable. This will underpin the ability of utilities and government agencies to develop strategies and take steps to prepare for climate impacts on water and wastewater infrastructure and services.

Climate assessments have been part of a growing effort by federal and state governments to more thoroughly understand and evaluate risks of climate disasters and opportunities to prepare for those risks by addressing underlying vulnerabilities across physical, social, environmental, and economic dimensions (NCSL 2023). The new White House administration in 2025 has added great uncertainty in future federal commitments to addressing climate change risks, but there are several ways that federal laws and policies have created programs and incentives for federal, state, local, and Tribal governments to perform climate risk assessments and hazard mitigation planning. One critical law directing this work is the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 ("Stafford Act"), which requires states and Tribes to submit approved hazard mitigation plans to FEMA every five years to be eligible for "nonemergency disaster assistance" and FEMA's hazard mitigation grants (42 USC. 5121 et seq.). The Stafford Act, along with its successor, the Disaster Mitigation Act of 2000, also requires states to create a process for local governments to perform hazard mitigation planning. While neither of these laws discuss climate change specifically, FEMA progressively integrated climate considerations into its hazard mitigation planning and funding policies until 2025. For example, the 2024 Hazard Mitigation Assistance Program and Policy Guide expanded eligibility of hazard mitigation funding to include projects addressing extreme temperature and air quality concerns related to wildfires, reflecting a broader approach to climate-related hazards (FEMA 2024b).

Federal laws have also compelled water utilities to perform risk and resilience assessments.[24] America's Water Infrastructure Act (AWIA), adopted in 2018, requires community water systems serving more than 3,300 people to conduct risk and resilience assessments. These assessments are required to evaluate a variety of factors, including:

> (i) the risk to the system from malevolent acts and natural hazards; (ii) the resilience of the pipes and constructed conveyances, physical barriers, source water, water collection and intake, pretreatment, treatment, storage and distribution facilities; (iii) the monitoring practices of the system; (iv) the financial infrastructure of the system; (v) the use, storage, or handling of various chemicals by the system; and (vi) the operation and maintenance of the system (Section 2013 of Public Law 115-270 (October 23, 2018), 132 Stat 3854, amending Section 1433 of the SDWA).[25]

The law also states that utilities are not required to, but may also include, the "evaluation of capital and operational needs for risk and resilience management for the system" in these assessments. Like the Stafford Act, this law does not explicitly require utilities to incorporate future climate change risk or evaluate climate vulnerability as part of these assessments. Therefore, it falls short of compelling water utilities to fully prepare for climate change disruptions.

America's Water Infrastructure Act, adopted in 2018, requires community water systems serving more than 3,300 people to conduct risk and resilience assessments.

One component of AWIA is that it set different requirements for utilities based on their size, which is determined by the population served (America's Water Infrastructure Act of 2018, Pub. L. No. 115-270). For example, different sized communities were subject to different deadlines for submitting their first assessment. Medium-sized systems (those that serve 50,000–99,999 people) and smaller systems (those that serve 3,301–49,999 people) had more time than larger systems (100,000+) to submit to the EPA a certification that the first assessment had been conducted. At least once every five years after the first certification submission deadline, utilities are required to review their assessment to determine whether the assessment needs to be revised. After their review, systems are required to submit to the EPA a certification that it has reviewed its assessment and conducted revisions where relevant. Systems serving communities with 3,300 or fewer people are not required to conduct assessments. Under the law, however, the EPA is required to provide guidance and technical assistance for these small systems on how to conduct resilience assessments and prepare plans. While the intention of this exemption was to reduce the burden on the smallest water utilities that often have limited financial resources, capacity, and staffing, these smaller utilities are just as vulnerable to climate change as larger utilities, if not more (Pacific Institute and DigDeep 2024).

There are several ways that AWIA could be revised to better achieve equitable, climate-resilient water and sanitation in the US. First, it could be updated to require smaller utilities serving

communities with 3,300 or fewer people to complete an assessment. To address capacity constraints of smaller utilities, these assessments could contain fewer required components or provide funding to help them cover the added costs of the assessment. Second, wastewater utilities could be made subject to AWIA. Wastewater utilities are not currently subject to AWIA and therefore are not legally compelled to conduct risk and resilience assessments despite their vulnerability to natural hazards and climate events. Third, the law could include stronger reporting requirements. AWIA lacks reporting requirements and does not require the assessments be submitted to the EPA or be made publicly available (see Section 6 for additional discussion of criteria related to water and climate data collection, monitoring, and reporting).

Local government can also require their local utilities to perform climate risk and resilience assessments. A resolution adopted by the Seattle City Council in 2017 required Seattle Public Utilities (SPU) to "prepare a risk and resiliency management assessment [. . .] to identify and evaluate potential impact and disruptions to Seattle Public Utilities' business and investment strategies" (Seattle City Council, Resolution 31760 (2017)). The resolution required SPU to submit both an interim status report to the Council President, and a final report by June 30, 2019, to be included in the 2021-2023 Strategic Business Plan Update process. Per the resolution requirements, the SPU Risk and Resiliency Strategic Plan identified seven strategic risk areas to SPU: climate change, disasters, investment priorities, economy, market forces, technology, and workforce (Seattle Public Utilities 2019). For each risk area, the plan provided a description of the risks and the efforts being made to address them. For example, SPU identified the climate change risks to drought, declining snowpack, rising temperatures, and more intense precipitation. In response to those risks, SPU has conducted several climate change assessments and incorporated uncertainty analysis into their long-term water demand forecasting. The plan also reports that they installed a new pump station and refurbished an existing pump plant for backup use, developed a water shortage contingency plan that sets guidelines for how to manage water supply and demand during periods of water shortage, and assessed how all proposed capital projects may be affected by climate change. This law serves as a good model for other local legislatures seeking to require their utility to assess their exposure to climate change impacts.

Local government can also require their local utilities to perform climate risk and resilience assessments.

In California, the Urban Water Management Planning Act requires water systems serving 3,000 urban water connections or providing over 3,000 acre-feet of water annually to submit an Urban Water Management Plan (California Water Code (CWC) § 10610-10656). Several amendments to the original bill have helped to incorporate climate change into these required Urban Water Management Plans. For example, after a 2019 amendment, under the section describing the contents of the plans (CWC § 10630-10634), the law now states: "It is the intention of the Legislature, in enacting this part, to permit levels of water management planning commensurate with the numbers of customers served and the volume of water supplied, while accounting for impacts of climate change" (CWC § 10630). This legal language makes climate change a core consideration in water planning. Furthermore, 2018 amendments to the law integrated climate change explicitly into the assessment process by

requiring the drought assessment to include "[c]onsiderations of the historical drought hydrology, plausible changes on projected supplies and demands under *climate change conditions*, anticipated regulatory changes, and other locally applicable criteria" (emphasis added) (CWC § 10635). This serves as a good model for other state legislatures who want to ensure utilities consider climate impacts on supply and demand.

Laws can also play an important role in ensuring that climate risk and vulnerability assessments include mapping of critical water and wastewater infrastructure and service areas. Preparing for and addressing climate impacts on these systems depends on knowing where key infrastructure is located and where services are delivered — that is, the locations of both utilities and their customers. These locations directly affect how vulnerable services are to climate change. Mapping the full path from the utility to the customer better informs both the assessment and the resulting plan.

There are limited examples of the law requiring mapping of drinking water and wastewater infrastructure. Even the basic service area boundaries for water and wastewater provision are difficult to find or nonexistent.[26] Federal law requires information to be gathered about the facilities and components of drinking water and wastewater systems. The regulations of the SDWA require states to adopt a procedure whereby public water systems in the state conduct sanitary surveys (40 CFR § 142.10). Sanitary surveys must address eight components: 1) source waters, 2) treatment, 3) distribution system, 4) finished water storage, 5) pumps and pump facilities, 6) monitoring and reporting and data verification, 7) system management and operation, and 8) operator compliance with state requirements (40 CFR § 142.16).

While "mapping" is not explicitly required, mapping is part of the sanitary survey. In fact, the guidance developed by the EPA to help utilities conduct a sanitary survey expects the surveyor to review basic information about the system, including a schematic of the public water system layout and a description of the major facilities and plans for future improvement (US EPA 2019c).

The CWA also does not require mapping of wastewater systems. Capacity, Management, Operation, and Maintenance (CMOM) programs, however, are typically included as a condition in National Pollution Discharge Elimination System (NPDES) permits to prevent sanitary sewer overflows, and maps are an element of CMOM programs (US EPA 2005). EPA guidance on developing a CMOM program discusses the importance of mapping collection systems to ensure efficient maintenance and repairs (US EPA 2015d).

The Massachusetts Department of Environmental Protection's purpose of improving mapping is to help utilities with critical infrastructure resilience planning and climate change adaptation.

While not required by law, Massachusetts has helped water and wastewater utilities to map their infrastructure. The Massachusetts Department of Environmental Protection's "Enhancing Resilience & Emergency Preparedness of Water Utilities through Improved Mapping" project was launched in 2016. The project inventoried existing water and wastewater system maps and worked with utilities to improve and create first time maps for utilities (Massachusetts Department of Environmental Protection 2024). The Department of Environmental Protection's purpose of improving mapping is to help utilities with critical infrastructure resilience planning and climate change adaptation.

In California, the Department of Water Resources, the agency in charge of overseeing the Urban Water Management Planning process, offers guidance to regulated water suppliers that encourages them to include several types of maps in their plans (California Department of Water Resources 2021). While California law does not require mapping, laws and regulations could require utilities to conduct an inventory of infrastructure and map water and wastewater infrastructure and services. Such an inventory can help utilities to better track maintenance and replacement routines as well as identify places where infrastructure may be vulnerable to flooding, sea level rise, or other climate disasters, better enabling them to prepare for and respond to climate impacts on infrastructure and service delivery.

Climate risk and vulnerability assessments, including mapping of water and wastewater infrastructure and service area, help water managers and the communities they serve to put plans in place for preparing for and responding to climate emergencies.

5.2 CRITERION 2: CLIMATE EMERGENCY PREPAREDNESS, RESPONSE, AND ADAPTION PLANNING

The law requires states and water and wastewater utilities to adopt climate adaptation and emergency response plans to protect water and wastewater infrastructure and services.

Climate planning informed by climate risk and vulnerability assessments allow for specific actions and projects to be identified that can reduce risks caused by climate change on water and wastewater infrastructure and services. As discussed in Section 5.1, AWIA requires community water systems that serve more than 3,300 people to develop an emergency response plan that incorporates findings from the risk assessment (America's Water Infrastructure Act, Section 1433(b)). The plan is required to include several components, including:

> (1) strategies and resources to improve the resilience of the system…; (2) plans and procedures that can be implemented, and identification of equipment that can be utilized, in the event of a malevolent act or natural hazard that threatens the ability of the community water system to deliver safe drinking water; (3) actions, procedures, and equipment which can obviate or significantly lessen the impact of a malevolent act or natural hazard on the public health and the safety and supply of drinking water provided to communities and individuals, including the development of alternative source water options, relocation of water intakes, and construction of flood protection barriers; and (4) strategies that can be used to aid in the detection of malevolent acts or natural hazards that threaten the security or resilience of the system.

The law requires that the plan include both emergency measures and measures that proactively reduce the impacts of floods and droughts and other (climate) hazards on the ability of the utility to provide drinking water. Wastewater systems are not subject to these planning requirements, despite also facing many risks from climate change. Therefore, they may remain less resilient to climate emergencies and less prepared to adapt to changing conditions.

Laws have also been adopted at the state level to require or encourage state agencies to conduct climate adaptation assessments. Climate adaptation assessments focus on identifying strategies for preparing for and responding to climate change impacts, but they are typically predicated on climate risk and vulnerability assessments. In 2016, the Governor of Massachusetts signed Executive Order 569, "Establishing an Integrated Climate Change Strategy for the Commonwealth." The Executive Order requires the Secretaries of Energy and Environmental Affairs and Public Safety to publish a climate adaptation plan. The purpose of the plan is to provide an adaptation strategy for the state that includes observed and projected climate trends and impacts, guidance for state and regional planning agencies and municipalities to address identified impacts, and goals and a path for achieving results.

As a step toward the climate adaptation plan, the state conducted a climate change assessment that details the expected impacts of climate change on the people, environment, and infrastructure in Massachusetts. The Massachusetts Climate Change Assessment evaluated 37 climate impacts across five sectors — human, infrastructure, natural environment, governance, and economy — and established urgency scores based on how large a climate effect is expected from the impact (Energy

and Environmental Affairs 2022). It also assessed if populations living in environmental justice areas[27] would be more affected than the rest of the population and whether Massachusetts is taking sufficient actions to adapt to the impacts. The assessment addressed reductions in clean water supply, but it did not address in detail climate impacts to water and wastewater infrastructure or services. The assessment did inform the 2023 ResilientMass Plan, Massachusetts's State Hazard Mitigation and Climate Adaptation Plan, which included risks to water and wastewater infrastructure, along with strategies to better understand and address those risks (Commonwealth of Massachusetts 2023). While broader climate risk assessments are informative, assessments specific to water and wastewater utilities are necessary to adequately identify how climate change will make it more difficult to provide safe and reliable water and wastewater services.

Laws can require local and county governments to plan for climate impacts to water and wastewater infrastructure.

Laws can require local and county governments to plan for climate impacts to water and wastewater infrastructure. In California, the adoption of Senate Bill No. 379 in 2015 required city or county governments to adopt a general plan that includes development policies that address climate hazards like flooding (Cal. Gov. Code § 65302). The general plan includes several elements, including a safety element for the protection of the community from any unreasonable risks associated with the effects of flooding and other seismic and geologic hazards.[28] The law required revisions to the safety element after January 2009 to identify information regarding flood hazards, and to establish goals, policies, and objectives for the protection of the community from the unreasonable risks of flooding. This includes but is not limited to "maintaining the structural and operational integrity of essential public facilities during flooding" (California Government Code (CGC) § 65302(g)(2)). Furthermore, when revising the local hazard mitigation plan[29] on or after January 2017, the law states that the "safety element shall be reviewed and updated as necessary to address climate adaptation and resiliency strategies applicable to the city or county" (CGC § 65302(g)(4)). The review of the safety element includes conducting a "vulnerability assessment" to identify the risks that climate change poses to the local jurisdiction, setting adaptation and resilience goals, policies and objectives, and developing a set of feasible implementation measures to carry out those goals.

While the California law does not specifically address impacts to drinking water and wastewater infrastructure, several of the elements, particularly the housing, conservation, and safety elements would benefit from including the vulnerability of drinking water and sanitation infrastructure and services to severe flooding and drought. For example, the safety and resilience element of the San Francisco General Plan, drafted to meet the requirements of this law, addressed different climate risks and established a variety of policies to protect people and assets from these risks (San Francisco Planning Department 2022). One policy in the plan requires the city to adapt the bay and ocean shorelines to current and future climate flood hazards to prevent "disrupted services of key assets such as utilities." Another policy in the plan requires the identification and replacement of vulnerable infrastructure and critical service lifelines in high-risk areas, recognizing that "two of the most critical networks will be the City's water system and its sewer and sanitation lines." Overall, the California law serves as a model for other states to facilitate local governments developing plans and policies that address climate adaptation strategies for critical local infrastructure.

Another California law encourages utilities to help support water conservation, a strategy that can help water utilities and the communities they serve adapt to more extreme droughts and other changes to the hydrologic cycle due to climate change (Gleick and Cooley 2021). The Water Conservation Act of 2009 required the state of California to reduce urban water consumption by 20% by 2020 ("20x2020"). As part of this, urban water suppliers were required to develop urban water use targets that would result in a 20% reduction from the baseline daily per capita water use by 2020 (California AB 1668, Section 10608.20 (2018)). This goal was achieved by the state by 2014 (California Legislative Analyst's Office 2024). Assembly Bill 1668/Senate Bill 606, adopted in 2018, built off the 2009 law and established a framework for achieving long-term urban water use efficiency requirements. AB 1668/SB 606 requires urban retail water suppliers to calculate an urban water use objective — defined as an "estimate of aggregate efficient water use for the previous year based on adopted water use efficiency standards and local service area characteristics for that year" — by November 2023 (CWC §10609.20). Each supplier is also required to submit a report on its urban water use objective, actual urban water use, and a description of the progress made toward meeting the objective (CWC §10609.24). Motivated by the impacts of climate change on water resources, the law helps utilities plan for declines in water resources available to meet water needs.

The Water Conservation Act of 2009 required the state of California to reduce urban water consumption by 20% by 2020.

California's Executive Order B-30-15 further supports climate planning in the state.[30] The Executive Order requires:

1. the California Natural Resources Agency to update California's climate adaptation strategy every three years;
2. state agencies to take climate change into account in their infrastructure planning and investment decisions; and
3. the Five-year Infrastructure Plan to take current and future climate change impacts into account in all infrastructure projects.

The California Climate Adaptation Strategy mandated by Assembly Bill 1482 in 2015 and originally published in 2021, identified priorities, goals within each priority, and action items for each goal (California Natural Resources Agency 2024). One of the action items proposed as part of Goal B — considering future climate impacts in governmental planning and investment decisions — includes ensuring proposed clean and drinking water State Revolving Fund (SRF) projects account for impacts related to climate change. This is one of several action items in the strategy seeking to address climate risks to drinking water and sanitation services.

Florida has also adopted state laws to plan for the impact of climate impacts related to sea level rise and flooding (Fla. Stat. § 380.093). Florida law requires the Department of Environmental Protection to develop a Statewide Flooding and Sea Level Rise Resilience Plan (Florida Department of Environmental Protection 2024a). The plan consists of a list of ranked projects that address the risks of flooding and sea level rise to coastal and inland communities in Florida that were

identified in the comprehensive statewide flood vulnerability and sea level rise assessment (Florida Department of Environmental Protection 2024b). Additionally, the plan states that projects can be submitted by counties, municipalities, regional resilience entities, regional water supply authorities, as well as several types of districts — special, water management, drainage, erosion control, and flood control districts. The 2025-2026 Flooding and Sea Level Rise Resilience Plan was published in December 2024 and identifies several drinking water and wastewater-related projects to be funded over the next two years (Florida Department of Environmental Protection 2024a).

Another legal approach that states can take to help water and wastewater utilities prepare for and adapt to climate change is to create state-level offices or positions dedicated to planning and coordinating climate adaptation and emergency response activities. At least 28 states and the District of Columbia have created a position, office, and/or task force to coordinate and direct disaster mitigation planning and climate-resilience efforts (NCSL 2023). According to the National Conference of State Legislatures, these entities are responsible for a variety of resilience planning activities, like coordinating actions across state agencies to improve disaster response, assisting communities in identifying and addressing their climate vulnerabilities, and streamlining processes for accessing federal, state, and private funding that supports mitigation and resilience activities. For example, with Act 315 of 2023 (H.B. 526), Louisiana created a position for a Chief Resilience Officer (CRO) within the governor's office and defined resilience as "a capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimal damage to social well-being, the economy, infrastructure, and the environment" (H.B 526 Sec. 220.41.D). The Act requires an annual statewide resilience report. Based on a review of CRO laws and placements, Georgetown's Climate Center made four recommendations for policymakers designing new laws to instate CROs:

1. Carefully consider organizational placement to maximize access to and coordination of state and federal resources;
2. Give CRO positions explicit authority to coordinate across agencies and levels of government;
3. Structure positions to enable strategic alignment of relevant funding sources and programs; and
4. Provide the CRO with sufficient staff, budget authority, and other resources to do the job, and enough certainty to insulate them from political pressures (Saks 2025).

Whereas the focus here is on state-level CRO positions, laws could create these positions within local governments as well. The Rockefeller Foundation's 100 Resilient Cities program supported cities from around the world to establish CRO positions with city government (Morales-Burnett and Marx 2022). The goal of the program was to enable cities to "survive, adapt, and grow in the face of chronic stresses and shocks." While this effort was not created with law or policy, it could serve as a model for codifying CROs at the local level.

Each of these laws take a different approach to requiring climate emergency or adaptation planning. The law can explicitly require utilities, or state and local governments on behalf of utilities, to assess climate risks and develop plans to prepare for and manage climate emergencies. It can also require state agencies and local governments to create adaptation plans that identify strategies for adapting water and wastewater infrastructure to climate change or to take actions, such as improving water conservation, to create more climate resilience. State and local laws can also require water utilities to pursue adaptation strategies, like in California, where a law specifically requires target setting and reporting on water conservation. Finally, climate resilience offices within state and local government can be centers for coordinating emergency response, preparedness, and adaptation planning in support of climate-resilient water and sanitation infrastructure and services.

Climate resilience offices within state and local government can be centers for coordinating emergency response, preparedness, and adaptation planning in support of climate-resilient water and sanitation infrastructure and services.

5.3 SUMMARY

Laws at the federal, state, and local levels can play a crucial role in ensuring that water and wastewater infrastructure is prepared for the impacts of climate change. These legal requirements can mandate that government agencies and utilities conduct climate risk and vulnerability assessments, which include evaluating and mapping critical infrastructure. Without such mandates, these vital planning efforts would largely be voluntary, leaving essential services for frontline communities at greater risk.

Importantly, these assessments must consider how climate change may affect the operation, maintenance, and rehabilitation of drinking water and wastewater systems. Two key criteria help evaluate whether existing laws sufficiently support climate resilience planning: the requirement for risk assessments and mapping, and the requirement for climate adaptation and emergency response planning.

These planning requirements lay the groundwork for a more resilient infrastructure system. Transitioning from planning to implementation, the next key area involves water and climate data collection, monitoring, and reporting to ensure accountability and track progress.

6. Water and Climate Data Collection, Monitoring, and Reporting Are Required

Attribute description: Laws across all jurisdictions create requirements to monitor and collect data and information critical to preparing water and sanitation infrastructure and services for climate change.

Credible, evidence-based information and data are critical for identifying climate change impacts to water and wastewater infrastructure and for monitoring changing conditions over time. “Data” refers to raw, unorganized facts or figures that lack context and meaning, while information is processed, analyzed, and organized data that provides context, making it meaningful and useful for decision making (CLRN 2024). In other words, data become information when it is analyzed and structured to convey significance. When information is tailored around specific contexts and decisions, it is often referred to as decision-support information. By legally requiring that information and data are regularly collected and analyzed, utilities can: (a) understand the challenges they face in operating and maintaining their infrastructure and providing safe and reliable services, and (b) be able to anticipate and respond to those impacts in an effort to reduce harm. This is important for the safety and reliability of water and sanitation infrastructure and services and for compliance with legal requirements. In addition, it can require that the information is made useful and usable for frontline communities so that they can prepare their water and sanitation systems for climate change.

Credible, salient decision-support information is important for equitable, climate-resilient water and sanitation access. It can support compliance and enforcement, create transparency, and facilitate public engagement. Without the relevant data and information, it is difficult to determine whether there is compliance with the law. Laws that require monitoring create an opportunity for public oversight of utility activities. This can demonstrate if utilities are meeting health-based standards for drinking water quality and wastewater discharges, which fosters accountability for protecting human health and the environment. When information is available and accurate, it allows the public to stay informed and take steps to protect their health. Furthermore, the collection and sharing of data and information allow the public to engage meaningfully in decision making and enforcement. When there is a reliable and credible source of information from public actors it can also help to address misinformation[31] and disinformation[32] about climate change and public health.

We identified two criteria that can be used to evaluate if the law enables adequate and transparent data collection information and inclusive public engagement.

1. The law requires the collection and reporting to the public of relevant, credible climate and water data and information.
2. The law facilitates the participation and engagement of the public in decision making about water-related climate adaptations.

6.1 CRITERION 1: MANDATORY PUBLIC DATA REPORTING

The law requires the collection and reporting to the public of relevant, credible climate and water data and information.

The exchange of credible information and data is important for keeping the public informed and engaged. Information keeps the public and other key stakeholders informed and able to make decisions about their health. Information is typically shared under three different circumstances: 1) information is collected and shared with the public periodically to keep them informed, 2) information is shared when something happens that poses a risk to public health and safety, and 3) information is shared upon formal requests, such as through Freedom of Information Act (FOIA) requests. The law establishes requirements for sharing information — the type of information, when it is transmitted, and who must comply with information-sharing requirements. The law can also set requirements about where the information must be posted and address barriers to accessing that information, such as paywalls or fees.

The SDWA, for example, requires public water systems, states, and the EPA Administrator to collect and report data and information (42 USCS § 300g-3(c)(4)). Under the SDWA, public water systems are required to prepare and publish a consumer confidence report (CCR) twice a year. The CCR provides information on the utility's compliance with drinking water standards that includes the safety of drinking water and key terms to help customers understand the information provided. For example, the CCR is required to include:

1. maximum contaminant levels[33] and action levels[34] for contaminants subject to mandatory reporting and whether there have been exceedances of those levels;
2. the likely source(s) of detected contaminants;
3. whether unregulated contaminants have been detected; and
4. whether a source water assessment has been completed (40 CFR 141.153).

CCRs are provided directly to the drinking water customer and give them the opportunity to understand if their drinking water is safe. Without these reports, water utility customers would not have an easily accessible way to understand what "safe" drinking water is or whether theirs is safe.

Reports required by states, public water systems, and the EPA Administrator shed light on broader themes and challenges across multiple water systems. States are required to annually prepare a report analyzing drinking water standard violations by public water systems within the state (42 USCS § 300g-3(c)(3)(A)). The EPA Administrator is required to annually prepare a report summarizing and evaluating the reports submitted by states as well as public water system compliance on Native American reservations (also known as, Tribal lands or "Indian country" in the law), including enforcement activities and financial assistance provided by the EPA (42 USCS § 300g-3(c)(3)(B)). Neither the law nor the regulations explicitly require the public water system, state, or the EPA Administrator to identify the sources or causes of any changes to water quality identified through this process, such as extreme temperatures, sea level rise, or other climate change phenomena. The data generated for these reports provide an opportunity for evaluating and tracking the trends in drinking water quality over time. With these data, water managers and other stakeholders may be able to understand how climate change — along with other factors like land use change — is affecting water supplies.

Data and information created by monitoring and reporting by public water systems for the SDWA are also used by the EPA to update drinking water quality regulations. As climate change degrades water quality, the ability to update these regulations affords the opportunity to adapt drinking water management to changing conditions. Amendments to the SDWA in 1996 require the EPA Administrator to publish the Candidate Contaminant List, a list of contaminants that are not subject to any proposed or existing national primary drinking water regulation, are known or likely to occur in public water systems, and which may require regulation based on the requirements of the law (42 USC Section 300g-1(b)(1)(B)). The administrator is required to select contaminants that present "the greatest public health concern" from the Candidate Contaminant List (42 USC Section 300g-1(b)(1)(C)). By law, this list must be published every five years after a series of consultations, including

consideration of the data available in the National Contaminant Occurrence Database (42 USC 300g-1(b)).[35] The list does not impose any requirements on public water systems. Instead, every five years, the EPA must issue preliminary determinations and then final determinations on whether to regulate such contaminants (42 USC 300g-1(b)(1)(B)). To complement this, the SDWA also requires that once every five years the EPA issue a list of unregulated contaminants to be monitored by public water systems.

The Unregulated Contaminant Monitoring Rule published in 2012 required monitoring for 30 contaminants, including multiple forms of per- and polyfluoroalkyl substances (PFAS) (commonly known as forever chemicals) (US EPA 2025d).[36] The data collected by public water systems following this monitoring rule contributed to increasing regulatory oversight of several forms of PFAS in drinking water. After national attention was brought to the issue by advocates and communities that had been harmed by PFAS in their water, beginning in 2016 the EPA issued a health advisory under its authority based in the SDWA (42 USC 300g-1(b)(1)(F)) for two types of PFAS chemicals (perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) (River Network 2025a; US EPA 2016b, 2016c). Health advisories provide nonenforceable, technical information about the concentration of a contaminant at which adverse health effects are not expected to occur based on exposure rates. Next, the EPA published the PFAS Action Plan in February 2019 and sent a proposed regulatory determination for PFOA and PFOS to the Office of Management and Budget (US EPA 2019d, 2019a, 2020a). On February 20, 2020, the EPA issued preliminary determinations to regulate PFOA and PFOS (US EPA 2020b). The final national primary drinking water regulations for five PFAS — including PFOA, PFOS, PFHxS, PFNA, HFPO-DA (commonly known as a GenX chemical),[37] and mixtures containing two or more of these — was issued in April 2024 (US EPA 2025c). In May 2025, however, the EPA announced that while the agency will keep the regulations for PFOA and PFOS, they will extend deadlines for compliance with the maximum contaminant levels to 2031(US EPA 2025f). Further, the EPA announced it intends to rescind the regulations of PFHxS, PFNA, HFPO-DA, and the mixture of two or more of these chemicals (US EPA 2025f).

> Climate change is making it more challenging and costly for water and wastewater utilities to maintain compliance with water quality standards.

The CWA also establishes monitoring and reporting requirements that require wastewater treatment plants to keep and publish certain information. Wastewater treatment plants, as part of the conditions in their permits, are required to develop and maintain records to demonstrate that the wastewater system is complying with the effluent limitations and other standards established in the law and regulations (33 USC §1318(a)). These reports are called Discharge Monitoring Reports (DMRs) and are submitted to and published on the EPA's Enforcement and Compliance History Online (ECHO) database (40 CFR 122.41(l)(4)).[38] The timeline for filing DMRs is stipulated in the permit. DMRs give wastewater customers the opportunity to understand whether their wastewater treatment provider is discharging treated wastewater in compliance with environmental and public health standards. Without these reports, customers may not know if the utility is adequately treating wastewater.

The CWA also requires the EPA Administrator to prepare an annual report to Congress on the measures taken to implement the CWA (33 USCS § 1375). For example, the report includes information about the status of state programs and the status of pending and completed enforcement actions. Neither the DMRs nor the EPA annual report to Congress are required by the CWA to discuss climate change impacts on wastewater infrastructure and services. However, both mechanisms could be used to identify any violations or challenges that have been exacerbated or are being caused by climate change. Beyond reporting on compliance with effluent limitations, DMRs could be used to provide operational context and a discussion of long-term environmental drivers impacting the wastewater treatment plant's ability to meet effluent limitations. Federal regulations or state regulations could be updated to require greater evaluation of the impact of climate change on wastewater services and infrastructure.

The importance of timely public notices will continue to grow as climate change leads to more frequent and severe storms, wildfires, and extreme heat.

Climate change is making it more challenging and costly for water and wastewater utilities to maintain compliance with water quality standards (Payton et al. 2023). Both the SDWA and CWA created reporting requirements for violations of drinking water or wastewater quality standards, respectively. If health-based standards for drinking water, such as a MCL or treatment technique,[39] have been violated, public notice is required (40 CFR 141.201). Violations are classified into tiers that determine the corresponding public notification obligations. For example, Tier 1 public notices are required for MCL violations of total coliforms when fecal coliform or E. coli are present in the distribution system (40 CFR 141.202(a)). Climate change is expected to increase the frequency and severity of storm events, putting unprepared drinking water systems at risk of system failures that lead to exceedances. Furthermore, public notice must be provided "as soon as practical but no later than 24 hours after the system learns of the violation or situation" (40 CFR 141.202(b)). Emergency information enables the public to protect their health and prevent exposure to dangerous bacteria or other chemicals. The importance of timely public notices will continue to grow as climate change leads to more frequent and severe storms, wildfires, and extreme heat, all of which can compromise water quality or disable treatment infrastructure (Pacific Institute and DigDeep 2024).

Wastewater treatment providers are under similar requirements. Permitted wastewater treatment plants are required to report "any noncompliance which may endanger health or the environment," including:

- an unanticipated bypass that exceeds an effluent limitation,[40]
- any upset that exceeds an effluent limitation[41],
- or any violation of a maximum daily discharge limitation for any contaminant included in the permit (40 CFR 122.41(l)(6), (l)(6)(iii)).

These violations can occur because of rainfall or flooding events that overwhelm the capacity of the sewer system or damage treatment plants or other critical components of the sewer system (Kenward, Yawitz, and Raja 2013). As climate change increases the intensity and frequency of rainfall events in certain geographies, sewer overflow events will become more common (Zouboulis and Tolkou 2015). This occurred, for example, after Hurricane Sandy in 2012 caused at least 11 billion gallons of untreated and partially treated sewage to be released into the environment, mostly in New York and New Jersey, due to damage to the wastewater treatment systems and pump stations caused by coastal flooding and power outages (Kenward, Yawitz, and Raja 2013).

The law requires that wastewater utilities provide information about noncompliance events within 24 hours of becoming aware that there has been a violation. This information is provided to the director of the state agency that issues NPDES permits or the EPA Regional Administrator where the EPA retains NPDES authority. They are also required to provide a written report within five days of becoming aware of the violation. The report is required to include a description of the noncompliance and its cause, the period of noncompliance, whether it was corrected, and steps taken to "reduce, eliminate, and prevent recurrence of the noncompliance" (40 CFR 122.41(l)(6), (l)(6)(iii)). If the violation is related to a combined sewer overflow,[42] sanitary sewer overflow,[43] or a bypass event, the report must also include the volume of untreated wastewater released, the type of human health and environmental impacts of the sewer overflow event, and whether the noncompliance was related to "wet weather" (the legal term used to describe any weather event that causes runoff of stormwater into a sewer system, including extreme precipitation or a flooding event such as Hurricane Sandy) (40 CFR 122.41(l)(6), (l)(6)(iii)). Including a requirement to identify where noncompliance resulted from wet weather can help to identify where climate change is impacting the ability of the wastewater treatment plant to appropriately treat wastewater. These types of legally mandated reports help inform the public about whether their drinking water and wastewater systems are in compliance with the law.

Laws can also require that information be gathered by conducting assessments. Sometimes government agencies, water managers, or communities lack complete understanding of specific circumstances and interconnections between water, climate, and society. Laws can mandate they be investigated to close knowledge gaps and minimize uncertainties to the extent possible. One example is the Illinois Urban Flooding Awareness Act, adopted in August 2014 (Public Act 098-0858). The act required the Department of Natural Resources, in consultation with other Illinois agencies and stakeholders, to submit an evidence-based report on flooding impacts to the governor. The report was required to include a review and evaluation of the most up to date information, research, and laws related to the prevalence and costs associated with urban flooding in the state. It also was required to include an examination of trends in the frequency and severity of flooding over the previous two decades, the impacts of climate change on flooding, and the how county stormwater programs reduce flood damage, among other related topics. The report was also required to provide recommendations based on the findings.

Laws requiring the collection and reporting of data on how climate change affects water and sanitation access, safety, and reliability are essential for building climate resilience.

Another example of a law that requires assessments related to climate change is the federal Flood Level Observation, Operations, and Decision Support (FLOODS) Act (Pub. L. No. 117-316, § 6, 136 Stat. 4406 (2022), which "addresses forecasting and the communication of flood, tornado, and hurricane events by the National Oceanic and Atmospheric Administration" (Congress.gov 2022). The act includes several provisions related to data collection, information, and assessment, such as a requirement that NOAA assess the flash flood watches and warnings issued by the National Weather Service and whether they effectively communicate risk to the public, inform action to prevent loss of life and property, and inform action to support flood preparation and response. Other parts of the Act are intended to help identify additional data needs. For example, the Act requires the assessment of the availability of short- and long-term data on large-scale freshwater flooding into oceans, bays, and estuaries (Pub. L. No. 117-316, § 7, 136 Stat. 4406 (2022)). This is intended to inform an inventory of data needs.

Lastly, mis- and disinformation present a growing challenge, especially with the proliferation of social media platforms. Climate mis- and/or disinformation fuel doubt and controversy despite the science demonstrating the existence and impact of climate change (McCright 2010; Douglas et al. 2019; Lewandowsky 2021). Some countries have started adopting laws to identify and remove bad information and penalize its distributors. For example, France adopted a law in 2018 enabling government to remove "fake news" during election season. The Swedish government passed a law in 2021 establishing a new agency, the *Swedish Psychological Defense Agency*, to counter disinformation and foreign influence in campaigns by promoting factual content that counters false content (Suliman 2022). To date, such laws have not been adopted in the US yet could be useful for verifying that published climate change-related information is evidence-based and accurate.

Laws requiring the collection and reporting of data on how climate change affects water and sanitation access, safety, and reliability are essential for building climate resilience. Without such data and information, the public is less able to remain informed and meaningfully engage in decision making.

6.2 CRITERION 2: PUBLIC PARTICIPATION IN WATER AND CLIMATE DECISION MAKING

The law facilitates the participation and engagement of the public in decision making about water-related climate adaptations.

The law can create requirements and opportunities for public engagement in water and climate decision making. This type of public engagement happens in two ways: when information is shared with the public and when information is collected from the public. The only way the public — including elected officials — can know whether the law is being implemented and enforced is if the information that is collected and shared illustrates whether the law is being followed, implemented, and enforced.

For example, the California State Water Resources Control Board (SWRCB) publishes a data dashboard to display the results of their annual drinking water needs assessment in accordance with requirements established by Senate Bill 200 (SB-200 (2020); California State Water Resources Control Board, n.d.). These data are used by the SWRCB to inform their prioritization of projects for funding from the Safe and Affordable Drinking Water Fund and by advocates and other stakeholders to hold the SWRCB accountable to their goals set forth in the Human Right to Water resolution (State Water Board Resolution No. 2016-0010). The EPA publishes compliance and enforcement data online on the ECHO database, empowering citizens to track compliance of water and wastewater systems. It is only through the publication of information that the public can determine whether the law is being followed as well as determine whether the law is having the anticipated and desired impact. In the example from California, the data dashboard includes information on some legal criteria, like treatment technique violations, but also on key metrics that speak to the resilience of individual water systems, such as the number of water sources each system depends on and whether a system is located in a critically overdrafted groundwater basin. It is through legal and regulatory requirements that data and information are collected and published, and public engagement can inform discussions of their water and wastewater systems and benefit decisions being made about how to address climate and water-related challenges.

The law can create public engagement opportunities to actively participate in decision making about preparing water and sanitation infrastructure and services for climate disruptions.

The law can create public engagement opportunities to actively participate in decision making about preparing water and sanitation infrastructure and services for climate disruptions. The law is responsible for creating the opportunities whereby members of the public can provide feedback on draft regulations issued by administrative agencies, like the EPA. The Administrative Procedure Act requires agencies to publish notice of proposed draft regulations in the Federal Register and provide the public the opportunities to submit feedback (5 USC. §553). Those comments are then made public. The law further requires agencies to consider and respond to the comments, which helps increase the likelihood that comments from the public will be incorporated

(5 USC. §553(c)). Members of the public can raise concerns through this notice and comment system about the impact of climate change on water and wastewater infrastructure and services. It also helps to identify areas where the regulations are enabling or hindering the ability of the government to anticipate and manage those impacts. In this way, public comments complement the government's compliance efforts. Local knowledges[44] and observations from lived experiences and expertise of the public about water and climate can help ground technical sciences in real world experience leading to better informed decision making (McNeeley et al. 2025).

Lawsuits are another means by which the public can influence water and climate decision making. Citizen suit provisions in federal, state, and local law enable residents to bring lawsuits to ensure implementation of, and compliance with, the law. (See Section 8 for more discussion about citizen suits.)

The inclusion of Indigenous consultation processes in water resource planning and decision-making frameworks exemplifies a commitment to recognizing and respecting traditional knowledge systems.

While laws enable the gathering of public input, there are barriers to receiving input from communities. Some communities and organizations may not have the capacity to prepare evidence-based written comments, thereby excluding their voices from this process. Alternative approaches to gathering feedback — such as listening sessions where members of the public can provide feedback orally — may create less of a barrier to participating in the rule-making process. However, there are often imbalances in influence when private interests and/or power dynamics that can relegate public input to nothing more than a check box exercise (McNeeley 2012). In other words, the public can give input, but those in positions of power have no obligation to incorporate that input into decision making or outcomes. This is often referred to as "procedural injustice," which is when unfair decision- and policy-making processes result in marginalizing certain groups in decisions about the allocation of resources (Holland 2017). The EPA often organizes regional listening sessions to collect feedback on proposed regulations and other activities, but unless required by law and enforced, this approach to public input may not always be taken.

Governmental policies and programs can further support the equitable integration of different knowledge systems into water and sanitation management practices (McNeeley et al. 2025). The inclusion of Indigenous consultation processes in water resource planning and decision-making frameworks exemplifies a commitment to recognizing and respecting traditional knowledge systems (Johnson et al. 2016). Such policies and programs aim to empower communities to participate actively in shaping policies and projects that affect their water resources, promoting resilience and sustainability. One example is the US Global Change Research Program (USGCRP) and the National Climate Assessment (NCA), established by Congress through the Global Change Research Act of 1990. This has enabled substantive involvement of Indigenous peoples since the mid-1990s in consulting on and authoring portions of the NCA, which has grown over time. Since its third edition, the NCA has included a dedicated Indigenous-focused chapter. In subsequent NCAs, Indigenous authors and expertise were included in other regional and sector chapters. In 2025, the White House

released the NCA6 authors from their duties, and the USGCRP office was closed, terminating its operating contracts and staff for the NCA. The legality of these actions is questionable because, per the Global Change Research Act of 1990, the federal government is legally obligated to continue producing these reports unless officially reversed by Congress.

Another example is the National Drought Policy Act of 1998, which established the National Drought Policy Commission and, subsequently, the National Integrated Drought Information System (NIDIS) established by the US Congress in 2006. This was created to improve the nation's capacity to proactively manage drought-related risks across sectors, regions, and jurisdictions. It was created by Congress to "enable the Nation to move from a reactive to a more proactive approach to managing drought risks and impacts." NIDIS has successfully brought together government partners and research organizations to advance a warning system for drought-sensitive areas of the US (Bierbaum et al. 2014). NIDIS works in close partnership with the National Drought Mitigation Center located at the University of Nebraska, Lincoln, which provides myriad data and tools to support drought decision making such as the US Drought Monitor. Laws that help to organize and engage a diversity of voices facilitate inclusive decision making that is informed by different experiences and expertise.

> Law plays an important role in facilitating public engagement in decision making about water and climate.

In conclusion, the law plays an important role in facilitating public engagement in decision making about water and climate. The law can require that data and information about the implementation and enforcement of the law are made publicly available. By having access to that information, the public can evaluate whether enough is being done to anticipate and manage the impacts of climate change. They can determine if more needs to be done and if the laws and/or regulations need to change. They can also analyze compliance levels and explore barriers to compliance and whether enforcement approaches are sufficient. Through notice and comment periods, the public can provide suggestions for how to improve proposed regulations so that the rules governing decision making and actions facilitate the management of climate change impacts. Notice and comment periods create spaces for incorporating local experiences and knowledges into the regulations. This helps to ensure regulations promote long-term, sustainable solutions that strengthen communities.

6.3 SUMMARY

The law can require that data and information are collected and monitored and that the public has opportunities to weigh into decision making. Both the SDWA and the CWA have provisions that require public water systems and wastewater treatment plants to report on their adherence to the public- and environmental-health standards established in these laws. Other provisions in these laws support reevaluation of new contaminants, like PFAS, in an effort to ensure that regulators regularly review and update drinking water standards as conditions change and new information becomes available. Laws requiring timely public notices help the public and decision makers stay informed during emergent events, like flooding, that can lead to drinking water contamination

and/or sewer overflows. There are also laws in some states and at the federal level that require deeper assessments of different climate phenomena, creating opportunities for the public and decision makers to be informed on the expected impacts of climate change. However, mis- and disinformation are increasingly a challenge for accurate climate change information and may require new laws.

Information and engagement enable transparency, accountability, and responsiveness to challenges faced by water and wastewater utilities in providing safe and reliable services. The law can support engagement by requiring that data and information be published in a publicly accessible manner. Laws can also mandate opportunities for public input, such as through public comment periods. These create opportunities for the public to raise concerns about climate change. However, barriers to equitable public engagement remain, especially for marginalized groups, inhibiting equal opportunity for input and integration of input from all. Some laws support equitable integration of different knowledge systems, such as through the inclusion of Indigenous consultation processes, for example, but more work is needed to expand these types of legal provisions.

7. Laws Govern Equitable Distribution of Climate-Resilient Infrastructure Funding

Attribute description: Federal and state laws equitably appropriate and distribute financial resources to fund and finance the rehabilitation of existing and construction of new climate-resilient water and wastewater infrastructure.

Significant financial resources are needed to construct and maintain climate-resilient water and wastewater infrastructure. In the US, most funding for water and wastewater infrastructure and services comes from local taxes, fees, and revenue paid by the communities that these systems serve. Capital-intensive projects are often financed through loans or bonds, for example. Ratepayers are ultimately responsible for repaying the debt through new taxes, fees, or higher rates.

Many US water and wastewater utilities lack sufficient revenue from rates and local sources to adequately maintain safe and reliable services, let alone have funding for improving climate resilience (McNeeley et al. 2025). This is especially true in small and/or rural systems (Taylor et al. 2024). To avoid raising rates, water and wastewater utilities may defer critical projects, leaving them at greater risk of failure in the event of a climate disaster (American Society of Civil Engineers 2021, 2025). When disasters occur, the water and wastewater utilities are forced to make immediate, major repairs or replace and relocate infrastructure. This costs the utilities and the communities they serve significantly more than they otherwise would have had they been prepared for the climate disaster and made planned, gradual improvements. Water and wastewater infrastructure have decades-long lifespans. For example, most wastewater treatment plants are designed with an expected lifespan of 60 to 70 years (Gibson 2017). This requires ongoing maintenance and operation and eventually larger capital improvement projects that replace or rehabilitate the system. Building climate-resilient water and wastewater infrastructure and services requires ongoing financial support.

Laws can serve as funding mechanisms for climate-resilient water and wastewater infrastructure and are used to, for example:

- appropriate financial resources from governments;
- determine how and for what government funding can be used;
- incentivize or disincentivize certain activities by establishing rules that determine how government funding can be used, such as placing limitations on the use of financial resources for certain programs; and
- set forth tracking and reporting requirements for government funding.

The ways in which laws determine and allocate government funding can also dictate if funding is distributed equitably and if it is accessible to the communities who need it most. This section reviews three ways that laws can fund equitable, climate-resilient water and sanitation projects. First, we discuss how legislatures allow for the expenditure of governmental financial resources through appropriations laws. The US Constitution grants the US Congress "power of the purse" by providing in the constitution that "[n]o Money shall be drawn from the Treasury, but in Consequence of Appropriations made by Law" (US Constitution, Article 1, Section 9, Clause 7). Therefore, it is Congress's responsibility to determine if and how national financial resources are to be spent.[45] Many states have similar requirements in their state constitutions. For example, the New York State Constitution states, "[n]o money shall ever be paid out of the state treasury or any of its funds, or any of the funds under its management, except in pursuance of an appropriation by law" (N.Y. Const. art. VII, § 7). Second, we focus on how laws can discourage or encourage certain behaviors by only funding or financing certain types of activities in certain areas. Third, we discuss how laws can require tracking and reporting of government funding to create transparency in how funding is distributed and used.

We identified three criteria that can be used to evaluate whether the law enables adequate, accessible funding for climate-resilient water and wastewater infrastructure.

1. Laws appropriate funding and create loan programs to enable climate-resilient access to water and wastewater services and to create and extend water and wastewater infrastructure to communities that currently lack access.
2. Laws create economic incentives to consider the water and climate risks of new development and ensure proactive rehabilitation and responsible redevelopment in flood-prone areas.[46]
3. Laws can mandate the tracking and reporting of climate disaster relief funding.

7.1 CRITERION 1: FUNDING AND LOAN PROGRAMS FOR CLIMATE-RESILIENT WATER ACCESS

Laws appropriate funding and create loan programs to enable climate-resilient access to water and wastewater services and to create and extend water and wastewater infrastructure to communities that currently lack access.

Water and wastewater infrastructure and services are primarily funded through local ratepayer fees or taxes, placing the financial burden on communities with widely varying sizes and fiscal capacities. Federal and state laws can ease this burden by establishing and funding grant and loan programs, including access to low- or no-interest capital with extended repayment terms. These resources are especially valuable for utilities serving low-income populations, helping them cover the costs of repairing aging infrastructure and building resilience to climate change impacts. If a utility secures grant funding or a low- or no-interest loan to cover all or a portion of their capital costs, then they may be able to maintain lower rates, reducing the affordability burden placed on the communities that they serve.

At the federal level, America's Water Infrastructure Act of 2018 (AWIA) established the Drinking Water Infrastructure Risk and Resilience Program. AWIA enables the funding of projects identified within emergency response plans through grants issued by the EPA Administrator to "owners or operators of community water systems for the purpose of increasing the resilience of such community water systems" (42 USC 300i-2). In accepting a grant, an owner or operator commits to use the funding toward planning, designing, constructing, or implementing a program or project consistent with its emergency response plan. This can include, for example, "the development of alternative source water options, relocation of water intakes, and construction of flood protection barriers" and the purchase of "equipment necessary to support emergency power or water supply, including standby and mobile sources" (42 USC. § 300i-2(g)(2)(I)–(J)). These types of projects can help to prepare water and wastewater utilities for climate disasters and help them manage and maintain their operations during emergency events. The law authorizes $25 million to be appropriated for these grants (42 USC. § 1433(g)(6)). This is a critical source of funding for helping water and wastewater systems to operate and to anticipate and manage the impacts of climate change on their services.

Established under both the Safe Drinking Water Act and the Clean Water Act, the State Revolving Funds are important sources of funding for community drinking water and wastewater systems in states, on Tribal lands, and in US territories.

Established under both the SDWA and the CWA, the SRFs are important sources of funding for community drinking water and wastewater systems in states, on Tribal lands, and in US territories. They are uniquely structured as revolving funds sustained through loan payments, interest payments, and new appropriations while also allowing subsidization for communities with greater financial limitations and challenges. The Clean Water Act State Revolving Fund (CWSRF) was established in 1987 (Congressional Research Service 2023). The CWA requires the EPA to make capitalization grants to each state. In return, states are required to 1) match the

funding at an amount equal to at least 20% of the total amount of the capitalization grants and 2) establish a water pollution control revolving fund (33 USC §1381, §1383). That same year the CWA also established the Clean Water Indian Set-Aside Program, for which the US Congress authorized 2% of the CWSRF each year, starting in 1992.

Several additional conditions apply to CWSRF funds, including that the state is required to commit the funding in an amount equal to 120% of the amount of the grant payment within one year of receiving the grant. In addition, the state is required to ensure the recipients account for the cost and effectiveness of the proposed project or activity. This requires the loan recipient to certify that the project has been evaluated and that the project or activity maximizes the "potential for efficient water use, reuse, recapture, and conservation, and energy conservation" (33 USC §1382).

The CWA specifically identifies the exclusive types of projects for which SRF funding can be used. This includes:

- the construction of publicly owned treatment works (POTWs);[47]
- the development and implementation of a conservation and management plan;
- the construction, rehabilitation, and replacement of decentralized wastewater treatment systems that treat municipal or domestic wastewater;
- measures to manage, reduce, treat, or recapture stormwater;
- measures to reduce the demand for POTW capacity through water conservation and efficiency;
- wastewater recycling or reuse; and
- the provision of technical assistance (33 USC §1383(c)).

These activities can each help to build climate resilience of water and wastewater infrastructure and services, so long as the implementing utilities or communities are intentional with their project goals and design. The CWA does not explicitly address climate change, but it does allow each state, Tribe, or US territory the opportunity to designate how funds are appropriated and used within the constraints established by the CWA through what is called the intended use plan (IUP).

Each state is required annually to adopt a CWSRF IUP that describes the uses of the funding and includes: 1) a description of the short- and long-term goals of the fund, 2) information on the activities to be supported, 3) a list of projects for construction of POTWs on the state's priority list developed under (33 USC §1296), and 4) the criteria and method for distributing funds, among others (33 USC §1386(c)). Annually, the state is required to provide a report on how they have met the goals and objectives identified in the IUP. The EPA Administrator is required to review both the IUP and annual report (33 USC §1386(d), (e)). State, Tribal, and US territory policymakers and advocates can advocate for an IUP to promote or prioritize projects that build climate resilience of water and wastewater systems through the public comment period during the IUP drafting process. The SRF State Advocates Forum identified three mechanisms in a state's SRF program that can be used to support projects that build climate resilience: 1) targeted ranking criteria that more highly favor projects that build climate resilience; 2) financing incentives, like reduced interest rates; and 3) additional subsidies like principle forgiveness (SRF State Advocates Forum 2023).

State, Tribal, and US territory policymakers and advocates can advocate for an Intended Use Plan to promote or prioritize projects that build climate resilience of water and wastewater systems through the public comment period during the Intended Use Plan drafting process.

The Drinking Water State Revolving Fund (DWSRF) was established in 1996 by Congress to create a "perpetual source of financial assistance" for drinking water infrastructure projects and other related activities as determined by the states (Congressional Research Service 2024). The SDWA directs the EPA Administrator to make capitalization grants to the states (42 USC § 300j-12(a)(1)(A)).[48] The SDWA also authorized the EPA to set aside up to 1.5% of the DWSRF as grants for federally recognized Tribes (SDWA § 1452i) and in 2010, Congress increased the Tribal set-aside funds to 2% (US EPA 2024a).

States are eligible to receive a capitalization grant once they create a revolving loan fund and fulfill other requirements as set forth in the law (42 USC § 300j-12(a)(1)(B)). Similar to the CWSRF, states are required to match the capitalization grant at an amount equal to at least 20% of the total amount of the grant made to the state (42 USC § 300j-12(e)). States are also required to annually prepare a DWSRF IUP that identifies the intended uses of the funding. This includes: 1) a prioritized list of projects to be supported, 2) the criteria and methods used to determine how the funds should be distributed, 3) a description of the financial status of the state loan fund, and 4) the short-term and long-term goals of the fund (42 USC § 300j-12(b)).

The SDWA allows states to set aside portions of the capitalization grant for specific uses, including for public water system supervision programs and to administer source water protection programs (42 USC § 300j-12(g)(2)(B)). Where the funding is used in "disadvantaged communities" as defined by each state, states can further subsidize those projects, including by forgiving the principle, issuing grants, or through alternative loan forgiveness or debt restructuring options (42 USC § 300j-12(d)).

The SRF programs are the largest source of federal funding for water and wastewater infrastructure. The funding for the CWSRF and DWSRF is sourced through annual appropriations and supplemental appropriations from Congress as well as loan repayments and interest payments, which makes SRF funding an annual political decision. In 2022, historic levels of federal funding were authorized by Congress through the Bipartisan Infrastructure Law (BIL, also known as Infrastructure Investment and Jobs Act) and the Inflation Reduction Act (IRA). Between these two laws, $58 billion over five years was dedicated to water infrastructure (Kane and Singer 2024). In 2024, the CWSRF and DWSRF programs together were allotted nearly $11.6 billion of funding from the federal budget (US EPA 2024f). Appropriations are at the discretion of Congress and programs funded through appropriations require an annual renewal within appropriations bills. Most of the funding for programs authorized by acts of Congress is secured through the appropriations process. In April 2025, the White House released a proposed budget for FY24-25 in which it proposed cutting Congressional allocation to the SRFs by 89%. If accepted by Congress during appropriations, this would represent a catastrophic decline in funding for SRFs.

> State Revolving Funds may be used for climate disaster recovery of water and wastewater infrastructure.

Earmarks also represent a threat to SRF funding. Most funding for programs authorized by Congress, like the SRFs, is secured through the appropriations process. The appropriations process is a political process, which can be challenging for ensuring sufficient funding is allocated for SRF funds. As more earmarks are used, they decrease the amount of funding available for SRF capitalization grants. For example, in the 2023 Consolidated Appropriations Act, the EPA was required to reserve 54% of the DWSRF appropriation and 53% of the CWSRF appropriation for community project funding or congressionally directed earmarks (Humphreys 2023). Earmarked dollars go straight from Congress to the identified persons or projects, leaving less for states to determine how to distribute based on their IUPs and the needs of their residents. Earmarks inject greater politicization into the allocation of funding for SRF programs. A more evidence-based approach Congress could use instead would be to look at EPA-conducted needs assessments and other evaluations of water and wastewater infrastructure needs — such as the American Society of Civil Engineers Infrastructure Report Cards — to inform a robust annual funding of the DWSRF and CWSRF.

SRFs may be used for climate disaster recovery of water and wastewater infrastructure. There are two ways this can happen. First, Congress can pass laws allocating disaster relief funding for specific events. The American Relief Act (Pub. L. No 118-158, 138 Stat. 1021 (2024)), for instance, included a Supplemental Appropriation of $3 billion for Hurricane Helene and/or Milton and Hawaii Wildfires for SRF programs. The law stated that the funds were to be made available as

capitalization grants from the CWSRF and DWSRF and specifically "provided to States or territories in EPA Regions 3, 4, and 9" (Pub. L. No118-158, 138 Stat. 1722, 1749-50). In 2025, the EPA Director of the Office of Groundwater and Drinking Water and the Director of the Office of Wastewater Management further clarified that the only states allowed to apply for these supplemental funds were Florida, Georgia, Hawaii, North Carolina, South Carolina, Tennessee, and Virginia (McLain and Sawyers 2025). Projects eligible for these funds must meet general SRF requirements and have "the purpose of reducing flood or fire damage risk and vulnerability or enhancing resiliency to rapid hydrologic change or natural disaster" (McLain and Sawyers 2025).

The second way that SRF funds may be available for climate disaster recovery was established under a 2024 Memorandum of Understanding (MOU) between the US EPA and FEMA (US EPA and FEMA 2024). The MOU outlines a framework for SRF programs to support and work with FEMA disaster assistance grant programs. The MOU allows states to expedite SRF funds for disaster recovery and disaster mitigation of water, wastewater, and stormwater infrastructure in places that have experienced a presidential-declared disaster. The MOU recognizes that non-federal SRF funds (i.e., the state's required matching funds) can "act as cooperative and nimble financing sources" for municipalities that are applying for FEMA disaster grant funding.

A major challenge with SRF funding is ensuring that it is equitably distributed (see McNeeley et al. 2025, p137–173 for an overview of these challenges and strategies for overcoming them). Often water and wastewater utilities with limited technical, managerial, and financial capacity are not able to meet all of the eligibility requirements, navigate the complex application processes, and meet the burdensome match requirements of their SRF programs and other federal funding opportunities (Vedachalam, Male, and Broaddus 2020; Smith 2023; Universal Access to Clean Water for Tribal Communities 2024; Hansen et al. 2021; Hammer and Olson 2024). Therefore, despite funding availability, often the communities with the greatest need cannot access the funding. Still further, state laws may limit the types of entities who can receive SRF funding (Hammer and Olson 2024). For example, Alabama state law requires public entities — such as local governments — receive SRF funding, leaving out households who may need funding to address onsite water and wastewater issues (PolicyLink 2025).

A federal policy initiative under the Biden Administration, Justice 40 (J40), sought to correct some of the funding distribution inequities of federal funding programs, including of SRF programs. After the historic funding authorized for the SRFs by the BIL, the White House published Executive Order 14008 that created the J40 Initiative. The purpose of J40 was to ensure the benefits of funding and programs from the BIL were more equitably shared and reached communities that have historically or are currently marginalized or discriminated against due to race, ethnicity, economic standing, gender, or other forms. While EO 14008 was rescinded in January 2025 by the new administration, the Environmental Policy Innovation Center found that at least 41 states had incorporated J40 principles into their SRF IUPs as of mid-2024 (Pritchard, Cork, and Cunningham 2024). Based on preliminary data from Fiscal Year 2023, the Center also found that disadvantaged communities (as defined by each state) were expected to receive approximately 45% of the total DWSRF funds compared to 37% pre-BIL. More work is needed to understand the full effect of J40 on the distribution of federal funding.

Often water and wastewater utilities with limited technical, managerial, and financial capacity are not able to meet all of the eligibility requirements, navigate the complex application processes, and meet the burdensome match requirements of their State Revolving Fund programs and other federal funding opportunities.

Another shortcoming of SRF funding is that IUPs do not prioritize climate adaptation or resilience. In a 2023 audit, the EPA Office of Inspector General reviewed state-developed CWSRF IUPs to identify which plans included climate adaptation or related resilience efforts (US EPA 2024e). The audit revealed that Congress does not require drinking water and wastewater projects that received federal assistance to incorporate climate resilience in the planning process. In addition, while 25 states included climate adaptation and resilience efforts in their 2022 CWSRF IUPs, only 13 states included climate adaptation or resilience as criteria for selecting projects they intended to fund. In discussions with the EPA, representatives from some states noted that either they were considering climate adaptation and resilience as part of their project prioritization without explicitly using these terms in their criteria or that prioritized projects were indirectly related to climate adaptation, such

as combined sewer overflow and flood mitigation projects, even if they were not explicitly labeled as climate adaptation projects. Explicitly identifying the impacts of climate change on water and wastewater infrastructure as a consideration when identifying and prioritizing projects in the SRF IUPs would help to ensure the long-term benefits of investment.

States also create financing mechanisms to support water and wastewater infrastructure projects. For example, The Water Quality, Supply, and Infrastructure Improvement Act (Proposition 1) was adopted in 2014 by California voters (CA Water Code § 79744). Proposition 1 authorized $7.545 billion in general obligation bonds to fund seven categories of projects with individual allocations designated for projects related to:

1. clean, safe and reliable drinking water;
2. protecting rivers, lakes, streams, coastal waters, and watersheds;
3. regional water security, climate, and drought preparedness;
4. statewide water systems operational improvement and drought preparedness;
5. water recycling;
6. groundwater sustainability; and
7. flood management.

The law was largely motivated by an effort to reduce the impacts of climate change on watersheds and water supply. To be funded, for example, projects must demonstrate they are for "regional water security, climate, and drought preparedness" and are implementing an integrated regional water management plan that "contributes to addressing the risks in the region to water supply and water infrastructure arising from climate change" (CA Water Code § 79742). Several of the eligible project types identified for the "regional water security, climate, and drought preparedness" category enable preparedness for climate change impacts. This includes water reuse and recycling for nonpotable and potable reuse, underground water storage (including groundwater aquifer cleanup or recharge), and water supply reliability improvement.

States can also enact laws to create funding for building and adapting climate-resilient water and wastewater infrastructure.

States can also enact laws to create funding for building and adapting climate-resilient water and wastewater infrastructure. In New York in 2022, citizens voted to approve a ballot initiative called the Environmental Bond Act that authorized the state to issue $4.2 billion in bonds for climate resilience projects (New York State Legislature 2022). It also led to the enactment of a comprehensive legal framework codified as Article 58 of the New York Environmental Conservation Law (N.Y. Envtl. Conserv. Law § 58, 2022) that establishes the legal structure for allocating the funds, setting project eligibility criteria, and ensuring accountability and equity in the act's implementation. The funding it provides is intended to help state agencies, local governments, and other stakeholders protect drinking water sources, reduce pollution, and protect communities and natural resources from climate change (State of New York 2025). The law specifically allocated

$650 million for water quality improvement and resilient infrastructure and another $1.1 billion for restoration and flood risk reduction.

In 2019, the Texas State Legislature passed two related bills, Senate Bills 7 and 8, while voters also approved a proposition (Proposition 8) that together created and appropriated approximately $793 million in funding for the Flood Infrastructure Fund (Harris 2019; River Network 2025b). The Flood Infrastructure Fund provides loans and grants to any political subdivision (e.g., cities and counties) for flood control, flood mitigation, and drainage projects. The bills were written to allow a broad range of project types to be eligible for funding, for example, preliminary engineering or project design plans, flood control or mitigation infrastructure, restoration of floodplains, and green stormwater infrastructure (Texas Water Development Board (WDB) 2023). Senate Bill 7 included a provision that prioritizes the monies for low-income communities. Specifically, it inserted language in the state Water Code that required the Texas Water Board, the fund's administrator, to adopt for the fund "rules establishing the criteria of eligibility" that give "greater importance to a county that has a median household income that is not greater than 85 percent of the median state household income" (Texas Water Code § 15.405(f)(1)).

In the case of the State Revolving Funds, each state is required by law to establish a plan for how they will prioritize their funds; this process creates an opportunity to prioritize funds for equitable climate resilience.

In sum, laws can enable the funding of projects that prepare water and wastewater infrastructure and services for the impacts of climate change. Federal and state laws have both established funding programs for water and wastewater utilities and municipal governments to design and construct more climate-resilient water and sanitation infrastructure. These programs are funded through annual appropriations, supplemental funds, loan repayments, and/or interest payments. In the case of the SRFs, each state is required by law to establish a plan for how they will prioritize their funds; this process creates an opportunity to prioritize funds for equitable climate resilience. Laws and government policies can be explicitly written to further improve the equitable allocation and distribution of government funding for frontline communities. Each of these strategies plays a critical part in helping to make funding available for building more equitable, climate-resilient water and sanitation infrastructure and services.

7.2 CRITERION 2: ECONOMIC INCENTIVES FOR FLOOD RESILIENCE

Laws create economic incentives to consider the water and climate risks of new development and ensure proactive rehabilitation and responsible redevelopment in flood-prone areas.

Building in areas that are prone to climate disasters makes it more challenging and costly to provide safe, reliable water and wastewater services to a community. Federal and state laws can limit development in flood-prone areas to ensure that the law is not contributing to an increase in communities exposed to climate risks. Laws can influence the placement of infrastructure and housing in areas of low flood risk through incentives and disincentives using public funds.

Federal laws help to disincentivize and limit new development in certain areas prone to flood risks. For example, the Coastal Barrier Resources Act of 1982 restricted the use of federal funding on properties located on coastal barriers (16 USC 3501, § 2 of P.L. 97-348). Coastal barriers are natural landforms like barrier islands, spits, and bay barriers, that protect mainland areas from the direct impact of coastal storms but are prone to move and change shape (Figure 5).

FIGURE 5. A Barrier Island, which Is a Form of Coastal Barrier, on the Outer Banks of North Carolina

Source: NOAA 2021

The purpose of the 1982 act was to "minimize the loss of human life, wasteful expenditure of federal revenues, and the damage to fish, wildlife, and other natural resources associated with the coastal barriers." The law establishes the Coastal Barrier Resources System, consisting of undeveloped coastal barriers located on the Atlantic and Gulf coasts of the US (16 USC 3503, § 4(a) of P.L. 97-348). Once established, no new expenditures nor financial assistance could be provided by the federal government within the coastal barriers system, including for the construction or purchase of any built infrastructure (16 USC 3505, § 6 of P.L. 97-348). While the law does not stop development within the coastal barriers, it transfers the financial burden of living in these flood-prone areas from taxpayers broadly to the people who chose to live there, thereby disincentivizing development (US Fish & Wildlife Service 2002). If preventing development in these areas is a policy priority, state laws could further help by limiting the use of state funding or fully prohibiting (new) development in areas with high flood risk.

State laws can also limit the use of public funds for development in areas identified as having high flood risk. For example, Florida law encourages local governments to "limit public expenditures that subsidize development in coastal high-hazard areas" (Fla. Stat. § 163.3177(6)(g)(6), 2016). This law is implemented within the process required by the state for local governments to adopt community Comprehensive Plans (Florida Statute § 163.3167(2), § 163.3177). Certain local governments must include a "coastal management element" in their plan where they must incorporate principles, guidelines, and standards that guide decisions about publicly funded development in high-hazard coastal areas. Different local governments take different approaches to incorporating these components into their plan. For example, Pinellas County's 2023 comprehensive plan restricted development and redevelopment within and directed population concentrations out of the Coastal Storm Area.[49] The county identified several policies and strategies for restricting (re)development in this area, including restricting expenditures for public infrastructure (Pinellas County 2025). Other measures to restrict (re)development in Coastal Storm Areas in the county include identifying areas that are vulnerable to sea level rise and coordinating with municipal partners to designate Adaptation Action Areas.

Laws can also use financial incentives to further climate resilient development. For example, the National Flood Insurance Reform Act of 1994 (NFIRA) was passed to incentivize more communities to participate in the National Flood Insurance Program (NFIP). The NFIRA required land use and control measures in flood hazard areas before businesses and households in a community would be eligible for federal flood insurance (42 USC §4022). Therefore, unless a city or county has adopted adequate land use measures, local businesses and community members are not eligible to receive federal flood insurance through the NFIP. Where the community adopts and enforces flood and erosion mitigation measures that *exceed* the criteria set forth by the FEMA Administrator under §4102 of NFIRA, the NFIP is required to offer credits on premium rates for flood insurance coverage in those communities (42 USC §4022(b)(2)). Such credits incentivize local governments to take additional steps beyond the baseline requirements, further helping to make communities more climate resilient.

However, one equity-related challenge of the NFIP is that the minimum requirements for participating in the program vary because, under the law, these requirements are dictated by a community's flood hazard and the level of data FEMA has collected and published about a community. Therefore, places where FEMA has not provided flood maps have few requirements, not

necessarily because there is no or low risk of flooding, but because the community has not been officially mapped by FEMA (US Government Accountability Office 2013). Flores and co-authors (2025) found that approximately 26 million people in the conterminous US live in unmapped flood hazard zones and that these unmapped zones contain a higher proportion of low-income households.

Another way laws can encourage local government to take proactive steps toward flood-related climate resilience is by providing additional financial support for certain measures. For example, the Public Assistance Program included within the Stafford Act increases the federal share of assistance from 75% to 85% when state or Tribal governments invest in measures that increase readiness for and resilience against major disasters (42 USC §5172(b)(3)). These measures include actions such as adopting a hazard mitigation plan and funding hazard mitigation projects or granting tax incentives for projects that reduce risk, among others.

Other federal laws have created financial incentives to encourage people to relocate to safer, less flood-prone areas. For example, the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 created a pilot program to purchase "severe repetitive loss properties." Severe repetitive loss properties are defined as properties that meet certain conditions, including single family homes that are covered by flood insurance who have received either four or more separate claims payments of more than $5,000 or at least two separate claims payments with the cumulative value exceeding the value of the property (42 USC 4102a §1361A(b)). The pilot program authorized states and communities to offer buyouts to owners of such properties, with a structured framework guiding the determination of purchase prices (42 USC 4102a §1361A(g)). Where a homeowner refuses to either pursue mitigation opportunities or pursue a buyout, the insurance premium is increased by an amount equal to 150% of the chargeable rate for the property at the time the purchase offer was made (42 USC 4102a §1361A(h)).

Funding incentives and disincentives can play a part in encouraging flood-prone communities with exposed water and wastewater infrastructure to improve climate resilience.

While the pilot program was only authorized through 2009, FEMA continued to offer eligible homeowners with repeated flood losses the option to accept buyouts, raise the elevation of structures, or relocate at least through mid-2025 (FEMA 2024c, 2025). The Stafford Act (1988) also gives buyout authority to the FEMA Administrator, who can offer "property acquisition and relocation assistance for projects" that meet certain criteria (42 USC §5170c). However, uncertainty in support from lawmakers for FEMA could mean this program may not be available in the future.

Funding incentives and disincentives can play a part in encouraging flood-prone communities with exposed water and wastewater infrastructure to improve climate resilience. As discussed here, laws do this by placing limits on how public funding can be used. The law can also encourage certain flood-risk reduction measures or actions to be taken by adding financial incentives, like access to federal flood insurance. Laws that create these incentives and disincentives can be implemented at the federal and state level to support more climate-resilient placement of water and wastewater infrastructure.

7.3 CRITERION 3: TRACKING AND REPORTING DISASTER RELIEF FUNDING

Laws can mandate the tracking and reporting of climate disaster relief funding.

Laws that require tracking and reporting on disaster assistance funding can improve transparency in government spending and support researchers in identifying trends in the impacts of climate disasters. Funding for disaster mitigation, response, and recovery assistance is distributed by multiple federal agencies. FEMA tracks funding obligated as part of the Disaster Relief Fund (DRF) established under the Stafford Act (1988). However, that tracking is limited to funding distributed to address disasters and emergencies declared under the Stafford Act. In 2016, the Government Accountability Office (GAO) conducted the first systemic accounting of federal obligations for disaster assistance outside the DRF as required by the Joint Explanatory Statement accompanying the Consolidated and Further Continuing Appropriations Act of 2015. It found that between 2005 and 2014, the federal government obligated $277.6 billion for disaster assistance programs and activities (US Government Accountability Office 2016). Otherwise, laws had not required the federal government to track the obligation and expenditure of funding for disaster assistance.

> Between 2005 and 2014, the federal government obligated $277.6 billion for disaster assistance programs and activities.

Laws requiring tracking and reporting of disaster assistance funding create greater transparency and a data-driven basis upon which to make informed funding and financing determinations. Research shows that the cost of inaction will be substantially greater than the costs of proactively adapting water and wastewater infrastructure to climate change. Greater collection and publication of disaster response spending helps to increase understanding of the costs of climate disasters and failures to prepare for those disasters. In their 2024 Climate Resilience Report, the US Chamber of Commerce estimated that every $1 invested in disaster preparedness yields $13 in savings (US Chamber of Commerce et al. 2024). That savings consists of $6 from reduced damage and cleanup costs and $7 from reduced economic disruptions such as job losses and GDP decline. A 2024 Swiss Re Institute report on the benefits versus costs of flood management similarly estimated that the net financial benefits of flood resilience are up to 10 times greater than the costs of rebuilding after a flood, with lower income countries benefiting the most (Gahlot, Gray, and Race 2024). They also found that in some cases, depending on the region, investments in flood protection could generate up to $120 in benefits per dollar invested. Furthermore, a 2019 report by the National Institute of Building Sciences found that implementing up-to-date building codes for flood protection can provide a $6 return for every $1 invested (Multi-Hazard Mitigation Council 2019).

Greater disaster data collection and reporting enables trends to be tracked and resources to be effectively allocated where the need is. Data can inform appropriations processes and help direct dollars toward climate change preparedness and disaster mitigation. This occurred in 2024, for example, when a Supplemental Appropriation of $3 billion for Hurricane Helene and/or Milton and Hawaii Wildfires for SRF programs was included in the American Relief Act (Pub. L. No 118-158, 138 Stat. 1021 (2024)).

Furthermore, not requiring the tracking of obligations and expenditures upfront makes it difficult to determine how funding was spent. According to the GAO report, documenting how funding was obligated or expended was difficult because obligations were not tracked separately and were embedded within broader department mission-related costs (US Government Accountability Office 2016). Being able to track funding also means having a clearly defined understanding of what qualifies as "disaster assistance," which could be defined in disaster-related laws. The more nuanced "disaster assistance" is defined, the better the tracking can monitor the flow of funding to efforts that anticipate versus respond to disasters. This helps illustrate the costs and harm that can be avoided through proactive action and supports directing funding to address the anticipated impacts of climate change on infrastructure and services.

> Greater collection and publication of disaster response spending helps to increase understanding of the costs of climate disasters and failures to prepare for those disasters.

7.4 SUMMARY

Greater investment is required to build and maintain climate-resilient water and wastewater infrastructure and services, yet most US utilities, especially small and rural systems, struggle to cover basic needs with local rates and fees. Overdue maintenance has left US water and wastewater systems with more risk and exposure to extreme weather. Laws can help shape whether adequate, accessible, and equitable funding reaches the water and wastewater utilities that need it the most. Laws can authorize and appropriate funding, set eligibility criteria for funding access, create incentives or limits on spending, and require transparency on funding allocation through tracking and reporting.

Laws can also steer development away from areas with high climate risks and reward adaptation, thereby helping to reduce exposure and long-term costs.

The federal SRF programs have historically been central to funding investments in drinking water and wastewater treatment, but they are dependent on annual appropriations, and therefore, are exposed to political swings. The prioritization of SRF funds happens mostly at the state level; this results in variable emphasis on climate resilience and adaptation in SRF funding at the state level. Equity remains a major challenge: disadvantaged and capacity-constrained communities often face complex applications, match requirements, and eligibility limits. Some states and initiatives (e.g., J40-informed IUPs, California Prop 1, New York's Environmental Bond Act, Texas's Flood Infrastructure Fund) demonstrate how law can prioritize climate resilience and frontline communities. Laws can also steer development away from areas with high climate risks and reward adaptation, thereby helping to reduce exposure and long-term costs. Finally, laws that mandate tracking and reporting of disaster assistance enhance transparency and can improve climate disaster prevention compared to response. These legal strategies can help enable more equitable, climate-resilient water and sanitation in the US.

8. Laws to Minimize Climate Disruptions to Water and Sanitation Access Are Enforceable and Enforced

Attribute description: Federal, Tribal, state, and local laws create enforcement mechanisms for ensuring that drinking water and sanitation systems serving frontline communities meet legal and regulatory standards to reduce risk of harm from climate change impacts to water and sanitation infrastructure and services.

Every law and regulation must be enforceable and enforced to have legal power. Enforcement — the compulsory or coercive aspect of any legal regime — takes many different forms. These forms range from physical coercion, like jailtime and fines, to personal compulsion to conform to group norms and customs. Effective enforcement often requires a prosecutor, court, or other institutional actor to serve as the factfinder and coercer that determines culpability, imposes a punishment, and implements the punishment. However, public opinion and collective action in the form of boycotts or protests can become a part of the enforcement of law, albeit one that sits outside these traditional mechanisms.

In the context of climate-resilient drinking water and environmental protection, enforcement of the standards codified in laws and regulations is key to maintaining water and sanitation infrastructure and safe, reliable service delivery.

In the context of climate-resilient drinking water and environmental protection, enforcement of the standards codified in laws and regulations is key to maintaining water and sanitation infrastructure and safe, reliable service delivery. Additionally, laws are often crafted to create equity and fairness in how these services are delivered. The enforcement of water laws is intended to keep water available, clean, and prevent sanitary waste from sickening people or the environment. However, climate change impacts are creating new challenges for maintaining water and sanitation infrastructure and services, pressuring the legal system to keep pace with evolving threats (Campbell-Ferrari et al. 2024).

To achieve equitable, climate-resilient water and wastewater services delivery three things must exist in a legal system:

1. laws or rules require climate-resilient water and wastewater infrastructure and services;
2. enforcement measures within the law allow for the rules to be enforced; and
3. compliance with and fulfillment of rules are enforced.

Rules play an important role in creating an enabling environment where the impacts of climate change can be anticipated and managed. These rules can require action or encourage changes that will make water and wastewater infrastructure and services more resilient. In addition to the rules and requirements related to the infrastructure and provision of services, the law establishes a framework for enforcing those rules and requirements. Enforceable laws require someone — government representatives or private citizens — to be given the power to enforce the laws. This requires the law to identify a governmental body responsible for monitoring compliance with the law's rules and requirements and initiating enforcement proceedings. The law must also identify consequences when the rule is not followed that can be applied against whomever has failed to comply with the law, with a range of penalties such as a fine or the loss of a permit. Once there are rules and requirements and someone is identified to act on them, those institutions and actors must pursue lawbreakers through enforcement actions (e.g., prosecutions, civil lawsuits, investigations) and determine penalties. These three factors together help ensure water and wastewater infrastructure and services are resilient.

Enforceable laws require someone — government representatives or private citizens — to be given the power to enforce the laws.

We identified five criteria that can be used to evaluate the enforceability of laws for achieving equitable, climate-resilient water and sanitation.

1. The law establishes consequences for noncompliance with drinking water and wastewater standards that protect public health, water quality, and the environment and considers the equity and fairness of those consequences.
2. The law creates enforcement tools that sufficiently deter behavior that violates the law and increases the risks of climate disruptions to water and wastewater services.
3. Enforcement actions are taken by governmental bodies responsible for implementing and enforcing the law.
4. The law creates opportunities for the public to enforce implementation of and compliance with the law.
5. Permits explicitly address anticipated climate change impacts and do not undermine compliance and environmental protection.

8.1 CRITERIA 1: CONSEQUENCES FOR NONCOMPLIANCE

The law establishes consequences for noncompliance with drinking water and wastewater standards that protect public health, water quality, and the environment and considers the equity and fairness of those consequences.

Climate change is having an increasing impact on water and wastewater utilities' abilities to provide reliable, safe services (Pacific Institute and DigDeep 2024). Enforcement actions and penalties incentivize water and wastewater utilities to ensure that they remain in compliance with the law, despite challenges like degraded water quality and damage from climate disasters. Beyond this incentive, penalties broadly serve as a deterrent for inaction or intentional neglect. As climate change necessitates anticipatory and proactive management of threats, compliance is becoming more difficult and enforcement is becoming more important (Hamilton, Barbour, and Bierwagen 2010; Whitehead et al. 2009; Delpla et al. 2009). Requisite penalties can reflect both the failure to comply with the law and a failure to think and plan ahead.

As climate change necessitates anticipatory and proactive management of threats, compliance is becoming more difficult and enforcement is becoming more important.

The Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA) include penalties for violations of these laws that were intended to increase accountability. The penalties often levied against water and wastewater utilities for violations are punitive, such as a financial punishment for violating the law. Although penalties serve as a deterrent and create accountability for noncompliance, they are often passed on to the community in the form of increased rates. Although utilities may suffer reputational damage as a result, it is unclear whether these penalties are serving the intended purpose of motivating utilities to better manage and adapt their infrastructure and service delivery (Allaire, Wu, and Lall 2018).

For example, under the CWA, wastewater utilities operate under a NPDES permit that allows the discharge of certain pollutants into bodies of water. When these permits are violated, Section 1319 of the CWA has already established who is responsible for enforcement and the maximum penalties that can be assessed for different types of violations (33 USC § 1319).[50] Systems are expected to meet the permit requirements, and many do. Where a system violates their permits in a systemic or persistent way or after specific events, this can reflect deeper issues like failures in management and planning or a deliberate decision not to comply with the law. As the impacts of climate change challenge the ability of water and wastewater systems to provide safe and reliable services, penalties for noncompliance or inadequate infrastructure serve to motivate water and wastewater utilities to better adapt to climate change. They also can serve as a bellwether to identify systems that are unable or unwilling to make these adaptations.

Systems impacted by climate change may be more likely to violate their permits, especially where infrastructure and service delivery have not been adapted to climate change impacts. For example, a 2022 report about the impacts of climate change on the city of Juneau, Alaska found that a significant spike in rainfall in 2020 was responsible for NPDES violations at the Mendenhall

Wastewater Treatment Plant (Alaska Coastal Rainforest Center 2022). The 2020 rain event represented a 100-year storm event, while Juneau's system is only designed to operate during a 20-year storm event. The sheer amount of rain made it impossible to treat the wastewater to the standard required by the permit (Alaska Coastal Rainforest Center 2022; University of Alaska Southeast 2022). This indicates a potentially worrying trend: as 100-year or stronger storm events (e.g., 500- or 1000-year) become more frequent, unprepared systems may find themselves violating the law more and more. While Juneau was not penalized, systems that do not act despite the benefit of time and foresight may not escape punishment in the future.

Penalties also raise issues of fairness and equity. Administrative and civil judicial penalties levied against the utility are ultimately paid by the community (i.e., by the ratepayers or the taxpayers in the community).[51] In other words, the penalties are not personally paid by the people who are responsible for violating the law. Because of this disconnect, financial penalties rely on service providers wanting to prioritize their reputation and trust with the community to make the right decisions that keep safe and effective services flowing. These penalties, particularly if they lead to rate increases, can also increase public interest in utility operations.

Penalties can also impact communities with limited financial resources more deeply. For these communities, a financial penalty adds an additional financial hardship that may compound struggles to find the resources to complete certain rehabilitation and compliance projects that would address some of the underlying issues leading to the noncompliance.

In addition to penalties, utilities are often required to make specific updates to their systems on a certain timeline as part of enforcement action settlements. These requirements, when compounded with fees, can stretch the resources of utilities, particularly those serving poorer communities. For this reason, the CWA allows for compliance timelines for CWA violations to be extended in certain financially disadvantaged communities. This has the consequence of extending the length of time that the people in and downstream of these communities must live with potentially harmful, noncompliant systems. The EPA's guidance on how these decisions are made is in the Financial Capability Assessment (FCA), authorized by language in the CWA. The FCA allows the community's ability to pay for legally required improvements to be considered when calculating the compliance timeline in a consent decree.[52] The more that the community is burdened, the longer the compliance timeline can be extended. Depending on the financial limitations of the community, the compliance timeline could be extended by five to twenty years, and potentially multiple times.[53] A drawback to these extended timelines is limited accountability for state and local governments and utilities to resolve violations and come into compliance. While the FCA is seen as a tool that promotes equity, the longer timeline exposes lower-income communities to health, environmental, and climate change risks for longer periods.

Because each state makes their own priority lists and sets their own definitions, similarly disadvantaged people in different states may not necessarily get the same access to the State Revolving Fund program's grants and low-interest loans.

Enforcement actions are often a last resort. For low-income communities, this can be the result of other decisions made about funding. Funding for water and wastewater systems is primarily through SRFs grants and low-interest loans designed to enable under resourced communities to update and rehabilitate infrastructure. These improvements increase the chances those communities can endure climate change effects. As of this writing, the law allows each state to determine the priorities for how SRF dollars are distributed. States also are allowed to define what constitutes a "disadvantaged community." These priority lists and the definition of disadvantaged community help determine which communities and projects receive the funding made available by Congress for water system upgrades and adaptations that are critical for building climate resilience (US EPA 2024b).[54] However, because each state makes their own priority lists and sets their own definitions, similarly disadvantaged people in different states may not necessarily get the same access to the SRF program's grants and low-interest loans. If EPA funding could be more equitably distributed and prioritized for disadvantaged communities and communities in frequent noncompliance with health-based standards, that would help keep utilities from breaching the law and obviate the need for FCA-like exceptions in the enforcement system.

Enforcement actions may also be an indicator that a water or wastewater utility is not operating in a sustainable manner. Enforcement of the law may be served if utilities are given options to consolidate or regionalize[55] instead of being punished through penalties. The SDWA allows states to require certain systems struggling with compliance to explore regionalization (40 CFR 142 89 FR 46998).[56] Regionalization can help improve the economies of scale and help to spread the financial

and capacity burden of operating and maintaining a wastewater or drinking water system across more people. By being able to spread the cost of services across a broader, and possibly more diverse, customer base, rates may not have to be as high as they otherwise would have to afford the necessary improvements to prepare for the impacts of climate change. However, there is some resistance to regionalization because it can also change community engagement and oversight of these systems, primarily by diluting community control, oversight, and management (Dobbin, McBride, and Pierce 2023; Landes et al. 2020; Mullin 2020). Combining multiple systems with significant systemic issues may help with economies of scale, but it may also create a larger entity facing the same infrastructure and income challenges. This makes it critically important to balance the financial and capacity benefits of regionalization with the needs and desires of the community.

Supplemental Environmental Projects (SEPs) that mitigate a portion of the civil penalties can also be a way to find equity and fairness in enforcement. SEPs allow violators to undertake environmentally beneficial projects as part of the settlement that it would otherwise not be obligated to complete (US EPA 2015b).[57] SEPs do not replace the violator's legal obligations to achieve compliance, but rather are projects that provide tangible public health or environmental benefits to the affected community or environment. Neither the CWA nor the SDWA explicitly allows the use of SEPs in enforcement actions; however, they have been accepted by the EPA and courts as valid and effective enforcement tools. SEPs have been used since 1980, with the most recent policy published in 2015 (Kristl 2007).[58] According to the 2015 Policy, SEPs must:

1. be sufficiently related to the violation;
2. cannot be inconsistent with the provisions of the statute(s) serving as the basis of the enforcement action and must advance at least one of the objectives of the statute(s); and
3. must relate to the underlying violation and be designed to reduce the likelihood of similar violations in the future, adverse impacts to public health and/or the environment to which the violation at issue contributes, or the overall risk to public health and the environment potentially affected by the violation at issue.[59]

SEPs provide dual benefits by both improving public health and the environment and mitigating the amount of civil penalty owed by a violator.[60] The 2015 EPA SEP Policy recognizes how SEPs further the EPA's mission to address climate change impacts:

> Preparing infrastructure and natural ecosystems for the changes that will occur with a changing climate can help communities adapt to climate change and be more resilient in avoiding or recovering from events resulting from a changing climate. For example, in some areas where increased rainfall is expected, increased runoff can lead to greater stress on water infrastructure and to degradation of water quality. Anticipating those impacts can help a community plan ahead to limit the negative impacts of these changes. Projects that address the impacts of climate change and that help increase a community's resilience in the face of these impacts on ecosystems or infrastructure, may qualify as SEPs.

Therefore, a wastewater treatment plant that violated its NPDES permit because of a heavy rainfall or flood event that caused the sewer system to overflow could agree to a SEP that restores

wetlands or adds green space. This SEP project could help absorb increased rainfall that would otherwise cause the system to fall out of compliance.[61]

Based on these examples of enforcement, there are avenues for enforcing the law without financially penalizing the water or wastewater system. New laws could include penalties that specifically incentivize improved climate resilience for water and wastewater infrastructure and services. Penalties that are more than just punitive can create broader environmental benefits while still holding the violator responsible for breaking the law.

8.2 CRITERION 2: DETERRENT ENFORCEMENT TOOLS

The law establishes enforcement tools that sufficiently deter behaviors that violate the law and increase the risks of climate disruptions to water and wastewater service.

Civil and criminal enforcement tools serve a critical role in deterring behavior that endangers the protection of human health and the environment. Environmental laws typically contain enforcement provisions and authorize the EPA to enforce the law against those who do not comply with the requirements of the law.[62] The EPA often has the authority to conduct inspections, request reports, impose administrative penalties, and issue administrative orders. The EPA also has the option to file a civil or criminal complaint[63] in federal court by referring the case to the Department of Justice (DOJ). The EPA, DOJ, and the courts have discretion in how those penalties are determined. Policies and guidance documents published by the EPA and DOJ inform how penalties are calculated, allowing for SEPs. The consequences for violations are then finalized during administrative, civil judicial, or criminal proceedings.

To achieve increased compliance, the penalties ultimately issued must be sufficient to (a) incentivize the water or wastewater system that has violated the law to return to compliance, (b) to disincentivize them from violating the law again, and (c) to disincentivize others from violating the law. These priorities have been captured in DOJ and EPA policy. In 1984, the EPA issued a General Enforcement Policy that remains in place to this day. The policy identified three enforcement priorities, including: 1) deterrence, 2) fair and equitable treatment of the regulated community, and 3) swift resolution of violations (US EPA 1984).[64] The 1984 EPA Civil Penalties Policy stated, “the penalty should persuade the violator to take precautions against falling into noncompliance again (specific deterrence) and dissuade others from violating the law (general deterrence).” The penalties must “display both consistency and flexibility.” The EPA must find the balance between consistently applying the policy so that the results are not arbitrary across similarly situated violators and allowing for flexibility when the circumstances are different. The policy also states that violations must be quickly resolved.

The penalties allowed by law must be enough to incentivize compliance and serve as a deterrent. The CWA establishes the parameters for both injunctive relief (like restraining orders or other limitations on someone’s actions), administrative penalties, and civil penalties. For example, any person who violates key provisions of the CWA or an order issued by the EPA Administrator can be subject to a civil penalty of up to $25,000 per day for each violation (33 USC § 1319(d)).[65] The law identifies factors for the court to consider in calculating the penalty.[66] The CWA also identifies the maximum amount of administrative penalties that can be assessed (33 USC § 1319(d)). Similarly, the SDWA identifies the rules for issuing administrative and civil penalties (42 USCS § 300g-3(b)).

To maintain the value of these civil penalties Congress passed the Federal Civil Penalties Inflation Adjustment Act in 1990. This act and additional amendments require annual inflation adjustments to help ensure that the value of the civil penalties keeps pace with inflation.[67] This helps maintain the deterrent impact of the CWA and SDWA's penalties.

State laws can vary significantly, which can greatly impact equitable enforcement. The CWA and SDWA allow states to apply to administer both the permit and pollution control programs established in those acts. This allows states to become the primary enforcement authority responsible for ensuring compliance with federal laws.[68]

Not all states with primary enforcement authority have incorporated the same penalties into their statutes implementing the CWA. As an example, while states cannot adopt less stringent effluent limitations than established under the CWA, states are not required to adopt the same penalties set forth in federal law. The provision authorizing states to take on primary enforcement authority merely states that the administrator must determine that the state has sufficient authority to "abate violations of the permit or the permit program, including civil and criminal penalties and other ways and means of enforcement" (33 USC § 1342(b)(7)). The CWA does not require the state to match the federal enforcement program or adjust penalties for inflation.

Under the Clean Water Act, states are expected to take the lead in implementing and enforcing the law over the federal government.

One exception to this is that EPA regulations governing the delegation of administration and enforcement authority to the states require that states must have the authority to assess a civil penalty of *at least* $5,000 per day (40 CFR 123.27(a)(3)). This minimum amount has not been updated since the adoption of the regulation in 1980 (Anderson and Vaughan 2023).[69] Some states have written their own laws to match this standard. In Iowa, for example, the state environmental agency is limited to issuing a civil penalty of no more than $5,000 per day for a CWA violation (Iowa Code §455B.191(2)). While this may have been deterrent in 1980, that coercive power has diluted over time.

Otherwise, different states have adopted different approaches to issuing civil penalties. According to data collected in 1995, some state statutes allow for maximum penalties per day up to $25,000 or within ranges of $10,000 to $24,999 or $5,000 to $9,999 (Environmental Law Institute 1995).[70] Other state statutes set penalties per violation instead of per day, or set maximum total penalties that could be recovered. Although things may have changed since the 1995 study, its conclusions show that states having flexibility can result in a severe lack of uniformity in how similar violations are penalized.

Under the CWA, states are expected to take the lead in implementing and enforcing the law over the federal government (33 USC § 1251(b)).[71] If a state has initiated an administrative action at the state level under its clean water statute, the federal government is precluded from bringing a federal civil action on the same grounds (33 USC § 1319(g)(6)). However, the state administrative proceeding must be similar to the administrative proceedings laid out in CWA Section 309. If it is not, the federal government may bring an administrative action. Unlike the example above, federal

authorities may commence a civil enforcement action even when the state has already brought a similar civil enforcement action. While the limitations under the law seem less onerous, executive branch policy can discourage these prosecutions. During the first Trump administration, the DOJ's Assistant Attorney General adopted a policy disfavoring the DOJ bringing civil enforcement actions seeking penalties under the CWA if a state had already initiated or concluded its own civil or administrative proceeding for penalties under a similar state law (US Department of Justice 2020b). The memorandum was later revoked by the Biden administration. While federal authority is generally maintained when it comes to parallel state and federal prosecutions, the executive branch can change how this operates, which can impact enforcement. The differences are even more stark when you focus on penalties.[72]

Climate vulnerabilities can be, and have been, used to guide enforcement decisions.

In practice, the differences in state enforcement statutes and practices result in wide variations of penalties across the United States. In a 2023 study using penalty data available through the EPA's ECHO website, researchers discovered that during the 10-year period from 2013 to 2022, the average federal CWA penalty was more than five times higher than the average state penalty (Anderson and Vaughan 2023).[73] State-to-state the median penalty varied significantly. For example, the median state penalty for Nebraska was $413,750 while the median state penalty for Michigan was $780 (Anderson and Vaughan 2023).

The median penalty also varied widely based on the EPA Region. For example, the median penalty in Region 2 (New York, New Jersey, Puerto Rico, US Virgin Islands, and federally recognized Indian Nations) and 6 (New Mexico, Oklahoma, Texas, Louisiana and Arkansas) was $10,000, while the median penalty in Region 5 (Minnesota, Wisconsin, Illinois, Michigan, Indiana and Ohio) was $54,734, and in Region 9 (California, Nevada, Arizona, American Samoa, Norther Mariana Islands, Micronesia, Guam, Marshall Islands and Palau) it was $68,388 (Anderson and Vaughan 2023). While not specific to water and wastewater utility compliance, the data speak to the variability in enforcement more broadly.

Climate vulnerabilities can be, and have been, used to guide enforcement decisions. In June 2024, the EPA issued a memorandum providing guidance on how EPA's enforcement arm could consider climate change in taking steps to bring violators into compliance and keep them compliant (US EPA 2024h). In CWA and SDWA cases, the memorandum states that enforcement should first have the alleged violators conduct a climate vulnerability assessment early in negotiations or as an early deliverable under a consent decree. The guidance suggests that defendants should then be required to implement the findings. These required actions should:

> perform as intended through at least the anticipated useful life of the required infrastructure and/or pollution controls and, as appropriate, should be designed to withstand and, to the extent possible, continue working effectively during extreme weather events such as storms, floods, wildfires, and droughts that are now more common due to climate change.

The memo also stated that enforcement actions should use the identified climate vulnerabilities to guide settlement requirements and ensure long-term compliance. Utilities' risk and resilience

assessments or emergency response plans could also be used as benchmarks for compliance (US EPA 2024h).[74]

These examples show how enforcement actions can use climate impacts to address current violations and future challenges side-by-side.

8.3 CRITERION 3: ENFORCEMENT ACTIONS ARE CARRIED OUT

Enforcement actions are taken by governmental bodies responsible for implementing and enforcing the law.

Enforcement requires action because the written laws and regulations are not self-executing or actualizing on their own. Though it may seem to be stating the obvious, governmental agencies tapped to enforce the law must enforce the law. The CWA and the SDWA both require monitoring and reporting of compliance data to the EPA.[75] While violations of maximum contaminant levels — the health-based standards governing the provision of safe drinking water — are not that common, monitoring and reporting requirement violations are more common. In 2015 for example, a nationwide analysis of 17,900 community water systems found that 9% received a health-based water-quality standards violation (Allaire, Wu, and Lall 2018).

> Because the EPA does not have the funding to investigate every possible violation, it relies on states and utilities to provide accurate data.

Violations of NPDES standards — typically effluent limitation violations — are much more common. In the 2017 National Water Quality Inventory report to Congress, states identified the most common sources of water-quality challenges, one of which was municipal discharges/sewage (US EPA 2017b). This suggests that wastewater utilities are struggling with compliance. While the law is enforced, inconsistencies and variability in enforcement stems from how the law structures enforcement processes and rules.

There are several barriers to enforcement. First, although compliance with the law is mandatory, enforcement is discretionary. The EPA and the DOJ have discretion to decide which violations they pursue, as with all prosecutions (33 USC §1319. *Sierra Club v. Whitman*, 268 F.3d 898 (9th Circuit)). It is not required to pursue every violation of the law. These decisions cannot be appealed or countermanded (i.e., revoked). Furthermore, enforcement is different from one presidential administration to another. For example, enforcement was reported to be more limited under the first Trump administration in comparison to the Obama and George W. Bush administrations (Lipton and Ivory 2017) and enforcement resources have been significantly cut again by the White House administration as of this writing in 2025 (McGuire et al. 2025). While citizens can use civil suits under the CWA and SDWA to enforce the law when the EPA and the DOJ do not, as discussed in more detail later in this section, this enforcement mechanism is rarely used. As a result, how a prosecutor chooses to move forward with a charge can serve as a barrier to effective enforcement.

Second, the data on compliance and enforcement are often incomplete or inaccurate. In a 2021 report, the GAO found that some states were not reporting certain data to the EPA, while others were submitting inaccurate data (US GAO 2021). Furthermore, the report states that certain

calculations reported on the EPA's ECHO database (based on reported data) are inaccurate as a result of issues with the underlying data. Because the EPA does not have the funding to investigate every possible violation, it relies on states and utilities to provide accurate data. When these data are corrupted, unintentionally or otherwise, this can have an impact on enforcement.

Third, limited staffing and budgets constrain the ability of both the EPA and state environmental agencies to conduct inspections and bring enforcement actions. For example, the Maryland Department of the Environment informed the governor's office and state General Assembly in 2022 that it needed almost 100 new employees to review expired permits and to increase inspections and issue enforcement actions (Azhar 2022; Rechtschaffen 2004).

Fourth, formal enforcement actions are staff and time intensive. They often take years to complete due to their complexity and the overburdened federal court system. This means the government is less likely to pursue litigation, which allows violations to

In all, bureaucratic, fiscal, and political challenges can often impede enforcement efforts. These enforcement challenges can ultimately hinder the achievement of equitable, climate-resilient water and sanitation systems.

continue while the litigation is ongoing. Additionally, for enforcement actions that go to court, the DOJ and the EPA must work together to manage each case. While they often have similar goals, this additional bureaucratic complication adds more time to each enforcement action.

In all, bureaucratic, fiscal, and political challenges can often impede enforcement efforts. These limitations can undermine the enforceability of the law as repeat violators take advantage of the government's challenges. These enforcement challenges can ultimately hinder the achievement of equitable, climate-resilient water and sanitation systems. Insufficient accountability for polluters and underperforming water and wastewater utilities disproportionately harm frontline communities who are already facing the brunt of climate change impacts.

8.4 CRITERION 4: EMPOWERING THE PUBLIC TO ENFORCE THE LAW

The law creates opportunities for the public to enforce implementation of and compliance with the law.

The public plays an essential role in ensuring that the law is being appropriately implemented and enforced. The law typically directs the government to take or refrain from specific actions, including adopting certain regulations. However, the law can also permit citizens to take legal action to enforce the law when governments are unwilling or unable to fulfill their legal responsibilities. For citizen enforcement to be viable to protect against climate change, the law must contain two components: first, there must be a legal obligation on someone to anticipate and manage climate change impacts on water and wastewater infrastructure and services, as discussed above; and, second, the public must have the right under the law to bring a lawsuit to enforce the law. These citizen suits are a feature of the regulatory environment, seeking to enhance enforcement overall: "citizen suits [. . .] operate as Congress intended — to both spur and supplement government enforcement actions" (S. Rep. No. 50, 99th Cong., 1st Sess. 28 (1985)). Citizen suits create an important and potentially active role for the public to play in ensuring the implementation and enforcement of the law.

Citizen suits create an important and potentially active role for the public to play in ensuring the implementation and enforcement of the law.

Water laws have specifically embraced this right. Citizen suits are explicitly authorized under the CWA and SDWA. Under the CWA, a citizen can bring a civil action against a person or government body, including the US and any other governmental agency violating the law or an order issued by an administrator or a state (3 USC §1365(a)). A person can also bring a civil action against the EPA Administrator when they are not fulfilling their nondiscretionary obligations as stated in law (3 USC §1365(a)). Similarly worded provisions are included in the SDWA (42 USC § 300j-8). This authority has been used by membership-based nonprofits to implement and enforce the law. For example, the Natural Resources Defense Council used civil suits to ensure that the EPA created a permit structure for stormwater discharges and developed regulations for stormwater runoff as required by the CWA.[76] Citizen suits play an important role in clarifying how the law is interpreted and applied and in ensuring it is implemented and enforced as expected by Congress.

While citizen suits are expressly permitted by the CWA and SDWA, state laws do not automatically allow citizen suits. Because state and federal laws are not carbon copies and do not change in parallel, having distinct citizen suit rights under both federal and state law is important. State laws cannot be less protective than federal law, but they can be more protective. If federal law retreats or is modified, the scope of citizen suits under federal law retreats as well. As a result, having state citizen suit provisions can help ensure the fullest protection of the law, regardless of political shifts.

As an example, in May 2023, the US Supreme Court issued its decision in *Sackett v. EPA*, which removed certain streams and wetlands from federal CWA protection. As the scope of federal protections for certain waterways were reduced, so did the legal basis for future potential citizen suits. Even though Maryland's law still protected the exact same waterways, because Maryland's law did not have a citizen suit provision at that time, there was no recourse left for citizens to enforce these rules. In April 2024, the Maryland state legislature adopted the Clean Water Justice Act, which established a citizen suit provision that allowed enforcement of Maryland's legal protections for water quality, helping to protect drinking water sources as well.[77] As a result, as federal law removed streams and waterways from protection, eliminating citizen's rights to sue to protect them, Maryland allowed communities to sue to enforce identical protections for the same streams and wetlands under state law.

Unfortunately, not all states allow communities and citizens to sue to enforce the law. Maryland is one of only 26 states that has given citizens some degree of authority to enforce state environmental laws, and the scope of that authority varies (May 2004). In about half of the United States, when federal law retreats and the government chooses not to enforce the law, people are left without any real power under the law to ensure their water and environment are clean. This is a failure of enforcement.

As climate change continues to intensify both longstanding and emerging challenges to infrastructure and water quality and quantity, empowering the public to enforce environmental laws is increasingly essential to securing equitable and climate-resilient access to water and sanitation.

8.5 CRITERION 5: CLIMATE CHANGE CONSIDERATIONS IN PERMIT ISSUANCE

Permits explicitly anticipate and address climate change impacts and do not undermine compliance and environmental protection.

While the CWA was drafted to return the waters of the United States to their pristine state, there was an understanding that water played an exceptionally important role in removing waste. As a result, the law included a permitting power that allowed specifically designated polluters to use the waters of the US to lawfully pollute. Beyond this example, permits generally define what compliance is for drinking water and wastewater utilities. Permits define enforceable standards — such as effluent or treatment standards — and the requirements for monitoring and reporting for each individual wastewater and drinking water utility. These permits are inherently derived from the standards established in regulations implementing the CWA and SDWA. The permits, therefore, define the criteria for compliance for these individual systems, making them critical tools in the enforcement process.

Permits could incorporate criteria specific to improving climate resilience as a condition of continued operations. This approach has already been put into practice. In March 2023, EPA Region 1 issued three NPDES permits to wastewater and stormwater utilities in Massachusetts that required these utilities to develop climate adaptation plans as part of the permitting process. This command gave these utilities impetus to assess how climate change may impact their infrastructure and services, as well as identify actions they could take to reduce those impacts.[78] This was the first time a requirement of this nature had been included in NPDES permitting.[79]

Permits could incorporate criteria specific to improving climate resilience as a condition of continued operations.

In the Massachusetts NPDES permits, there were three components of climate adaptation plans. First, the permittee was required to identify critical assets and related operations with the wastewater treatment system that were most vulnerable to major storm and flood events under baseline and future conditions (US EPA 2023c).[80] Second, the permittee was required to develop an assessment of adaptive measures that minimize the impacts of future conditions on the critical assets and related operations of the wastewater treatment system and/or sewer system. Third, the permittee was required to submit to the EPA a proposed schedule for implementation and maintenance of adaptive measures, summarizing the broad types of significant risks and the adaptive measures taken or planned to minimize those risks. These new requirements received some pushback, which the EPA addressed. In response to comments challenging the appropriateness of including the adaptation plan as part of the permitting process, the EPA described the need for wastewater treatment plants to be better prepared to face more frequent severe storms and flood events. The EPA identified several examples where wastewater treatment plants had endured infrastructure damage and service interruptions as a result of storm events, while also identifying other examples where wastewater treatment plants had taken steps to anticipate and manage those impacts (US EPA 2023b). The EPA further stated that the adaptation plan permit conditions were necessary to achieve the overarching goal of the CWA to restore and protect the chemical, physical,

and biological integrity of the nation's waters. In its justification, the EPA noted that this was a natural evolution, designed to ensure that permits are always followed:

> The Adaptation Plan requirements are an iterative update to EPA's standard O&M permit provisions and intend to address serious and increasingly prevalent threats to Permittees' compliance with permit effluent limitations . . . [M]ajor storm and flood events can gravely impact discharges from WWTSs [Wastewater Treatment Systems] and thus water quality. That is, plant and/or sewer system failure due to storms, increased precipitation/floods, storm surge, and sea level rise can and do lead to bypasses, upsets, and violations of some or all of the permit limits, including water quality-based limits and limits based on secondary treatment standards. The Adaptation Plan is designed to reduce and/or eliminate noncompliant discharges that result from impacts of major storm or flood events through advanced planning and adaptation measures and is authorized by both EPA regulations and the CWA [. . .] In other words, the Permittee cannot satisfy its obligation to operate properly "at all times" if it cannot do so during and after major storms or flooding events (US EPA 2023b).

Through these permits and the companion guidance document on developing adaptation plans (US EPA 2025e), the EPA makes clear that compliance with the law should be expected even during severe storms and floods. If climate change impacts are not anticipated and managed from the outset, then the permittees are not fulfilling their obligations under the law. In this case, the EPA made the decision that the law should be followed at all times, not just when it is easy or convenient. While adding these requirements may be costly for utilities, as noted above, research suggests that proactive adaptation to climate change will be less costly than fixing and replacing infrastructure damaged by major climate disasters (US Chamber of Commerce, Allstate, and US Chamber of Commerce Foundation 2024).

Research suggests that proactive adaptation to climate change will be less costly than fixing and replacing infrastructure damaged by major climate disasters.

Permitting proactively, with climate change in mind, requires a holistic process. For example, the US Army Corps of Engineers (USACE) issued a dredge and fill permit for Denver Water that allowed them to expand the Gross Reservoir and dam to increase water storage in preparation for reduced water availability (Thakore 2024). The expansion was intended to collect 77,000 more acre-feet of water, 72,000 of which would be for customer use (Denver Water 2025). As reported by Denver Water, the additional water was expected to come from winter and spring runoff during high runoff months in May, June, and July. While several environmental groups challenged the issuance of the permit by filing a lawsuit in 2018, Denver Water continued with construction of the dam expansion. Six years after the suit was filed, the US District Court of Colorado ruled that USACE violated the CWA and the National Environmental Policy Act when it issued the permit to Denver Water. First, the judge found that USACE did not consider viable alternatives that would have had less impact on the environment and wetlands. The judge also concluded that USACE did not consider the possibility of there being no extra water to impound, which would make the project pointless.[81] The judge wrote:

> Incredibly, the Corps even recognized that climate change's impact on hydrology might render the Proposed Action ineffective enough to warrant the need for "additional replacement sources [of water] to ensure an adequate supply." Yet, despite acknowledging that future climate conditions might neuter the Gross Dam's value as a water storage solution, [USACE] expressly declined to attempt to quantify the impacts of climate change — or even provide an educated guess, for purposes of discussion. This proves fatal to [USACE's] [. . .] finding because, if the Gross Reservoir has no extra water to impound, or that water is lost to the sun or flora, the Proposed Action cannot possibly be practicable in a logistical sense.

While Denver Water was trying to increase its water supply to prepare for future droughts, the court determined the benefits were potentially illusory, based on the project's own environmental studies. However, the law did not prevent the project from continuing, and the project was a *fait accompli* despite the court's ruling. In this case, while climate changes were considered in the permitting process, here the regulator (USACE) weighed the potential climate resilience benefits of the project too heavily and the potential resilience challenges too lightly. This is a cautionary tale of how flawed enforcement procedures can result in flawed outcomes.

Permitting is the first line of enforcing the law. Permits set out the responsibilities of polluters and the conditions of allowing them to operate. In many ways this serves as a contract between the government and the permittee. If the contract's terms are fulfilled, then the utility can operate without impediment. If the contract's terms are breached, the government will enforce the law and impose consequences. Proactive permitting for climate resilience recognizes that adaptation is necessary for this contract to be followable. Approving permits with requirements that are not realistically achievable puts both permit holders and their surrounding communities at risk of noncompliance.

8.6 SUMMARY

Laws designed to minimize climate disruptions in the water sector are only as effective as their enforcement mechanisms. Legal frameworks establish not only standards for drinking water and wastewater management but also the consequences for noncompliance, which serve as crucial deterrents. Federal and state agencies like the EPA have discretion in deciding when and how to enforce these laws, often considering fairness, community capacity, and potential climate impacts. Enforcement actions may include penalties, required system upgrades, or alternatives such as Supplemental Environmental Projects, which can support compliance without placing undue financial burden on low-resourced communities. In some cases, laws allow utilities struggling with compliance to pursue solutions like regionalization.

Effective enforcement also hinges on the availability of robust tools and legal avenues for both agencies and the public. Federal policies, such as the EPA's General Enforcement Policy, guide penalty decisions, while courts often determine the severity of fines within set limits. Additionally, state-level variations in enforcement standards can influence compliance incentives across the country. Importantly, many laws include provisions that allow citizens to take legal action when government enforcement falls short, empowering communities to uphold environmental protections. Moreover, the permitting process itself can require utilities to proactively address climate risks — such as through climate adaptation plans — which ensures that compliance strategies are forward-looking and resilient in the face of climate change.

9. Conclusion

The analysis in this report confirms a simple but powerful truth: without an explicit, enforceable legal foundation, the US will struggle to deliver safe, reliable water and sanitation to every community as the climate warms and weather extremes intensify. We reviewed hundreds of federal, state, and local statutes and distilled them into six core attributes — siting, design, and construction requirements; protection of household water use during climate disruptions; climate-resilience planning; water and climate data collection, monitoring, and reporting; equitable funding; and enforcement — that together define an enabling environment for equitable, climate-resilient water and sanitation infrastructure and services. We identified 19 actionable law and policy criteria and more than 60 strategies that can be used to operationalize each attribute, demonstrating that workable language already exists in some jurisdictions and can be adapted elsewhere (see the Appendix for a table with all identified criteria and strategies).

The analysis in this report confirms a simple but powerful truth: without an explicit, enforceable legal foundation, the US will struggle to deliver safe, reliable water and sanitation to every community as the climate warms and weather extremes intensify.

The 19 criteria catalogued herein should not be construed as a uniform model code, but rather as a diagnostic checklist. Policymakers may employ it to benchmark existing statutes, regulators can integrate the criteria into guidance and permitting, utilities may use it to align capital plans, and communities and their supporters can use the criteria to drive change and improve the climate resilience of the laws governing their water and sanitation systems.

Our review also identified three areas where there remain critical gaps developing laws and policies that support equitable, climate-resilient water and sanitation.

- **Decentralized and onsite systems.** While most US households are served by centralized water and wastewater systems, millions who rely on decentralized and onsite systems are typically less protected legally from climate impacts.
- **Integration of climate science.** Many statutes still rely on historic understanding of climate patterns, and methods for regularly updating design storms (i.e., the intensity and/or frequency of a storm event to which infrastructure systems are designed to withstand), flood maps, and water rights require new laws and policies at all levels of government.

- **Effectiveness of enforcement.** New quantitative studies linking specific enforcement tools to improved climate outcomes for water systems are needed.

Addressing these gaps will require collaboration among legal scholars, policymakers, water resource managers, scientists, utilities, Tribal governments, and community organizers.

Water is life, and the obligation to secure it for current and future generations is, at its root, a matter of justice. Climate change is already testing the physical limits of the US's water and sanitation infrastructure along with the limits of the legal and policy frameworks that guide this infrastructure. The attributes set forth in this report demonstrate that the law — when well crafted, resourced, and enforced — can help create more equitable, climate-resilient water and sanitation for frontline communities.

Appendix: Table of Criteria and Strategies for Laws and Policies that Help Achieve Equitable, Climate-Resilient Water and Sanitation

TABLE A1. Criteria for Laws and Policies that Help Achieve Equitable, Climate-Resilient Water and Sanitation

CRITERIA[1]	LAW AND POLICY STRATEGIES
Siting, Design, and Construction Requirements Address Climate Change	
(3.1) Codes and standards require water and sanitation structures and equipment to be elevated and/or protected from flooding, wildfire, and other climate disasters.	State and local laws can require that building codes use the best available science to account for the impacts of climate change on climate risks.
	State and local governments can adopt standards that are more stringent than those currently offered by federal agencies.
	State or local laws governing the post-disaster rehabilitation or rebuilding of water and wastewater infrastructure can incorporate future climate risks.
(3.2) State law requires drinking water utilities to have adequate storage capacity or be physically connected to at least one backup or alternative source of water supplies.	State laws can be created to enable interties (physical, pipped connections) with neighboring water utilities or update existing laws that may inhibit interties.
	State laws can create incentives or guidance for water utilities to have more than one water source or sufficient backup storage.
	States can create policies that require augmentation plans.
	States can facilitate water availability for domestic supplies during droughts by authorizing rainwater harvesting for domestic use or allowing temporary reallocation of water rights.

CRITERIA[1]	LAW AND POLICY STRATEGIES
(3.3) Water efficiency is incorporated into building codes for new construction and retrofits.	States and local jurisdictions can adopt laws that require building and plumbing codes to incorporate higher water efficiency standards than exist at the federal level into new construction.
	State or local laws can require inefficient fixtures or appliances to be replaced upon sale or change of ownership of a property.
	State or local laws can ban nonfunctional turf or set requirements for installing water-efficient landscapes and irrigation systems in new and retrofitted properties.
Water Uses in Frontline Communities during Climate Disruptions Are Legally Protected	
(4.1) Water laws allow for flexibility in the allocation of water during times of water scarcity.	State or regional water managers can be given the ability to temporarily alter water allocations and priorities to ensure water remains available for drinking and sanitation during times of drought and scarcity.
	States can define and regulate wasteful or unreasonable uses of water, particularly during times of drought or scarcity.
	States can make water use permits time-limited so that permit holders must periodically renew their license, during which the water management agency can re-evaluate the water use in the context of changes in the hydrologic system, ideally including the most up to date projections of climate change.
	States can add flexibility and allow for the redistribution of water use allocations during drought by creating laws that allow for water shortage sharing agreements.
(4.2) The law protects and prioritizes household water use during times of water scarcity.	States can make laws that prioritize water for household purposes by prioritizing municipal water use, even if the municipal water use has more junior rights than other uses.
	Laws can create the ability for state or regional water managers to temporarily give preference to water rights for human consumption during officially declared droughts.
	States can adopt water laws to support rainwater harvesting for domestic use that do not require water rights.
	States can adapt laws to allow for temporary transfers of water rights to domestic or municipal users during times of drought.
	States can make laws that protect household water use by having more relaxed water permitting requirements for domestic use relative to other forms of use.
(4.3) The law explicitly requires the impacts of climate change to be considered when administering water rights.	States can adopt laws that require climate change to be one of the factors considered when renewing or issuing a new water right or water use permit.

CRITERIA[1]	LAW AND POLICY STRATEGIES
(4.4) Federal, state, and local laws recognize the human right to water and sanitation.	The federal government can amend the US Constitution and/or codify the human rights to water and sanitation in federal law.
	States can codify the human right to water and sanitation through state constitutional amendments or state legislation.
	Local governments can enact laws or adopt amendments to municipal charters that recognize the human right to water and sanitation.
	Resolutions that direct programs, funding, and other resources to communities in need can support the realization of the human right to water and sanitation, especially as climate change threatens the reliability of drinking water and wastewater infrastructure and drinking water sources.
Climate Resilience Is Required in Planning	
(5.1) The law requires water and wastewater utilities or government agencies to conduct climate risk and vulnerability assessments, including mapping of critical infrastructure and service areas.	Federal laws can require states and Tribes to create and submit hazard mitigation plans and integrate climate considerations into related hazard mitigation assistance programs.
	Federal laws can require water utilities serving more than 3,300 people to conduct risk and resilience assessments (RRAs) that evaluate the risk of different (climate) hazards on water utility infrastructure and operations and maintenance.
	State and local laws can require local-level risk and resilience assessments.
	Laws can require climate vulnerability assessments to include mapping of drinking water and wastewater infrastructure.
(5.2) The law requires states and water and wastewater utilities to adopt climate adaptation and emergency response plans to protect water and wastewater infrastructure and services.	Federal laws can require water utilities serving more than 3,300 people to develop an emergency response plan. America's Water Infrastructure Act (AWIA) requires that the plan include both emergency measures and measures that proactively reduce the impacts of floods and droughts and other natural hazards on the ability of the utility to provide drinking water.
	State laws can require or encourage state agencies and local governments to conduct climate adaptation assessments and create climate adaptation plans. In California, state law requires city or county governments to adopt a general plan that addresses climate change impacts to critical infrastructure, like water and sanitation.
	State laws can encourage or require utilities to implement climate adaptation strategies, such as water conservation. In California for example, state law required urban water suppliers to develop urban water use targets that resulted in a 20% reduction in water use by 2020 compared to baseline daily per capita water use.
	States can pass laws that create state-level positions, offices, or taskforces dedicated to coordinating climate adaptation and emergency response activities.

CRITERIA[1]	LAW AND POLICY STRATEGIES
Water and Climate Data Collection, Monitoring, and Reporting Are Required	
(6.1) The law requires the collection and reporting to the public of relevant, credible climate and water data and information.	Laws can require information to be provided to the public about the quality of drinking water and wastewater services and their compliance with health-based standards. These reports, however, rarely include information on how climate change is affecting service delivery, which makes it more challenging to plan for and respond to those impacts.
	Federal laws can create opportunities for oversight of critical functions of water and wastewater infrastructure and services that are susceptible to climate impacts, as have been done in the Safe Drinking Water Act (SDWA) and Clean Water Act (CWA).
	Laws can require public notices of higher risk drinking water and wastewater violations so that the public can take measures to protect themselves.
	Laws can require studies and assessments to be conducted through which data and information are collected and evaluated to inform recommendations for future action related to climate risks.
(6.2) The law facilitates the participation and engagement of the public in decision making about water-related climate adaptations.	The law can require publication of data and information related to climate risks to water or wastewater infrastructure or services online to facilitate public access to information.
	The law can require administrative agencies to offer the public the opportunity to provide feedback on draft regulations and guidance they issue. Diverse types of public engagement, including written comments and listening sessions, may ensure that more members of the public can provide feedback.
	The law can mandate consultation processes with historically marginalized groups such as Tribal Nations. For example, the US Global Change Research Act (1990) mandated an Indigenous consultation process as part of the National Climate Assessment.

CRITERIA[1]	LAW AND POLICY STRATEGIES
Laws Govern Equitable Distribution of Climate-Resilient Infrastructure Funding	
(7.1) Laws appropriate funding and create loan programs to enable climate-resilient access to water and wastewater services and to create and extend water and wastewater infrastructure to communities that currently lack access.	Federal lawmakers can pass laws, such as America's Water Infrastructure Act of 2018, the Clean Water Act, and the Safe Drinking Water Act, to create funding mechanisms and appropriate funding for specific types of projects that help water and wastewater utilities to provide safer, more resilient services.
	Federal and state legislatures can appropriate funding or provide supplemental funding for climate-resilient water and sanitation using laws.
	Federal lawmakers can create mechanisms that make climate disaster funding easier to access, such as by appropriating disaster relief through State Revolving Funds (SRFs).
	Lawmakers and government agencies can create laws and policies to more equitably distribute climate resilience funding.
	SRF intended use plans (IUPs) can prioritize funding for improving the climate resilience of water and wastewater infrastructure.
	State laws can authorize state governments to issue bonds to fund projects that help water and wastewater systems adapt to climate change.
	Laws can include provisions to prioritize funding for frontline communities. For example, the Texas Flood Infrastructure Fund was adopted through laws that specifically require prioritization of funds for low-income communities.
(7.2) Laws create economic incentives to consider the water and climate risks of new development and ensure proactive rehabilitation and responsible redevelopment in flood-prone areas.	Federal and state lawmakers can pass laws that restrict the use of government funding from supporting development in certain flood-prone areas. For example, the Coastal Barrier Resources Act of 1982 restricted the use of Federal funding in coastal barriers.
	Federal lawmakers can encourage state and county governments to adopt more climate-resilient land-use practices by making federal flood insurance contingent on implementing and enforcing these practices.
	Federal law can incentivize states and Tribes to take proactive steps to improve disaster readiness and resilience by offering a higher share of assistance for these types of activities, as has been done under the Stafford Act.
	Laws can authorize funding to buy properties from people who choose to move after repeated climate disasters.
(7.3) Laws can mandate the tracking and reporting of climate disaster relief funding.	Federal law can require governments to track funding obligations and expenditures to provide greater transparency on disaster assistance and preparedness.
	Laws can require nonfunding agencies, like the Government Accountability Office, to review and report on government funding expenditures.

CRITERIA[1]	LAW AND POLICY STRATEGIES
Laws to Minimize Climate Disruptions to Water and Sanitation Access Are Enforceable and Enforced	
(8.1) The law establishes consequences for noncompliance with drinking water and wastewater standards that protect public health, water quality, and the environment and considers the equity and fairness of those consequences.	Laws can establish penalties for noncompliance with regulations and determine who is responsible for enforcing specific regulations.
	Enforcement action settlement can require that utilities that fail to comply with regulations make specific updates to their systems on a certain timeline.
	The SDWA allows for water systems that are struggling to comply to explore consolidation or regionalization to address water quality issues.
	Monetary fines as consequences can create an additional burden on less well-resourced communities and their ability to come into compliance. Alternative penalties — like Supplemental Environmental Projects — can better support compliance.
(8.2) The law establishes enforcement tools that sufficiently deter behaviors that violate the law and increase the risks of climate disruptions to water and wastewater service.	Federal laws can set priorities for how agencies determine enforcement penalties. For example, the EPA's General Enforcement Policy (1984) identifies three enforcement priorities that guide the agency in setting penalties for EPA regulations.
	Laws can set the maximum fine allowed but still allow courts to decide the level of penalty under that maximum. For example, the CWA identifies factors for the court to consider when calculating penalties under the law.
	States may adopt different maximum financial penalties for noncompliance with the CWA and SDWA, creating different incentives across the US for complying with the same laws.
	Government agencies can set policy that directs enforcement departments to incorporate climate change into their enforcement efforts. EPA policy provided guidance to its enforcement arm to consider climate change in its efforts to bring violators into compliance with the SDWA and CWA.
(8.3) Enforcement actions are taken by governmental bodies responsible for implementing and enforcing the law.	State and federal enforcement agencies can choose to enforce existing laws. While compliance with the law is mandatory, enforcement is discretionary.
(8.4) The law creates opportunities for the public to enforce implementation of and compliance with the law.	Because federal laws allow it, citizens can bring lawsuits to enforce the CWA and SDWA against the government and other actors.
	State laws can allow citizens to bring lawsuits to enforce environmental laws. Approximately half of states have these laws. Citizen suit provisions are particularly important in states that have broader waterbody protections than covered by a post-Sackett Clean Water Act.
(8.5) Permits explicitly anticipate and address climate change impacts and do not undermine compliance and environmental protection.	EPA Regions can issue National Pollution Discharge Elimination System (NPDES) permits to wastewater utilities that require the utilities to develop climate adaptation plans as part of the permitting process.

Note: 1. Criteria are numbered according to the section where they appear in the report.

Endnotes

1 Public water systems are defined by the Safe Drinking Water Act as "a system for the provision of public water for human consumption through pipes or other constructed conveyances, if such serves at least twenty-five individuals" for at least 60 days per year (42 USC 300f; 40 CFR 141.2).

2 The authors did not perform a review of Tribal laws for this report. More work is needed to evaluate Tribal laws and policies for their ability to support equitable, climate-resilient water and sanitation.

3 Water and wastewater utilities are here considered any entity, publicly or privately owned and operated, that provides drinking water or wastewater services to customers.

4 The California Water Code (CWC), used by Feinstein et al. (2017), defines a disadvantaged community as "a community with an annual median household income that is less than 80% of the statewide annual median household income (CWC 79505.5a).

5 The International Code Council is a US-based nonprofit that develops model building codes and standards used by local, state, and federal governments around the world to improve building safety. See codes.iccsafe.org for more information.

6 The wildland-urban interface is the zone where human development ends and transitions into wildland.

7 The term "100-year flood" has also been used by federal, state, and local governments to mean base flood; however, 100-year flood is often misinterpreted to mean "once every 100 years," which is incorrect (Association of State Floodplain Managers 2020). The base flood is a statement of probability of occurrence in any given year.

8 FEMA's Risk Rating 2.0 resources were removed from the agency's website sometime prior to the publication of this report. An archived version of this cited factsheet can be found at: https://web.archive.org/web/20230822125717/https://agents.floodsmart.gov/sites/default/files/fema-Risk-Rating-2.0-Fact-Sheet-2022.pdf

9 Adler and Scata (2019) point out that the NFIP's substantial improvement/damage standard is only triggered when damages or repairs equal or exceed 50% of a structure's fair market value and that regulatory definitions do not consider repetitive cumulative damage or repairs over time. They argue that reforming this standard to include these considerations would strengthen the NFIP's benefits for climate resilience, reduce taxpayer burden, and improve community safety. States can support these reforms through model flood ordinances, building codes, other regulations and guidance. While the authors proposed model ordinance language for state or local adoption, they acknowledge potential challenges related to tracking, financing, and equity and offer ways to address them.

10 As noted in Section 2 of this report, many federal laws, policies, programs, and funding were being actively rescinded, removed, or redesigned by order of the White House in 2025. As such, the fate of some federal agencies, including FEMA, is uncertain. The administration initially called for the elimination of FEMA. However, attention seems to have been refocused on restructuring and limiting the role of FEMA (Hersher 2025; Sy and Norris 2025).

11 For example, in Kansas v. Colorado, 514 U.S. 673 (1995), the Supreme Court held that Colorado had violated the Arkansas River Compact's anti-depletion clause by drilling new irrigation wells that materially depleted the water that would have otherwise been available for use by Kansas. Despite no explicit mention to groundwater in the compact, the Supreme Court interpreted the compact as applying to surface waters and hydrologically connected groundwater. The Supreme Court is interpreting interstate water compacts as they apply to groundwater in current cases before the court, including *Texas v. New Mexico*, 592 U.S. (2020) and *Nebraska v. Colorado*, No. 220161 (U.S. filed July 16, 2025).

12 Public water system is defined in the SDWA as 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.

13 Consolidation between two or more water systems is when the systems create a shared governance structure, which can range from more informal partnerships to full, legal transfers of ownership (Landes et al. 2020).

14 As of July 2025, the future of the WaterSense program is uncertain due to major changes in federal policy brought about by the new administration.

15 The definitions used for water conservation and efficiency are based on (Gleick, et al. 2003) where conservation was defined as any action or technology that increases the productivity of water use. Water efficiency was defined reducing the amount of water needed for achieving a goal while still accomplishing that goal.

16 The following states have water laws that follow the prior appropriation doctrine, in part or in full: Washington, Oregon, California, Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, New Mexico, Alaska, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas (Waters and Spitzig 2018).

17 We focus on voluntary changes to water allocations in the western US because larger, mandatory reallocations may trigger claims of a taking under the takings clause of the 5th Amendment of the US Constitution. However, whether water rights in California are considered property rights is debated and has not been clearly determined by a court (Jacobs 2015). Some additional options for reallocating water rights without triggering a takings claim may include applying the doctrine of necessity, nuisance, or the public trust doctrine. An additional challenge in the western US is the role of water project contracts. The Bureau of Reclamation holds the water rights and contracts for water delivery where they construct irrigation and water projects. Therefore, water delivery is subject to the terms of the contract rather than rules of prior appropriation, and those contracts often "provide that there are no delivery obligations if water is not available" (Craig 2025a).

18 The USGS defines public supply as "water withdrawn by public and private water suppliers that furnish water to at least 25 people or have a minimum of 15 connections."

19 Though this percentage varies a lot throughout the US.

20 The Kentucky 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.

21 In Kentucky, "[a]ny owner of land contiguous to public water shall at all times have the right to use 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).

22 According to (Craig, Adler, and Hall 2017) there are four ways water rights can "arise:" through 1) ownership of property along a river, a lake, or overlying an aquifer, 2) the actual taking and use of water, 3) completion of a state permitting process, or 4) completion of a water right adjudication or other court process. This report addresses incorporating climate change into the third and fourth processes.

23 The US Climate Resilience Toolkit explains that climate risk assessments focus on identifying the magnitude of the hazard and estimating the likelihood for impacts from the hazard on different "assets," which can include groups of people and infrastructure. It explains that climate vulnerability assessments analyze who or what is most at risk considering exposure, sensitivity, and adaptive capacity. For more information, see the US Climate Resilience Toolkit: https://toolkit.climate.gov/assess-vulnerability-and-risk.

24 Risk and resilience assessments evaluate the vulnerabilities, threats and consequences from potential hazards. Under the AWIA, they include natural hazards and malevolent acts (i.e., all hazards), resilience of water facility infrastructure (including pipes, physical barriers, water sources and collection, treatment, storages and distribution, and electronic, computer and other automated systems), monitoring practices, financial systems (e.g., billing systems), chemical storage and handling, and operation and maintenance (US EPA 2019b).

25 A natural hazard is defined as a "natural event that threatens the functioning of a community water system, including an earthquake, tornado, flood, hurricane, wildfire, and hydrologic changes" 42 U.S.C. § 300i-2(h)(2). Climate change is drastically altering the intensity, frequency, and geographic extent of many of these hazards.

26 Because of the lack of data, other stakeholders developed a map of service area boundaries for drinking water systems. The map was developed by the Environmental Policy Innovation Center in partnership with other nonprofit, industry, and government partners and is available at https://www.policyinnovation.org/technology/water-utility-service-area-boundaries.

27 An environmental justice area in Massachusetts is any neighborhood meeting one or more criteria such as low household income (≤65% of the state median), a high percentage of minority residents (≥40%), limited English proficiency (≥25% of households), or a combination of ≥25% minority population with moderate municipal income (≤150% of the state median) (Commonwealth of Massachusetts 2025).

28 The other elements include: 1) land use, 2) circulation, 3) housing, 4) conservation for the conservation, development and utilization of natural resources including water, 5) open space, and 6) noise.

29 Local hazard mitigation plans are adopted in accordance with the federal Disaster Mitigation Act of 2000 (P.L. 106-390).

30 The Executive Order was followed by several bills that support the initiatives set forth in the Executive Order, such as AB 1482 (which requires the Natural Resources Agency to update the state's climate adaptation strategy every three years and to include the vulnerabilities to climate change by sector and priority actions needed to reduce risks in those sectors) and AB 2800 (requiring state agencies to "take into account the current and future impacts of climate change when planning, designing, building, operating, maintaining and investing in state infrastructure.") (California AB 1482 (2015) and AB 2800 (2016)).

31 Misinformation can be defined as "unintentionally published inaccurate or misleading information" (College of Staten Island Library 2025).

32 Disinformation can be defined as "deliberately fabricated or manipulated information" (College of Staten Island Library 2025).

33 Maximum contaminant levels (MCLs) are the highest level of a contaminant that is allowed in drinking water (42 USC § 300f(3)). It is an enforceable standard.

34 An action level is the concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow. Action levels are established by federal law for lead and copper (40 CFR § 141.80 et seq.).

35 Amendments to the SDWA in 1996 required the development and maintenance of an occurrence database (42 USC Section 300j-4). The law requires specific information to be included about regulated contaminants and unregulated contaminants. Furthermore, the law states that "information from the database shall be available to the public in readily accessible form" (42 USC Section 300j-4((g)(5). The National Contaminant Occurrence Database is available here https://www.epa.gov/sdwa/national-contaminant-occurrence-database-ncod.

36 PFAS are a class of chemicals used to make products resist heat and stains, repel water, and reduce friction. These chemicals are used in everyday products like cook pans, furniture, and cosmetics, and persist indefinitely in the environment. They have also been linked to several diseases and health concerns, including testicular cancer, elevated cholesterol, decreased fertility, and thyroid problems (Kwiatkowski et al. 2020). Gander (2022) has identified several potential links between climate change and the contamination of surface water and groundwater with PFAS.

37 Perfluorohexane sulfonate (PFHXS), Perfluorononon anoic acid (PFNA), Hexafluoropropylene oxide dimer acid (HFPO-DA)

38 The ECHO database is available at https://echo.epa.gov/.

39 A treatment technique "is an enforceable procedure or level of technological performance which public water systems must follow to ensure control of a contaminant" (US EPA 2015c).

40 An unanticipated bypass is when a wastewater treatment plant stops working unexpectedly, either partially or completely, but sewage continues to flow through plant, allowing partially treated or untreated sewage to be released into the environment.

41 Upset is defined as an "exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee" (40 CFR 122.41).

42 Combined sewer overflow describes when a sewer system that collects and transports both wastewater and stormwater is overwhelmed and therefore, allows some of the combined flow to go directly into rivers, lakes, or the ocean.

43 A sanitary sewer overflow describes when a sewer system that collects and transports only wastewater unintentionally discharges untreated or partially treated wastewater into the environment (such as into streets, basements, storm drains, or into surface water bodies).

44 Although "knowledge" is considered a singular, uncountable noun, we intentionally use the plural "knowledges" to indicate that there is no one monolithic knowledge to understand and address complex issues at the nexus of water and climate equity and that problems and solutions to address climate change require many types of knowledges from myriad disciplines and sources, including local and Indigenous knowledges.

45 Appropriations laws are adopted annually to authorize the expenditure of government funds. Continuing resolutions are used as temporary funding measures to allow government operations to continue when the regular appropriations bill has not been adopted by the start of the fiscal year. Supplemental appropriations laws are used to provide additional funding to address unforeseen circumstances or emergencies after the regular budget has been enacted. Certain mandatory laws also establish programs that automatically receive funding and do not require annual appropriations, such as Social Security, Medicaid, and Medicare.

46 This criterion was written to focus on flood-prone areas, but similar criteria could apply to areas prone to other types of climate disasters, like drought, wildfires, or hurricanes.

47 Publicly owned treatment works (POTWs) are defined in the CWA as treatment works owned by a state or municipality with any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial waste of a liquid nature. It also includes sewers, pipes, or other structures that convey wastewater to the POTW treatment plant (40 CFR § 403.3).

48 The SDWA allows funding to be withheld under certain conditions, including if the state has not obtained the authority to ensure that all new community water systems demonstrate technical, managerial, and financial capacity with respect to each national primary drinking water regulation (42 U.S.C. §300g-9(a)), that they have developed and are implementing a strategy to assist public water systems in acquiring and maintaining this capacity (42 U.S.C. §300g-9(c)), and if the states have not adopted a program for certifying operators that meet the requirements of the guidelines published by EPA (42 U.S.C. §300g-8).

49 Coastal Strom Areas are defined by a specific set of criteria and land types as described in the Pinellas County Comprehensive Plan (Pinellas County 2023).

50 Statute 33 USC § 1319 identifies the types of enforcement actions that can be brought.

51 Administrative and civil judicial penalties are typically deposited into the US Treasury's General Fund. The funds are not earmarked for water or environmental projects but instead go into the federal government's general revenue. Where the EPA has delegated enforcement authority to states and the state assesses the penalty, at the state level penalties can be directed to a state environmental fund, thereby ensuring environmentally related penalties are reinvested into environmental protection efforts. For example, the California Water Code established the State Water Pollution Cleanup and Abatement Account to provide grants for the cleanup of pollution where no responsible party is available to undertake the work and to address an "urgent drinking water need" (Cal. Wat. Code § 13442). The Fund is supported by court judgments and administrative civil penalties assessed by the State Water Resources Control Board and the Regional Water Quality Control Boards through enforcement actions under the California Water Code and Clean Water Act (Cal. Wat. Code § 13441). Allowing for administrative and civil penalties recovered by the EPA and the DOJ to be earmarked for drinking water and wastewater projects, specifically where utilities are facing increasing impacts of climate change, would support long-term compliance with the CWA and SDWA. Furthermore, more states should have environmental funds resourced by administrative and civil penalties. Those funds could also prioritize or explicitly fund projects to help drinking water and wastewater service providers anticipate and manage the impacts of climate change on their infrastructure and services.

52 CWSC Public comments to FCA Rulemaking, Comments available here: https://www.regulations.gov/comment/EPA-HQ-OW-2020-0426-0082.

53 Technically, violations of a consent decree can lead to a modified consent decree with new timelines and a new determination of financial capability.

54 Individual Intended Use Plans (IUPs) are published by the states.

55 Consolidation and regionalization can refer to a wide range of partnership and cooperation approaches between nearby water systems. According to the Regional Community Assistance Partnership, consolidation and regionalization between two or more water systems is when the systems create a shared governance structure, which can range from more informal partnerships to full, legal transfers of ownership (Landes et al. 2020).

56 Citation for Water System Restructuring Assessment Rule. CWSC Comments available at https://www.regulations.gov/comment/EPA-HQ-OW-2022-0678-0045.

57 Additional information about SEPS available at https://www.epa.gov/enforcement/supplemental-environmental-projects-seps.

58 Citing the EPA's *Civil Penalty Policy — Clean Water Violators and Stationary Source Violators of the Clean Water Act*, July 8, 1980. While SEPs were used before 1980, the EPA first discussed SEPs in its policy on determining civil penalties published in 1980. The policy on SEPs was later separated out and revised in 1998 and 2015.

59 SEPs can also include third-party payments under certain circumstances (US EPA 2015b).

60 The degree to which the SEP mitigates the amount of the penalty is within the discretion of the EPA. However, the 2015 EPA SEP Policy sets forth guidelines for calculating the final settlement penalty when an SEP has been agreed to. Special rules apply to municipalities negotiating settlement agreements. A municipality is eligible to mitigate up to 40% of the penalty for an SEP, which has been established in the CWA Penalty Policy and the national municipal litigation considerations (NMLC) (US EPA 2015b, US EPA 1995).

61 On March 12, 2020, the Assistant Attorney General issued a memorandum removing SEPs from the "suite of relief the Environment and Natural Resources Division seeks in its cases." The memorandum alleges that SEPs violate the Miscellaneous Receipts Act by converting dollars that would otherwise go to the federal government into financial benefits (i.e., projects) that benefit a third party. The memorandum also takes issue with the executive branch "funding" environmental projects that would otherwise be funded through Congressional appropriations (US Department of Justice 2020a). The Trump administration's approach was codified at 28 CFR 50.28. The claims made in the memorandum have been disputed in legal articles, including Daniel Alvarez, et al. (2024). On May 5, 2022 the Attorney General issued a memorandum reviving the ability of the DOJ to use SEPs in settlement agreements (US Department of Justice 2022). Furthermore, the Trump administration's regulations prohibiting SEPs were revoked in an interim final rule effective on May 10, 2022 (87 FR 27936). Ultimately, whether SEPs are used is up to the parties negotiating the settlement.

62 Enforcement actions can be taken against entities and individuals, including water and wastewater systems, depending on the law and the violation.

63 Criminal enforcement may be viable based on the type of violation and intent, such as for knowing conduct. While prosecutors and regulators can make the decision about what type of case to bring, the law will often dictate what penalties are available, such as a minimum and/or maximum penalty for specific types of violations. Therefore, the law establishes the menu of punishments or penalties, with prosecutors and judges making the final decision about what punishment to seek.

64 While the 1984 Policy has not been replaced, additional policies have been adopted to inform the calculation of penalties under specific statutes, such as the CWA. This includes the CWA Penalty Policy for Civil Settlement Negotiations published in 1986 (US EPA 1985).

65 For administrative penalties, a Class I civil penalty cannot exceed $10,000 per violation, up to $25,000 (33 USC § 1319(g)(2)(A)). A Class II civil penalty cannot exceed $10,000 per day for each day during which the violation is ongoing, up to $125,000 (33 USC § 1319(g)(2)(B)).

66 The court is required to consider the "seriousness of the violation or violations, the economic benefit (if any) resulting from the violation, any history of such violations, any good-faith efforts to comply with the applicable requirements, the economic impact of the penalty on the violator, and such other matters as justice may require" (33 USC § 1319(d)). While providing some perspective on what should be considered, the factors are vague and "do not specify what should be considered when analyzing each factor, how much weight to give them, or which are most important"(Anderson and Vaughan 2023).

67 The Federal Civil Penalties Inflation Adjustment Act of 1990 (28 U.S.C. § 2461) was amended by the Debt Collection Improvement Act of 1996 (31 U.S.C. §§ 3701-3718) and the Federal Civil Penalties Inflation Adjustment Act Improvements Act of 2015 (Publ. L. 114-74, § 701). Starting in 2016, with the adoption of the Inflation Adjustment Act, inflation adjustments have been required on an annual basis. The Inflation Adjustment Act also provides the formula for calculating the adjustments. A Civil Monetary Penalty Inflation Adjustment rule is adopted annually to reflect the increases to the maximum penalties allowed based on the Inflation Adjustment Act. (See 88 FR 89309; recorded at 40 CFR Part 19.) More information available at https://www.epa.gov/enforcement/enforcement-policy-guidance-publications #penalty.

68 CWA state primacy authority for NPDES discharge permit program (33 U.S.C. §1342(b)(7); also known as Section 402). CWA state primacy authority for dredge and fill program (33 U.S.C. §1344; also known as Section 404). CWA state primacy authority for water quality standards (33 U.S.C. §1313; also known as Section 303). Citation for SDWA (42 U.S.C. §§ 300f to 300j-27).

69 Anderson and Vaughan (2023) highlighted that the original proposed regulation established that states would have the same maximum and minimum penalty authority as set forth in the CWA. However, states did not respond well, and the EPA set only the minimum penalty requirement (Page 28). The EPA's interpretation of the delegation provision has been upheld by courts (Page 29).

70 An earlier edition of this report was published in 1986 and is available here. No more recent editions can be found, and no more recent surveys of this topic can be identified by the authors.

71 It is Congress's policy to preserve and protect the "primary responsibilities and rights of States to prevent, reduce, and eliminate pollution."

72 It is difficult to determine whether lower civil penalties at the state level result in water and wastewater utilities being less likely to take the steps necessary to remain in compliance with the law. Related to water resources, we have a clear example of how low penalties disincentivizes compliance. In 2022, farmers in the Shasta River Water Association defied a state drought order and drained two-thirds of the water from the river over an 8-day period. The farmers who defied the state order could only be fined a maximum of $500/day or a total of $4000 or $50 per farmer. Ultimately, the fines were too low to stop farmers from violating drought orders. Therefore, in 2024 the California state legislature adopted California Assembly Bill 460 (AB 460). AB 460 raises the cost of the fine assessed per day to $1000 per day and adds an additional financial penalty per acre foot withdrawn in violation of a regulation or order adopted by the State Water Resources Control Board. By raising the fine, the law looks to make it less economically beneficial for farmers to violate drought orders (James 2024).

73 The study examines penalties for violations under Section 301 and Section 402 of the CWA, which includes municipal wastewater treatment plant NPDES violations.

74 The memo identified examples of resilience and adaptation measures that can be incorporated, including green infrastructure projects (which are encouraged by 33 USC §1377a), infiltration reduction measures, stormwater infrastructure upgrades, and restoration of wetlands.

75 Under the CWA, facilities with a NPDES permit must submit a Discharge Monitoring Report to the EPA or the delegated state authority. The EPA is required to maintain the ECHO database and to issue a NPDES Noncompliance Report under 40 CFR 123.45. Under the SDWA, states are required to submit to the EPA annual reports of drinking water violations within their states under 42 U.S.C. 300g-3(c)(3). Maryland's Safe Drinking Water Act Annual Compliance Report for Calendar Year 2023 is available at https://mde.maryland.gov/programs/water/water_supply/ Documents/PWS/ACRs/WSP-ACR-CY2023.pdf. Furthermore, EPA is required to submit a National Water Quality Inventory to Congress biennially under Section 305(b)(2) of the Clean Water Act. The last Inventory was conducted in 2017 and is available at https://www.epa.gov/waterdata/national-water- quality-inventory-report-congress.

76 *Natural Resources Defense Council, Inc. v. Costle*, 568 F.2d 1369 (1977). *Natural Resources Defense Council, Inc. v. United States Environmental Protection Agency*, 966 F.2d 1292, 1295 (1992).

77 State of Maryland, SB 653 sponsored by Sen. Malcolm Augustine (crossfiled as HB1101, sponsored by Del. Sara Love), 2024. Available at https://mgaleg.maryland.gov/mgawebsite/Legislation/Details/SB0653?ys=2024RS.

78 Massachusetts and New Hampshire, both within EPA Region 1, do not issue NPDES permits; NPDES permits are instead issued by EPA Region 1.

79 Previously, similar requirements were considered within the required Wastewater Treatment Facility Major Storm and Flood Events Plan (US EPA 2025).

80 The same language is included within two additional permits issued at the same time: 1) NPDES Permit No. MA 0101168, Authorization to Discharge Under the National Pollutant Discharge Elimination System, Town of Palmer, Massachusetts, 2023 Final Permit (US EPA 2023a); and 2) NPDES Permit No. MA 0101800, Authorization to Discharge Under the National Pollutant Discharge Elimination System, City of Westfield, Massachusetts, 2023 Final Permit (US EPA 2023b).

81 Civil Action No. 18-cv-03258-CMA, Save the Colorado et al. v. Todd Semonite et al. and the City and County of Denver, *Order on Petition for Review of Agency Action*, filed 10/16/2024, page 20.

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