

ACTIONABLE SOLUTIONS FOR PUBLIC WATER SYSTEMS



NOVEMBER 2019

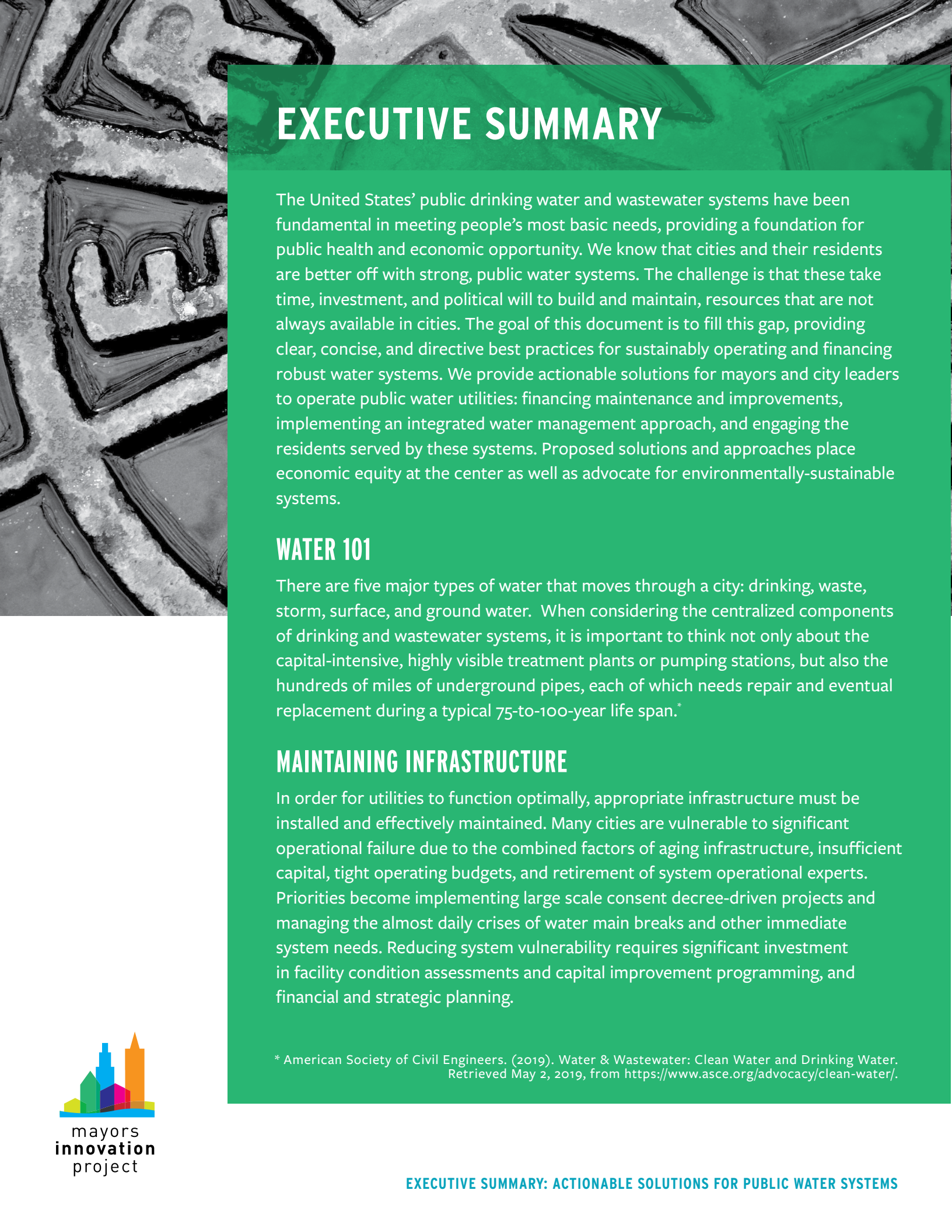
ABOUT US

The Mayors Innovation Project is a learning network among American mayors committed to “high road” policy and governance: shared prosperity, environmental sustainability, and efficient democratic government. We are a project of COWS based at the University of Wisconsin.

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The background of the page is a close-up photograph of marbled paper, showing intricate, swirling patterns in shades of grey, black, and white. A solid green rectangular area is overlaid on the right side of the page, containing the main text.

EXECUTIVE SUMMARY

The United States' public drinking water and wastewater systems have been fundamental in meeting people's most basic needs, providing a foundation for public health and economic opportunity. We know that cities and their residents are better off with strong, public water systems. The challenge is that these take time, investment, and political will to build and maintain, resources that are not always available in cities. The goal of this document is to fill this gap, providing clear, concise, and directive best practices for sustainably operating and financing robust water systems. We provide actionable solutions for mayors and city leaders to operate public water utilities: financing maintenance and improvements, implementing an integrated water management approach, and engaging the residents served by these systems. Proposed solutions and approaches place economic equity at the center as well as advocate for environmentally-sustainable systems.

WATER 101

There are five major types of water that moves through a city: drinking, waste, storm, surface, and ground water. When considering the centralized components of drinking and wastewater systems, it is important to think not only about the capital-intensive, highly visible treatment plants or pumping stations, but also the hundreds of miles of underground pipes, each of which needs repair and eventual replacement during a typical 75-to-100-year life span.*

MAINTAINING INFRASTRUCTURE

In order for utilities to function optimally, appropriate infrastructure must be installed and effectively maintained. Many cities are vulnerable to significant operational failure due to the combined factors of aging infrastructure, insufficient capital, tight operating budgets, and retirement of system operational experts. Priorities become implementing large scale consent decree-driven projects and managing the almost daily crises of water main breaks and other immediate system needs. Reducing system vulnerability requires significant investment in facility condition assessments and capital improvement programming, and financial and strategic planning.

* American Society of Civil Engineers. (2019). Water & Wastewater: Clean Water and Drinking Water. Retrieved May 2, 2019, from <https://www.asce.org/advocacy/clean-water/>.



WATER QUALITY

One of the basic functions of water utilities is to provide safe drinking water for their communities. Water utilities should aim to achieve a set of objective goals to keep watersheds healthy, regardless of the source or treatment technology. In addition to working within the utility on programming to optimize the handling and distribution of high-quality water, public water operators can collaborate with fellow municipal water providers, agencies, unions, and/or non-governmental organizations.

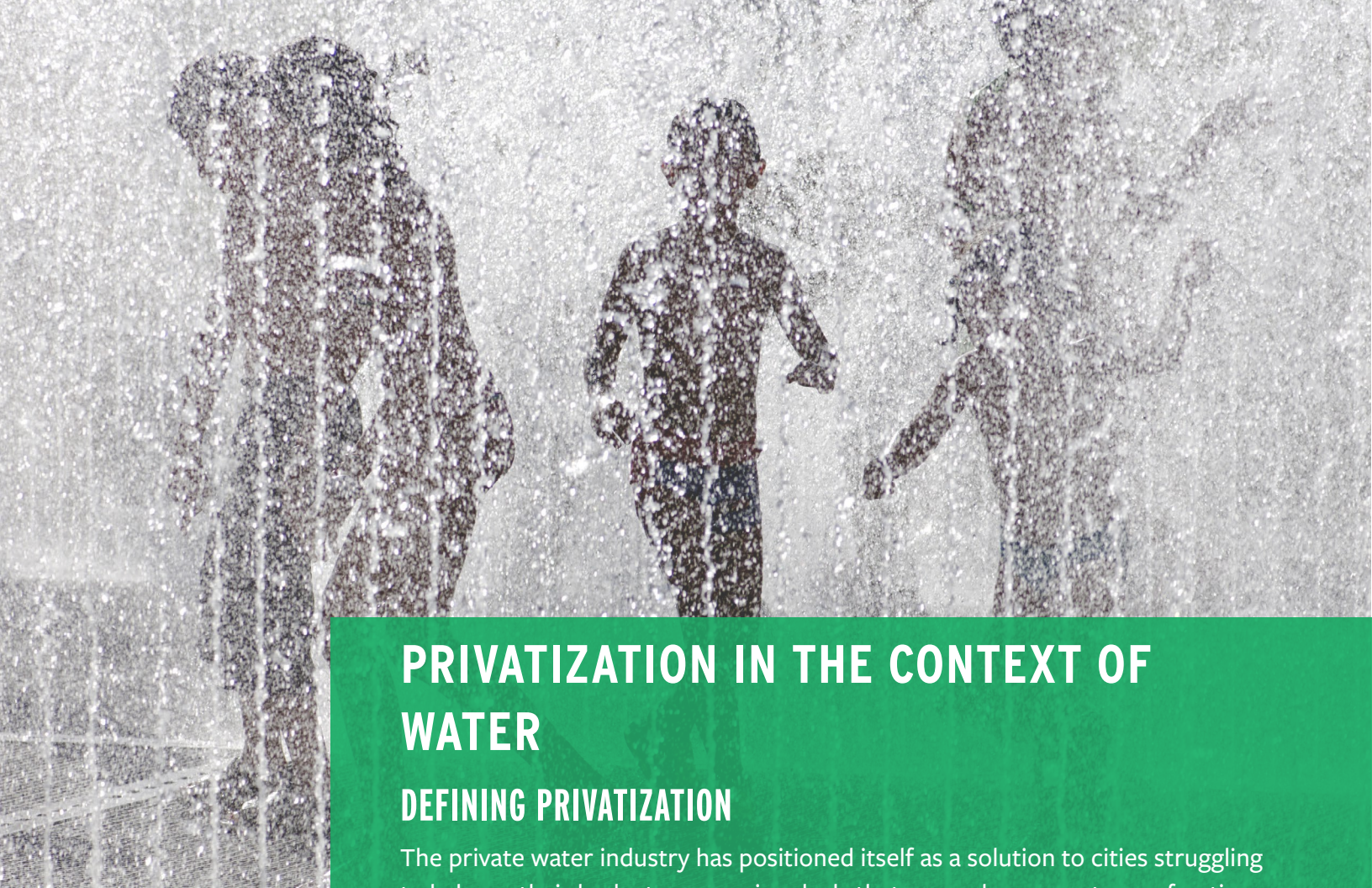
GOVERNMENT COMPLIANCE

City and water utility leaders must fully understand and implement the laws, regulations, and guidelines established by federal and state entities for all types of water systems. These safeguards are the bedrock of our cities' ability to provide safe drinking water for all people and protect the watersheds on which we all depend.

SMART SYSTEMS

Geographic Information Systems (GIS) now offer city and utility leaders a planning and management tool that would have been unthinkable only a couple of decades ago. GIS data can now be used to help utilities to organize, prioritize, and inform public projects that are taking place across the service area. The information that this software can provide, when used effectively, has enormous impacts on efficiency and cost saving at the project level, especially when paired with real-time service data provided through smart metering and the Internet of Things. To benefit, cities must have the capacity to purchase and use such smart systems, however, which might be a challenge for struggling utilities. Here too, partnerships with neighboring municipalities and academic institutions may be beneficial.





PRIVATIZATION IN THE CONTEXT OF WATER

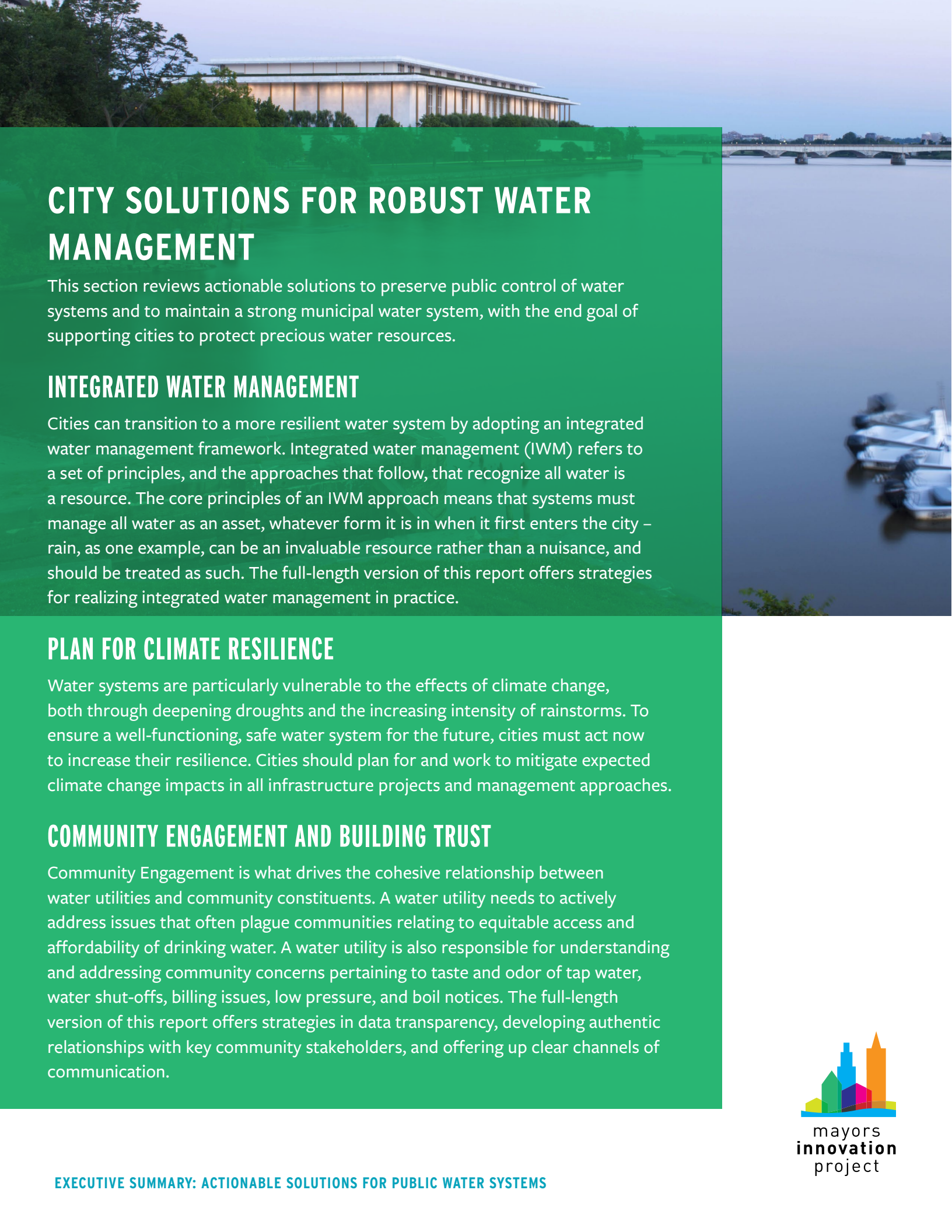
DEFINING PRIVATIZATION

The private water industry has positioned itself as a solution to cities struggling to balance their budgets, proposing deals that span a large spectrum of options. Generally speaking, the term privatization refers to the transfer of managerial and financial responsibilities of a public water utility to private water corporations.* In these arrangements, the private sector takes on a decision-making role that can directly impact system investments, water rates, and other water management policies. Privatization shifts the primary focus of running a water system from provision of service for all people to maximization of private profits.

IMPACTS OF PRIVATIZATION

Unfortunately, private water corporations cannot and do not fill the investment gap our water systems face. In many cases, deals have backfired on cities, leaving them with skyrocketing water rates, cost-cutting that jeopardizes water quality, and failing infrastructure. Rather than contract with the private water industry, there are countless cities across the country who are not only maintaining public control of their drinking and wastewater systems, but also setting the example of how to provide quality service, stable rate setting, and infrastructure improvements for consumers. Informed, strong city leadership is necessary to retain municipal control of water utilities.

* American Society of Civil Engineers. (2019). Water & Wastewater: Clean Water and Drinking Water. Retrieved May 2, 2019, from <https://www.asce.org/advocacy/clean-water/>



CITY SOLUTIONS FOR ROBUST WATER MANAGEMENT

This section reviews actionable solutions to preserve public control of water systems and to maintain a strong municipal water system, with the end goal of supporting cities to protect precious water resources.

INTEGRATED WATER MANAGEMENT

Cities can transition to a more resilient water system by adopting an integrated water management framework. Integrated water management (IWM) refers to a set of principles, and the approaches that follow, that recognize all water is a resource. The core principles of an IWM approach means that systems must manage all water as an asset, whatever form it is in when it first enters the city – rain, as one example, can be an invaluable resource rather than a nuisance, and should be treated as such. The full-length version of this report offers strategies for realizing integrated water management in practice.

PLAN FOR CLIMATE RESILIENCE

Water systems are particularly vulnerable to the effects of climate change, both through deepening droughts and the increasing intensity of rainstorms. To ensure a well-functioning, safe water system for the future, cities must act now to increase their resilience. Cities should plan for and work to mitigate expected climate change impacts in all infrastructure projects and management approaches.

COMMUNITY ENGAGEMENT AND BUILDING TRUST

Community Engagement is what drives the cohesive relationship between water utilities and community constituents. A water utility needs to actively address issues that often plague communities relating to equitable access and affordability of drinking water. A water utility is also responsible for understanding and addressing community concerns pertaining to taste and odor of tap water, water shut-offs, billing issues, low pressure, and boil notices. The full-length version of this report offers strategies in data transparency, developing authentic relationships with key community stakeholders, and offering up clear channels of communication.





FINANCING

Understanding the intricacies of water utility financing supports mayors and other leaders to be stronger advocates for safe, reliable, and equitable water service in cities. Utilities can pursue innovative mechanisms to finance projects, building on the traditional route of municipal bonds and state or federal subsidized grants and loans to also employ green bonds, environmental impact bonds, and cross-department partnerships that can access new financing streams.

In the full-length version of this report, this section covers how utilities can find efficiencies in their water systems to cut down on costs and how to plan long-term for improving financing schemes.

INCREASING REVENUE

Since the decline in federal funding for utilities, the rates paid by residents and commercial users for services are the primary revenue mechanism for most utilities. This presents significant challenges for utilities, as the decline in federal investment has increasingly meant that the full cost of operations, maintenance and capital investments must be carried by people and companies. Local leaders must understand the basics of rate-setting, especially options for rate structures and affordability considerations. The full-length version of this report offers strategies for raising rates adequately and equitably, structuring rates to promote affordability and conservation, how to roll out impact fees, and the many financing tools utilities might consider leveraging.

WORKFORCE DEVELOPMENT AND GOVERNANCE

Adequately staffing a water utility is crucial to its capacity to function effectively. Staffing includes those employed by the utility in both permanent and contract positions, across blue collar, management, and consulting roles. This section explores strategies related to building workforce capacity and improving workplace culture to create water utilities that function better from the inside out.



GETTING STARTED

- ✓ Implement Integrated Water Management (IWM) as a guiding framework to protect and restore water resources: integrate into one utility, realizing the co-benefits of IWM, and collaborating across political boundaries.
- ✓ Engage the community to build trust, promote data transparency, develop authentic relationships with key community stakeholders, and offer clear channels of communications.
- ✓ Assess options for financing, including long-term planning frameworks; improving energy efficiency in operations; reducing leaks and costs of infiltration/inflow; and reducing volume through land-based solutions.
- ✓ Increase available revenue by raising rates adequately and equitably; by structuring rates to promote affordability and conservation; by charging impact fees for development; exploring alternative sources of revenue; and by partnering with other city departments.
- ✓ Promote workforce development programs in utilities that build capacity and advance a supporting workplace culture.

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INTRODUCTION

The United States' public drinking water and wastewater systems have been fundamental in meeting people's most basic needs, providing a foundation for public health and economic opportunity. Cities and their residents are better off with strong, public water systems, but these take time, investment, and political will to build and maintain.

Cities regularly face a host of challenges in maintaining their water systems and fulfilling their core mandates of supplying their communities with clean drinking water, affordable to all, and protecting environmental and human health through effective wastewater and stormwater management. City utilities are under pressure to spend less and find new sources of funding or financing, while maintaining or improving service. Some systems, especially those that are smaller or still suffering in the wake of economic crises, struggle to access needed capital. From reduced federal funding, to aging infrastructure to our changing climate, many public water systems are in urgent need of solutions to keep them thriving.

In response to this set of challenges, the private water industry has attempted to position itself as an alternate solution for providing water services. Local government leaders might be unsure of what to believe, how to evaluate such proposals, or how to accomplish their goals while protecting the public interest. In the face of privatization proposals, many mayors have expressed a need for resources about options to maintain or strengthen public water systems, how to finance infrastructure, and how to ensure their water systems are running efficiently.

The goal of this document is to fill this gap by providing clear, concise, and directive best practices for sustainably operating and financing robust water systems.¹ Water infrastructure systems are complex, but elected and public sector leaders in cities are well-positioned to advance more sustainable funding arrangements while addressing the affordability of the water bill for their lowest-income residents. This brief articulates actionable solutions for mayors and city leaders to operate public water utilities: financing maintenance and improvements, implementing an integrated water management approach, and engaging the residents served by these systems. Proposed solutions and approaches place economic equity at the center as well as advocate for environmentally-sustainable systems.

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HISTORY OF WATER AS A COMMONS

Today, the majority of drinking water and wastewater systems in the U.S. remain under public ownership, serving millions of U.S. residents. Up until the late nineteenth century, the landscape of water service across the U.S. looked very different: many of the country's largest cities were served by private

water operators. As the country's population rapidly grew, concerns too began to grow among residents and city officials about increases in waterborne diseases and destructive fires in cities that were under private water management. This spurred thousands of cities from Los Angeles² to Boston to claim public control of these drinking and wastewater systems³ during the late nineteenth and early twentieth century.

For the millions of residents impacted, public control of these water systems resulted in lower water rates, sharp declines in the spread of disease, and renewed and necessary investments in drinking and wastewater infrastructure.⁴ Throughout the twentieth century the federal government too recognized the value of investing in publicly run water systems. At its peak in the 1970s, direct federal funding accounted for upwards of 30% of the cost of operating of our nation's water systems.

After more than two centuries of public water systems supported by the federal government, the US has one of the highest rates of access to safe drinking water in the world. But our water systems now face a critical time of need. Over the past 40 years the federal government's direct investment in these essential services dropped to 4% by 2014⁵, subsequently shifting the cost of funding, maintaining, and improving drinking and wastewater systems increasingly onto state and local governments—and therefore, individual ratepayers. This decline in funding has happened at a time when much of the water infrastructure in the U.S. is nearing the end of its lifespan. These factors have pushed the limits of these aging systems and the city administrations that are tasked with running them.⁶ According to the EPA, guaranteeing access to adequate drinking water and wastewater systems will require an average of more than \$35 billion per year in funding over the next twenty years.

Cities and their residents benefit from strong, public water systems, but these take time, investment, and political will to build and maintain. Many cities regularly face aging infrastructure, water quality problems, combined sewer overflows, and other challenges. These impact the quality of life of everyone within the city. City and utility leaders around the country are faced with a core dilemma: they lack the funding, and in some cases the expertise, to maintain and improve their drinking, storm, and wastewater systems. They are under pressure to spend less, to find new sources of funding and financing, and to address affordability, all while maintaining or improving

service. Most systems, especially those that are smaller or still suffering in the wake of economic crises, struggle to access needed capital. With federal and state funding mostly absent, many encounter difficulties raising rates to bring in sufficient revenue for system operation and maintenance, much less to capture sufficient funds to pay for new debt.

Often, cities are approached by private companies with proposals to address these and other problems. Local government leaders may be presented with false solutions and are unsure what to believe, how to evaluate such proposals, or how to accomplish their goals while protecting the public interest. Many mayors remain reluctant to turn to the private sector to solve their water problems. For example, a mayor expressed that, "Doing a PPP in the water sector is like selling off your house, piece by piece, without a backup plan."⁷ However, many mayors don't know where to turn to pursue alternatives. They have expressed a need for more resources covering fully public options they might pursue to finance water infrastructure needs or to ensure their water systems are running efficiently. Mayors have reported that they have pursued privatization or PPP options simply because private water industry representatives are often the only ones offering solutions.

Water infrastructure systems are complex, but elected and staff leaders in cities are well poised to advance more sustainable funding arrangements while addressing the affordability of the water bill for their lowest-income residents. Through this paper, we articulate actionable solutions for city staff and elected leaders to operate public water utilities, while addressing availability, financing, quality and other key issues that may be at the core of considering private expertise. Whatever the size or nature of the challenges facing urban water systems, this brief provides an overview of the existing mechanisms to manage water systems and promising new methods for mayors and other elected leaders to consider. Solutions here include mechanisms to finance maintenance and improvements, implementing an integrated water management approach, and new ways to engage the community on water. Addressing economic equity, as well as advocating for the most environmentally sustainable systems, are central concerns in these approaches.

BACKGROUND

CHALLENGES OF WATER SYSTEM MANAGEMENT

The core principle guiding an urban water system is often left unstated in more technical frameworks for water planning: residents depend on safe and reliable access to water and wastewater services, for everything from basic sustenance to operation of their businesses. Mayors and other political leaders can and must underscore the centrality of high-quality, reliable water management as a core tenet of a livable city. A city cannot thrive without a well-managed, resilient, and equitable water system that serves all residents.

The lead crisis in Flint, Michigan not only raised a crisis of democracy -- stemming from the anti-democratic installation of an emergency manager -- but also raised the vital importance of a functioning public water system to the national consciousness. An estimated seven million plus people in the United States live in housing served by lead service lines, a major source of water-borne lead, and that is just one example of common water contaminants that threaten human health.⁸ Over 800 cities still utilize combined sewer systems, which during heavy rains can overflow and discharge pollutants from stormwater runoff and raw sewage directly into local waterways, with serious risks to human and animal health for those exposed.⁹ Elements of structural racism and classism have shaped where the best water infrastructure has been developed and maintained, both between cities and, especially, within them. For a city to be truly equitable, it must maintain a just and healthy water system accessible and affordable to all residents.

Cities have a staggering need for investment in water system repair and improvement due to several converging trends. The majority of pipes in urban drinking water systems were constructed in the early or mid-20th century with an average lifespan of 100 years. Utilities' typical replacement rate is just 0.5% annually (primarily due to budget constraints), creating a large backlog of deferred maintenance.¹⁰ Additionally, the American Society for Civil Engineers (ASCE) estimates that few urban water systems are right-sized for their current or projected populations, due to changes in population trends,¹¹ economic factors, and the growing intensity and regularity of severe weather events, including storms and droughts. The important— but costly— regulatory push for improved ecosystem and human health via state and federal consent orders to reduce combined sewer overflows and to minimize the concentration of various nutrients and pollutants in drinking and wastewater has further exacerbated the financial strains facing public utilities. Improved efficiency in fixtures and more emphasis on water conservation measures is another potential contributor to reduced water-use based revenue streams.

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Given the extent of disrepair and changes in demand, the ASCE rated the nation's drinking water infrastructure a "D" and wastewater infrastructure a "D+" in 2017.¹² They estimate a need to invest \$271 billion in the country's wastewater and stormwater systems over the next twenty years.¹³ While a costly investment, these projections account for not only needed maintenance but also leapfrogging to upgrade or replace system components to 21st century standards. To perform this sorely-needed upgrade and replacement of capital assets – and to meet growing needs for operation and maintenance – it is critical for utilities to identify creative ways to develop and cross-leverage infrastructure investments.

One cause of inadequate investment in water systems is a major shift over the past few decades from federal to state and local funding for water infrastructure. The University of North Carolina Environmental Finance Center (EFC) notes that during the 1970s and 1980s, the federal government provided a massive investment in subsidized funding to utilities (mostly in grants), which peaked in 1977 at \$17 billion in 2014 dollars.¹⁴ However, in 2014 this investment plummeted to just \$4.4 billion, disbursed

primarily as subsidized loans rather than grants. State and local spending comprised the other 96 percent of investment, with EFC estimating that the vast majority of this spending was by local governments or utilities. The current federal investment for capital projects is primarily administered via the State Revolving Funds (SRFs) for drinking and wastewater.¹⁵

Many city leaders face significant challenges in adopting innovations in water management, or in considering new approaches to these myriad challenges. Adopting state of the art management systems and best practices is incredibly challenging when the system and infrastructure are failing. While new practices appeal to leaders with a vision of integration and collaboration across departments, implementation of such changes are stymied by growing budget constraints and the complexities of predicting climate change impacts. To effectively understand and implement new approaches, mayors and city leaders need support, analysis, and creative financing. Smaller systems, especially, face issues with staffing capacity, where they might be part-time employees, without access to training or funding needed to advance this approach.



WATER 101

This section will review key context and background for understanding a local water system and the tasks and challenges involved in running effective systems.

There are five major types of water that moves through a city: drinking, waste, storm, surface, and ground water. Surface water is the lakes and rivers within a city, and ground water is the water found underground in the water table. These are both potential sources of drinking water. Drinking water and sewer systems are perhaps the most readily understood because every city has a utility system to treat and purvey clean, safe drinking water, and to convey and treat wastewater before returning it to a surface water body (where it then flows downstream, often becoming drinking water for another city). When considering the centralized components of drinking and wastewater systems, it is important to think not only about the capital-intensive, highly visible treatment plants or pumping stations, but also the hundreds of miles of underground pipes, each of which needs repair and eventual replacement during a typical 75 to 100-year life span.¹⁶

Both water and wastewater (also referred to as “sewer”) pipes come in two basic varieties: mains, which have a larger diameter to serve as the artery flowing underneath public streets; and laterals, which generally have both a utility-owned length that reaches from the main to the property line as well as a privately-owned length extending into the property. Additionally, an array of distributed tools can positively impact utility systems while being owned and maintained by private property owners, including rain barrels (that collect rain water that can be used for irrigation, keeping the rain out of the stormwater system and conserving treated drinking water) and on-site grey water/non-potable reuse systems.

In addition to providing clean water and reliable wastewater service, cities are also often charged with managing stormwater. With the advent of climate change and extreme storm events, these more intense and/or frequent storms in some areas are creating new challenges and costs. For example, one inch of rainfall over an acre (just under the size of a football field) is equivalent to more than 27,000 gallons of water.¹⁷ The current design standard is that of a municipal separate storm sewer system (MS4), in which stormwater is conveyed separately from

sewage and is discharged, untreated, into waterways or a plot of land. The lack of treatment means that stormwater carries pollutants that can damage ecosystems and human health, while intense storms can introduce such a volume of water into creeks and rivers that harmful erosion or flooding occurs.

The other type of centralized stormwater infrastructure, and that prevalent in many older cities and towns across the US, is a combined sewer system (CSO). Here, stormwater is channeled into wastewater pipes where it combines with sanitary sewage and is then jointly conveyed to a treatment facility. These systems also pose a public health and environmental risk when intense rainfall overwhelms system capacity and this overflow—now a mix of polluted stormwater and sewage—discharges directly into nearby surface waters. Given the risks in each kind of system, it is critical for any city to consider how distributed tools like green stormwater infrastructure (a set of land-based stormwater solutions that allow for longer-term storage or short-term retention to encourage infiltration into the ground) can help reduce the volume of stormwater entering a centralized system.

MAINTAINING INFRASTRUCTURE

In order for utilities to function optimally, appropriate infrastructure must be installed and effectively maintained. Many cities are vulnerable to significant operational failure due to the combined factors of aging infrastructure, insufficient capital, and operating budgets, and retirement of system operational experts. Priority-setting may become focused on implementing large scale consent decree-driven projects and managing the almost daily crises of water main breaks and other immediate system needs. To reduce vulnerability requires significant investment into facility condition assessments and capital improvement programming, as well as financial and strategic planning.

WATER QUALITY

One of the basic functions of water utilities is to provide safe drinking water for their communities. The general upkeep of water facilities includes visual assessment of infrastructure, as well as backup and redundancy of electricity, pumps and feeds needed to maintain functionality. Major transmission pipes are often prone to failures, leakages, and breaks due to the natural consequences of aging and neglect—they need to be actively monitored

and maintained. Infrastructure failures can lead to health risks, depending on the material of the city/utility pipes. General site components to be actively monitored and maintained include wastewater treatment plants, membrane facility, chlorine boosters, and reservoirs.

Water utilities should aim to achieve a set of objective goals to keep watersheds healthy, regardless of the source or treatment technology. Source water comes from either a surface water or a ground water supply. Wellhead protection programs are often implemented to protect groundwater drinking water sources, and many utilities relying on ground water incorporate filtration and treatment at the well site. For unfiltered surface water supply systems, source water protection programs invest in science to ensure that the highest quality of water is provided to the tap. Without the ability to rely on a billion-dollar filtration system, water utilities tasked to manage the source waters of an unfiltered system need to understand the hydraulics, fluvial geomorphology, and geologic materials of their systems - in addition to the approval or disapproval of recreational engagement on the surface-water reservoirs. And where restoration projects are needed, water utilities should use stream and groundwater science to inform the engineering behind the project. For filtered systems, source water protection programs are necessary to ensure the sustainability and longevity of the water supply, especially in urbanized watersheds. If, as a key example, the biggest threat to the water supply system in a particular location is turbidity or suspended sediment, then erosion control of the source water system should be a top priority, mitigating the deterioration of the natural landscape and supply conduits.

Public water operators can collaborate with other municipal water providers, agencies, unions, and non-governmental organizations for networking and capacity development through inter-municipal collaboration and other forms of public-public partnerships (PUPs). PUPs are defined as “the collaboration between two or more public authorities or organizations, based on solidarity, to improve the capacity and effectiveness of one partner in providing public water supply and/or sanitation services.”¹⁸ PUPs operate by promoting the following:

- ✓ In-house restructuring: Public utilities can team up with more-efficient public utilities or non-governmental organizations to make system improvements, build institutional capacity, and offer technical support to help reduce costs and maximize efficiency.¹⁹
- ✓ Bulk purchasing: By instituting purchasing cooperatives or agreements, utilities can reduce costs and increase efficiency by purchasing chemicals, fuel, equipment, and other materials in bulk and then jointly distribute.²⁰
- ✓ Shared services: Public water utilities can save money by collaborating on joint capital projects and shared service agreements that help lower total investment costs for those utilities involved.²¹

Public utilities can team up with more-efficient public utilities or non-governmental organizations to make system improvements, build institutional capacity, and offer technical support to help reduce costs and maximize efficiency.¹⁹

Above all, PUPs encourage public participation and responsive and accountable decision making by involving community groups and labor unions to ratepayers and the municipality itself to maximize the accountability and transparency of the utility while promoting equity in water services. An example of a successful PUP was in Massachusetts, where four towns (Fairhaven, Marion, Rochester, and Mattapoisett) saved \$4.9 million in costs (or 23%) by building and sharing a water treatment facility.²²

Water quality monitoring and reporting require qualified personnel within the utility, with institutional knowledge on scientific methods and regulations on which to focus and direct funding. Water utilities are tasked with ensuring laboratory adequacy for both quality and capacity. Laboratory staff must be aware of and prepared to detect a variety of contaminants of concern. Examples of contaminants include: cryptosporidium (often found in private wells), Giardia, emerging contaminants, corrosion control treatment via zinc orthophosphate, lead service lines, and cancer-causing contaminants.²³

GOVERNMENT COMPLIANCE

City and water utility leaders must fully understand and implement the laws, regulations, and guidelines established by federal and state entities for all types of water systems. At the federal level, two pieces of legislation, The Clean Water Act (CWA) and The Safe Drinking Water Act (SDWA), revolutionized the integrity of our water supply and distribution systems. In 1972, the CWA instituted the basic outline and platform for regulating pollution of United States waterways. The SDWA quickly followed in 1974, established to specifically ensure potable water safety, including by encouraging partnerships between public water systems to maximize technical and financial capacity. Not only did these legal parameters instill tangible means for ensuring the safety of the United States' waterways and drinking water sources, but it challenged the (at that time) current, harmful mindset that our waterways were an appropriate place to dump waste. Water utilities should ensure that they are actively in compliance with both the CWA and the SDWA.

At the state level, the department of environmental protection or natural resources oversees a set of laws and regulations, often devolved from the federal government. Examples of water quality regulations in the state of Pennsylvania, enforced by the state DEP include: The Lead and Copper Rule, Groundwater Rule, Stage 2 Disinfectants/Disinfection Byproducts Rule, Long Term 2 Enhanced Surface Water Treatment Rule, Radionuclide Rule, Long Term 1 Enhanced Surface Water Treatment Rule, Filter Backwash Recycling Rule, and Interim Enhanced Surface Water Treatment Rule.²⁴ Other states have comparable sets of regulations governing their operations. These safeguards are the bedrock of our cities' ability to provide safe drinking water for all people and to protect the watersheds on which we all depend.

SMART SYSTEMS

Geographic Information Systems (GIS) now offer city and utility leaders a planning and management tool that would have been unthinkable only a couple of decades ago. The vast quantities of data we now have access to are readily put to use with mapping software. These programs allow utilities to organize, prioritize, and inform public projects that are taking place across the service area. GIS also provides utilities with unparalleled analytic capabilities which can be used to predict water flow under various weather conditions, provide the depth of groundwater and the soil type and chemistry for a given area, and measure the hydrological impacts of a determined land use change. The information that this software can provide, when used effectively, has enormous impacts on efficiency and cost saving at the project level, especially when paired with real-time service data being provided through smart metering and the Internet of Things. Cities must have the capacity to purchase and use such smart systems, however, which might be a challenge for struggling utilities.

PRIVATIZATION IN THE CONTEXT OF WATER

DEFINING PRIVATIZATION

The private water industry has positioned itself as a solution to cities struggling to balance budgets. The proposed deals span a large spectrum of options. Generally speaking, the term privatization refers to the transfer of managerial and financial responsibilities of a public water utility to private water corporations. In these arrangements, the private sector takes on a decision-making role that can directly impact system investments, water rates, and other water management policies. Privatization shifts the primary focus of running a water system from provision of service for all people to maximization of private profits.

On the far end of the privatization spectrum is the full sale of a drinking water or wastewater system. In such an exchange, cities turn over full ownership and management of a water utility and its assets to a private company. Anything outside of a full-sale is often referred to as a public-private-partnership, or PPP and involves varying levels of local control being given to a corporation. These include: lease/concession contracts, management, operations and maintenance, design and build, and consulting contracts.

- ✓ Lease Deals: Often decades in length, these contracts maintain public ownership of the system but transfer day to day decision making power to a corporation. These deals leave the public still responsible for financing these improvements.
- ✓ Concession Agreements: These are similar to lease agreements in length and contract away local control of systems, but also include investment decision making under corporate control.
- ✓ Management contracts: These typically last 10 years. The local government owns and finances the system, but the day to day management of the authority is transferred to a private operator, resulting in key decision-making in the hands of a private corporation.
- ✓ Operations and Maintenance: Also known as O&M contracts, these contracts often last 2 to 5 years, in which the local government maintains ownership of the water authority and must finance infrastructure improvements. A private corporation operates and maintains portions or the entirety of the utility and exercises major decision-making power. This can include staffing policies within the authority, whether and how to make investments in the system, and keeping the system regulatory compliance.
- ✓ Consulting contracts: While this can take different forms, some of these contracts are “performance based,” where water companies take a cut of the savings they realize through cost-cutting measures. This can create an incentive to cut costs in an effort to maximize corporate return.
- ✓ Design and Build: In these contracts, a corporation is contracted to design and build a system within a utility but does not exercise decision making power past completion of the project. Some arrangements are design-build-operate, in which the corporation does exercise decision-making power after project completion.

IMPACTS OF PRIVATIZATION

Through this range of options for cities, the private water industry presents itself as a logical partner for cities who are looking to inject direct investment into their water systems, improve their service, or save operation costs. Unfortunately, private water corporations cannot and do not fill the investment gap our water systems face. Contracting with private entities for discrete tasks must be coupled with robust oversight from a public agency, yet fully signing over operation or even ownership of a public utility into private hands limits public oversight of water system operations. In many cases, these deals have backfired on cities, leaving them instead with skyrocketing water rates, cost-cutting that jeopardizes water quality, and failing infrastructure.

Since infrastructure investments do not yield the level of profit many corporations are seeking when entering into contracts, many privatizers rely on rate increases and cutbacks on operation and maintenance as a way to generate additional revenue. On average, private utilities charge households 59 percent more than local governments charged for drinking water service -- amounting to an extra \$185/year.²⁵ Public systems can often negotiate raising rates over a longer period, with less of a focus on investment returns than private systems. In Bayonne, NJ, a PPP deal involving Suez and private equity firm KKR has left residents with skyrocketing rates. The \$150 million upfront payment the city received has come at a high price to residents who are not only paying back that massive sum, but also paying the added cost of investment returns demanded by the private sector. Some residents struggling to pay their water bills—with rates already increased by nearly 28 percent—have had liens placed on their homes that could lead to foreclosure.²⁶

Another impact of privatization of water services is more challenging working environments for employees of the water authority. Corporations running water systems have downsized the workforce to cut costs and increase

profits, such that employees lose their jobs or need to take on almost unmanageable amounts of work while receiving lower pay than working for local governments.²⁷ After the workforce is downsized, many systems then see water quality suffer and backlogs in maintenance orders accrue. Cities also risk losing technical and human resource expertise. For example, over the course of a 3 ½ year management contract between the City of Pittsburgh, Pennsylvania and Veolia, 23 staff were laid off or fired—including many safety and water quality managers, as well as the heads of finance and engineering. Additionally, the utilities laboratory staff, tasked with testing quality across the system, was cut in half.²⁸ While under Veolia's management the corrosion control chemical used to prevent lead leaching was also changed to a cheaper alternative without the required approval, violating state law²⁹. Following this switch, lead levels exceeded the EPA's federal action limit for the first time in the city's history.³⁰ Veolia ultimately walked away from its contract in Pittsburgh with over \$11 million³¹, leaving the authority to replace lead lines and improve the system with a severely reduced staff.

Quality issues are not the only problems that can befall drinking and wastewater systems after cities enter into contracts with corporations. Many cities who have had their systems privatized have also experienced a lack of maintenance and investment in system infrastructure, often running counter to promises made by the corporations. For example, under Veolia's operation of Plymouth, Massachusetts' wastewater system, 10 million gallons of raw sewage flooded the city and harbor between December 2015 and January 2016. This spurred a lawsuit against Veolia by the state, resulting in a \$1.6 million settlement.³² In citing that Veolia failed to properly maintain and operate the wastewater facilities, Massachusetts Attorney General Maura Healey claimed that “companies like Veolia are not only violating the law, they are threatening public health and our invaluable coastal water resources.”³³

Even many seemingly limited consulting contracts between cities and water companies can end with disastrous consequences. In February 2015, at the height of the Flint lead crisis, the city hired Veolia to address drinking water quality. The company declared the city's water safe, failed to warn the city of possible lead contamination, and even recommended a chemical change that the state alleges worsened the crisis. The state of Michigan is currently suing Veolia and another company for their consulting contracts in the city.

On top of the financial, labor, and quality risks associated with these different models of water privatization, the reality for many cities is that it is the residents who bear the ultimate risks and liabilities of running the water systems. This is because these contracts often set a minimum return rate on investment or set a fixed percentage of the corporations' gross income as remuneration of manage-

ment.³⁴ These contractual terms incentivize corporations to view water privatization projects as successful based on their ability to generate revenue rather than guarantee access, creating a non-competitive market where there is little profit motive to improve water quality or service.

Rather than contract with the private water industry, there are countless cities across the country who are not only maintaining public control of their drinking and wastewater systems, but also setting the example of how to provide quality service, stable rate setting, and infrastructure improvements for consumers. Informed, strong city leadership is necessary to retain municipal control of water utilities.



CITY SOLUTIONS FOR ROBUST WATER MANAGEMENT

It's clear that a city's water system is much more than water treatment plants or water flowing from the tap: it is the pipes, distributed infrastructure, and land use, all of which depends on myriad decisions that elected officials make. City governments must take care to protect water resources in all forms from pollution and depletion, keep systems running efficiently, and establish agencies with the ability to monitor storm, surface, and ground waters. Each of these might be under the purview of a different entity – a city, municipal or county department, or a regional authority. An enormous range of decisions affecting water are squarely in the wheelhouse of city leaders, such as land use and development requirements, source water protection, management of the urban forest, and more. In this section, we will review actionable solutions to preserve public control of water systems and to maintain a strong municipal water system, with the end goal of supporting cities to protect precious water resources. Solutions covered include a sample of best practices from cities around the country, including governance and staffing practices, community engagement to enhance public knowledge, helping systems be more responsive to considerations of ratepayers, improving financing structures, and maintaining key infrastructure.

CITY SOLUTIONS: IMPLEMENT INTEGRATED WATER MANAGEMENT

Cities can transition to a more resilient water system by adopting an integrated water management framework. Integrated water management (IWM) refers to a set of principles, and the approaches that follow, that recognize all water is a resource. While we use the term “integrated water management,” the term “One Water” is used to describe similar efforts to integrate and optimize urban water systems within the larger context of the city. “One Water” is defined as an approach that “considers the urban water cycle as a single integrated system, in which all urban water flows are recognized as potential resources, and the interconnectedness of water supply, groundwater, stormwater and wastewater is optimized, and their combined impact on flooding, water quality, wetlands, watercourses, estuaries and coastal waters is recognized.”³⁵

The development of efficient and integrated management practices is the most important direction cities and urban utilities can take to preserve and promote their water systems, while simultaneously reducing the likelihood of any further urban water crises and realizing new co-benefits. This approach requires a paradigm shift in the way that cities and citizens view water, and in the way that municipalities integrate their typically siloed departments and projects.

The core principles of an IWM approach means that systems must manage all water as a resource, whatever form it is in when it first enters the city – rain, as one example, can be an invaluable resource rather than a nuisance, and should be treated as such. Cities must also reduce waste and capture all possible value, not only from water but from other resources in the process. Finally, these shifts also require that cities integrate management approaches wherever possible. Given that all water is a resource, it should not be managed in discrete, disconnected flows. Beyond the question of water in different forms, water management must also be integrated into every other city decision, from land use to economic development planning. Integrated water management helps cities preserve water as an essential resource foundational to life and ensure that it is accessible for all.

Another significant benefit of integrated water management is reducing greenhouse gas emissions from water utilities and improving their energy efficiency. Water utilities can improve efficiency through infrastructure improvements like leak detection systems, water saving technologies, water conservation incentives, management of wastewater concentration and flows, light bulb replacement, and upgrades for wastewater plants through pump optimization.³⁶ Some cities have been looking at ways to use renewable energy to power water and wastewater utilities too.³⁷ Using solar or wind to power these facilities might not be feasible for all utilities, but is something every city should consider.

A new addendum to the Clean Water Act, from January 2019, supports IWM use. The policy provides new opportunities for more closely aligning committed investments to broader municipal priorities for capital investments, tailoring the combination of solutions to local water issues and considering sustainability and affordability factors. It codifies integrated planning and green infrastructure, optimizing municipalities' abilities to develop flexible, affordable, and adaptable programs addressing critical water quality impacts.³⁸

The use of IWM provides, broadly, a smart, integrated approach to infrastructure management. It could entail planning maintenance and construction in conjunction with other utilities and streets work, or layering funding for water, transportation, and economic development to leverage the multiple benefits of clean surface water or green infrastructure. By investing in integrated solutions like energy efficiency upgrades and green infrastructure, utilities and cities have a chance to save money, and if done right, to see a return on their investment.

INTEGRATED WATER MANAGEMENT IN PRACTICE

Cities around the country are showing what IWM can look like on the ground. IWM articulates a broad vision but practices “the art of the doable” with the following core set of approaches.³⁹

Protect and Restore Water Resources in the Environment

To reduce the treatment burden for drinking water, and to preserve water resources for their own sake, cities must adjust land use to preserve the natural areas surrounding bodies of water. Where feasible, cities

should consider directly purchasing land, or working with regional partners, to create conservation easements. By preventing land development near waterways, cities can reduce pollutant loads upstream, saving the city money in treatment costs. Preserving vegetative cover in undeveloped land along waterways also encourages filtration of runoff while preventing erosion. Additionally, restoring natural areas within city bounds can enhance recreational opportunities.

Cities in both dry and wet climates understand the value of preserving natural land to protect water resources. New York, NY acquires “hydrologically sensitive” land through outright purchase or conservation easements, enabling the city to preserve natural areas undeveloped in order to protect water quality by reducing pollutants as well as supporting plants that filter out water contaminants.⁴⁰ The San Francisco Public Utilities Commission implemented a ten-year program from 2006 to 2015 to monitor, protect, and restore natural areas in the utility's service area, spanning across several watersheds.⁴¹

Conserve Water

Water conservation ensures a sustainable long-term supply and reduces lost revenue for a city. Cities should audit current systems to eliminate leaks and other sources of waste from municipal pipes, as such waste squanders a valuable resource, costs cities financially, and impacts availability of service to residents. An estimated 14 to 18 percent of municipal water is lost through leaks, inaccuracies in tracking, and unauthorized consumption.⁴² The Birmingham, Alabama Water Works Board audited their water system to identify leaks and other issues. The audit found that nearly 3 billion gallons of lost water had cost the utility over \$900,000 in 2011.⁴³ It is important for utilities to focus their efforts on reducing “non-revenue water” by fixing leaks and addressing non-payment by large commercial water users rather than by penalizing any low-income households that are simply connecting to the system for the water needed to survive. Technological innovations that better enable utilities to make sense of data collected can prove especially helpful for leak detection.

Reducing over-usage is a second necessary step to conserve water. Many cities experiencing drought have instituted mandatory use restrictions, assessing fines to violators. A wider range of voluntary programs should also be adopted, from high-efficiency appliance rebates

to training on water-wise irrigation. The Las Vegas, Nevada area utility has a particularly successful Water Smart Landscapes Rebate program to reduce the area of water-intensive lawns. With rebates of \$3 per square foot of grass removed and replaced with desert landscaping, the program has already converted 185 million square feet to water-efficient landscaping.⁴⁴ But it's not just dry cities striving to conserve via reductions in usage – Madison, Wisconsin, for example, has a high-efficiency toilet rebate program.⁴⁵

As a part of reducing drinking water over-usage, cities must also reevaluate many instances of current drinking water use – especially outdoor irrigation and industrial uses – that do not in fact require water treated to potable standards. These uses can instead utilize rainwater, greywater (all used water from a building, except that used for toilets), or reclaimed water (wastewater effluent, treated either for non-potable use or more intensively for drinking water purposes). Austin, Texas' City Code requires customers building near a “purple pipe” main (the term for pipes carrying water that has been treated to non-potable standards)⁴⁶ to use this reclaimed water for uses such as cooling and irrigation.⁴⁷

Note that in the instance of cities with a surplus of water, the implications of these decisions will vary. For example, for water efficiency programs where the bill structure has a significant portion related to actual usage (versus to a fixed base charge independent of usage) customer reduction in use results in less revenue for a utility. Because fixed costs do not vary and are usually the bulk of costs, this can really impact the financial sustainability of a utility.

Rain is a Resource

A key component of an IWM approach is the management of stormwater. Traditional approaches squander rain's potential to serve as a resource by funneling away water in large pipes, either directly to a water body in separate sewer systems (dumping pollutants in street run-off straight into waterways while sending water away downstream) or into a combined sewer system (risking sewer overflows into local waterways and increasing wastewater treatment loads). Instead, where possible and permitted by state law, cities should strive to capture rain where it falls, either via direct capture into cisterns or by groundwater recharge via infiltration. In addition to enhancing supply, this also reduces localized flooding risks. Note that state law varies significantly on harvesting rainwater and subsequent uses of that water.⁴⁸

On a systemic level, cities should reevaluate their land use practices to reduce impervious surface cover. Green stormwater infrastructure approaches (in contrast to the “gray” infrastructure – traditional concrete and pipes) reduce impermeability and often also capture rain for reuse. There are a host of green infrastructure interventions: from tools to filter water, such as rain gardens in street bump-outs or green roofs, to those that capture rain for reuse, like cisterns. Cities should install green infrastructure wherever feasible, taking into account capacity for its maintenance in project planning. Developing incentives for private sector development of green infrastructure can be more cost-efficient than developing it on public lands. Green infrastructure

Traditional approaches squander rain's potential to serve as a resource by funneling away water in large pipes, either directly to a water body in separate sewer systems or into a combined sewer system.

has co-benefits beyond water quality and supply. These investments can be leveraged to provide air purification, urban heat island effect reduction, aesthetic improvements, and green jobs.

Many cities that have a combined sewer system in at least part of their service area have been leading in the use of green infrastructure, but there are benefits for even cities with separate sewer systems. Philadelphia, Pennsylvania's Green City, Clean Waters is a model program that implements green infrastructure systematically throughout the city, using green infrastructure in many city projects from new street construction to playgrounds at local school districts.⁴⁹ Grand Rapids uses green infrastructure extensively in its stormwater system, through the \$6 million Vital Streets program, mandating its use on any street upgrade projects. Drought-stricken Los Angeles, California has advocated for green infrastructure and other tools to increase the volume of stormwater captured from current levels (just under 9 billion gallons) to 50 billion gallons by 2035.⁵⁰

No More “Waste” Water

With water supplies becoming more strained by industrial over-use and the impacts of climate change, cities cannot afford to deem any water flow as “waste.” Instead, cities should optimize their water reclamation process to keep as much water recirculating within city limits in a usable form, rather than sending it all downstream. While reducing wasted water, cities can also optimize processes to reduce wasted energy and maximize value from water treatment by-products (by creating fertilizer from biosolids, for example).

As a primary step in waste reduction, cities might consider reclaiming wastewater to bolster supply. As mentioned, “purple pipes” (reclaimed water used for non-potable purposes) may be an option to be used in cities to conserve drinking water. Better still, highly treated wastewater effluent should be used for drinking water, though only a few cities have started using this approach. More cities are using indirect potable reuse, also known as groundwater recharge. The Orange County (California) Water District, working in partnership with the Sanitation District, now has one of the world's largest groundwater recharge systems, pumping treated wastewater out to percolation basins where the water recharges the aquifer.⁵¹

IWM Response to Varied Climate Conditions

Water systems are particularly vulnerable to the effects of climate change, both because of deepening droughts and the increasing intensity of rainstorms. To ensure a well-functioning, safe water system for the future, cities must act now to increase their resilience.

Cities should plan for and work to adapt to expected climate change impacts in all infrastructure projects and management approaches. Modeling is a critical first step to understand the likely effects of changing weather patterns in order to alter design standards. Seattle Public Utilities has conducted long-term modeling and planning to mitigate projected effects of climate change on infrastructure, from sea level rise to frequent deluges.⁵² Every city, even those in drought, will have to take into account the increasing intensity of storms that will strain current stormwater systems. Cities should work to enhance stormwater capture to reduce volumes flowing through the system. Additionally, long-term planning for drought (even in areas currently at normal levels) will ensure that supply can meet increasing demand as temperatures rise. The small city of Las Vegas, New Mexico has had success in strengthening its own conservation programs like leak detection measures as well as cultivating partnerships with the county emergency response team and a state-wide collaboration between water systems, allowing the city to borrow a tanker from its larger neighbor Albuquerque in case of emergency.⁵³

TRANSFORMING APPROACHES: THE “HOW” OF IWM

Explore integrating into one utility

Starting at the utility level, cities should consider the feasibility of merging the management of all water flows (drinking, waste, storm and surface) into a single utility for best use of scarce funds and to enable more alignment in planning. Such integration can encourage the use of IWM approaches, from planning for drinking water reuse in wastewater management decisions, to ensuring that stormwater is managed more effectively as an asset. Altoona, Iowa merged its drinking water and wastewater utilities in 2011, a measure that saved costs and added a stormwater utility.⁵⁴ The City of Los Angeles' One Water LA Plan is managed by LA Sanitation alongside the Department of Water and Power to integrate management of water resources and policies between all City departments, partners, and stakeholders.⁵⁵ So far the plan

has had many achievements, such as a stormwater and urban runoff facilities plan that “incorporates water supply, water quality, and flood protection, and identifies more sustainable and resilient green infrastructure.”⁵⁶

Within the city, leaders should strive to integrate planning between departments to encourage a “big picture” approach that plans for water wherever it is found, not just limiting proactive planning to drinking water or wastewater flows. Consider a culture shift to prioritize regular meetings between water managers and land use planners: this shift alone might improve water quality (it’s harder to site a gas station near a well when in regular conversations about water) and supply (thinking about water could also lead to tighter efficiency standards in city code). There are structural, informal, and policy levers that cities may wish to employ to drive integration in water management.

Leaders should initiate integration as a shift in city government culture by convening all utilities and departments that work on water. Mayors and other city leaders are well within their authority to request these kinds of internal meetings. They can use these gatherings as a launching point to explore concrete changes to better integrate water management. While initial convenings may include land use and transportation stakeholders (along with water managers), there are very few departments that do not interact with water in some way (at least via rain). Los Angeles, California’s One Water LA 2040 Plan details the outcomes of meetings between all relevant city departments and other government districts within the city limits, from the airport to the zoo, to align their own water management with the larger water planning goals.⁵⁷

Where mergers may not be possible or the right approach, cities should consider coordination mechanisms to improve integration of services. Cities should implement policy changes for the most lasting and wide-reaching integration of water management into other planning. Many cities, from Philadelphia, Pennsylvania⁵⁸ to North Saint Paul, Minnesota,⁵⁹ have adopted green streets policies that weave green infrastructure and related stormwater mitigation planning into every street renovation or construction project. Updating these guidelines also presents an opportunity to improving biking and pedestrian infrastructure standards, further enhancing livability. Cities have considerable untapped potential to expand required integration of water planning with planning for other outcomes, like inclusive economic development (particularly job creation for local residents via infrastructure investment, or renewed investment along surface waters), land use planning that promotes density, and more. For example, Austin, Texas formalizes integration between water planning and land use review processes.⁶⁰

Realize co-benefits

The co-benefits of efficient and sustainable water management through IWM offer city leaders appealing ways to bolster other parts of their agenda while providing real benefits to residents that would not emerge from traditional approaches. Utilizing a “triple bottom line” analysis – one that considers not just economic, but also social and environmental outcomes – underscores

The co-benefits of efficient and sustainable water management through IWM offer city leaders appealing ways to bolster other parts of their agenda while providing real benefits to residents that would not emerge from traditional approaches.

the benefits inherent to an integrated approach. Bringing in other potential funders, such as private partners or other public agencies, early in these conversations could help ease the cost burdens of water departments, and help set direction for broader goals.

Financially, IWM could trim budgets by seeking to remove inefficiencies in spending and by seeking more collaborative sources of funding. Some typical IWM interventions, such as green infrastructure, avoid water treatment costs or eliminate the need for costly infrastructure expansion by reducing volumes moving through the system. Connecting water outcomes to other city issues like transit or economic development can also expand the pool of funding available. Coordinated land use planning and development efforts can benefit water utilities, and vice versa. Cities can use open space as emergency flood management. For example, parks and sports fields can be designed to hold and infiltrate water over time, mitigating flooding and impacts on the stormwater system. Waterfront land development—when paired with an equity lens—can be an economic boon for cities. South Bend, Indiana has put considerable effort into beautifying the St. Joseph riverfront, including using technology to reduce their combined sewer overflows (CSOs).

Environmentally, IWM also prioritizes good stewardship of natural lands and waters in the region, preserving these resources for their own sake as well as for the outcomes regarding water quality.

Collaborate across political boundaries

Collaboration to manage water in an integrated manner across jurisdictions ensures better use of constrained funding and staff capacity. Water does not respect political boundaries—it exists within the natural boundaries of the watershed; so too should water management transcend these political distinctions. While challenging, finding ways to work with other local and regional governments and stakeholders is an essential element of IWM.

Collaborating across political boundaries to align with the actual watershed boundaries helps rally stakeholders around shared goals for water supply and quality. After years of conflict over water use, Yakima, Washington was a key player in negotiations within the Yakima River Basin to create an integrated water management plan that respected the needs of fisheries, farms, municipal users,

and other stakeholders in the region.⁶¹ In response to persistent drought conditions, eight of the San Francisco Bay Area's largest water authorities formed the Bay Area Regional Reliability (BARR) partnership. They focused on addressing drought preparedness and water supply concerns regionally, with combined services to over seven million residents, and coordinated funding. This regional agency aims to enhance water supply reliability, leverage existing infrastructure investments, facilitate water transfers during shortages or natural disasters, improve climate change resiliency, and better meet community and environmental needs.⁶² Los Angeles started a Water Cabinet in 2014, which convenes department heads with regional authority, academic, and non-profit leaders monthly to discuss water planning, review data on the water system, and brainstorm project ideas. The Cabinet is headed by the Deputy Mayor for Sustainability.

City utilities should also maintain strong relationships with utilities throughout their region in order to share best practices and stay updated on environmental trends or potential water contamination. Water utilities should also consider participating in regional or watershed based networks to stay abreast of water quality trends in the surrounding areas. These relationships can also advance solutions more quickly when crises arrive. Toledo, Ohio's water utility has opened up all of its records on wastewater effluence and now attends regular meetings with regional agriculture organizations. Through Inter-city partnerships, cities can develop direct relationships with other cities in their regions. Cities in the Southwest struggling with intense water stress have demonstrated innovative regional-scale partnerships that transcend the typical service area boundaries of broader metro, instead stretching across cities. Aurora, Colorado leases some of its capacity to Denver, helping to reduce costs. They are also exploring developing a shared reservoir with Colorado Springs.

Collaboration with partners outside of city government can also enhance the technical capacity and other resources available to utility and political leaders. In Cincinnati, OH, the utility worked with other government stakeholders (the county and EPA) and nearby universities to improve data collection about green infrastructure. The co-benefits of efficient and sustainable water management through IWM offer city leaders appealing ways to bolster other parts of their agenda while providing real benefits to residents that would not emerge from tradi-

tional approaches. Integrated Water Management infrastructure installations in Cincinnati at the watershed scale saved an estimated \$200 million in public funds by preventing combined sewer overflows.⁶³

CITY SOLUTIONS: COMMUNITY ENGAGEMENT AND BUILDING TRUST

Community engagement is what drives the cohesive relationship between water utilities and community constituents. A water utility needs to actively address issues that often plague communities relating to equitable access and affordability of drinking water. A water utility is also responsible for understanding and addressing community concerns pertaining to taste and odor of tap water, water shut-offs, billing issues, low pressure, and boil notices.

The United States has seen publicly, in places like Flint, Michigan and more recently in Newark, NJ, what can result of a utility and government that fails to address the continued distribution of less than acceptable drinking water. A lack of transparency to communities can exacerbate problems related to service delivery failure. The failure of the water utility and local government as a result of an emergency management takeover by the state in the City of Flint ultimately resulted in dwindling trust and animosity between parties. This lack of trust did not stay siloed in Michigan; it has negatively affected the perception many city/utility customers have of tap water across the US. As a result, cities have suffered from unnecessary, negative environmental effects such as excessive usage of single-use plastic water bottles and the financial burden on economically vulnerable communities paying for bottled water.⁶⁴ Thus, a water utility is tasked with promoting and ensuring customer confidence in the service it provides.

Utilities, at a minimum, need to have a solid communications plan that allows them to frequently reach their constituents with clear, honest information. This kind of ongoing education and transparency will help when there is a crisis to communicate about or concerns to be aware of to ensure that utilities are consistently communicating with residents. However, simply disseminating information isn't enough. Cities and utilities should develop ways to proactively invite community engagement with the utility so they are aware of any concerns or problems and can address them in a timely manner. The following are approaches to community engagement that build utility-resident trust, proactively respond to resident needs, and in turn increase the efficacy of the utility to deliver affordable and safe water to the residents that it serves.

DATA TRANSPARENCY

One of the most powerful ways that a water utility can build trust with its residents is through offering consistent and reliable data on water quality and possible sources of water contamination, such as combined water sewage overflow, harmful algal blooms, and lead. Water utilities should make use of enhanced data capturing technologies (covered in the section on Financing

Community engagement is what drives the cohesive relationship between water utilities and community constituents.

section of this report) not only to be acutely aware of any changes in water quality and water usage dynamics, but also to be able to share this information with the public.

Many crises around water quality could have been avoided through more accurate reporting and related media coverage. It is also crucially important that water utilities are able to disseminate reliable information on water quality, in the native language of the residents affected. After dealing with the public outrage following the aftermath of a harmful algal bloom, Toledo, Ohio now posts daily water quality data to its website to keep the public informed on primary source updates regarding water quality.

Utilities can not only rely on online communication to share crucial information or speak with residents. The Pittsburgh Water and Sewer Authority (PWSA) launched an online interactive map where residents can input their address to access records on where lead service lines are located in the city, which lead service lines have been replaced, and which will be replaced through June 2020.⁶⁵ In order to increase community response and encourage lead service line replacements, the PWSA went a step further and conducted door-to-door canvassing to speak to residents about the utilities plan to replace lead service lines free of charge and get their permission to begin replacement.⁶⁶ PWSA workers also left door hangers on homes that did not answer, attended dozens of community meetings⁶⁷ to educate residents, and posterized over 250 locations across the city with additional information on where lead service lines are located and how to get them replaced.⁶⁸ As of September 2019, 1,932 public service line replacements were completed and 1,575 private replacements have been conducted with thousands of residents contacted about the process.⁶⁹

When made available to the public via a utilities website, Geographic Information Systems data has become invaluable as a customer service tool. In Philadelphia, for example, a mapping program called the Stormwater Credits Explorer allows property owners to calculate the potential savings of implementing different green infrastructure technologies.⁷⁰ This not only educates the public and makes them more likely to support the city's Green City, Clean Waters initiative, but it also means that homeowners are more likely to invest in property improvements that are maximally-effective and money-saving.

Presentation of data is almost as important as the data itself. Utilities should curate reliable and consistent data on water quality in easily understood formats. Creating digitally accessible and attractive data navigators, such as on a water utility's website, has become a popular means of sharing the right level of data without overwhelming the average viewer.

Additionally, water utilities are responsible for writing and distributing yearly reports. These reports include the water quality data obtained from the laboratories and other water quality related programming such as source water protection initiatives. A key component to the success of any water utility is transparency. Thus, yearly reports serve as an opportunity for the water utilities to communicate directly to the public on why the water is safe to consume, what (if any) are the risks, and what resources are available for customers to make knowledge-based decisions regarding their water consumption habits. In addition to yearly reports, monthly operating reports (MORs) are required for water utilities to comply with the Environmental Protection Agency (EPA) and should be submitted to state EPA offices. The content of MORs includes statistical presentation and analysis of a variety of components regarding the functionality of the water utility. Statistical components of MORs include average, daily, monthly, maximum, and minimum intake information that are computed automatically. Statistical information can also be manually entered and included in the MOR. Examples of manually entered data into the MOR includes water quality data discerned by utility laboratory technology and staff, as well as maintenance and operation information logged by appropriate staff.

DEVELOP AUTHENTIC RELATIONSHIPS WITH KEY COMMUNITY STAKEHOLDERS

It is becoming increasingly imperative that city water utilities view themselves as political actors that maintain strong relationships with a range of relevant stakeholders, just as any other well-functioning arm of government should. The public tends to think of utilities as any other government entity; utilities can and should leverage this baked-in perception to build public trust and better anticipate and respond to resident needs. To do this, utilities should systematically identify all relevant stakeholders, including those that they may not have engaged with consistently in the past. Utilities should pay special

attention to marginalized groups, such as low-income residents and communities of color who have historically had far less clout in public input processes. These communities are also disproportionately more likely to live in areas with older and/or failing water infrastructure, often putting them on the front line of water quality breaches. In Los Angeles, CA, water decision-making used to be dominated by the wealthy West side of the city, but sustained effort at inclusive stakeholder outreach and engagement has transformed that dynamic. Other city utilities should take note of this shift in dynamic by power mapping its customer base and concentrating outreach efforts to communities that have historically held less political power.

Effective community engagement is often stifled by the overall lack of capacity by city water utilities to reach all of the stakeholders that they need to. Utilities can amplify their reach by maintaining relationships with trusted community partners, such as non-profit coalitions, who hold their own respective networks of communication with community residents and are generally more attuned to community needs. This not only makes for a more efficient process of community engagement, it also legitimizes water utility outreach, as community coalitions are far more likely to be well-trusted by the communities that they represent. This style of partnership utilizes public input and stakeholder engagement in decision-making processes.

In Grand Rapids, MI, the water utility has developed a partnership with the West Michigan Environmental Action Council, with an annual twelve-community water celebration that helps build trust and foster community involvement. The utility also reaches out regularly to speak at neighborhood groups and Rotary Club meetings to better inform and communicate with the public. Such engagement efforts can raise critical awareness of and support water management priorities, while expanding capacity with volunteers. Clean Water Services, a utility based in Hillsboro, OR, convened over thirty partners from the county to conservation non-profits to plant over two million trees and shrubs in a single year for the Tree for All project.⁷¹ Such engagement efforts can raise critical awareness of and support water management priorities, while expanding capacity with volunteers.

Utilities should also seek to establish connections with anchor institutions, such as hospitals and universities. Such institutions can advocate on a utility's behalf, add academic credibility to initiatives, help fund and generate necessary research for innovative projects, and convene disparate stakeholders.



OFFER CLEAR CHANNELS OF COMMUNICATION

Water is more than just a service that utilities provide; it is a human right and a necessity. Thus, utilities should do everything in their capacity to ensure that residents have a clear understanding of how to contact utilities with questions and concerns. This requires that utilities establish clear channels of communication between their community liaisons and the constituents that they serve.

Utilities should create hotlines that are available to community residents 24 hours a day, 7 days a week. Such hotlines are not only crucial in times of crisis, but also foster a consistent dialogue between a utility and the community that can provide utilities with key data about service issues that may not have even yet come to the utility's attention. Through a city-wide rebranding, Toledo OH's public utilities essentially took over the city's call center when the city's water was plagued with a harmful algal bloom (HAB). Since that time, the utility has won two national awards while expending little or no additional cost (\$16K a year) relative to 311. The call center is staffed with very competent customer service agents (often trained 911 dispatchers who want a less intense environment) who have improved tracking and progress updates to residents.

Utilities should also hire as many bilingual (or multilingual) staff as possible. Tucson, AZ is a city with many monolingual Spanish speakers, so the drinking water utility aims to be as bilingual as possible amongst its staff. Utilities might consider hiring staff who are culturally competent and possess language skills reflective of the community the utility serves.

Communities often have very little understanding of how water utilities function from source to a consumer's tap. Utilities can be doing more to educate their customers on where drinking water comes from, as this in turn strengthens dialogue between the utility and the community. In addition to the data transparency tactics identified in the first section of community engagement best practices, water utilities should consider how to provide educational programming to their constituents. This might include regular guided tours of utility facilities, brochures and pamphlets, and partnerships with local schools so that basic water utility knowledge is embedded in children's education from an early age. Some utilities with limited capacity and funding may also find success by partnering with local NGOs to aid with outreach. By helping NGOs "speak utility," they can then help the public "speak utility" too. This ultimately helps utilities to engage with customers on a personal level, which helps bridge the ever-present divide between residents and government.

Water is more than just a service that utilities provide; it is a human right and a necessity.

A CASE STUDY ON TOLEDO'S RESPONSE TO THE 2015 HAB

Public trust often crumbles when cities face a public health crisis of the magnitude of Toledo's harmful algal bloom (HAB) in 2015. Toledo's water utility, however, serves as a model for other cities for turning crisis into opportunity. Though Toledo has sufficient capacity with chlorine disinfection facilities to treat the HAB, the mistrust between the city and its residents posed a challenge for the community and their ability to move on from the incident. The anxiety and fear that the Flint water crisis spurred has compromised the credibility of many utilities in the Great Lakes region. Toledo addressed this mistrust by rolling out a robust and transparent communications strategy that empowered constituents to stay informed on the city's water quality and participate in decision-making processes around water city water. This not only quelled residents' fear about the usability of their water, but it also built resident trust in the municipality.

When cities work to build trust with residents, involve them in the decision-making processes, and stay connected to larger regional networks, they are better able to address the most pressing of problems. This benefit extends to other aspects of city governance, and the lessons learned are widely applicable to public crises of all kinds. Toledo's experience demonstrates three principles of community engagement best practices: data transparency, developing authentic relationships with stakeholders, and clear channels of communication with constituents:

Data transparency: Present data in a way that is clear and easy for residents to understand. In the case of the HAB, the data was clear and uncontroversial enough to be useful in gaining public trust: the water was either drinkable, or it wasn't. Toledo now publishes daily water quality data that residents can access at any time. The city has also created a dashboard so that this data remains available to the public, the state, and the EPA.

Developing authentic relationships with stakeholders: One communications campaign did not strengthen Toledo's relationship with its residents alone, but the city did strategically employ community partnerships to gain public trust. The city formed a stakeholder group that gave residents real power over how the city would handle the HAB and other water utility issues. Allowing the public to be a part of the solution to the problem shifted both the optics and real decision-making processes around ownership and responsibility of city water.

Clear channels of communication: Toledo has made an earnest commitment to be responsive to resident inquiries. Toledo's public utilities were deeply involved with the call center when it was revamped into "Engage Toledo" using the SeeClickFix platform. The call center is staffed by highly competent customer service agents who have improved tracking and progress updates for residents. In this age of increasing connectivity, it is vital that cities carry their transparency across all platforms. For Toledo, this meant creating both online and interpersonal mechanisms to keep their residents aware of the water quality in the city and to demonstrate the city has nothing to hide.



The EPA has released a report called “Energy Efficiency in Water and Wastewater Facilities” which outlines many steps that cities and utilities can take to increase the efficiency of their water and wastewater infrastructure.⁷⁷ Cities and utilities can install efficient pumping systems, use downhill energy capture (a form of hydropower that captures the energy created when water moves downhill through motors), and strategic water storage to avoid pumping at peak times. Water treatment facilities can also ensure that their Supervisory Control and Data Capture (SCADA) systems are up to date, as this is a foundational water monitoring system that gives utilities a more accurate read on how and where water is used. One of the simplest steps water facilities can take to improve their efficiency is replacing lights and lighting systems with LEDs on timers to reduce facility energy consumption.

There are further efficiency opportunities within wastewater treatment. Sheboygan, WI upgraded its aging wastewater treatment infrastructure to invest in a micro-turbine system that burns biogas produced by the plant’s digesters, resulting in 20 percent less energy use compared to pre-installation baselines. This saves the utility up to \$63,000 annually, and has made the plant 70 to 90 percent self-sufficient in energy production.⁷⁸ Several utilities, including The Metropolitan Water Reclamation District of Greater Chicago, are also using purified biosolids extracted during the wastewater treatment process. For instance, the MWRD used a blend of biosolids to make nearly 12,000 cubic yards of custom topsoil that were applied to Maggie Daley Park in Chicago to keep it flourishing and appealing to residents and tourists alike.⁷⁹

The efficiencies built into an IWM approach can also lead to important reductions, particularly reducing the amount of energy required, the volumes in the system, and the emissions that accelerate climate change.

Reducing Leaks and Infiltration/Inflow

Currently, a significant amount of drinking water is lost due to leaks, and wastewater systems experience inflow and infiltration,⁸⁰ which reduces revenue or raises costs. An estimated 14 to 18 percent of municipal drinking water is lost through leaks, inaccuracies in tracking, and unauthorized use.⁸¹ The same metric has not been estimated nationally for I/I, but its effects are significant for wastewater systems.

Several approaches to leak detection, from low to high tech, can assist drinking water utilities in reducing non-revenue water loss and wastewater utilities in addressing infiltration of fresh water into sewer laterals. One tool for drinking water utilities is a thorough water audit, which identifies leaks, unauthorized consumption, or authorized non-revenue use like firefighting by using the methodology developed by the International Water Association and the American Water Works Association.⁸²

It is important for utilities to focus their efforts on reducing “non-revenue water” on fixing leaks and addressing non-payment by large commercial water users rather than penalizing any low-income households that are simply connecting to the system for the water needed to survive.

The efficiencies built into an IWM approach can also lead to important reductions, particularly reducing the amount of energy required, the volumes in the system, and the emissions that accelerate climate change.

Utility or city staff can also integrate GIS technology with records about various factors affecting pipe integrity in order to map and then proactively repair areas of the water system most likely to break. The Innovation Team in Syracuse, NY worked with the Data Science for Social Good fellowship based at the University of Chicago to develop a predictive modeling system of the City's drinking water pipes that included data about pipe material and age, soil type, and other factors that weaken pipes.⁸³ Using this system, crews were able to prioritize repairs on the water mains identified as most likely to break.

A major tool to find efficiency in improvements is taking advantage of other infrastructure updates, such as the installation of necessary transit, electrical, or other needs along or under streets. Cities can also prioritize effective communication between municipalities to realize possible savings. Cities can take advantage of the dig by systematically installing green infrastructure when upgrading streets, especially in the form of curb bump-outs and medians. A handful of US cities have adopted this approach- often called "green streets" - to weave green infrastructure into the core fabric of all street projects, including Portland, and Dallas⁸⁴.

Utilities can require crews to test the integrity of nearby pipes as a routine step in any project. This approach offers a growing number of higher-tech tools, some of which install sensors or use sound waves to locate leaking pipes. Upgrading water meters to report usage in real time, or close to it, can also help identify leaks both on the user's side of the meter and between meters in the system. Los Angeles' One Water Plan⁸⁵ helps get buy-in across departments on complex projects. For example, the city was sued over sidewalks in bad condition, and LA Sanitation saw an opportunity to work with the state, the drinking water utility, and LA's Streets Department to integrate green infrastructure into repair projects.

Explore Land-Based Solutions

Land-based methods can also generate efficiencies by reducing the treatment load in both water and wastewater systems. Source water protection, which often

means buying conservation easements along waterways upstream of a city, can reduce the treatment burden at drinking water plants. Working with landowners upstream to encourage installation of good management practices is also effective. New York City implemented Riparian Buffer Protection Programs, through which the owners of property adjacent to source water received landscape redesign services in exchange for a commitment to not mowing their lawn their lawn, helping to avoid erosion.⁸⁶

At the other end of the system, green infrastructure added to service areas with combined sewer systems can reduce the volume of stormwater that ends up in the wastewater system. This can provide its own benefits like aesthetic and air quality improvements,⁸⁷ have positive health impacts, and help avoid costly fees for violating consent decrees or other regulatory mechanisms. A study of green infrastructure in Lancaster, PA projects "a value of more than \$120 million in avoided gray infrastructure capital costs and nearly \$5 million in annual benefits beginning after the 25-year implementation period."⁸⁸ Additionally, their green infrastructure provided an estimated \$2.8 million in benefits annually while avoiding over \$600,000 in wastewater treatment costs.⁸⁹

Following Pittsburgh's consent decree that the municipality incorporate green infrastructure solutions to lower construction costs, an opportunity emerged to improve the natural and built environment while providing employment and job training programs in the city. Landforce, a Pittsburgh-based community development program, provided employment to over 50 crew members who had faced barriers to entering the workforce. Through projects in 16 neighborhoods, crews have restored natural landscapes in the city that reduce and treat stormwater runoff and flooding, resulting in tens thousands of gallons of stormwater being captured and diverted annually in the city. In addition to saving money and bringing economic benefit to the area, over 87 percent of crew members have directly moved onto future jobs by the end of the season.⁹⁰

CITY SOLUTIONS: INCREASING REVENUE

Raise Rates Adequately and Equitably

Since the decline in federal funding for utilities, the rates paid by residents and commercial users for services are the primary revenue mechanism for most utilities. This presents significant challenges for utilities, as the decline in federal investment has increasingly meant that full costs of operations, maintenance and capital investments must be carried by people and companies. Depending on utility governance, elected officials may have a large role in decision making about when and how rates are raised. Since the mid-1990s, a gap between these costs has widened and now utilities spend about twice as much on operation and management as on capital projects.⁹¹ Local leaders must understand the basics of rate-setting, especially options for rate structures and affordability considerations.

Water rates have become increasingly unaffordable for low-income residents across the U.S. The need for affordable water is profound: an estimated 14 million (12 percent) of U.S. households have water bills that are too

expensive, or above the EPA's recommended threshold of 4.5 percent of household income.⁹² Unlike for energy, there is no federal assistance available for individual ratepayers struggling to afford drinking, waste, and stormwater bills. Given the core responsibility of municipal governments to provide safe water to their residents at rates they can afford, and the devastating impacts that water shutoffs have on low-income people, this is a critical issue that must be addressed. For example, the Pittsburgh Water and Sewer Authority passed a moratorium for water shutoffs for low-income residents during winter months which not only ensures reliable water service but also ensures the ability to keep their homes heated.

Strong affordability policies are also good for the bottom line of our utilities, in part because receiving an affordable payment from a customer is preferable to bill default. Groundbreaking income-based rate-setting structures like that of Philadelphia (see text box) have proven to actually increase the revenue generated by the utility. When residents can pay their bills, the revenue flowing into the utility increases. Additionally, many utilities offer customer assistance programs to address the cost of water service. A key challenge with these programs is ensuring eligible customers sign up to take advantage of program offerings.

PHILADELPHIA, PENNSYLVANIA'S TIERED ASSISTANCE PROGRAM

Philadelphia's approach to keeping utility bills affordable through the income-based Tiered Assistance Program (TAP) offers an exemplary model for cities. TAP groups ratepayers into tiers based upon their income level in relation to federal poverty levels (FPL). Customers who are at 0-50 percent of the FPL have their bill capped at 2 percent of their monthly income. Customers' rates at 51-100 percent of the FPL are capped at 2.5 percent of their monthly income. Customers whose income is 101-150 percent of FPL have their bill capped at 3 percent of their monthly income. Finally, TAP caps monthly bills at 4 percent for customers who are at 151 percent or more of the FPL. In addition, TAP doesn't require interest payments and late fees on past due bills (from before the implementation of TAP) if customers pay their bill in full and on time for 24 months. Customers at 151 percent or above the FPL also have the ability to apply for special hardship assistance.⁹³

This affordability initiative means that customers will have continued water service and no longer have to choose which bills to pay.⁹⁴ Not every state allows different rate structures among the same customer type, given the complex legal requirements or precedents that can limit their use. State regulations often stipulate that rates must be structured based on the true cost of service. While not every city can pursue a water affordability program, a good first step is to explore if state law and other barriers might restrict pursuing this program.

Rate-based programs like Philadelphia's are the gold standard for such programs because they address the issue of affordability at its roots, charging residents a small percentage of their income. Unfortunately, not all states allow income-based programs. Some states' legislation remains unclear about whether a water utility can use revenue generated from rates to fund assistance programs to a subset of the ratepayers.⁹⁵ While income-based affordability rate-setting is the most comprehensive way to ensure residents can afford their bills and continue to receive water service, cities can implement some stopgap tools that can at least provide some short-term relief to residents in crisis. A 2016 Environmental Protection Agency report about outlined some examples of customer assistance programs, including rebates or direct installation of efficient fixtures and temporary assistance programs.⁹⁶ Portland, Oregon, as one example, provides a \$150 crisis voucher per year to customers and offers an income-based discount program for households.⁹⁷

Structure Rates to Promote Affordability and Conservation

City and utility leaders must select a rate structure that covers the utility's capital and operational costs and that is affordable for all residents. Most utilities can and do charge a different rate for residential versus commercial customers. There are a handful of rate structures in widespread use, each geared to different outcomes. The Environmental Finance Center at UNC currently has data on rate structures within 12 different states on their website.⁹⁸ For the 2786 water systems they survey across seven states, the most prevalent rate structures they identified were:

- ✓ Uniformity, where every 1,000 gallons is charged at the same rate, is used by 40% of utilities. This structure allows utilities to predict income most reliably, but is regressive because it charges low-income families the same rate as large-scale industrial users. Uniformity also fails to send cost signals to incentivize conservation.
- ✓ Increasing Block rates where those with larger volumes of use incur higher per-gallon rates. This structure addresses the inequality of uniformity. About a third of water utilities use this.
- ✓ Decreasing Block rates where the price per 1,000

gallons decreases at larger volumes. Used by 26% of drinking water utilities, this incentivizes high-demand industrial users and wasteful outdoor irrigation by reducing the rate at higher tiers of usage.⁹⁹

These structures can be set up to capture revenue in a way that is more responsive to customer usage than flat fees or uniform rates, but the higher degree of variability built in can make it harder for utilities to project revenue and budget appropriately for O&M. There are a variety of alternative pricing models that utilities can consider to increase their resiliency in the face of fluctuating demand. One such example is the PeakSet Base system, which removes the financial penalty from utilities when customers are consumer more efficiently.¹⁰⁰ Under this model, the base rate is set based on prior consumption, and ultimately, "better balances the oftentimes conflicting pricing objectives for revenue recovery/stability and customer conservation."¹⁰¹

Utilities that are not bound to the cost of service standard should explore conservation pricing to ensure the long-term sustainability of water resources, even if the supply is not currently a concern. Conservation pricing refers to a toolkit of rate structures that encourage conservation by reducing a user's rate when they use less or avoid usage during peak system demand. A quarter of drinking water utilities use some form of conservation pricing, which includes increasing block rates (users are charged a higher rate with increasing usage), time of day rates (charging a higher rate during peak demand periods), water surcharges (charging a fee for usage in excess of regional averages), or seasonal rates (charging higher rates in the summer).¹⁰²

When implementing a conservation price structure, it is critical that utilities calibrate rates to still recoup sufficient revenue despite the desired reduction in demand. It is important to take income level into account when considering conservation pricing. A low-income person might use more water than others due to a variety of factors, including (but not limited to) larger household sizes and lower efficiency due to leaks, broken meters, inefficient toilets, and more. Cities should make sure that low-income residents should have the ability to increase the efficiency of their household water infrastructure. Any programs around affordability must also prioritize avoiding punishment for larger households, especially larger low-income families, putting a strain on their ability

to pay their water bill.

Utilities that can establish different rates should use that flexibility to implement additional options for low-income households. For more detailed information about the legality of various customer assistance programs for public water utilities in all 50 states, refer to the UNC Environmental Finance Center report listed in the Resources section at the end of this report.¹⁰³

When introducing both rate increases and assistance plans, deliberate and targeted communication with community stakeholders is crucial. City and utility leaders should survey the socioeconomic data of their community to determine the best rate structures and assistance programs to meet community needs. Direct dialogue with community leaders can also shed light on selecting an appropriate assistance program. Further, utilities and city leaders should roll out robust communications and community engagement strategies to ensure that constituents are aware of rate structure changes and their potential eligibility for assistance programs. Enrollment in assistance programs should be as transparent and simple as possible and should not, if possible, require government-issued identification (this disproportionately excludes undocumented residents and residents of color). Finally, utilities should maintain comprehensive customer assistance helplines to respond to questions and concerns.

Implement Impact Fees

A number of utilities are expanding their use of impact fees. This is a fee charged either one time to developers during construction, such as to cover the cost of a new connection and system expansion, or to the property owner on an ongoing basis, such as through stormwater fees based on the property's impermeable surface area. Philadelphia, PA developed one of the first stormwater impact fees, assessing a fee to both residential and commercial properties based on the amount of impervious surface area.¹⁰⁴ Under state law, all cities in Texas mandate a connection fee for new construction. The city of Austin, TX recently raised the fee for new housing developments to meet revenue requirements from the state and to help increase city water utility revenue.¹⁰⁵



Establish a stormwater utility

Stormwater utilities in the US are becoming more common, with a 2018 Western Kentucky University study indicating around 1,681 stormwater utilities across the country.¹⁰⁶ Stormwater utilities can be an effective and dedicated source of funding for stormwater management programs and infrastructure investments. Often, utility fees are often calculated by estimating each property's impervious surface (rooftop, driveway, etc.). Since a fee is charged on the basis of use, it is not considered a tax.

Stormwater utilities create a stable revenue stream for addressing stormwater-related problems. Fees generate revenue to meet program needs and to reduce reliance on general funds. Additionally, this structure collects fees from tax-exempt properties. Stormwater utility fees are the most equitable way of paying for stormwater services.

Alternative Sources of Revenue

While rates will undoubtedly generate the bulk of revenue, utilities can pursue many creative and often environmentally sustainable tactics to supplement revenue.

- ✓ Generating surplus renewable energy - Oakland, CA's East Bay Municipal Utility District has the first water treatment facility that is a net producer of energy, procuring food scraps to power twelve biodigesters.¹⁰⁷ This innovative strategy to divert organic waste and generate energy also brings in about \$500,000 in annual electricity sales.¹⁰⁸ The Portland Water Bureau (PWB) generates enough energy to power 150 homes by operating turbines in several of its water mains; the private company that installed and maintains the turbines, Lucid Energy, currently sells the energy to Portland's electric utility and shares a portion of the profits with the PWB.¹⁰⁹
- ✓ Selling fertilizer from wastewater biosolids - Several utilities, including the Western Virginia Water Authority¹¹⁰ are using purified biosolids extracted in the water reclamation process to produce and sell fertilizer.
- ✓ Leasing utility-owned property or services – The Water Research Foundation has identified other ways to leverage property or in-house expertise. A few examples include water utilities in El Paso, Texas that lease land for ranchers to graze cattle; the Utilities Commission in Orlando, Florida contracts with the City to service police vehicles in its fleet shop; utilities across the country rent out space on water towers for cellular antennas; and utilities with lab space contract with smaller utilities that do not to provide testing services.¹¹¹

While rates will undoubtedly generate the bulk of revenue, utilities can pursue many creative and often environmentally sustainable tactics to supplement revenue.

Partner with Other City Departments

As described in the sections on IWM, water utilities can and should partner with other city departments to make the most out of limited budgets. Utilities can partner with economic or workforce development agencies to create job training programs to hire qualified operations staff while saving on turnover and training costs. Water utilities that partner with streets departments to sequence pipe repairs with street repairs may be able to share the costs of digging and street repair. The economic benefits of clean surface water and aesthetic enhancements of green infrastructure could each be incentive for a partnership with economic development agencies. In one example of this thinking, the Environmental Services Department and Parks & Recreation, Planning, and Community Development Departments of Grand Rapids, Michigan formally partnered in an MOU to leverage funding and labor costs to upgrade stormwater infrastructure while improving recreational opportunities in Joe Taylor Park.¹¹²

LEVERAGE FINANCING

The primary financing tool for capital projects is the use of municipal bonds. Through this tool, a utility can borrow large sums at a relatively low interest rate (compared to private sector borrowers) by pledging its future rate revenue.¹¹³ The borrowing costs are lower in part because the repayment periods are much longer than for a typical loan; as many as thirty to fifty-year periods are common. However, not all utilities have equal borrowing power. Because the major credit rating firms rate utilities based on the ability of their customers to actually pay that revenue and other factors affecting credit worthiness, utilities face challenges to access in shrinking and/or very high poverty cities.

INNOVATION WITH CONVENTIONAL MUNICIPAL BONDS

DC Water, the utility serving the Washington, D.C., region, utilizes a range of mechanisms built on the conventional municipal bond structure, including century bonds, green bonds, and environmental impact bonds. The utility continues to be an innovator among public water utilities, issuing the first municipal century bonds (municipal bonds that are paid off over 100 years, in contrast to the more typical 30 to 50 year repayment periods) to pay for a very large stormwater tunnel project as part of the \$2.6 billion total DC Clean Rivers Project.¹¹⁴ The century bonds will contribute to underground stormwater infrastructure, including the construction of 13 miles of tunnels that are designed to last well beyond the bond period without requiring significant maintenance. Additionally, these bonds were certified green, leveraging the growing “green bond” market of certified environmentally-sustainable investments.¹¹⁵

DC Water has also experimented with environmental impact bonds (EIB), which pair the conventional municipal bond structure with an additional performance contract – a version of the “pay for success” models sometimes used for social services.¹¹⁶ DC Water found a market among private investors for its EIB focused on the use of above-ground stormwater infrastructure as part of its DC Clean Rivers Project, namely low-impact development and use of green infrastructure tools. Private investors are lending \$25 million to the project and will receive \$3.3 million in an “outcome payment” if runoff is reduced by more than 41.3 percent. If runoff is reduced by between 18.6 and 41.3 percent, investors will recoup their investment with no additional outcome payment. If runoff is reduced by less than 18.6 percent, investors will make a \$3.3 million “risk share payment” to DC Water.

Consider Using Green Revolving Funds

Green revolving funds use initial seed capital to fund municipal energy and water efficiency projects, which then generate savings on operations bills – savings that are then added back into the revolving fund to pay for the next round of projects, thereby creating a fully municipally-run source of capital that also incentivizes water and energy efficiency.¹¹⁷ Green revolving funds have been used extensively in higher education, and now in the City of San Antonio, Texas for drinking and wastewater systems.¹¹⁸ San Antonio's fund was started in 2011 using American Recovery and Reinvestment Act funds to catalyze energy conservation projects, and currently, about \$1.2 million is returned to the fund each year.

Access State and Federal Sources of Subsidized Grants or Loans

Utilities can apply for a variety of funding sources to access subsidized capital from federal and state agencies. These programs are structured such that the more federal sources you can leverage for co-funding, the more favorably each given federal agency will look upon a particular capital project. Here is a partial list of the federal funding sources available:

- ✓ **State Revolving Funds (SRFs)** –SRFs are federally-funded, state-administered programs providing subsidized loans (and occasionally grants) to utilities. The Drinking Water SRF program funds drinking water utilities to install or replace treatment plants, storage facilities, distribution systems, and other infrastructure that will increase compliance with the Safe Drinking Water Act requirements.¹¹⁹ The Clean Water SRF program funds wastewater utilities to construct publicly owned treatment works and improve energy efficiency at plants, and funds any entity to address nonpoint source pollution, stormwater management, water reuse, and decentralized wastewater treatment projects.¹²⁰ However, some cities find the cost of capital to be uncompetitive, and the paperwork involved in SRF applications unduly cumbersome.
- ✓ **CDBG** – The Housing and Urban Development Administration awards Community Development Block Grants to cities for “long-term needs to repair, construct, or buy public infrastructure.”¹²¹

- ✓ **USDA Rural Development Grants** – The USDA provides long-term, low-interest loans for drinking, waste, and stormwater infrastructure to rural areas, although it is worth reviewing if your area is included (e.g. towns of populations up to 10,000 are considered eligible).¹²²
- ✓ **WIFIA Financing** – Signed in 2014, the Water Infrastructure Financing and Innovation Act's basic premise is to support very large/expensive projects with subsidized financing.¹²³ While administered separately, WIFIA is designed to work closely with SRF programs, and can finance up to 49 percent of eligible projects. The program is still in its early stages, but in its second year, 39 projects were invited to apply for loans totaling up to \$5 billion.¹²⁴
- ✓ **State-specific resources** – State-based financing opportunities change frequently, but the Environmental Finance Center Network maintains a list of potential infrastructure financing opportunities, with resources specific to various regions or states.¹²⁵
- ✓ **Looking outside the typical water financing streams** – Utilities can explore partnerships with other agencies to access some portion of financing for other infrastructure upgrades. For example, Seattle, Washington incorporated a green infrastructure installation as part of its design criteria for the Mercer Street Corridor project, which was awarded a grant through the transportation-focused TIGER program.¹²⁶

Explore Resilience “Bonds”

Resilience or catastrophe bonds are financial tools that leverage bets by investors that a given disaster (say, \$X million in hurricane damage, or a storm surge Y feet in excess of the constructed sea wall) will not happen over the given bond term, usually less than five years.¹²⁷ If the disaster does not happen, the investors receive a better-than-average rate of return; however, if the pre-defined level of disaster occurs, the insurance purchaser receives the original capital as a payout to cover financial losses from the event. These bonds have not yet been used widely, though the New York Metropolitan Transit Authority was the first municipal entity to purchase one in 2013 to assist with Hurricane Sandy recovery.¹²⁸ Given

the high capital costs involved with centralized water infrastructure, resilience bonds may become a more promising financing tool, especially for cities located along the coast or inland waterways.

CITY SOLUTIONS: WORKFORCE DEVELOPMENT AND GOVERNANCE

BUILD CAPACITY

Adequately staffing a water utility is crucial to its capacity to function effectively. Staffing includes those employed by the utility in both permanent and contract positions, across blue collar, management, and consulting roles. Cities struggle with issues related to workforce development or staff capacity and a loss of expertise. Succession planning with current employees is a tool to maintain and prevent further loss of workforce skills. Utilities must continuously keep track of employees eligible to retire within the subsequent four years, as well as key vacancy opportunities. This will help utilities maintain a productive balance between institutional knowledge and the inevitable energy and new ideas of newly hired staff.

City utilities should also invest in the development of a strategic plan, and consider staffing utility leadership to fulfill the roles of a Director of Strategic Development. Someone in this role will look beyond profit-driven incentives towards the complete functionality and holistic management of their utility. As a leader in this role creates and implements the strategic plan, different sectors of the utility are more likely to communicate, understand each other's roles, and more effectively work towards delivering safe drinking water to its residents at rates they can afford. This person would also develop and execute a communication plan to relay the performance, success, and transparency of a utility. A communication plan should ensure that the voices of those who have been historically silenced are heard, understood, and served.

Utilities should also develop adequate emergency plans to address risks of varying degrees of intensity under the context of operating rules and policies. These plans should include employee training to be completed within the first two months of employment. All employees must be tested and fully knowledgeable of all emergency actions plans and aware of where all emergency exits are located. Utility employees that will be working in any capacity in the field must be OSHA certified, with yearly re-certifications undertaken. Employees tasked with the handling of hazardous waste materials must be OSHA HAZWOPER certified before the interaction with said materials or working on any hazardous sites. These certifications are not only good practice, but essential in promoting worker protections.

Adequately staffing a water utility is crucial to its capacity to function effectively.

WORKPLACE CULTURE

City leaders, and especially utility leaders, should advance a culture of professionalism within water utilities. A positive working environment fuels good work ethic, collaboration, and sustainable outcomes. Employee morale is crucial in going beyond what is expected of a water utility and in developing innovative advancements. Strong leadership is necessary for employee morale to infiltrate throughout the entire utility. Staff are a utility's best asset for informing their communities about utility plans and adding credibility to the department. Leaders can empower workers and show their value to the department through smaller-scale yet key actions, such as coffee chats, town hall updates, birthday cards, employee surveys, certificates of appreciation, and visits by management to project sites. Management must be properly trained on how to establish trust with employees to truly foster a collaborative and community-focused work environment.

A crucial role of utility leadership is that of hiring and training new employees. It is key to have a strong human resource department comprised of leaders that are committed to imparting their institutional knowledge to new employees and building the capacity of their colleagues with energy and vision. Water utility staff must be willing to collaborate and cooperate with departments across the city and with other utilities across their watershed. When water utilities are part of interdepartmental municipal conversations, a city's water concerns are fully integrated into its vision and goal and are not ancillary.

Cities might also consider the apprenticeship model to develop the skills of their workforce. Utilities can receive funding from a variety of sources, including private foundations and the federal Department of Labor, to establish formalized apprenticeship programs to create clear career pathways to work in water utilities. While apprentices learn the ins and outs of water utility management, they are also paid for their time with family-supporting, fair wages.

Grand Rapids, Michigan offers an excellent example of investments in training by offering its water resource recovery technician training ten times each year to staff of local utilities. The City has expanded this training to residents ages 15-24 through the local community college's "To School, Through School" program. Additionally, the program is supported by the water technician's union. Detroit, Michigan's utility partners with a local vocational training program to train recent high school graduates, and a staff trainer has successfully cultivated several young employees for the utility.

CASE STUDIES

The three cities highlighted here exemplify solutions that shore up robust public water systems, and describe how they have or are approaching the varying challenges in accomplishing this.

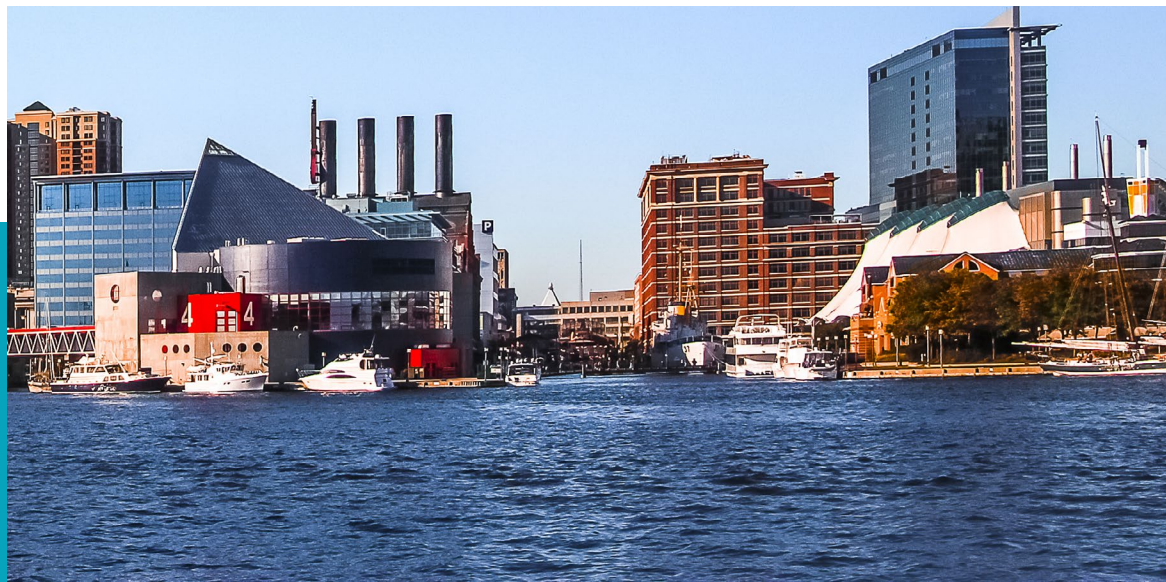
BALTIMORE, MARYLAND

Baltimore's experience illustrates the dilemma that exists for many municipalities: because cities often do not have the financial capacity to issue debt and because raising water rates is challenging because of affordability concerns, they may consider water privatization. Facing critical infrastructure needs and lack of funding to meet them is a story many American cities know too well. Companies often offer significant upfront payments, marketed as avenues to address city budget gaps. This approach, as mentioned in the Privatization in the Context of Water section, is widely understood to have significant negative impacts across a range of issues. Baltimore tackled this complicated set of issues and became the first large municipality in the US to ban water system privatization.

In 2017, Suez Water, backed by the private equity firm Kohlberg Kravis and Roberts, proposed privatization of the City of Baltimore, Maryland water system. Suez promised a \$2 Billion upfront payment to the City – a significant sum and attractive in helping the City with other financial priorities. The population of the Baltimore metropolitan area was just under 2.8 million at that time, making it the 20th largest metropolitan area in the country and part of a thriving region. The independent City of Baltimore, with a population of 600,000, however, has faced financial and economic challenges for decades as residents and businesses have moved out to surrounding counties, as a part of the national trend of white flight affecting so many cities.

Baltimore's water system is one of the city's most valuable assets. A number of citizen advocacy groups and environmental advocates, most notably Food and Water Watch, strongly opposed water privatization. When the Baltimore proposal came to light in the press, it became nearly impossible for the mayor at that time, Catherine Pugh, to support. The deeply unpopular prospect of turning over such an essential public resource to a profit-driven corporation, and in particular the prospect of skyrocketing rates post-privatization, stopped the deal in its tracks. The City went even further in rejecting privatization by proposing an amendment to its City Charter to permanently ban the most extreme forms of privatization of the water system. The charter amendment was approved by City voters through a measure put on the ballot in the November 2018 election.

Baltimore, MD



This move reassured residents of the City’s commitment to public water. Baltimore is among the first municipalities to take such bold action to prevent privatization, with the notable and important exception of the 2016 ban on privatization by the City of Northampton, Massachusetts, passed via local ordinance. After the charter amendment referendum in Baltimore was approved by the voters, the City Department of Public Works, which operates the water system and is controlled by the City Mayor, announced a rate hike of 30% to take effect over the next three years. The City Council has opposed this plan, offering an alternative proposal with caps and sliding scales for low-income residents. The Water Accountability and Equity Act, which was introduced by the Council President Young in December 2018, calls for establishing a “Water-for-All Discount Program”, which will help low- and moderate-income customers pay their water and sewer bills. It will also create new avenues for customers to resolve billing disputes and errors. The ordinance has been scheduled for a public hearing in May 2019. And the question remains if the City will be able to fund its infrastructure needs with increased water rates alone.

Rather than selling off this key public resource, Baltimore was able to make the choice of avoiding privatization. In November 2019, the City passed the Water Accountability and Equality Act to ensure that revenue-generating resources like their water systems remain in the public’s hands—allowing for more equitable, flexible, and democratically-decided solutions to these challenges.¹²⁹ This passage demonstrates how keeping water publicly-owned and by involving residents in decision-making can lead to transformational change that prioritizes equity.

PITTSBURGH, PENNSYLVANIA

In late 2017, Pittsburgh’s water system was at a critical juncture. Facing multiple, serious drinking water issues, a high level of public concern, and increasingly vulnerable infrastructure, the City and the Pittsburgh Water and Sewer Authority (PSWA) needed both immediate fixes and long-term solutions that could help them provide clean, healthy, affordable water service while preserving public accountability.

The Mayors Innovation Project worked directly with the City of Pittsburgh and PWSA to explore options for retaining public control of the authority. In brief, the Mayor of Pittsburgh had issued an RFP asking for proposals for addressing issues within the PWSA, in light of its highly vulnerable infrastructure, lead contamination issues, high debt load, and perceived disorganization and lack of capacity. The winning bidder (IMG) issued a report recommending a version of privatization, while at the same time People’s Gas was working behind the scenes to try and buy PWSA. In partnership with the Water Center at Penn, our report proposed alternative public solutions that addressed the concerns around PWSA while supporting the relatively new board and management team that have been working hard to address the multitude of problems the authority faces. These recommendations were adopted in large part by the Mayor’s Blue Ribbon Panel, whose recommendations were accepted by the Mayor.



Pittsburgh, PA

In particular, our report honed in on three main areas of concern: governance, operations, and infrastructure. For each of the three areas, we recommended a holistic approach that addressed foundational dysfunction within the utility structure as well as shorter-term fixes that could alleviate the most pressing issues at hand. For instance, our long-term recommendations on utility governance largely focused on employee hiring, training, retention, motivation, knowledge management, supervision, and integrated expertise. Shorter-term fixes acknowledged a potential need to outsource gaps in expertise, but emphasized that such outsourcing should be conducted only on a temporary basis.

Utilities face an enormous amount of pressure to privatize when they are underperforming. Pittsburgh's work illustrates that utilities can find alternative public solutions through financing models, finding efficiencies, and infrastructure improvements, even in the face of public scrutiny.

SOUTH BEND, INDIANA

South Bend, Indiana is a city of 100,000 on the St. Joseph River, near its southernmost bend, from which it derives its name. Like many Midwestern cities, its population has declined since its peak in 1960, with most of a 25% decline occurring between the 1960s and 1980s. Mayor Pete Buttigieg, elected in 2011, has prioritized economic development, education, blight and violence reduction, and sustainability initiatives like Complete Streets. Despite a set of significant challenges across governance, finance and infrastructure, South Bend has made progress on several fronts of water issues, and their experience is illustrative to many cities facing similar challenges.

South Bend operates both a drinking water utility and wastewater utility that also serve nearby municipalities, and incorporates stormwater management into both its wastewater utility and its Engineering Department, all under the Division of Public Works (DPW). Despite being housed in the same department, there is siloing between environmental services (drinking, waste, stormwater utilities), sustainability planning, engineering, and the external manager of the CSO system. The city has continuing needs for maintenance and faces a significant liability to meet regulatory requirements for stormwater management under a consent order related to combined sewer overflows (CSOs) contaminating the St. Joseph River.

The South Bend Bureau of Sewers manages wastewater and stormwater through one treatment plant and 590 miles of sewer pipes (the majority of which are combined sewer and stormwater). South Bend has been implementing a long-term control program. Before this plan, an average of 2 billion gallons of sewage entered the river during 80 CSO events yearly. The scale of these overflows led to a costly consent decree imposed by the EPA, projected to cost the City \$509 million but now totaling more than \$850 million. City leaders are addressing the challenge that the stormwater authority is not funded and local flooding events are more frequent and severe annually.

South Bend, IN



Since the project's beginning in 2008, the City has been better able to focus staff resources on the highest rainfall areas during a storm to prevent overflows. The system uses an array of intelligent sensors and valves to balance the flow and reduce overflow incidents. South Bend became the first city to migrate its sewer system management to the cloud. When a section of the system is under heavy use, this system can divert flow to other, less busy, sections. Via more efficient sewage management this cutting-edge system has helped to save the city an estimated 100 million dollars in new sewage pipes. Additionally, a successful roof leader/downspout disconnection program helped to reduce stormwater flow from properties. Now, South Bend experiences an average of just four CSO events yearly, down from 80. Financial needs to comply with CSO mitigation are overwhelming and the community is generally not amenable to rate increases for either drinking water or wastewater infrastructure investments.

Through working with EmNET, South Bend was able to map, optimize, and automate their current stormwater and wastewater systems. They also were able to identify what type (green, gray, or blue) and where infrastructure updates were needed. Before this process, they received estimates of \$1 billion in investments to meet the consent decree, but in working with EmNET, South Bend is working to renegotiate the consent decree price, as they believe they can reduce the needed cost and meet the requirements of the decree with about a \$250 million investment. This reduced cost will significantly benefit the city, and ultimately, ratepayers as well.

South Bend is also using green infrastructure in some neighborhoods. There is a partnership that has brought together local high schools and colleges in an effort to install green infrastructure while improving STEM education, providing workforce development in GI maintenance, and providing the city with trees for its urban forestry program.

After 10 years without a rate increase, the city moved forward with a plan to stagger a rate increase over two years. This increase will only cover \$23 million of an estimated \$88 million in capital needs over the next six years, a fact that the Water Works advertises publicly. The affordability of water and wastewater services to average and low-income households is a significant concern for the city. The city is trying to track water shutoffs both to diagnose that problem and as a proxy for evictions. They would like to develop an early warning system and a way to provide assistance to households in danger of shut offs and/or eviction, both as a way to maintain service and to help stabilize neighborhoods.

CONCLUSION

Mayors and cities face a host of challenges in maintaining their water systems and fulfilling the core mission of those systems: to ensure access to clean, safe water at rates all people in the community can afford. The solutions for managing robust public systems offered in this brief range from integrating management approaches for water with other goals; to engaging the public in conversations about this valuable resource; to promoting affordability of water services; among many more. Implementing these options can lead to cities that not only have more sustainable, well-maintained, and financially viable water systems, but are also more livable, equitable, and resilient places on the whole.

GETTING STARTED

- ✓ Learn about your city's specific water utility structure and management of waste, storm, surface and ground water, governance structures, and public versus private operations.
- ✓ Assess its financial status: the capital and operating budgets; the rate structure and customer assistance programs; the condition and location of physical assets; and especially the sources of the largest costs and borrowing.
- ✓ Identify opportunities for water management to align with other city priorities, such as economic development, multi-modal transportation, dense land use patterns, and more.
- ✓ Develop policies that integrate water planning into other city functions and projects consistently.
- ✓ Establish formal collaborations within the city, between departments and utilities, and within the region, with other cities, county government, and federal stakeholders.

NEXT STEPS

Building on these steps for assessment and advancement of collaborations, cities should explore the broad range of policies and practices that promote sustainable public water systems:

- ✓ Implement Integrated Water Management (IWM) as a guiding framework to protect and restore water resources: integrate into one utility, realizing the co-benefits of IWM, and collaborating across political boundaries.
- ✓ Engage the community to build trust, promote data transparency, develop authentic relationships with key community stakeholders, and offer clear channels of communications.
- ✓ Assess options for financing, including long-term planning frameworks; improving energy efficiency in operations; reducing leaks and costs of infiltration/inflow; and reducing volume through land-based solutions.
- ✓ Increase available revenue by raising rates adequately and equitably; by structuring rates to promote affordability and conservation; by charging impact fees for development; exploring alternative sources of revenue; and by partnering with other city departments.
- ✓ Promote workforce development programs in utilities that build capacity and advance a supporting workplace culture.

RESOURCES FOR CITY LEADERS

[The City Upstream and Down: How Integrated Water Management Can Help Cities Thrive](#) (American Rivers 2016). This report provides insight from expert city leaders nationwide on how elected officials and utility leaders can best collaborate to implement IWM in cities.

[Pathways to One Water](#) (Water Environment Research Foundation 2015). This brief provides numerous examples of cities transforming how water is managed, breaking down water management integration through a multi-strategy approach.

[The Value of Green Infrastructure](#) (Center for Neighborhood Technology & American Rivers 2010). A comprehensive overview of various green infrastructure tools and their multiple co-benefits, with metrics to quantify benefits by technical and financial standards.

[Integrated Urban Water Management for Planners](#) (Water Research Foundation & American Planning Association 2014). Written from a land use planning perspective, this brief offers a different take on the potential synergy and benefits of integration for water management.

[Tools to Assist Water Utilities with Financial Decision Making](#) (UNC Environmental Finance Center 2016). A clearinghouse of resources related to drinking and wastewater utility financial decisions, including tools to analyze rates and revenue, benchmarking, affordability, and capital finance.

[Utility Financial Sustainability and Rates Dashboard](#) (UNC Environmental Finance Center 2013). An interactive dashboard that compares rate data and financial sustainability metrics for utilities across various states.

[Seven Strategies for Identifying Who is Willing and Able to Pay for Household Water Services](#) (Urooj Ahmad 2017). A set of questions to consider who in your city is unable to pay for water services, conduct more effective outreach to residents eligible for assistance programs, and analyze their effectiveness.

[Drinking Water Infrastructure: Who Pays and How \(And For What?\)](#) (American Rivers 2013). A primer on financing drinking water infrastructure as well as critical insight about how to balance conservation, the need for revenue, and affordability for ratepayers.

[Energy Efficiency in Water and Wastewater Facilities: A Guide to Developing and Implementing Greenhouse Gas Reduction Programs](#) (EPA 2013). A guide by the EPA providing actionable steps cities can and should take to reduce water and wastewater utility GHG emissions and improve efficiency.

ENDNOTES

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