

An Overview of Clean Water Access Challenges in the United States



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Acknowledgements

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The Environmental Finance Center at the University of North Carolina at Chapel Hill is part of a network of university-based centers that work on environmental issues, including water resources, solid waste management, energy, and land conservation. The EFC at UNC partners with organizations across the United States to assist communities, provide training and policy analysis services, and disseminate tools and research on a variety of environmental finance and policy topics. The EFC at UNC is dedicated to enhancing the ability of governments to provide environmental programs and services in fair, effective, and financially sustainable ways.



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EXECUTIVE SUMMARY

In 2015, almost 200 United Nations member countries, including the United States, adopted 17 Sustainable Development Goals, a unanimous commitment to address global issues by improving quality of human life, while also protecting the planet. Sustainable Development Goal 6 serves as a commitment that participating countries ensure access and sustainable management of water and sanitation for all.

While the concept of no access to clean water or sanitation likely conjures an image of a community in a developing country where residents use outhouses, and walk miles carrying buckets of water just to meet basic needs, the problem is not limited to those communities. In the United States, one of the world's wealthiest countries, millions struggle to access clean water or adequate sanitation, and that struggle comes in the form of various diverse challenges. Challenges, which the United States has committed to address by 2030, through its adoption of the Sustainable Development Goals.

		<p>United Nations Sustainable Development Goal 6: Ensure availability and sustainable management of water and sanitation for all</p>
6.1	Provide access to safe, affordable drinking water for all.	
6.2	Provide access to adequate, equitable sanitation and hygiene for all.	
6.3	Improve water quality by reducing pollution, dumping, and release of hazardous chemicals and materials.	
6.4	Increase water-use efficiency and reduce water scarcity.	
6.5	Implement integrated water resources management at all levels.	
6.6	<p>Protect and restore water-related ecosystems.</p> <ul style="list-style-type: none"> • 6.a: Expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities • 6.b: Support and strengthen the participation of local communities in improving water and sanitation management 	

In order to begin addressing Sustainable Development Goal 6, it is important to understand the nature of water and sanitation access challenges in the United States. In every state across the country, there are individual access challenges ranging from lack of household running water to fecal contamination from individual wells, and there are community access challenges ranging from water and wastewater bills skyrocketing to lead service lines still running into the homes of individuals all over the country, despite the grave health risks of lead poisoning.

There are also more access challenges on the horizon as antiquated water infrastructure degrades further, as more severe weather events bring about flooding and threats to property and human lives, and as utilities and local governments struggle to keep up with ever-increasing financial, technical, and operational demands.

Many of the individuals facing water access challenges are low-income, and many are minorities. The struggles of such communities are often overlooked and their voices not heard; thus, many of the water and sanitation access challenges in this country are not being addressed in a comprehensive way. However, there is also much research and good work being done in this area, with many groups on the ground and on a policy level trying to address access issues by working directly with affected individuals. Additionally, utilities and local governments are investigating ways to finance solutions to these challenges. This paper highlights United States water and sanitation access challenges, references current solutions and initiatives, and suggests further options to be investigated and considered.

Figure 1. Solving Access Challenges

Solving Access Challenges Requires Multiple Interventions



UTILITIES

- Primary service provider
- Maintain assets
- Assist vulnerable customers
- Protect community public health and environment



NOT FOR PROFIT SECTOR & EDUCATION

- Facilitating partnerships
- Research and development
- Training new leaders
- Communication



STATE GOVERNMENT AGENCIES

- Assure environmental and economic regulatory oversight
- Support new and emerging governance models
- Strategic infrastructure investment
- Explore role in developing customer assistance programs



CORPORATE & ECONOMIC INTERESTS

- Model utility customer that leads by example
- Research and development



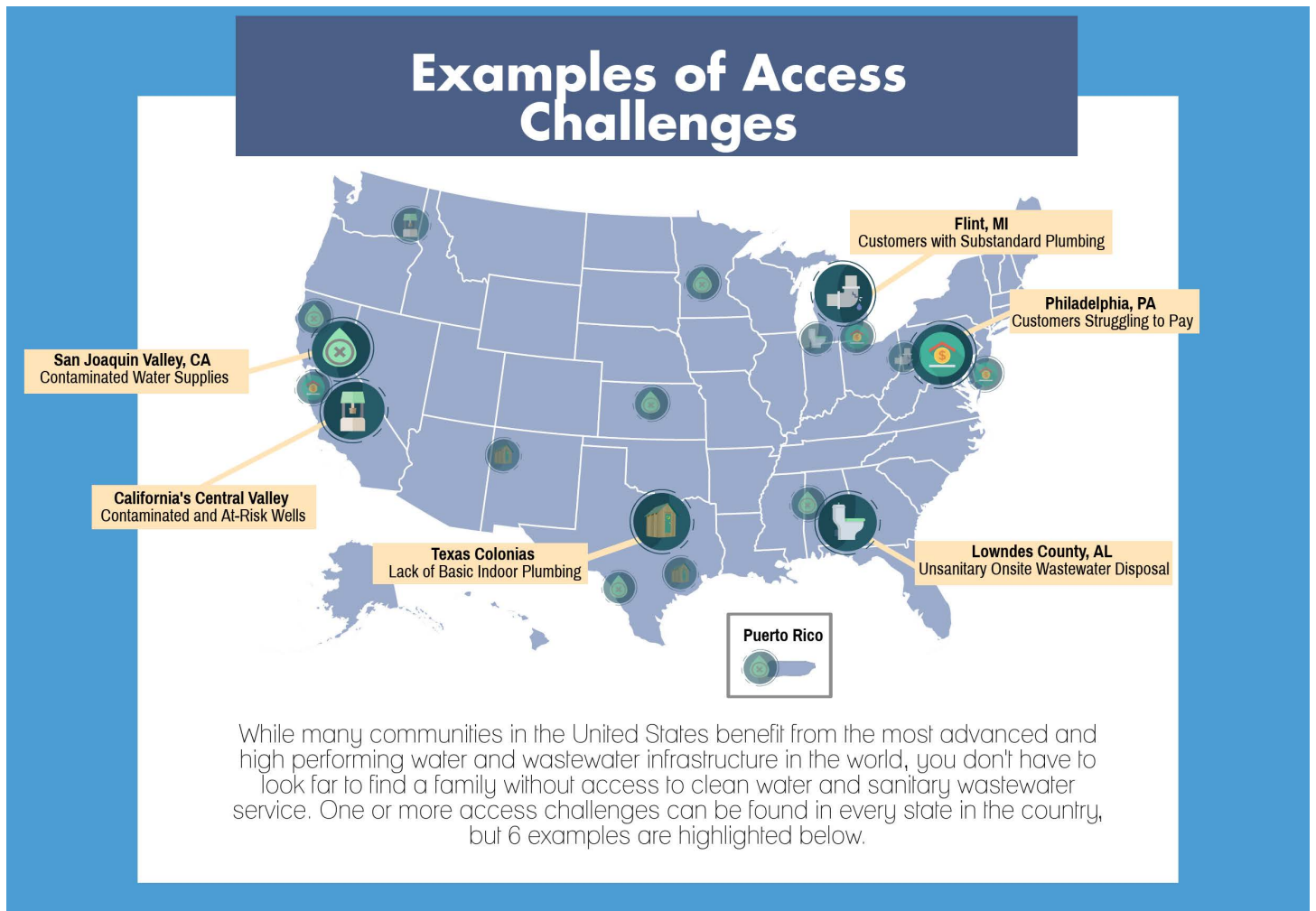
FEDERAL GOVERNMENT

- Research and Development
- Oversee national environmental regulatory framework
- Strategic infrastructure investment
- Explore role in supporting customer assistance programs

INTRODUCTION

The 323 million people that live in the United States rely on a complex array of facilities and service providers for their drinking water and wastewater needs. While great strides have been made in the country since the days when widespread waterborne illnesses and contaminated water bodies posed direct public health threats, many communities and families face significant challenges in gaining and maintaining their access to essential water and wastewater service. At one time, the predominant access challenge in the United States was characterized by a lack of indoor plumbing or basic sanitation. While pockets of the United States population still face these extreme situations, many more face new and emerging challenges to their access that have as much to do with economic and natural resource vulnerability as they do with a lack of plumbing. This paper provides a brief overview of the range of challenges facing communities across the country and the current and potential initiatives for mitigating or preventing those challenges. Addressing each of the access challenges highlighted below would help the US in addressing one or more of the components of Sustainable Development Goal 6, as is noted at the heading of each challenge.

Figure 2. Access Challenges Around the Country



Many communities in the United States benefit from the most advanced and high performing water and wastewater infrastructure in the world. However, it is possible to travel a short distance from a community with an advanced wastewater or water treatment facility and find a family relying on water from a polluted source or wastewater service from an outhouse. According to American Community Survey, an estimated 1.6 million people reported a lack of complete plumbing facilities in their households in 2012.¹ According to the American Water Works Association, at least one trillion dollars in investment is needed to maintain and expand buried drinking water infrastructure over the next 25 years.² As the cost of water and wastewater infrastructure has risen, so have the access issues related to poverty. US Census data from 2014 indicates that nearly 50 million people in the United States lived below the poverty level.³ Even where people have access to some type of water service, there are still significant contamination issues facing communities like Flint, Michigan, with lead in its water, or the Navajo Nation with uranium in its water. And there is the added concern about the scarcity of water, particularly in western regions of the US. Based on a study conducted between 2012 and 2014, California just experienced its worst drought in at least 1,200 years, with more than 40 percent of the state placed in the highest category, “exceptional drought.”⁴ With all these simultaneous struggles, there is no question that the problem of insufficient access to clean, safe, affordable water and wastewater services is real.

DIVERSE ACCESS CHALLENGES THROUGHOUT THE COUNTRY

There are many ways to dissect and further understand access problems in order to begin to address them with practical on-the-ground solutions. For example, some types of access challenges are driven by the declining capacity of community water systems to provide service to their customers while other access problems can be traced directly to individual household obstacles or conditions. In some cases, the same type of access problem exists for both water and wastewater services, and in other cases, there are important distinctions that require separate consideration.

¹ https://www.washingtonpost.com/news/wonk/wp/2014/04/23/1-6-million-americans-dont-have-indoor-plumbing-heres-where-they-live/?utm_term=.16dcd2fe91e4

² <http://www.climateneeds.umd.edu/reports/American-Water-Works.pdf>

³ US Census Bureau American Community Survey, 2014.

⁴ “California Is In the Middle of Its Worst Drought in 1,200 years and These People Are Doing Something About It,” http://www.huffingtonpost.com/2015/04/09/doing-something-about-the-drought_n_7000126.html.

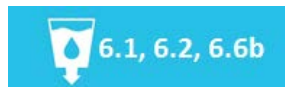
Figure 3. Six Diverse Access Challenges



HOUSEHOLD SYSTEM CHALLENGES

While most people in the United States rely on centralized community water and wastewater systems, a significant part of the population is still responsible for addressing their own water and wastewater needs by utilizing individual water supplies, and septic systems.⁵

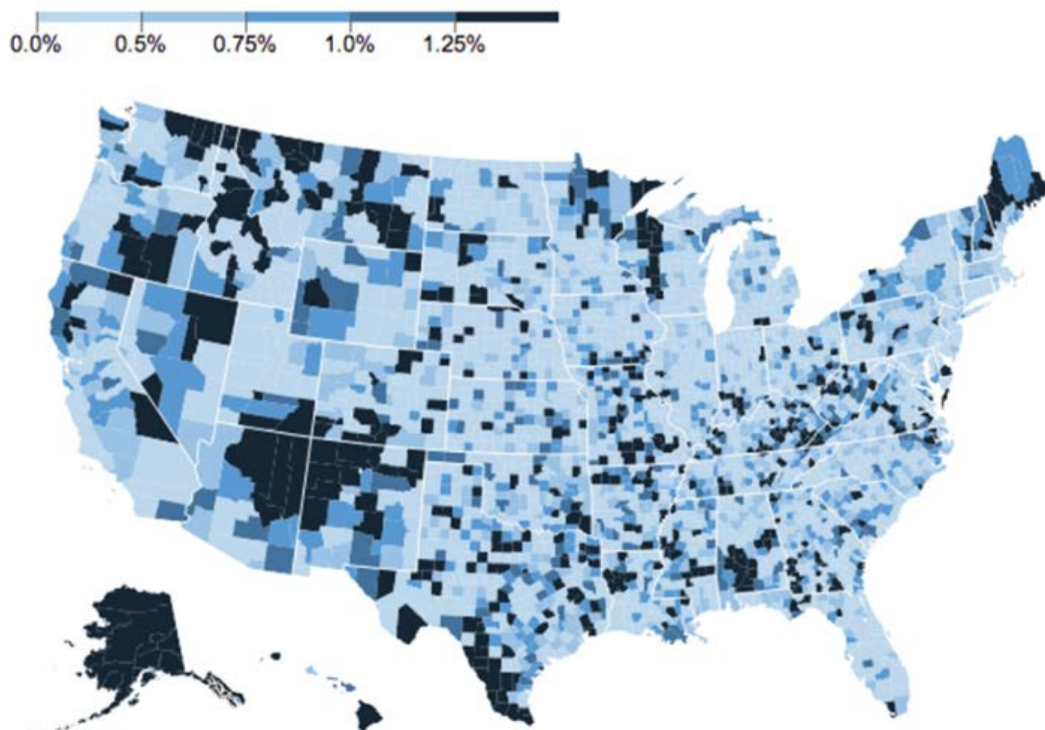
1. LACK OF BASIC INDOOR PLUMBING



Even in 2017, in certain pockets around the country, there are families and individuals who continue to live in properties that do not have indoor toilets or fully functioning indoor plumbing systems. Based on American Community Survey data, an estimated 1.6 million individuals in the United States do not have one or more of the following in their home: a toilet, a tub or shower, or running water.

In 2014, the Washington Post published a map based on the American Community Survey data referenced above. The map shows, by county, the percentage of housing units lacking complete plumbing facilities.

Figure 4. Percentage of Housing Units Lacking Plumbing by County



Source: Ingraham, C. (2014, April 23). *1.6 Million Americans Don't Have Indoor Plumbing. Here's Where They Live.* [The Washington Post.](#)

Although a lack of indoor plumbing may be thought of as a developing country issue, as the map above represents, there are many communities across the United States without even the most basic of water infrastructure. Some stark examples include:

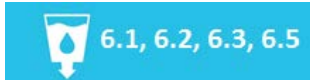
⁵ <https://water.usgs.gov/edu/wups.html>

- **Sandbranch, Texas**—Located 14 miles from Dallas, Texas, this town has never had running water in the 138 years since its establishment. The residents, only 80 of which have remained, are 97 percent minority, and all live below the federal poverty threshold.⁶
- **New Mexico**—40 percent of the Navajo Nation residents lack running water and instead get their water from monthly deliveries.⁷
- **Texas Colonias**—500,000 people populate 2,294 colonias.⁸ More than 40 percent live below the poverty line, and many still lack access to running water or sewer systems.⁹ As of 2014, 337 colonias still lacked access to basic infrastructure.¹⁰

Investment in adequate indoor plumbing is not only crucial from a human rights standpoint, but lack of access to water supplies and plumbing contributes to poverty, unemployment, and health problems, which all have associated costs. It makes populations without access more dependent on government services, and discourages economic investment in communities or regions.

There are currently regional or modest scale initiatives to address access issues associated with lack of complete indoor plumbing. Some Community Based Organizations, like DIGDEEP, are working on developing water access in communities where access to basic infrastructure is an issue.¹¹ Additionally, some members of Congress are advocating for water settlements on Native American lands, so that some communities of Native Americans without basic plumbing, can waive certain water rights'¹² claims against the government in exchange for up front capital to build infrastructure to bring clean water to their communities. For more, see a 2016 report from the House Committee on Natural Resources.¹³

2. UNSANITARY ON-SITE WASTEWATER DISPOSAL



Even where there is indoor plumbing, many households are served by individual wastewater disposal systems that provide substandard and sometimes dangerously insufficient treatment. This inadequate treatment ranges from homes where sewage is directly piped to nearby streams to homes where failed septic systems result in fecal contamination.

According to the US Census Bureau's American Housing Survey, about one out of every five housing units in the United States are not connected to a community sewer system and instead rely on some form of decentralized facility such as a private septic system¹⁴. While many of these systems are

⁶ <http://www.theroot.com/sandbranch-texas-a-small-community-denied-water-for-o-1790858153>

⁷ <http://www.npr.org/sections/codeswitch/2015/01/06/374584452/for-many-of-navajo-nation-water-delivery-comes-monthly>

⁸ The Texas Secretary of State defines "colonia" as a residential area along the Texas-Mexico border that may lack some of the most basic living necessities, such as potable water and sewer systems, electricity, paved roads, and safe and sanitary housing.

⁹ <https://www.theatlantic.com/business/archive/2016/03/the-americans-without-running-water/471909/>

¹⁰ *Id.*

¹¹ <http://digdeep-annual-reports.squarespace.com/2016>

¹² Water Rights for Native Americans arise under federal law and vest with the grant of the reservation land, which provides property rights to the land and an implied right to "sufficient water to fulfill the purposes of the reservation." Native American water rights hold priority over future appropriations, and are not abandoned for nonuse. For more about Native American water rights, see <https://journals.law.stanford.edu/stanford-environmental-law-journal-elj/blog/tribal-reserved-water-rights-groundwater-recognized-settlements-and-litigation-status-and>.

¹³ <http://blackfeetnation.com/wp-content/uploads/2016/10/House-NRC-Water-Report-Minority-10-10-16.pdf>

¹⁴ https://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html?s_areas=a00000&s_year=n2015&s_tableName=Table4&s_byGroup1=a1&s_byGroup2=a1&s_filterGroup1=t1&s_filterGroup2=g1

functioning as designed and provide adequate and appropriate service, a significant portion have been shown to fail at achieving the basic goal of keeping contaminants away from individuals and the nearby environment. Evaluating the extent of this challenge is difficult, as nationwide census data on household sanitation has not been gathered since 1990.

Access to clean water is greatly inhibited by issues related to unsanitary wastewater disposal. Two community examples of the problem include:

- **Barry-Eaton District Health Department, Michigan**—Michigan state officials estimate that 10 percent of the state’s 1.3 million on-site wastewater treatment systems have failed or are polluting the environment. Specifically, within Barry and Eaton counties, the health district discovered nearly 1,000 failed septic systems and 300 houses with no septic systems, where household sewage was instead running into the nearest farm drain, lake, or stream.¹⁵ Barry County borders the county where Grand Rapids, MI, the second largest city in the state is located.
- **Lowndes County, Alabama**—In a county that is 74 percent African-American and where almost a third of the population lives below the poverty line, hookworm, a disease that was thought to have disappeared by the 1980s, is thriving, largely due to a lack of sanitary waste disposal. Of the residents who were surveyed, 73 percent reported raw sewage washing into their homes from faulty septic or waste pipes, and some reported facing criminal prosecution for open-piping sewage from their homes. In Lowndes County, 34 percent of residents who were tested as part of the study, tested positive for traces of hookworm.¹⁶

Similar to a lack of indoor plumbing, unsanitary wastewater disposal contributes to health problems for low-income individuals, who are dependent on government health services, and discourages economic investment in communities or regions. Additionally, the waste pollutes bodies of water, which serve as drinking water supplies, eco-system habitats, and recreational sites. The cost to rehabilitate failed systems and/or remove nutrients or other fecal waste and contamination once it has reached the environment is typically higher than the upfront cost of putting in place alternative infrastructure, promoting better maintenance, or inspecting and repairing failing systems.

Despite gaps in the data on septic systems and community wastewater disposal, the EPA has recognized the need for resources for communities to address concerns arising from unsanitary disposal. In 2012, the EPA put together a compendium that serves as a guide for community leaders to use to address decentralized wastewater treatment issues. The compendium lays out fourteen case studies of communities who have overcome a wide range of wastewater treatment issues, and provides guidance on how other communities can use the valuable lessons learned to address their own problems.¹⁷ Additionally, the Decentralized Water Resources Collaborative was created to support decentralized wastewater and stormwater systems. It is funded by the EPA and primarily focuses on research and development projects to address gaps in knowledge related to decentralized wastewater and stormwater treatment.¹⁸

¹⁵ http://www.mlive.com/environment/index.ssf/2013/05/thousands_of_failed_septic_tan.html

¹⁶ https://www.theguardian.com/us-news/2017/sep/05/hookworm-lowndes-county-alabama-water-waste-treatment-poverty?CMP=share_btn_fb

¹⁷ <https://www.epa.gov/sites/production/files/2015-06/documents/decentralized-case-studies-2012.pdf>

¹⁸ http://www.decentralizedwater.org/about_dwrc.asp

This challenge requires individualized attention to select the proper solution. While in some cases the only solution is to run community wastewater sewer lines to families, in other cases, rebuilding existing systems and developing more resilience maintenance and oversight of systems can restore impaired access.

3. CONTAMINATED AND AT RISK INDIVIDUAL WELLS



The US Geological Survey (USGS) estimates that 14 percent of the United States population receive their drinking water from self-supplied sources, which, in general, refer to individually managed wells and pump systems located on private property.¹⁹ While many of these wells provide adequate service, researchers across the country have found a relatively high number of water quality problems among these systems ranging from fecal contamination due to insufficient wastewater systems to chemical contamination due to natural (e.g. arsenic) or environmental pollution. Additionally, as regions across the country face increasing episodes of drought, many individuals are faced with wells that are drying up. This is a problem for both domestic and community wells.

According to USGS data in 2010, 23 percent of 2,167 domestic wells sampled across the United States had at least one contaminant exceeding acceptable limits for human health. One of the regions of the country that most exemplifies the issue of contaminated and at-risk individual wells is California.

- **California's Central Valley**—The latest data from California's Water Resources Control Board show 700,000 Californians are currently being exposed to contaminated water at home or at school. In addition to those with contaminated water, another 3,511 California households reported having wells that are still dry according to state data released in January 2017. The vast majority of those wells are located in California's Central Valley in places like Tulare County, Madera County, and Stanislaus County.
- **Airway Heights, WA**—In May, 2017, residents were instructed not to drink their tap water after samples from private wells on and around the Fairchild Air Force Base indicated elevated levels of polyfluorinated alkyl substances (PFAS). Fairchild is one of thirty air force bases where PFAS contamination was discovered in 2017.²⁰

As has already been highlighted with insufficient indoor plumbing or wastewater disposal, a lack of clean water also contributes to health risks, particularly for individuals who are unaware of the condition of their well water. There are human suffering costs and concerns. There are also clean-up costs associated with well contamination. Additionally, lack of a stable water supply stunts economic growth and potential for communities, because industries or businesses need stable water supply to thrive.

Researchers at the University of North Carolina at Chapel Hill's Gillings School of Global Public Health are highlighting unsafe drinking water in the US through various projects, including evaluating how the high presence of metals, such as arsenic, manganese, and cadmium, in drinking water have negative effects on pregnant women and their infants. Such information is being used to educate individuals in

¹⁹ <https://pubs.usgs.gov/circ/1405/pdf/circ1405.pdf>

²⁰ <https://www.publicintegrity.org/2017/08/18/21105/military-bases-contamination-will-affect-water-generations>

vulnerable communities. Additionally, researchers are bringing to light racial disparities in water quality issues, by specifically looking at the contamination levels of well water in African-American communities located outside of urban areas.²¹

While ongoing research is critical to defining the scope of the challenges that need to be addressed related to contaminated individual wells, there are also current on-the-ground initiatives to try to protect communities and individuals. The Water Well Trust assists low-income families or individuals who have wells that no longer function properly, have contaminated wells, or who have no access to wells at all. One of its most recent projects, funded by the US Department of Agriculture, is providing funds to households in 15 rural Georgia counties.²² Additionally, the University of New Mexico has received funds from the EPA and the National Institute of Health and opened a Center for Native American Environmental Health Equity Research.²³ As part of its work, it has collaborated with other universities to conduct home well tests on Native American lands, and educate residents about the risks associated with the contaminated wells.²⁴

As with individualized wastewater systems, some individual well systems will never be able to provide adequate access to clean water and the solution will involve providing some form of community water to the area. In other cases, more widespread well testing, new management structures, and focused community education efforts and support can help minimize continuous exposure to contaminated water. In the most extreme cases, where community systems are impossible and private systems cannot be improved, more drastic methods may be required. If a house is uninhabitable because of a lack of access to clean water, or in some cases, any water at all, it is not so different from a house that becomes uninhabitable due to flooding or other natural disasters. In the latter situation, there are government programs, such as the Federal Emergency Management Agency, that buy up the uninhabitable properties. In the worst-case scenarios for water access issues in a home, perhaps this option should be considered.

COMMUNITY SYSTEM CHALLENGES

While connecting households to community water and wastewater systems may address the access problems described above, there is ample evidence that being served by a community system is not enough to guarantee access to high quality water and wastewater services. In fact, many households served by community water and wastewater systems may encounter access problems that are as challenging and intractable as households relying on individual systems.

4. COMMUNITY SYSTEMS WITH CONTAMINATED OR DEPLETED WATER SUPPLIES



6.1, 6.3, 6.4, 6.5, 6.6b

As of 2010, an estimated 105 million people receive water from public water systems that use groundwater, and based on a study done by the USGS, an estimated 22 percent of public wells for those systems have one or more contaminants at unsafe levels for human health.²⁵ In 2014, during California's last major drought, at least 28 small California communities cycled on and off of a list of critical water systems at risk of running out of

²¹ <http://sph.unc.edu/cphm/bridging-troubled-waters/>

²² <https://www.waterwelltrust.org/about-us/>

²³ <https://www.niehs.nih.gov/research/supported/centers/ehd/grantees/unm/index.cfm>

²⁴ <http://www.montana.edu/news/16238/msu-little-big-horn-college-researchers-receive-grant-to-address-well-water-issues-on-crow-reservation>

²⁵ https://water.usgs.gov/nawqa/studies/public_wells/

water. The USGS map in Figure 5 represents these numbers, and is based on a sampling of domestic wells in 45 states, as well as 27 principal aquifers. Many community water systems facing contamination or shortage issues serve low-income, rural populations who cannot afford the treatment necessary to bring the water up to safe and acceptable standards or to outsource water supplies.

Unfortunately, there are an abundance of communities with contaminated water supplies from a range of causes. Some regional examples include:

- **San Joaquin Valley, California**—The San Joaquin Valley has more than one million people who have been exposed to contaminated drinking water.²⁶ Most of the affected communities are small and rural, and the residents are low-income and Latino.²⁷ Of the 680 contaminated public water systems in the region, 506 (74 percent) are totally reliant on the contaminated groundwater.²⁸ The most critical contaminant in San Joaquin Valley is nitrate.
- **Jim Hogg County, Texas**—In this south Texas county, more than 5,000 people have been exposed to arsenic concentrations in their water in amounts more than four times the designated safe levels, for a period of at least 5 years. And a 2016 study found the arsenic levels in 65 community water systems to be above the safe limit over the previous two years.²⁹
- **Uniontown, Alabama**—Uniontown was hit with more than three million cubic yards of coal ash as a result of a 2008 spill in Kingston, Tennessee. The EPA and the Tennessee Valley Authority reached an agreement, and, utilizing the superfund framework, the spill was cleaned up over the course of five years.³⁰ Because of the metal concentration in coal ash, there is a major risk to groundwater quality from coal ash spills. Uniontown is 90 percent African-American, and almost half of the population lives below the poverty line.³¹
- **California's Central Valley and the High Plains** - A study recently published in Environmental Research Letters looked at 2 million wells across 17 western states, and estimates that one out of every thirty wells was dry between 2013 and 2015. The researchers found that the dry wells were concentrated in heavy farming areas like the Central Valley and High Plains, and estimate that in some of those regions, as many as one out of every five wells was dry.³²
- **Puerto Rico** – According to the National Resource Defense Council's analysis of the EPA's Safe Drinking Water Information System, Puerto Rico had the worst rate of drinking water violations of any state or territory in the US. Specifically, in 2015, 99.5 percent of people in Puerto Rico were served by community water systems with drinking water violations that year.³³
- **Minnesota** – According to the Minnesota Pollution Control Agency, about forty percent of shallow wells in the central region of Minnesota, as well as most of the sand and gravel aquifers in southern Minnesota, have nitrate levels that exceed safe drinking water standards set by the EPA.³⁴

²⁶ <http://www.swrcb.ca.gov/gama/ab2222/docs/ab2222.pdf>

²⁷ <https://www.newsdeeply.com/water/articles/2017/07/05/living-in-californias-san-joaquin-valley-may-harm-your-health>

²⁸ <http://www.swrcb.ca.gov/gama/ab2222/docs/ab2222.pdf>

²⁹ <http://environmentalintegrity.org/wp-content/uploads/Arsenic-Report.pdf>

³⁰ <https://www.epa.gov/tn/epa-response-kingston-tva-coal-ash-spill>

³¹ <https://www.scientificamerican.com/article/toxic-coal-ash-hits-poor-and-minority-communities-hardest/>

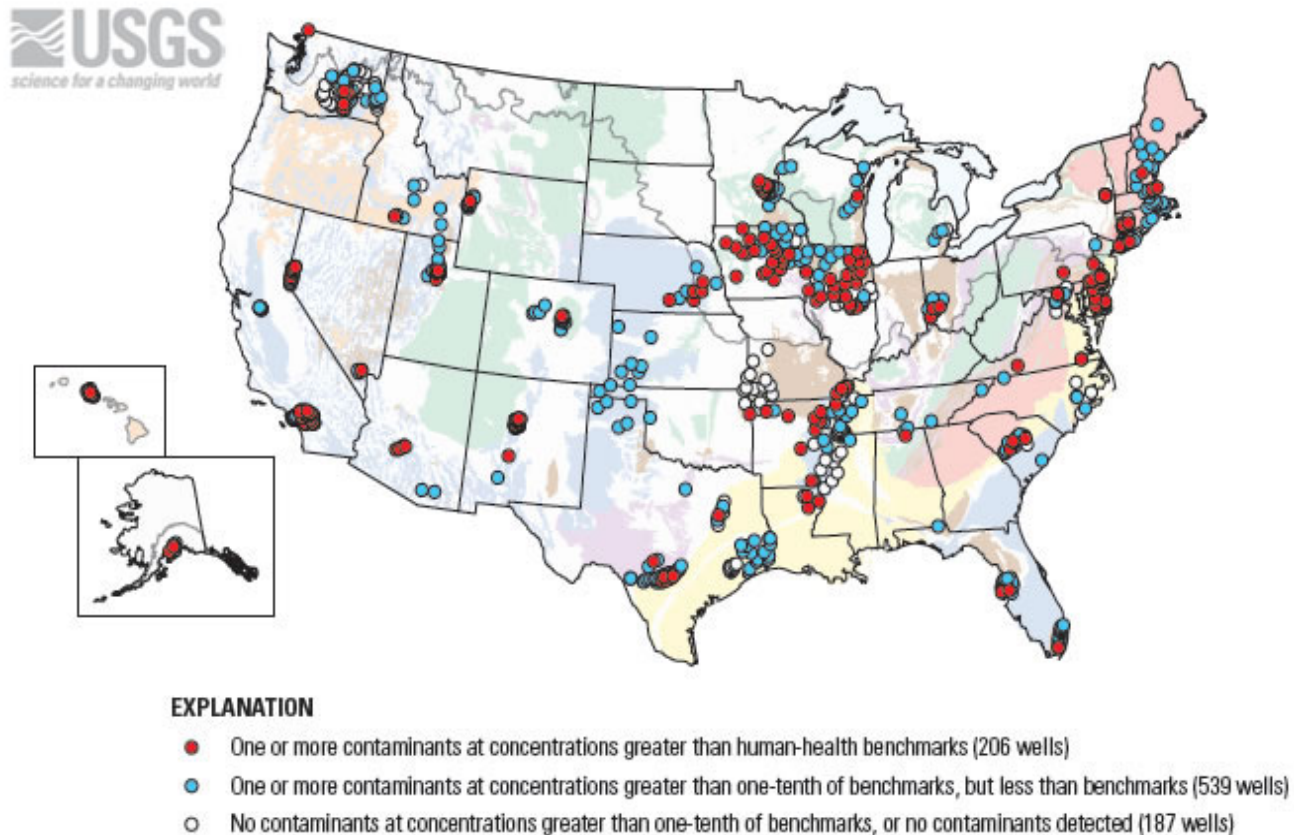
³² <http://iopscience.iop.org/article/10.1088/1748-9326/aa8ac0>

³³ <https://www.nrdc.org/sites/default/files/threats-on-tap-drinking-water-puerto-rico-ip.pdf>

³⁴ <https://www.pca.state.mn.us/water/state-groundwater>

- **Pretty Prairie, Kansas** – This community has 672 residents and is surrounded by 12,000 acres of farmland. The level of nitrate in Pretty Prairie’s tap water has exceeded the EPA’s legal limit for more than 20 years, and in 2014 and 2015 was twice the legal limit.³⁵

Figure 5. Quality of Water from Public Wells in the United States



Source: United States Geological Survey. *National Water-Quality Assessment (NAWQA) Project*

5. COMMUNITY SYSTEM CUSTOMERS STRUGGLING TO PAY FOR SERVICE



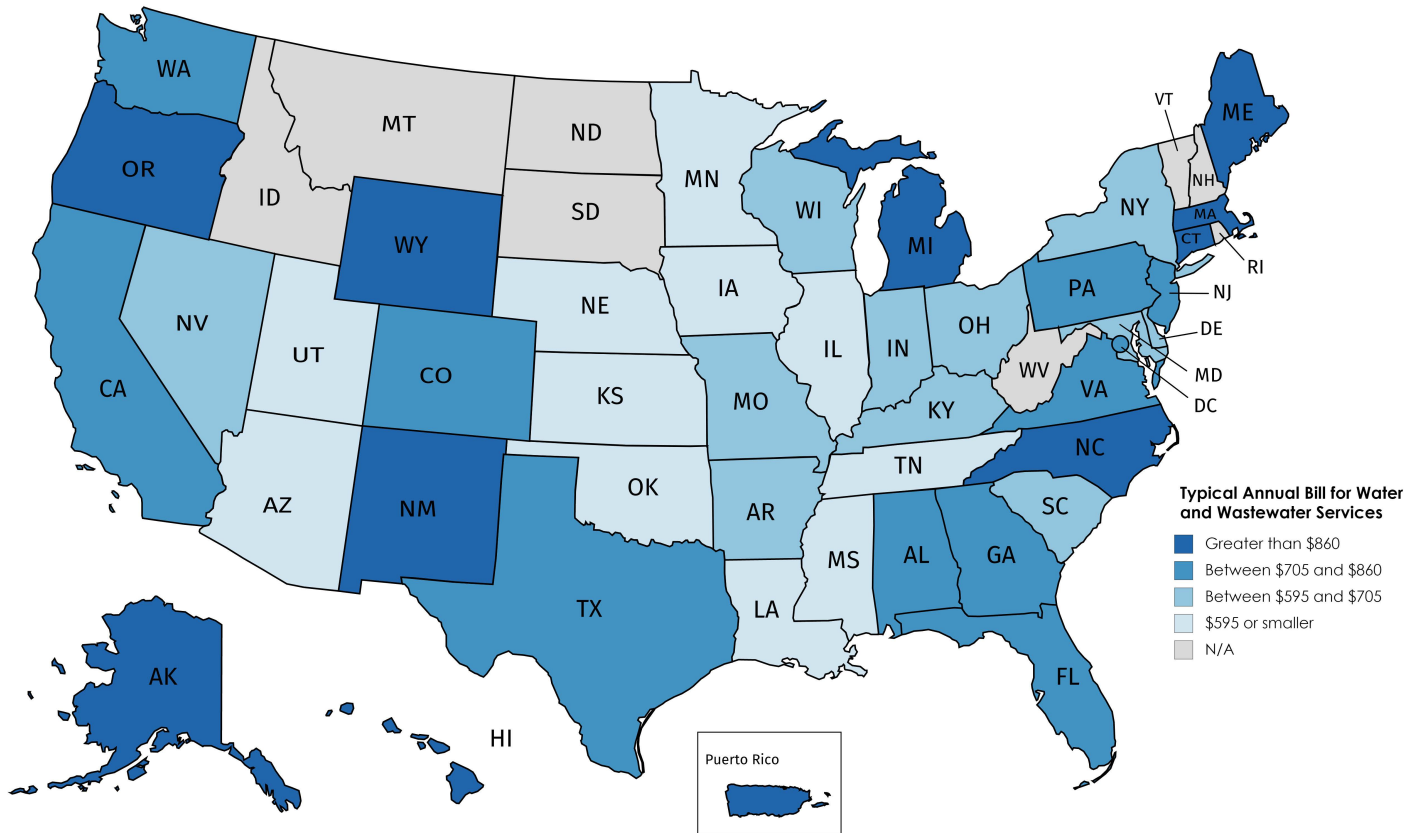
6.1, 6.4, 6.5, 6.6b

In areas where large numbers of the population are living below the poverty line, many customers cannot keep up with increasing rates and face having their water and/or wastewater services shut off or, in the worst case scenario, losing their homes to foreclosure for failure to pay their bills.³⁶ Additionally, water and wastewater rates in certain hot spots in the country are rising at a rapid pace, for a variety of reasons ranging from drought, to significant infrastructure investment, to costs associated with lost water due to antiquated infrastructure. Even where there is customer financial assistance available at the state or utility level, it falls short of the needs of the increasing number of low-income customers nationwide, because legal barriers or perceived legal barriers to the use of rate revenue for customer assistance programs, have kept utilities in many states from implementing robust programs to help soften the financial blow to vulnerable customers.

³⁵ <https://www.ewg.org/tapwater/trouble-in-farm-country.php#.WfNaAhNSxPN>

³⁶ For an example of a community facing the possibility of numerous foreclosures over delinquent water bills, see http://www.huffingtonpost.com/entry/flint-residents-unpaid-water-bills-foreclosure_us_5909e494e4b05c397684e4ec.

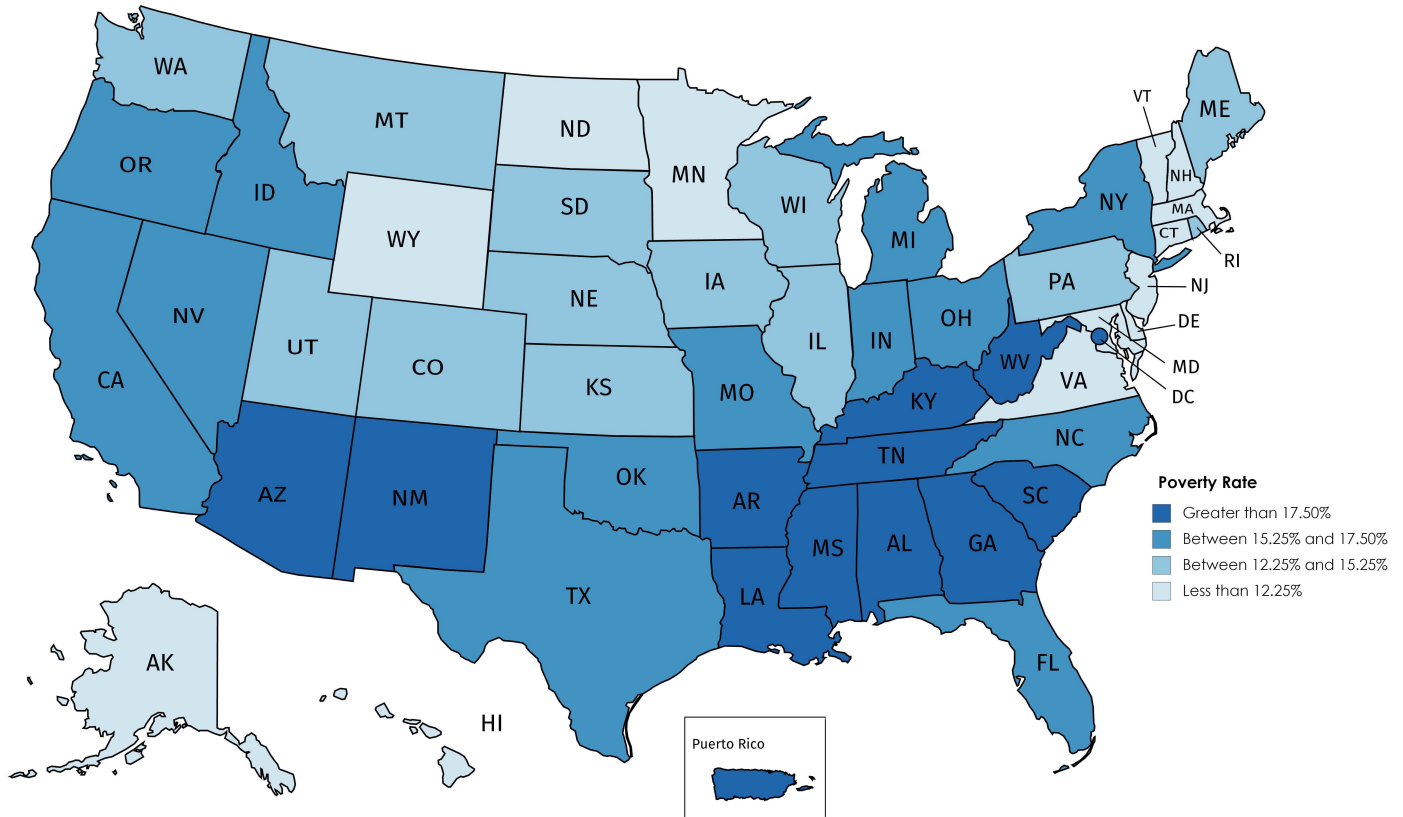
Figure 6. Typical Annual Bill for Water and Wastewater Services



There is considerable debate about how to measure customer affordability.³⁷ But however affordability is measured, there is clear evidence that the burden is significant in many areas of the country and varies considerably between regions of the country. In some situations, challenges are due primarily to what a household has to pay (as shown in Figure 6). In other situations, the challenge rests more at the fundamental resource capacity households have to meet all their expenses, not just water and wastewater (as shown in Figure 7). The two state level maps below show the variation in these burdens across large regions of the US and suggest some very general conclusions about which areas of the Country may be encountering more significant problems. For example, large areas of the Southern United States are seen as having higher poverty levels, and at the same time residents in those areas report having to pay higher bills.

³⁷ <http://www.circleofblue.org/2017/water-management/comes-water-service-expensive-expensive/>

Figure 7. Poverty Rate by State



A state by state analysis provides some general views about water service payment challenges, but information at the utility level is needed to fully understand the diversity of challenges across the country. There is currently no reliable national scale utility level database on water expenditures and affordability but there are several national surveys that provide snapshots of challenges at the utility level. The Environmental Finance Center at the University of North Carolina maintains the largest database of up to date pricing in the country, but it only covers a fraction of all of the utilities in the country.³⁸ Due to the decentralized nature of water service provision and the variation in costs and utility sizes, water payment challenges can vary significantly even within a very close geographic proximity. Table 1 below shows how much water charges can vary in a highly-urbanized county such as Los Angeles.

³⁸ This rate data can be accessed here: <https://efc.sog.unc.edu/project/utility-financial-sustainability-and-rates-dashboards>

Table 1. Most and Least Expensive Water Systems in Los Angeles County

System Name (Population Served)	Annualized Cost for 18 CCF
Five Most Expensive Systems	
1. CA Water Service Co.—Lake Hughes (711)	\$2,244
2. CA Water Service Co.—Leona Valley (1296)	\$1,834
3. LA County Water Works Dist. #21—Kagel Canyon (991)	\$1,658
4. Park Water Company—Bellflower/Norwalk (67,200)	\$1,539
5. Park Water Company—Lynnwood/Compton (45,400)	\$1,502
Five Least Expensive Systems	
1. Maywood Mutual Water Co. #1 (5,500)	\$145
2. Pico Rivera Municipal Water Co. (39,000)	\$192
3. Lomita Municipal Water (20,256)	\$235
4. City of Industry Waterworks System (7,000)	\$278
5. LA County Waterworks Dist. #40—Antelope Valley (9,822)	\$282

Source: Greg Pierce, UCLA. "Ensuring Drinking Water Affordability: Challenges and Opportunities in Current Policy Making at Local, State and National Levels." Water and Health Conference 2017. 17 Oct. 2017.

Table 2 shows similar information for a rural county in North Carolina. In this case, the variation in affordability challenges can be seen to be driven by both differences in water cost (more than two-fold difference for nearby utilities) and community poverty rates (more than three-fold difference between two towns). Thus, affordability challenges can vary substantially even among communities within a relatively close proximity.

Table 2. Variation in Affordability Challenges for Anson County, North Carolina

Anson County						
Utility Owner	Water and Wastewater Bill at 5,000 gallons	Population	Median Household Income	Combined Bill at 5000 gallons as a Percentage of MHI	Poverty rate (24,600)	Combined Bill as percentage of \$24,600
Anson County	\$49.31	12,750	\$33,228	1.78%	24.21%	2.41%
Ansonville	\$66.51	1,262	\$29,583	2.70%	21.53%	3.24%
Lilesville	\$113.25	900	\$40,074	3.39%	13.36%	5.52%
Morven	\$81.82	512	\$22,361	4.39%	40.20%	3.99%
Peachland	\$80.00	600	\$35,000	2.74%	31.63%	3.90%
Polkton	\$62.50	800	\$30,667	2.45%	27.49%	3.05%
Wadesboro	\$76.75	6,500	\$27,361	3.37%	32.17%	3.74%

Source: EFC at UNC Rates Survey and the American Community Survey

Different factors contribute to rising water and wastewater rates. Whether it is the shrinking population and subsequent loss of revenue of a big city, drought driven conservation of water use and subsequent reduction in revenue, or federally mandated infrastructure upgrades that require a new source of revenue, there are many examples all over the country of skyrocketing water rates among customer

bases that cannot keep up with the bills.

- **Detroit, Michigan**—In 2016, more than one in six Detroit households had their water cut off for unpaid water bills.
- **Philadelphia, Pennsylvania**—In Philadelphia, more than 40 percent of the city’s water utility customers are delinquent in paying their water bills.^{39, 40}
- **Baltimore, Maryland**—Based on the projected rate increases, rates in Baltimore will have doubled over eight years.⁴¹
- **Stockton, California**—In Stockton, scheduled rate increases, resulting from drought conservation, are leading to a 40 percent increase over five years.⁴²

Similar to the variations of contamination issues, the inability to pay for water has human suffering costs as well as health risks associated with the lack of access to water resulting from a shut off. Unpaid water bills can additionally increase costs for utilities, and some utilities have begun recognizing that having an affordability rate structure reduces the costs incurred from shutoffs to service, bad debt, fruitless collection expenses, or other administrative costs.⁴³

Because of the pervasive nature of affordability issues, there is much research being done in this area to help utilities and local governments determine what their options are for addressing water and wastewater services affordability. In 2016, the EPA published a compendium that highlights Customer Assistance Programs (CAPs)⁴⁴ at utilities across the country.⁴⁵ In 2017, the Environmental Finance Center at the University of North Carolina at Chapel Hill also published a report targeting this issue. The report, *Navigating Legal Pathways to Rate-Funded Customer Assistance Programs*, evaluates the legal potential for public and private utilities in every state, as well as the District of Columbia and Puerto Rico, to fund robust CAPs using rate revenue, which is not currently a widespread practice.⁴⁶ Also in 2017, the Water Research Foundation published a guide for utilities to use in establishing CAPs that will specifically reach hard to reach customers.⁴⁷

One takeaway from the EPA’s CAPs compendium, which is researched comprehensively in the EFC at UNC Pathways report, is that overcoming legal barriers to broader assistance programs requires the use of rate revenue. Because of legal barriers or uncertainties, there needs to be modification of state and local laws to allow utilities to use rate revenue to fund such programs.

³⁹ <http://www.governing.com/topics/transportation-infrastructure/gov-philadelphia-income-based-water-bills.html>

⁴⁰ <http://www.phila.gov/water/educationoutreach/customerassistance/pages/default.aspx>

⁴¹ <http://www.baltimoresun.com/news/maryland/baltimore-city/bs-md-ci-water-rate-discounts-20170701-story.html>

⁴² <http://www.kcra.com/article/stockton-approves-water-rate-hike/6429381>

⁴³ <https://efc.sog.unc.edu/project/navigating-legal-pathways-rate-funded-customer-assistance-programs>; See also the AWWA’s business case for affordability rate structures <https://www.awwa.org/store/productdetail.aspx?productid=61556627>

⁴⁴ Customer Assistance Programs are referring to household affordability programs operated by utilities and local governments directed at customer ability to pay for water and wastewater services.

⁴⁵ https://www.epa.gov/sites/production/files/2016-04/documents/dw-ww_utilities_cap_combined_508.pdf

⁴⁶ <https://efc.sog.unc.edu/project/navigating-legal-pathways-rate-funded-customer-assistance-programs>

⁴⁷ <http://www.waterrf.org/Pages/Projects.asCpx?PID=4557>

Utility Level Solutions

Some individual utilities around the country are taking the lead on utilizing different forms of revenue to fund customer assistance programs, which helps the programs serve more low-income customers.

<p><i>Baltimore City Department of Public Works—</i></p> <p>Low-Income Water Assistance Program and Hardship Exemption Program</p>	<p><i>City of Philadelphia—</i></p> <p>Tiered Assistance Program (“TAP”)</p>	<p><i>California Water Service—</i></p> <p>Low-Income Rate Assistance (“LIRA”)</p>
<ul style="list-style-type: none"> • Low-Income Assistance program provides credit of \$216 toward delinquent account • Customers must have incomes less than 175 percent of federal poverty level • In 2016—1,992 participants received \$356, 246 in benefits • Hardship Exemption Program waives the Bay Restoration Fee and the local stormwater fee • In 2016—3,180 customers received the hardship exemption 	<ul style="list-style-type: none"> • Estimated that as many as 40 percent of water utility customers are delinquent in paying their water bills • Approximately 60,000 customers should be eligible • Customers must have incomes less than 150 percent of federal poverty level • Income-based consistent monthly bill • Past due amounts are suspended and not enforced while customers enrolled 	<ul style="list-style-type: none"> • Cal Water is the largest private water utility in California, and the third largest publicly traded private water company in the country • As of 2015, 18 percent of Cal Water’s nearly 500,000 customers were enrolled in LIRA • Customers receive a fixed monthly discount equal to 50 percent of the 5/8”x 3/4” meter service charge for their district • Eligibility for LIRA is linked to other federal assistance programs and requires a declaration of income level by the family
<p><i>How is the program funded?</i></p> <p>Through RATE REVENUE</p>	<p><i>How is the program funded?</i></p> <p>Through RATE REVENUE— The program is expected to cost \$18 million per year.</p>	<p><i>How is the program funded?</i></p> <p>Through RATE REVENUE— The program is funded through a surcharge or tariff paid by all Cal Water customers not enrolled in LIRA. As of 2017, the surcharge was calculated as 1.542 percent of the “basic water charge.”</p>

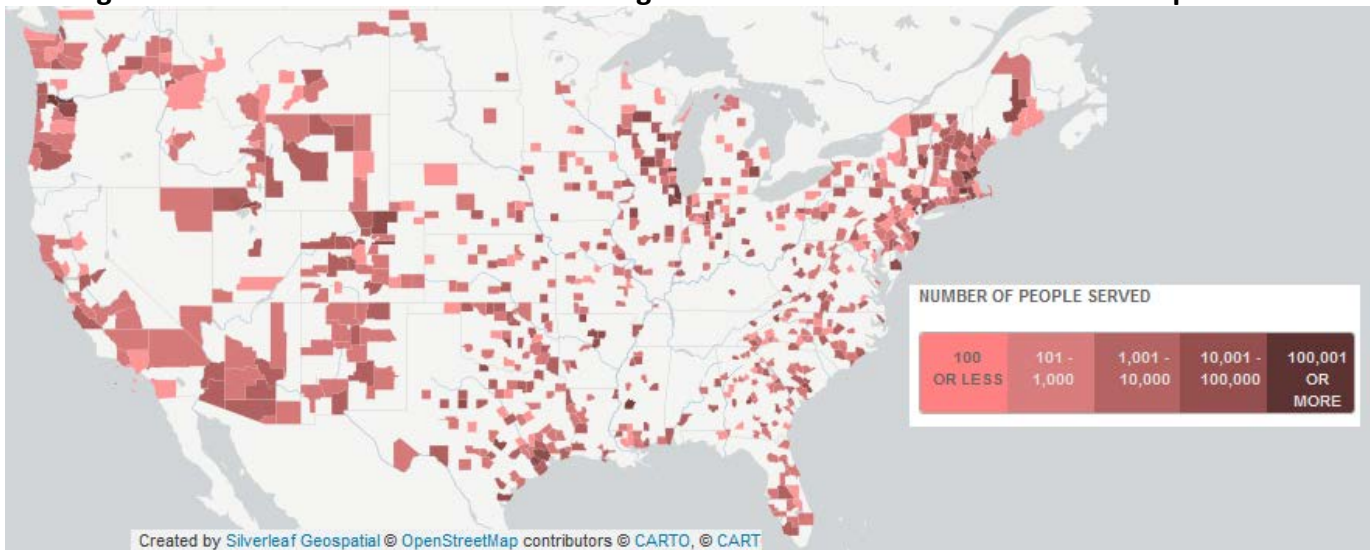
6. COMMUNITY SYSTEM CUSTOMERS WITH SUBSTANDARD PLUMBING



6.1, 6.3, 6.4, 6.6b

Customers served by even the highest functioning water systems who live in residences with vulnerable plumbing still face serious access challenges. Tenants who have leaky pipes and have limited control or resources to fix the plumbing may pay enormous bills for water they do not benefit from, or may face having their water shut-off for unpaid bills related to leaks. Additionally, the crisis in Flint, Michigan, has highlighted the vulnerability of households that rely on service lines or other components of indoor plumbing that contain lead.⁴⁸ While the problem of vulnerable in-house plumbing is widespread in low-income communities in general, it is particularly pervasive in affordable housing and rental markets.

Figure 8. 2015 Lead Action Levels Exceeding the EPA’s Lead Action Level of 15 Parts per Billion



Source: Olson, Erik D. and Fedinick, Kristi Pullen. (2016, June 28). *What's in Your Water? Flint and Beyond*. NDRC

Without going door to door to gather information about individual vulnerabilities in plumbing, there are big picture examples that capture how these vulnerabilities can be seen widespread in communities.

- **Baltimore, Maryland**—Baltimore sent more than 1,800 owner-occupied properties to tax sale in 2016, with more than 315 being sent due to unpaid water bills. Many of the unpaid high water bills were elevated due to leaks in the house in sinks or toilets.⁴⁹
- **Pittsburg, Pennsylvania**—An estimated 17,000 homes served by the Pittsburgh Water and Sewer Authority have lead service lines.⁵⁰
- **Flint, Michigan**—An estimated 29,100 residents have lead or galvanized steel service lines that need to be replaced, at an estimated cost of at least \$140 million.⁵¹

The Flint crisis painted a picture of the human health and suffering risks associated with vulnerable plumbing, such as lead service lines. While the total costs associated with Flint are yet unknown, some

⁴⁸ <http://www.npr.org/sections/thetwo-way/2016/04/20/465545378/lead-laced-water-in-flint-a-step-by-step-look-at-the-makings-of-a-crisis>

⁴⁹ <http://www.baltimoresun.com/news/maryland/baltimore-city/bs-md-ci-water-billing-20170223-story.html>

⁵⁰ <http://triblive.com/local/allegheeny/12678203-74/fixing-americas-costly-lead-problem-could-yield-billions-more-in-benefits-report>

⁵¹ <http://www.detroitnews.com/story/news/michigan/flint-water-crisis/2017/07/11/flint-lead-pipes-replacement/103623316/>

experts have estimated that the harm done to children by the lead exposure will result in \$395 million in social costs.⁵² Additionally, in 2017, the Health Impact Project conducted an economic study to assess costs associated with lead poisoning of children, and created a cost-benefit analysis for responding to the problem, through projects such as replacement of lead service lines.⁵³ For other non-lead related vulnerable plumbing issues, addressing the damage from out of control leaks can cost far more than preemptive replacement and repair.

There are some noteworthy initiatives being done at a local government and federal level to address concerns related to substandard plumbing. At the federal level, the EPA is considering revisions to strengthen and clarify the current Lead and Copper Rule, in part, in response to the Flint crisis.⁵⁴ Additionally, there is current legislation pending in the House of Representatives. Specifically, HR 3387, the Drinking Water System Improvement Act, would put more money in Drinking Water State Revolving Funds and expand some of the uses of funds to help with these issues.⁵⁵

At the local government level, Pittsburgh, Pennsylvania, recently advanced legislation, which would allow the Pittsburgh Water and Sewer Authority to replace individual lead service lines, and separate legislation, which would require disclosure of lead pipes at the sale of properties.⁵⁶ Milwaukee, Wisconsin, provides full replacement of lead service lines if a leak is discovered, and Woonsocket, Rhode Island, requires builders to replace lead service lines when a structure is sold, demolished, or replaced.⁵⁷

The lead problem has highlighted the extreme variation in the scale and scope of infrastructure challenges in the US. A city like Flint not only has aging, large-scale community infrastructure challenges, such as centralized treatment plants and large public water distribution lines, but the challenges go right up to and, in some cases, inside individual residences. The intersection of community-owned assets and privately-owned assets like internal plumbing presents its own set of challenges. Who should be responsible for replacing or maintaining privately-owned plumbing that is linked to a public system? If the answer is the household, then what should be done if the household does not have the means to address the problem? The Environmental Finance Advisory Board is studying this issue and will be releasing a report in the near term with suggested strategies. Meanwhile, in some areas, communities that previously saw their responsibility stop at the property line are stepping in. For example, unrelated to lead concerns, Libertyville, Illinois, is trying to put in place a program to help residents replace their own sanitary sewer systems to avoid the harmful waste spills.⁵⁸

To further address risks associated with vulnerable plumbing, there could be changes to landlord/tenant laws to help protect renters against the risks of maintenance failures. Additionally, there could be a modification to the appeal process to water utilities for abnormally high bills, to prevent immediate shut offs when a bill sky rockets and goes unpaid, due to faulty plumbing fixtures.

⁵² <http://www.reuters.com/article/us-michigan-water/social-costs-of-flint-michigan-water-crisis-total-395-million-study-idUSKCN10J26Q>

⁵³ <http://www.pewtrusts.org/en/research-and-analysis/reports/2017/08/10-policies-to-prevent-and-respond-to-childhood-lead-exposure>

⁵⁴ https://www.epa.gov/sites/production/files/2016-10/documents/508_lcr_revisions_white_paper_final_10.26.16.pdf

⁵⁵ <http://www.washingtontimes.com/news/2017/sep/13/an-infrastructure-priority-ensuring-safe-drinking/>

⁵⁶ <http://triblive.com/local/allegheny/12526032-74/legislation-allowing-pwsa-to-replace-private-lead-lines-advances>

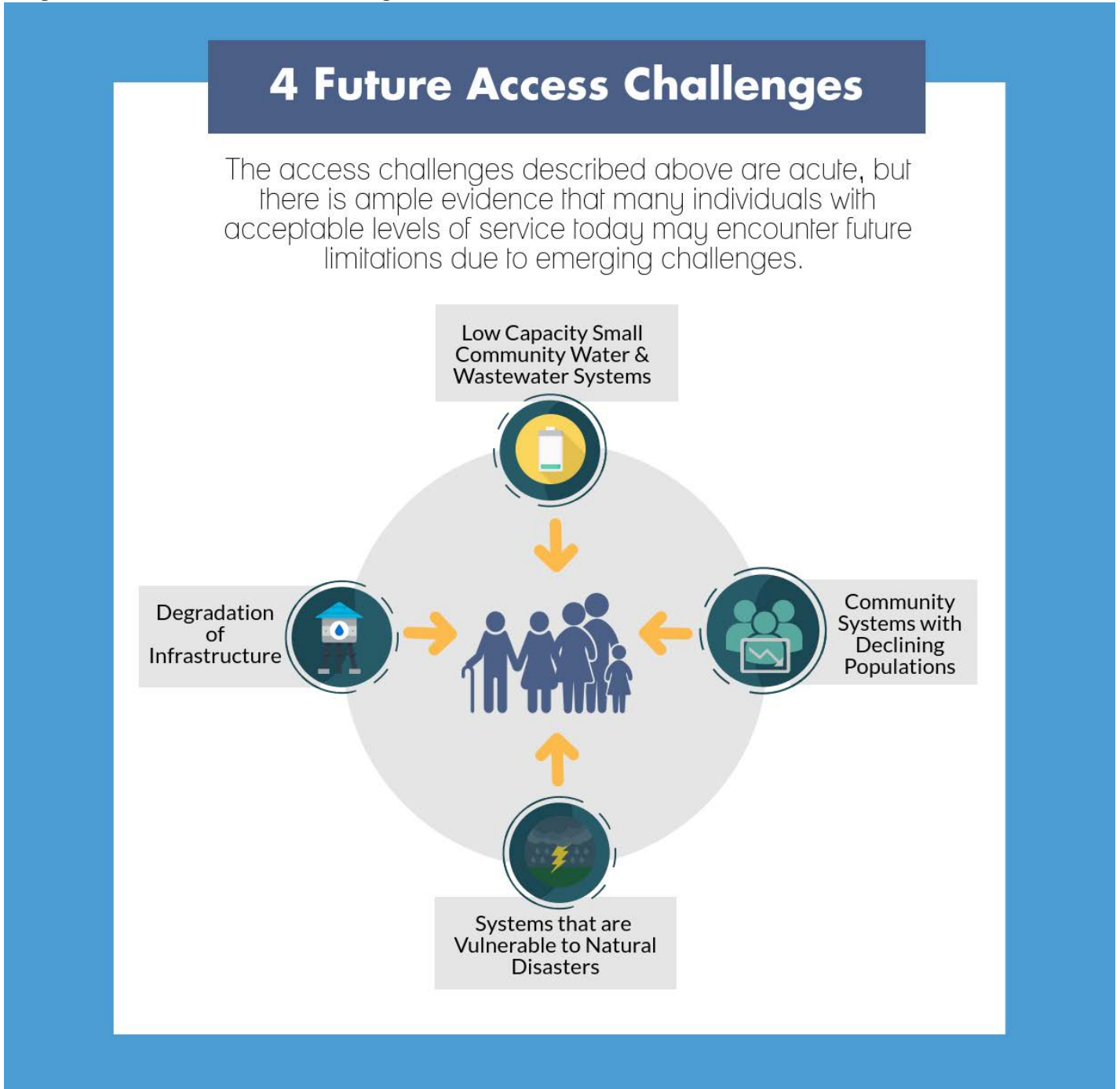
⁵⁷ http://www.pewtrusts.org/~media/assets/2017/08/hip_childhood_lead_poisoning_report.pdf

⁵⁸ <http://www.chicagotribune.com/suburbs/libertyville/news/ct-lbr-overhead-sewer-grant-flooding-town-hall-tl-0824-20170817-story.html>

EMERGING AND FUTURE ACCESS CHALLENGES

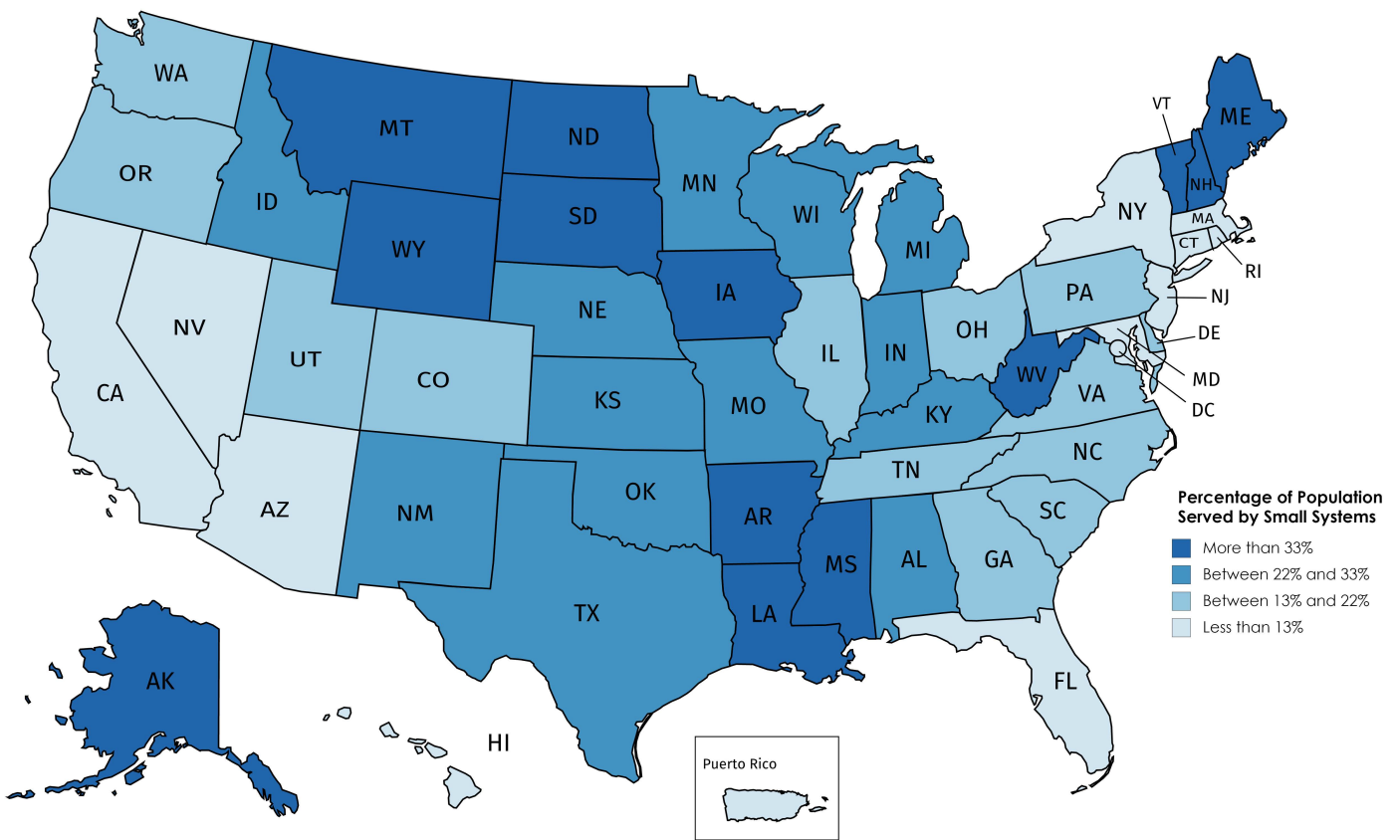
The access challenges described above are acute today, but there is ample evidence that many individuals with acceptable levels of service today may encounter future limitations due to emerging challenges.

Figure 9. Four Future Access Challenges



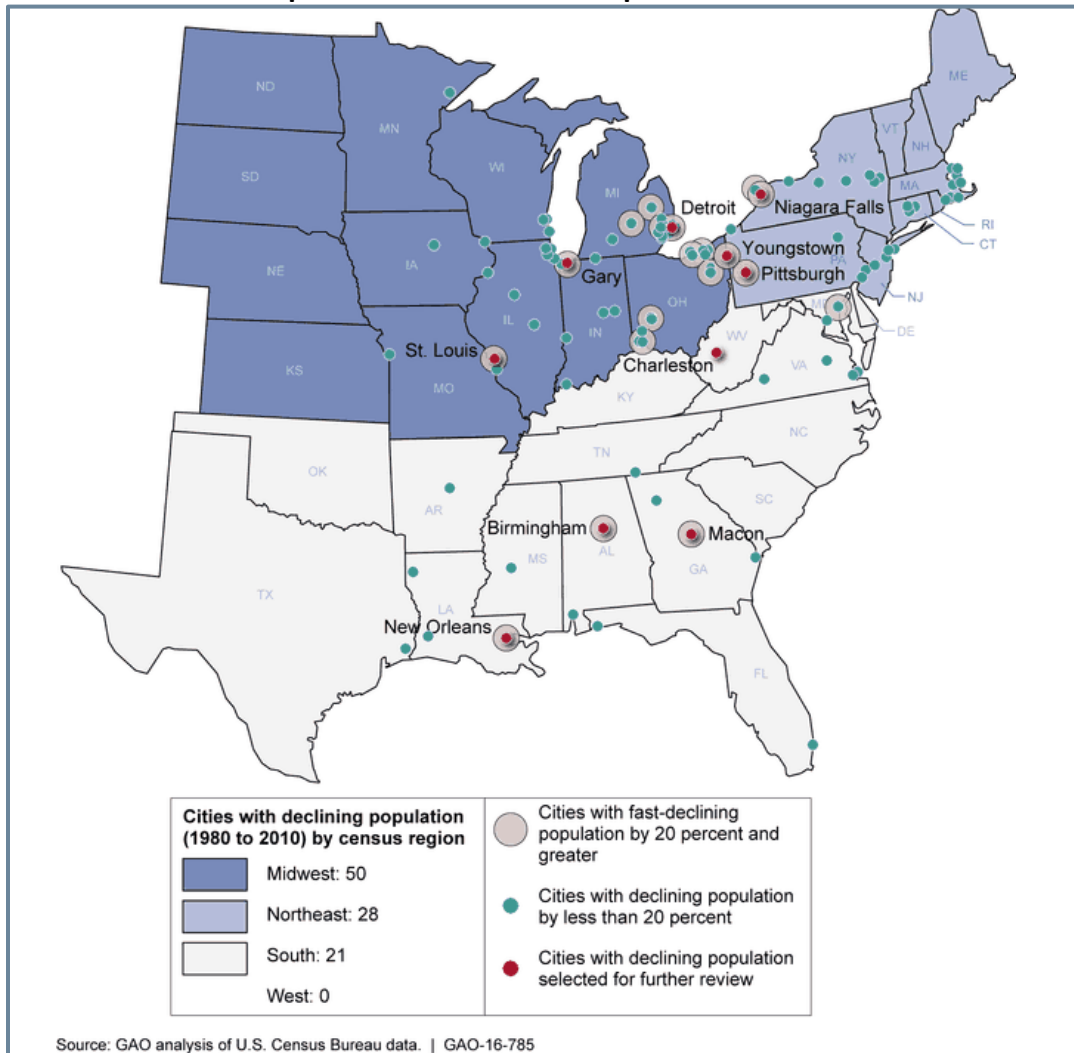
Low Capacity Small Community Water and Wastewater Systems. While there are many examples of small community water and wastewater systems that are able to provide high quality service, there are also numerous examples of small and often isolated systems that have been linked to chronic poor performance that hinder access to high quality services. Small systems have fewer customers to share costs and generally have less access to capital to make investments. On the operational side, small systems have less revenue available to hire managers and operators and must rely on staff that are asked “to do it all.” Many small community systems have insurmountable capital needs and revenue challenges that essentially make them non-viable or non-sustaining. The map in Figure 10 shows the percentage of each state served by small systems.

Figure 10. Percentage of Each State Served by a Small Water System



Community Systems with Declining Populations. Customers served by small water and sewer systems are not the only ones at risk of seeing their service decline to the point of threatening basic access. Midsize and large cities experiencing population decline have less customers and therefore less revenue to address major infrastructure needs, primarily pipeline repair and replacement and wastewater improvements to control combined sewer overflows.

Figure 11. Location of US Cities with 2010 Populations of 50,000 or Greater that Experienced a Decline in Population from 1980 to 2010



Source: United States Government Accountability Office. *Information on Selected Midsize and Large Cities with Declining Populations*

Systems that are particularly vulnerable areas to natural disasters and weather fluctuations. The repercussions of the 2017 Storm Season demonstrate how fast a community system can lose its ability to provide essential services. At the time this article was being written, thousands of American Citizens were without water service in areas of Puerto Rico, Florida, and Texas, and the resulting contamination to water systems in those regions is yet unknown.⁵⁹

Degradation of Infrastructure. Perhaps the most daunting access challenge is also the most prevalent—failure to keep up with basic investment needs. Maintaining high quality service requires investments, and a lack of investment in aging infrastructure, either as a policy choice, or as a result of insufficient funding, has led to notable access problems. The American Society of Civil Engineers (ASCE) grades the US water infrastructure as a “D” and wastewater infrastructure as a “D+.” As of 2017, the ASCE estimates that there are roughly 240,000 water main breaks per year, which waste over two

⁵⁹ <https://www.texastribune.org/2017/09/08/post-harvey-houston-extent-water-contamination-unknown/>

trillion gallons of treated drinking water. Additionally, the US EPA estimates that 23,000 to 75,000 sanitary sewer overflow events occur each year.⁶⁰

WHAT CAN BE DONE TO INCREASE AND MAINTAIN CLEAN WATER ACCESS

Development of Alliances and Partnerships. Given the complexities of most access challenges, addressing them successfully typically requires multiple organizations working together. Figure 1 shows some of the different sectors and types of organizations that have and will continue to play a major role in assuring access to high quality and affordable water and wastewater services. Organizations and initiatives such as the US Water Alliance and the US Water Partnership have demonstrated the power of partnerships through their efforts to bring together diverse stakeholders from the governmental, non-profit, and corporate sector. The US Water Alliance recently published a major report that lays out a road map for addressing access challenges as well as underlying equity issues that often are interwoven with access challenges.⁶¹ Continuing to foster and build these partnerships at the national, state, and regional level provides a forum for identifying problems and harnessing resources in a collaborative manner.

New and Expanded Finance and Governance Models. The existing finance and governance models in many states are not able to address many community level challenges. Many small isolated community systems and community systems with declining and low wealth customer bases and outdated and degraded infrastructure assets have little opportunity for improvement under existing governance systems. Larger regional systems or distributed investor owned utilities have little incentive to support these troubled systems. Historically, state and federal government agencies have relied primarily on subsidized project loans and grants to support troubled communities, but this type of assistance does not address a core lack of capacity that exists in many of these systems. States such as Delaware and California have begun expanding their support for water access beyond project funding. For example, California has passed LIRA, and passed an ability to require mergers. Maintaining local involvement in governance while creating a sustainable management structure is not simple and typically requires state involvement in creating legal utility governance structures (water authorities, receivership models, state chartered utilities); targeted financial assistance, and regulatory oversight.

Targeted Household Assistance. The access problems linked to household financial capacity are often best addressed by providing direct assistance to households. Nationwide, there are relatively few customer assistance programs that are able to address the needs of their customers. This type of assistance can help customers pay a portion of their bill and address substandard plumbing issues. There are multiple channels for providing this assistance ranging from local charitable organizations to federal assistance programs. In some cases, local resource pools at the utility or local government level are sufficient to address their community's distressed households, but in other situations, local resource capacity is so limited, that the state or federal government, with its broad financial pooling capacity, may be the only realistic option. Historically, state and federal government programs have been almost exclusively oriented to providing system-wide assistance or project assistance through subsidized project loans and grants

⁶⁰ <https://www.infrastructurereportcard.org/cat-item/drinking-water/>;

⁶¹ http://uswateralliance.org/sites/uswateralliance.org/files/publications/uswa_waterequity_FINAL.pdf

Addressing National Data Gaps on Water and Sanitation Access. To effectively address the broad water access challenges, managers, policy makers, advocates, and others need to understand the extent and location of different water access challenges. Nationwide census data on household sanitation has not been gathered since 1990, and there is insufficient data on other aspects of the nation's water infrastructure, as well. Detailed data and information gathering should be included in all strategies to address water access challenges.

Strategic Project Investment. Supporting the above initiatives will not replace the need for on-going financial support for projects. There will continue to be a need for federal and state support for financing and funding strategic projects. The key is to assure that basic capacity and management issues are addressed before or at least at the same time as specific projects are funded. Many organizations are focused on the issue of access. Federal and state money has focused on addressing access issues through project investment. Support for specific projects should continue to be an integral part of an overall access strategy, but many access problems cannot be addressed by funding a simple project and require new forms of assistance that range from household level assistance to governance models.

CONCLUSION

In light of the recent commitment by the United States to the Sustainable Development Goals, it is essential that the country's leaders and decision makers understand the nature of water and sanitation access challenges. Every state in the country, as well as every US territory, is affected by one or more of the access challenges discussed above. Some directly touch individuals, while others affect entire communities. Most of the challenges overlap with others, and those working on policies and practices to mitigate such challenges should take that relatedness into consideration. As the language of Sustainable Development Goal 6 recognizes, a multifaceted approach is required to meet the goals of access to safe affordable water and adequate sanitation nationally and internationally. It requires integrated water resources management, community involvement, partnership at the local and global levels, conservation of natural resources, reduction of pollution, and improvement of water quality. Although there are federal agencies, organizations, states, local governments, utilities, non-profits, and legislators working on different parts of these challenges, as this paper highlights, there are many more needs that must be addressed for the US to fulfill the mandate of Sustainable Development Goal 6, and ultimately, to ensure availability and sustainable management of water and sanitation for all.

APPENDIX

Table of Resources

Table of Resources		
Overview of Water and Wastewater Equity and Access Issues		
US Water Alliance “An Equitable Water Future”	National Briefing Paper – This 2017 report highlights US access and equity challenges for water and wastewater, and lays out a road map for addressing such challenges.	http://uswateralliance.org/sites/uswateralliance.org/files/publications/uswa_water_equity_FINAL.pdf
Lack of Indoor Plumbing		
DIGDEEP	On-the ground assistance – A group working directly with communities to build and manage low-cost water systems	https://digdeep.org/
Report on Native American Water Settlements	Policy changes – A 2016 report from Democratic Staff of the House Committee on Natural Resources highlighting Native American water access issues and advocating for water settlements on reservations	http://blackfeetnation.com/wp-content/uploads/2016/10/House-NRC-Water-Report-Minority-10-10-16.pdf
Unsanitary On-Site Wastewater Disposal		
EPA Case Studies of Decentralized Wastewater Management Programs	Research Guide – A compendium of 14 case studies which highlights guidance for communities to use to address decentralized wastewater challenges	https://www.epa.gov/sites/production/files/2015-06/documents/decentralized-case-studies-2012.pdf
Decentralized Water Resources Collaborative	Research Organization – An organization funded by the EPA that supports research and development on decentralized wastewater and stormwater systems	http://www.decentralizedwater.org/about_dwrc.asp
Contaminated and At-Risk Individual Wells		
Water Well Trust	On-the-ground assistance – A group that assists low-income families and individuals who have wells that no longer function properly, have contaminated wells, or who have no access to wells at all.	https://www.waterwelltrust.org/

UNC Chapel Hill Gillings School of Global Public Health	Research – Multiple projects focused on unsafe drinking water in the United States and equity issues related to water quality	http://sph.unc.edu/cphm/bridging-troubled-waters/
Center for Native American Environmental Health Equity Research	Research Organization – An organization addressing environmental health disparities through research and community engagement with Native American communities.	https://www.niehs.nih.gov/research/supported/centers/ehd/grantees/unm/index.cfm
Community Systems with Contaminated or Depleted Water Supplies		
Report on Toxic Drinking Water in Texas	Research Study – A 2016 report put out by Environmental Integrity Project, which highlights high levels of arsenic in 65 community water systems in Texas	http://environmentalintegrity.org/wp-content/uploads/Arsenic-Report.pdf
USGS National Water Quality Assessment Project	Research Database – An ongoing assessment of US water quality changes in response to human activities and natural factors	https://water.usgs.gov/nawqa/
Community System Customers Struggling to Pay for Service		
UNC Environmental Finance Center’s “Navigating Legal Pathways to Rate-Funded Customer Assistance Programs”	Research Guide – A 2017 report evaluating the legal potential for public and private utilities in every state as well as Puerto Rico and D.C., to fund robust Customer Assistance Programs using rate revenue	https://efc.sog.unc.edu/project/navigating-legal-pathways-rate-funded-customer-assistance-programs
Water Research Foundation’s “Customer Assistance Programs for Multi-Family Residential and Other Hard to Reach Customers”	Research Guide – A 2017 guide for utilities to use in designing Customer Assistance Programs that will meet hard to reach customers.	http://www.waterrf.org/Pages/Projects.aspx?PID=4557
UNC Environmental Finance Center’s Utility Rates Dashboards	Research Database – The largest database of up to date utility pricing in the country.	https://efc.sog.unc.edu/project/utility-financial-sustainability-and-rates-dashboards
Manuel Teodoro’s “Measuring Water and Sewer Utility Affordability”	Research Study – This working paper highlights flaws in current metrics most often used to determine affordability of water and wastewater rates, and proposes alternative metrics that more accurately identify affordable rates.	http://mannyteodoro.com/wp-content/uploads/2017/08/MTeodoro_Affordability-Method-

		Working-Paper-Aug2017.pdf
EPA “Drinking Water and Wastewater Utility Customer Assistance Programs”	Research Guide – This compendium documents drinking water and wastewater Customer Assistance Programs at utilities in every state across the country.	https://www.epa.gov/sites/production/files/2016-04/documents/dw-ww_utilities_cap_combined_508.pdf
Community System Customers with Substandard Plumbing		
EPA “Lead and Copper Rule Revisions White Paper”	White Paper – This 2016 EPA white paper lays out the concerns with the current Lead and Copper Rule, and discusses current recommendations and proposals for modifying it to address those concerns.	https://www.epa.gov/sites/production/files/2016-10/documents/508_lcr_revisions_white_paper_final_10.26.16.pdf
Health Impact Project’s “10 Policies to Prevent and Respond to Childhood Lead Exposure”	Research Study – This economic study assesses costs associated with lead poisoning of children, and includes a cost-benefit analysis for responding to the problem through initiatives such as replacement of lead service lines.	http://www.pewtrusts.org/en/research-and-analysis/reports/2017/08/10-policies-to-prevent-and-respond-to-childhood-lead-exposure
ASCE Infrastructure Report Card	Research Database – This annual report put out by the American Society of Civil Engineers provides “grades” for aspects of US infrastructure and includes detailed explanations and statistics to support the findings.	https://www.infrastructurereportcard.org/cat-item/drinking-water/

