United States Government Accountability Office

Report to the Ranking Member, Subcommittee on Environment and the Economy, Committee on Energy and Commerce, House of Representatives

September 2016

WATER INFRASTRUCTURE

Information on Selected Midsize and Large Cities with Declining Populations

GAO-16-785

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GAO Highlights

Highlights of GAO-16-785, a report to the Ranking Member, Subcommittee on Environment and the Economy, Committee on Energy and Commerce, House of Representatives

Why GAO Did This Study

Many midsize and large cities throughout the United States, including the Midwest and Northeast, have lost a substantial percentage of their population. These cities face the challenge of a corresponding decline in utility revenues from a loss of ratepayers, which makes it difficult to address their water infrastructure needs. Overall, water and wastewater utilities across the United States face substantial costs to maintain, upgrade, or replace aging and deteriorating infrastructure—approximately $655 billion for water and wastewater utilities over the next 20 years according to EPA's most recent estimates.

GAO was asked to review the water and wastewater infrastructure needs in midsize and large cities with declining populations. This report examines (1) the economic characteristics of such cities and their water and wastewater infrastructure needs; (2) strategies that selected cities and utilities have used to address their infrastructure needs and the affordability of their water and wastewater rates; and (3) what existing federal programs and policies, if any, could assist such cities in addressing their needs. GAO analyzed decennial census and American Community Survey data, relevant studies, and utility financial statements for 10 cities with the largest population declines from 1980 through 2010 and 14 water and wastewater utilities in those cities. GAO also reviewed laws, regulations, policies, and guidance for six federal programs; analyzed program and city and utility funding data; and interviewed agency and city officials and representatives from 12 of the 14 utilities.

View GAO-16-785. For more information, contact J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov.

What GAO Found

Midsize cities (with populations from 50,000 to 99,999) and large cities (with populations of 100,000 and greater) that have experienced a population decline are generally more economically distressed than growing cities. Specifically, GAO's review of American Community Survey data for 674 midsize and large cities showed that the 99 cities with declining population had higher poverty and unemployment rates and lower median income than cities with growing populations. Little research has been done about these cities' overall water and wastewater infrastructure needs, but the needs of the 10 midsize and large cities that GAO reviewed generally reflected the needs of cities nationally, as identified in needs assessments conducted by the Environmental Protection Agency (EPA). Water and wastewater utility representatives whom GAO interviewed described major infrastructure needs, including pipeline repair and replacement and wastewater improvements to control combined sewer overflows (i.e., wastewater discharges to streams and other water bodies during storms).

Utilities for the 10 cities GAO reviewed used the strategy of raising rates to increase revenues to address water and wastewater infrastructure needs and used other strategies to address concerns about rate affordability for low-income customers. Most of the 14 utilities GAO reviewed raised rates annually to cover declines in revenues related, in part, to decreasing water use from declining populations, or to pay for rising operating and capital expenses. To help address rate affordability concerns, all of the utilities reviewed had developed customer assistance programs, a strategy to make rates more affordable, for example, by developing a payment plan agreeable to the customer and the utility. In addition, most utilities were using or had plans to use one or more cost-control strategies to address needs, such as rightsizing system infrastructure to fit current demands (i.e., reducing treatment capacity or decommissioning water or sewer lines in vacant areas). For example, as part of rightsizing, representatives GAO interviewed for 5 wastewater utilities said that they planned or were considering using vacant areas for green infrastructure (vegetated areas that enhance on-site infiltration) to help control stormwater that can lead to sewer overflows.

As of June 2016, six federal programs and one policy could assist midsize and large cities with declining populations in addressing their water and wastewater infrastructure needs. Cities with declining populations may receive funding from the six programs, managed by EPA, the Economic Development Administration, the Department of Housing and Urban Development (HUD), and the Federal Emergency Management Agency, for such projects. For example, states can use a portion of EPA's Clean Water and Drinking Water State Revolving Funds to provide additional subsidies in the form of principal forgiveness or negative interest loans to cities that meet state affordability criteria, such as median household income. The Birmingham Water Works Board, one of the 14 utilities GAO reviewed, received $11.6 million from the Drinking Water State Revolving Fund in fiscal years 2010 through 2015, including $1.7 million with principal forgiveness to pay for green projects, such as water efficiency projects.

GAO provided a draft of this report to EPA, the Economic Development Administration, and HUD for comment. The agencies provided technical comments that were incorporated, as appropriate.

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Abbreviations

EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
HUD	Department of Housing and Urban Development
SRF	State Revolving Fund

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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September 15, 2016

The Honorable Paul D. Tonko
Ranking Member
Subcommittee on Environment and the Economy
Committee on Energy and Commerce
House of Representatives

Dear Mr. Tonko:

The discovery of lead in the drinking water in Flint, Michigan, in 2015 highlighted the risks that some cities confront in maintaining drinking water and wastewater infrastructure in the face of declining populations and deteriorating economic conditions. Indeed, Flint—once a large city with a peak population of more than 196,000 in 1960 that has declined to a midsize city with an estimated population of about 98,000 by 2015—is not unique in the challenges it faces.[1] Many midsize and large cities throughout the United States, including the Midwest and Northeast, such as Detroit, Michigan, and Utica, New York, have lost a substantial percentage of their populations and corresponding revenues from utility rates. Researchers use "legacy cities" to refer to older industrial cities that have steadily lost population and jobs since the 1950s or 1960s. On the whole, researchers note that these cities have increased rates of poverty, among other effects, and show signs of economic distress. These researchers also note that a key challenge of population decline is a decrease in a city's revenues, while the costs of city services rise.

Water and wastewater (i.e., sewer) utility operations, maintenance, and replacement costs are usually paid for with revenues raised from rates charged to customers for drinking water and wastewater services provided by publicly or privately owned utilities.[2] Water and wastewater utilities serving cities with declining populations have the challenge of

[1]In this report, we define cities with a population of 50,000 to 99,999 as midsize, and cities with a population of 100,000 or more as large cities, based on Census Bureau and National League of Cities definitions.

[2]We use "water and wastewater utilities" to refer to both drinking water and wastewater utilities.

managing their systems with decreasing numbers of ratepayers, which causes decreased utility revenues and therefore increases costs to remaining ratepayers to maintain existing infrastructure designed to support larger populations. While drinking water and wastewater rates in the United States have typically been low, they have been increasing in recent years. According to an American Water Works Association survey, typical water and wastewater bills for residential customers have increased due to rate increases from 2008 through 2014 by 41 and 37 percent, respectively. In addition, according to a 2015 study, prices for water and sewer maintenance continued to rise at a much higher rate than the overall rate of inflation, in contrast to price trends for other utilities, including electricity, natural gas, and telecommunications, that are tracking at or below the rate of inflation.[3] As rates increase to pay for replacing or rebuilding existing infrastructure, they may become unaffordable—that is, high enough that some customers may be unable to pay their water and wastewater bills without financial hardship.

Overall, water and wastewater utilities across the United States are faced with substantial costs to maintain, upgrade, or replace aging and deteriorating infrastructure—approximately $655 billion for water and wastewater utilities over the next 20 years according to the Environmental Protection Agency's (EPA) most recent estimates.[4] Across the country, there are about 52,000 drinking water systems and 16,000 wastewater treatment plants managed by water and wastewater utilities. Utilities typically sell municipal bonds to pay for water and wastewater infrastructure and repay the bonds with a portion of the funds raised by rates charged to customers. Federal assistance is also available for the construction and maintenance of water and wastewater infrastructure.

[3]Janice Beecher, *Trends in Consumer Prices for Utilities through 2014.* (East Lansing, Mich.: Michigan State University, Institute of Public Utilities, February 2015).

[4]EPA's most recent water estimate indicated that drinking water infrastructure funding needs totaled $384 billion (as of 2011), and wastewater infrastructure needs totaled $271 billion (as of 2012). EPA conducts a separate needs survey and cost assessment for drinking water and wastewater infrastructure on separate 4-year schedules. These cost estimates reflect the 20-year projected drinking water and wastewater infrastructure costs, starting with the year that each survey was conducted. See Environmental Protection Agency, *Drinking Water Infrastructure Needs Survey and Assessment: Fifth Report to Congress*, EPA 816-R-13-006 (Washington, D.C.: April 2013), and *Clean Watersheds Needs Survey 2012: Report to Congress*, EPA-832-R-15005 (Washington, D.C.: January 2016).

EPA provides grants through two programs—the Drinking Water State Revolving Fund (SRF) program and the Clean Water SRF program—to states to capitalize state-level SRF programs.[5] In fiscal year 2015, Congress appropriated approximately $907 million for the Drinking Water SRF and $1.4 billion for the Clean Water SRF.

Given the revenue problems facing cities with declining populations and concerns about affordable utility rates, you asked us to review the drinking water and wastewater infrastructure needs of midsize and large cities with declining populations.[6] This reports examines (1) what is known about the economic characteristics of midsize and large cities with declining populations and their drinking water and wastewater infrastructure needs; (2) strategies that selected midsize and large cities with declining populations and their associated utilities used to address their infrastructure needs and the affordability of their water and wastewater rates; and (3) what existing federal programs and policies, if any, could assist midsize and large cities with declining populations, and their associated utilities, in addressing their water infrastructure needs.

To examine what is known about the economic characteristics of midsize and large cities with declining populations and their drinking water and wastewater infrastructure needs, we reviewed relevant studies and interviewed experts in water and wastewater utility management, finance, engineering, and urban planning about infrastructure needs and population decline. We identified studies and experts through a literature review and referrals from EPA officials, representatives of water and wastewater industry associations, and other academic and nonprofit

[5]EPA's Drinking Water SRF program was created under the Safe Drinking Water Act Amendments of 1996. Pub. L. No. 104-182, § 130, 110 Stat. 1613, 1662-1672 (codified as amended at 42 U.S.C. § 300j-12 (2016)). EPA's Clean Water SRF program was created under the Water Quality Act of 1987. Pub. L. No. 100-4, § 212, 101 Stat. 7, 21-28 (codified as amended at 33 U.S.C. §§ 1381-1388 (2016)). The Water Quality Act of 1987 amended the Clean Water Act.

[6]In its surveys, EPA defines drinking water infrastructure and wastewater infrastructure needs as the total capital investment required to continue providing safe drinking water, or to address water quality or water quality-related health problems, up to a 20-year period as reflected in planning documentation. For the Drinking Water Needs Survey, EPA includes only capital investments that are eligible for funding from the Drinking Water SRF.

experts.[7] We defined midsize cities (population 50,000 to 99,999) and large cities (population 100,000 or greater) using the thresholds defined by the U.S. Census Bureau and the National League of Cities. We identified cities with population loss using decennial census data from 1980 through 2010, which we found to be the most extended period for consistent decennial census data.[8] We then analyzed the Census Bureau's American Community Survey 5-year estimates for 2010 through 2014 to identify any economic and demographic trends for midsize and large cities with any decline in population.[9] Based on our review of documentation for decennial census data and American Community Survey data, and statistical analyses of American Community Survey data, we found both sets of data reliable for the purpose of examining the economic characteristics of midsize and large cities with declining populations. To analyze information on water and wastewater needs nationally, we obtained EPA's survey data on water and wastewater infrastructure needs and attempted to match these water utility data with cities identified in the decennial census data. We reviewed documentation and interviewed EPA officials knowledgeable about the data and determined that the data were sufficiently reliable for our purposes of summarizing national needs. We determined that we could not estimate the needs of utilities in cities with declining populations overall because,

[7]We asked EPA officials, industry representatives, and experts we spoke with about any studies we should be aware of, and for suggestions of others to contact with relevant expertise or research focused on infrastructure needs in cities with declining populations.

[8]We calculated population loss based on the difference between 1980 and 2010 population using decennial census data, which are collected from the Census Bureau's survey of all households every 10 years.

[9]We used data from the Census Bureau's American Community Survey, specifically 5-year estimates for 2010 through 2014. The 5-year estimates are based on data collected from a sample of households during 60 months of the 5 most recent calendar years to provide annually updated information. Because the American Community Survey 5-year data followed a probability procedure based on random selections, the sample selected is only one of a large number of samples that we might have drawn. Since each sample could have provided different estimates, we express our confidence in the precision of our particular sample's results as a 90 percent confidence interval. This is the interval that would contain the actual population value for 90 percent of the samples we could have drawn. All 5-year American Community Survey percentage estimates presented have margins of error at the 90 percent confidence level of plus or minus 10 percentage points or less, unless otherwise noted. All non-percentage estimates presented using the 5-year American Community Survey had data within 20 percent of the estimate itself, unless otherwise noted.

among other reasons, although EPA surveys a generalizable sample of utilities for drinking water to estimate national needs, the sample is not designed to make nationwide estimates of the needs of utilities in cities with declining populations. We also had difficulties matching EPA data for utilities with their corresponding cities because utility and city boundaries do not always correspond.[10] We obtained and summarized EPA's national needs data for utilities and compared them to information on needs we collected for a nonprobability sample of 10 cities.

We used a nonprobability sample of 10 cities to obtain information on the water and wastewater needs of cities with declining populations and to examine what strategies the cities, and the utilities associated with them, used to address their infrastructure needs and the affordability of their rates. We selected the 10 cities that experienced the greatest percentage of population loss from 1980 through 2010,[11] using decennial census data, without repeating cities in any state to allow for geographic distribution. We also selected for size, choosing 5 midsize and 5 large cities. The 5 midsize cities we selected were Charleston, West Virginia; Gary, Indiana; Niagara Falls, New York; Macon, Georgia;[12] and Youngstown, Ohio. The 5 large cities we selected were Birmingham, Alabama; Detroit, Michigan; New Orleans, Louisiana; Pittsburgh, Pennsylvania; and St. Louis, Missouri. Because this was a nonprobability sample, the findings related to the 10 cities cannot be generalized to all cities with declining populations. However, the sample highlights the issues faced by a geographically diverse range of cities and

[10]Service area boundaries for drinking water and wastewater utilities differ from city and county boundaries and can cover broad areas. Often, neither city nor county are identified in EPA data for these utilities because of broader service areas or because multiple utilities provide drinking water or wastewater services to a specific city or county. In addition, treatment facilities may be located outside of the service area. All of these factors present difficulties in matching utilities with corresponding cities.

[11]We stopped with 2010, because that was the most recent year for which decennial census data were available. Although all cities we reviewed experienced an overall decline in population from 1980 to 2010, based on Census Bureau estimates, New Orleans's population grew by more than 13 percent from 2010 through 2015, and Birmingham's population grew by 0.1 percent over the same period.

[12]The city of Macon, Georgia, merged with Bibb County effective in January 2014 to form Macon-Bibb County. Population trends of the city and county differ. The city of Macon's population declined by nearly 22 percent from 1980 to 2010, and the county's population grew by about 3.5 percent over the same period.

corresponding utilities that have experienced the greatest population losses in recent decades. Because cities may be served by multiple utilities, our sample included the14 utilities from the 10 selected cities, 6 that were responsible for both water and wastewater infrastructure, 4 that were responsible solely for drinking water infrastructure, and 4 others that were responsible solely for wastewater infrastructure.[13] We interviewed city officials for the 10 cities in our sample and representatives willing to speak with us from 12 of the 14 utilities, which included utilities that provide drinking water and wastewater services to 9 cities. In the interviews, we asked about infrastructure needs, infrastructure and financial condition, funding and management strategies, and challenges in managing water and wastewater infrastructure. We collected documentation from the representatives we interviewed from 12 of the 14 utilities. We also reviewed publicly available documents for all 14 utilities, including the 2 utilities whose representatives did not agree to meet with us. We reviewed audited financial statements for all 14 utilities for fiscal years 2012 through 2014, the most recent years available; reviewed reports from agencies that rate utility and other bonds; and calculated selected financial indicators, including the debt coverage ratio that reflects a utility's ability to repay its long-term debt. We conducted site visits to 6 of the 10 selected cities, based on the geographic distribution and size of the cities.[14] For the remaining cities, we conducted interviews by telephone.

To examine what federal programs and policies could be used by midsize and large cities with declining populations, and their associated utilities, to help address their water infrastructure needs, we reviewed relevant laws, regulations, and policies of federal agencies that fund water and wastewater infrastructure needs and interviewed relevant agency officials about the programs. The agencies were EPA, the Department of Housing

[13]Utilities we reviewed were Birmingham Water Works Board and Jefferson County in Alabama, West Virginia American Water and Charleston Sanitary Board in West Virginia, Detroit Water and Sewerage Department in Michigan, Indiana American Water and Gary Sanitary District in Indiana, Macon Water Authority in Georgia, Sewerage and Water Board of New Orleans in Louisiana, Niagara Falls Water Board in New York, Pittsburgh Water and Sewer Authority in Pennsylvania, St. Louis Water Division and the Metropolitan St. Louis Sewer District in Missouri, and City of Youngstown in Ohio.

[14]Specifically we visited Gary, Indiana; Youngstown, Ohio; Detroit, Michigan; New Orleans, Louisiana; Niagara Falls, New York; and Macon, Georgia.

and Urban Development (HUD), the Economic Development Administration, and the Federal Emergency Management Agency (FEMA).[15] We reviewed relevant policy and guidance for program purpose and eligibility requirements, including any considerations given to affordability. We also analyzed federal funding data for fiscal years 2010 through 2015 from agency funding reports to determine the amounts the agencies directed to financing and maintaining drinking water and wastewater infrastructure, to the extent the data were available. Based on our review of documentation and information collected from agency officials, we found these data to be sufficiently reliable for the purposes of our reporting objectives. We then obtained and reviewed federal funding provided to the 10 selected cities and their associated utilities.

We conducted this performance audit from July 2015 to September 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. A more detailed description of our scope and methodology is presented in appendix I.

Background

Older industrial U.S. cities that have experienced steady, long-term population declines and job losses, called legacy cities, also have diminished revenues and ability to provide services, such as drinking

[15]Other agencies, such as the Department of Agriculture's Rural Utilities Service, the Department of Health and Human Services' Indian Health Service, the U.S. Army Corps of Engineers, and the Department of the Interior's Bureau of Reclamation, can provide assistance for water and wastewater infrastructure. For example, the U.S. Army Corps of Engineers is authorized to provide assistance to nonfederal entities for specific projects, including wastewater treatment and related facilities and water supply, storage, treatment, and distribution facilities, by section 219 of the Water Resources and Development Act of 1992, as amended. In addition, there are four federally chartered and funded economic development commissions that can provide assistance to utilities for water and wastewater infrastructure. We did not review these agencies because we did not find them to be large sources of funding for midsize and large cities' water infrastructure.

water and wastewater services, according to recent studies.[16] These cities are largely scattered across the Midwest and Northeast regions. Two studies identified a number of factors that have contributed to the cities' decline, including the loss of major industries, suburban flight, and reduced housing market demand.[17] These factors have contributed to such effects as decayed buildings and neighborhoods, or blight; increased vacant land; and increased rates of poverty. The two studies also noted that fiscal and other challenges for cities with declining populations were created by a combination of decreased revenues and increased costs of city services.[18] With most legacy cities having experienced peak population levels in the 1950s and 1960s, they have experienced such declines for a long and sustained period and may have greater fiscal challenges than other cities.[19]

Many older U.S. cities, including legacy cities, also face water and wastewater infrastructure problems, including lead pipes in drinking water service lines that connect the main pipeline in the street to an individual home or apartment building. In the late 19th and early 20th centuries in the United States, lead was often used in the construction of drinking water service lines because of its malleability and ease of use, among other factors, as described in a National Bureau of Economic Research

[16]Alan Mallach and Lavea Brachman, *Regenerating America's Legacy Cities* (Cambridge, Mass.: Lincoln Institute of Land Policy, 2013), and 110th American Assembly, *Reinventing America's Legacy Cities: Strategies for Cities Losing Population* (Detroit: American Assembly of Columbia University in collaboration with the Center for Community Progress and Center for Sustainable Urban Development of the Earth Institute at Columbia University, April 2011).

[17]Mallach and Brachman, *Regenerating America's Legacy Cities*, 2. 110th American Assembly, *Reinventing America's Legacy Cities: Strategies for Cities Losing Population*, 6.

[18]Mallach and Brachman, *Regenerating America's Legacy Cities*, 9, 15. 110th American Assembly, *Reinventing America's Legacy Cities: Strategies for Cities Losing Population*, 22.

[19]Fiscal sustainability presents a challenge shared by all levels of government. For example, our long-term model that tracks the fiscal condition of the federal government shows that it faces long-term fiscal pressures to fund entitlement programs, such as Medicaid and Social Security. Similarly, our model shows that state and local governments also face long-term fiscal pressures driven primarily by the rising health-related costs of Medicaid and compensation for employees and retirees. GAO, *State and Local Governments' Fiscal Outlook, 2015 Update*, GAO-16-260SP (Washington, D.C: December 2015).

study.[20] According to the results of a 2016 American Water Works Association survey,[21] about 7 percent of the total population served by U.S. drinking water utilities has either full or partial lead service lines serving their homes.[22] The survey results also indicate that the highest percentages of systems with lead service lines are located in the Midwest and Northeast. Ingesting lead may cause irreversible neurological damage as well as renal disease, cardiovascular effects, and reproductive toxicity.[23]

In addition, older U.S. cities, primarily in the Midwest and Northeast, have wastewater systems constructed as combined sewer systems and face challenges controlling overflows from these systems, called combined sewer overflows, during storms. Combined sewer systems collect stormwater runoff, domestic sewage, and industrial wastewater into one pipe, unlike sanitary sewer systems that collect domestic sewage and industrial wastewater in sewer lines that are separated from stormwater pipelines. Both types of systems may overflow during storm events. Under normal conditions, the wastewater collected in combined sewer pipes is transported to a wastewater treatment plant for treatment and then discharged into a nearby stream, river, lake, or other water body. However, during heavy rain or snow storms, when the volume of the wastewater can exceed a treatment plant's capacity, combined sewer systems release excess untreated wastewater directly into nearby water

[20]Werner Troesken and Patricia E. Beeson, "The Significance of Lead Water Mains in American Cities: Some Historical Evidence," ch. 7 of *National Bureau of Economic Research Conference Report: Health and Labor Force Participation over the Life Cycle, Evidence from the Past* (Chicago: University of Chicago Press, January 2003).

[21]According to its website, the American Water Works Association was established in 1881, and with approximately 50,000 members, is the largest nonprofit scientific and educational association dedicated to managing and treating water.

[22]D. A. Cornwell et al., "National Survey of Lead Service Line Occurrence," *Journal American Water Works Association*, vol.108, no. 4 (2016), 182-191.

[23]Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, Environmental Medicine and Educational Services Branch, *Case Studies in Environmental Medicine: Lead Toxicity*, Course WB 1105 (Atlanta: Aug. 15, 2012).

bodies.[24] According to EPA documents, as of September 2015, 859 communities across the country, primarily in the Northeast and Midwest, have combined sewer systems. According to the results of EPA's 2012 survey of clean water infrastructure needs, projects to prevent or control combined sewer overflows, which involve building large holding tanks or tunnels, will cost about $48 billion over the next 20 years.

Federal, State, and Utility Roles in Water and Wastewater Infrastructure

The federal government works in partnership with states to help ensure drinking water is safe and to protect the quality of the nation's rivers, streams, lakes, and other waters. As required by the Safe Drinking Water Act, EPA sets standards for public drinking water utilities that generally limit the levels of specific contaminants in drinking water that can adversely affect the public's health. Under the Clean Water Act, EPA regulates point source pollution—that is, pollution such as wastewater coming from a discrete point, for example, an industrial facility or a wastewater treatment plant. Most states have primary responsibility for enforcing the applicable requirements of the Safe Drinking Water Act and administering the applicable requirements under the Clean Water Act,[25] and EPA also has oversight and enforcement authority. Generally speaking, states and EPA may take administrative action, such as issuing administrative orders, or judicial action, such as suing an alleged violator in court, to enforce environmental laws such as the Safe Drinking Water Act and Clean Water Act. An administrative action may be issued as a consent order, which is an enforceable agreement among all parties involved, and a judicial action may result in a consent decree, which is also an enforceable agreement signed by all parties to the action.

The federal government and states also provide financial assistance for water and wastewater infrastructure, either through grants to states or

[24]The occasional unintentional release of sewage to waterways from sanitary sewer systems is referred to as a sanitary sewer overflow. Causes include, but are not limited to, blockages, line breaks, sewer defects that allow stormwater and groundwater to overload the system, lapses in sewer system operation and maintenance, power failures, inadequate sewer design, and vandalism.

[25]Specifically, for drinking water utilities, all states—except Wyoming and the District of Columbia—have primary enforcement responsibility under the Safe Drinking Water Act. For wastewater utilities, all states except four states (Idaho, Massachusetts, New Hampshire, and New Mexico) have delegated full or partial permitting and enforcement responsibility under the Clean Water Act.

grants and loans to cities. EPA's Drinking Water SRF and Clean Water SRF programs provide annual grants to states, which states use, among other things, to make low- or no-interest loans to local communities and utilities for various water and wastewater infrastructure projects. States are required to match the federal grants by providing an amount equal to at least 20 percent of the federal grants. EPA has provided about $18.3 billion to states for the Drinking Water SRF from 1997 through 2015 and about $39.5 billion for the Clean Water SRF from 1988 through 2015. In those same periods, states provided about $3.3 billion to the states' Drinking Water SRF programs and about $7.4 billion to the states' Clean Water SRF programs. In addition to the SRF programs, the federal government can provide financial assistance for water and wastewater infrastructure projects through two programs that primarily serve a range of purposes, including assistance with public works projects and providing housing assistance or economic development assistance. The first program is HUD's Community Development Block Grant Program, which provides federal funding to cities, counties, other communities, and states for housing, economic development, neighborhood revitalization, and other community development activities, including water and wastewater infrastructure.[26] The second program is the Department of Commerce's Economic Development Administration's Public Works Program,[27] which awards grants to economically distressed areas, including cities that meet the statutory and regulatory eligibility criteria, to help rehabilitate, expand,

[26]The Community Development Block Grant program was created by Title I of the Housing and Community Development Act of 1974, Pub. L. No. 93-383, tit. I, 88 Stat. 633, 633-653 (1974) (codified as amended at 42 U.S.C. §§ 5301-5321). In addition, according to HUD officials, there are two additional HUD programs that can be used for water and wastewater projects under specific circumstances. When appropriated by Congress, Community Development Block Grant Disaster Recovery funds may be provided to a jurisdiction to respond to a presidentially declared disaster; these funds may be used for the same eligible activities. Also, any entitlement grantee may apply for a Section 108 Loan Guarantee for water and sewer infrastructure activities (among other eligible activities) as a way to leverage Community Development Block Grant funds for larger-scale projects.

[27]The Economic Development Administration's Public Works Program is authorized by Section 201 of the Public Works and Economic Development Act of 1965, as amended (42 U.S.C. § 3141). In addition, according to Economic Development Administration officials, the agency's Economic Adjustment Assistance program—which provides a broad range of assistance to help states and localities respond to various economic challenges—can fund the construction of water and wastewater infrastructure.

and improve their public works facilities, among other things.[28] In addition, FEMA's Public Assistance Grant Program and Hazard Mitigation Grant Program may provide funding for water and wastewater infrastructure projects in certain circumstances when the President has declared a major disaster.[29]

In addition to the funds they use to match federal grants, if required, states can also provide assistance to help water and wastewater utilities address infrastructure needs. More specifically, some states have special programs or funds to pay for water and wastewater projects, and others use their state bonding authority to provide funds to utilities for projects. For example, Georgia has the Georgia Fund, which provides low-interest loans to water and wastewater utilities for water, wastewater, and solid waste infrastructure projects. Ohio and West Virginia sell bonds to support utility projects.

Water and wastewater utilities are generally subject to requirements under the Safe Drinking Water Act and Clean Water Act, respectively, and are responsible for managing and funding the infrastructure needed to meet requirements under these acts.[30] To pay for general operations, maintenance, repair, and replacement of water and wastewater infrastructure, utilities generally follow a strategy of raising revenues by

[28]Projects eligible for assistance generally must be located in areas that have an unemployment rate that is, for the most recent 24-month period for which data are available, at least 1 percent over the national average; have a per capita income that is 80 percent or less of the national average; or have experienced or are about to experience a special need arising from actual or threatened severe unemployment or economic adjustment problems resulting from severe short-term or long-term changes in economic conditions. 42 U.S.C. § 3161(a).The regulatory eligibility criteria are in 13 C.F.R. § 301.3(a).

[29]Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act as amended authorizes FEMA to provide public assistance grants and section 404 authorizes FEMA to provide hazard mitigation grants. Pub. L. No. 100-707, §§ 404, 406 (1988) (codified as amended at 42 U.S.C. §§ 5170c, 5172).

[30]Utilities are organized differently, depending on the city. Drinking water services may be provided by one utility, and wastewater services may be provided by another, or a single utility may provide both services. A water or wastewater utility can be owned and managed by a municipality, a county, an independent district or authority, a private company, or a not-for-profit water association, among others. Often a water or wastewater utility provides service to a city and neighboring area, a county, or across multiple counties.

charging rates to their customers, according to an American Water Works Association document.[31] More specifically, utilities charge users a rate for the water or wastewater service provided, raising these rates as needed. Utilities generally develop long-term capital improvement plans—from 5 to 20 years—to identify the infrastructure they will need to repair and replace pipes, plants, and other facilities. To pay for large capital projects, utilities generally issue or sell tax-exempt municipal bonds in the bond market or get loans from banks, their state governments, or federal lenders. According to a 2016 Congressional Research Service report, in 2014, at least 70 percent of water and wastewater utilities relied on municipal bonds or other debt to finance their infrastructure needs and sold bonds totaling about $34 billion, to pay for their infrastructure projects.[32] Utility bonds are rated by the three major ratings agencies, Moody's, Fitch, and Standard and Poor's.

Water and Wastewater Rates and Affordability Policies

As water and wastewater utilities increase rates to pay for maintaining old and building new infrastructure, according to government and industry groups, rate affordability is a concern, particularly for low-income customers. According to a 2010 Water Research Foundation study,[33] one-third of customers in the lowest 20th percentile income level have had months where they could not pay all their utility bills on time and are three times more likely to have their service disconnected.[34] The study also found, when household budgets near poverty thresholds as defined by the Census Bureau, competing needs may determine whether a household can pay its utility bills. Furthermore, according to a 2016 Water Research Foundation study, utility revenues are affected by a reduction in the average per household indoor water use, which has declined

[31]American Water Works Association and Raftelis Financial Consultants, Inc., *2014 Water and Wastewater Rate Survey* (Denver: American Water Works Association, 2015).

[32]Congressional Research Service, *Legislative Options for Financing Water Infrastructur*e (Washington, D.C.: Apr. 27, 2016).

[33]The foundation conducts research related to drinking water quality, treatment and utility infrastructure to help water utilities and professionals provide safe, reliable, and affordable drinking water. Approximately 950 utilities, manufacturers, and consultants subscribe to the foundation's research, most of which are based in the U.S., but many are international.

[34]J. E. Cromwell, III, et al., *Best Practices in Customer Payment Assistance Programs* (Denver: Water Research Foundation, 2010). This publication was sponsored by the Water Research Foundation and EPA.

nationally by 22 percent since 1999 with the increased use of water conservation appliances like low-flow toilets and clothes washers.[35]

EPA addresses the affordability of water and wastewater utility rates in several different ways, including the following.

- The Safe Drinking Water Act authorizes states to provide additional subsidization to disadvantaged communities, which are service areas that meet state-established affordability criteria.
- Under the Safe Drinking Water Act, EPA must under some circumstances identify variance technology that is available and affordable for public water systems serving a population of 10,000 or fewer to meet new drinking water standards.[36] As established in EPA's 1998 variance technology findings, its most recent policy regarding drinking water affordability, EPA continues to use drinking water bills above a national-level 2.5 percent of median household income as affordability criteria to identify affordable compliance technologies.[37]
- The Clean Water Act authorizes states to provide additional subsidization to benefit certain municipalities, including those that meet state affordability criteria, in certain circumstances. We refer to municipalities that meet the affordability criteria as disadvantaged communities in this report.
- In 1994, EPA issued its Combined Sewer Overflow Control Policy, which remains in effect, to provide guidance for permitting and enforcement authorities to ensure that controls for combined sewer overflows are cost-effective and meet the objectives of the Clean

[35]W. B. DeOreo et al., *Residential End Uses of Water, Version 2* (Denver: Water Research Foundation, April 2016).

[36]Specifically, the Safe Drinking Water Act requires EPA to identify affordable technologies that systems serving fewer than 10,000 people may use to implement new drinking water standards. If EPA is unable to identify such technologies, then it must identify variance technologies that are affordable and that protect human health even though they do not achieve full compliance with the standard.

[37]Environmental Protection Agency, Office of Water, *Variance Technology Findings for Contaminants Regulated Before 1996*, EPA-815-R-98-003 (Washington, D.C.: September 1998). In 1998, EPA found that there was no basis for listing variance technologies for any of the 80 contaminants then regulated under the Safe Drinking Water Act and has not found any drinking water standards to be unaffordable for small systems.

Water Act. Under the policy, implementation of combined sewer overflow controls may be phased in over time depending on several factors, including the financial capability of the wastewater utility.[38] EPA issued guidance in 1997 on how to assess a city's financial capability as a part of negotiating schedules for implementing Clean Water Act requirements.[39] The guidance considers wastewater costs per household that are below 2.0 percent of median household income to have a low or midrange effect on households.

- In 2016, EPA's Water Infrastructure and Resiliency Finance Center, which was created in 2015 to provide expertise and guidance on water infrastructure financing, published a report on customer assistance programs that utilities across the United States have developed to help their low-income customers pay their bills.[40]

EPA's Environmental Financial Advisory Board (a group created to provide expert advice on funding environmental programs and projects), the U.S. Conference of Mayors, industry groups, and others have critiqued EPA's definition of affordability and have suggested that EPA use other measures to assess the effect of water and wastewater bills on low-income households and a community's overall financial capability. For example, in 2007 and again in 2014, EPA's Environmental Financial Advisory Board recommended that EPA use the lowest 20th percentile of income—as opposed to 2.5 percent of median household income—as a measure of a household's ability to afford a rate increase, when assessing the affordability of infrastructure to control combined sewer overflows on low-income customers. In 2013, the U.S. Conference of Mayors issued a tool for assessing affordability that using EPA policies considers a cost increase of less than 4.5 percent for water and

[38]59 Fed. Reg. 18,688 (Apr. 19, 1994).

[39]Environmental Protection Agency, Office of Water, Office of Wastewater Management, *Combined Sewer Overflows—Guidance for Financial Capability Assessment and Schedule Development*, EPA 832-B-97-004 (Washington, D.C.: February 1997).

[40]Environmental Protection Agency, Water Infrastructure and Resiliency Finance Center, *Drinking Water and Wastewater Utility Customer Assistance Programs* (Washington, D.C.: April 2016).

wastewater bill as affordable.[41] Based on discussions with local governments and in response to these critiques, EPA has taken steps to clarify its guidance with memorandums issued in 2012 and 2014, which describe flexibilities in applying affordability indicators.

Legislation has been introduced to address the affordability of increases in utility rates. One bill, the Water Resources and Development Act of 2016, introduced in the Senate in April 2016, would provide a definition of affordability that differs from current EPA definitions and would require EPA to update its financial capability guidance after a National Academy of Public Administration study on affordability.[42] Another bill would provide federal assistance to help low-income households maintain access to sanitation services, including wastewater services.[43] According to industry reports about the proposed legislation, the proposed program is similar to the Department of Health and Human Services' Low Income Home Energy Assistance Program that provides assistance to low-income households to help pay their heating bills.

Midsize and Large Cities with Declining Populations Are More Distressed Compared with Growing Cities, but Little Is Known about Their Water Infrastructure Needs

Midsize and large cities with declining populations are generally more economically distressed, with higher poverty and unemployment rates and lower per capita income than growing cities. Little research has been done on the water and wastewater infrastructure needs of cities with declining populations, but the needs of 10 selected midsize and large cities we reviewed generally reflected the needs of cities nationally.

[41]The conference added EPA's affordability limits for small drinking water utilities and for wastewater services and combined sewer overflow controls to get 4.5 percent. U.S. Conference of Mayors, American Water Works Association, and Water Environment Federation, *Affordability Assessment Tool for Federal Water Mandates* (Boulder: 2013).

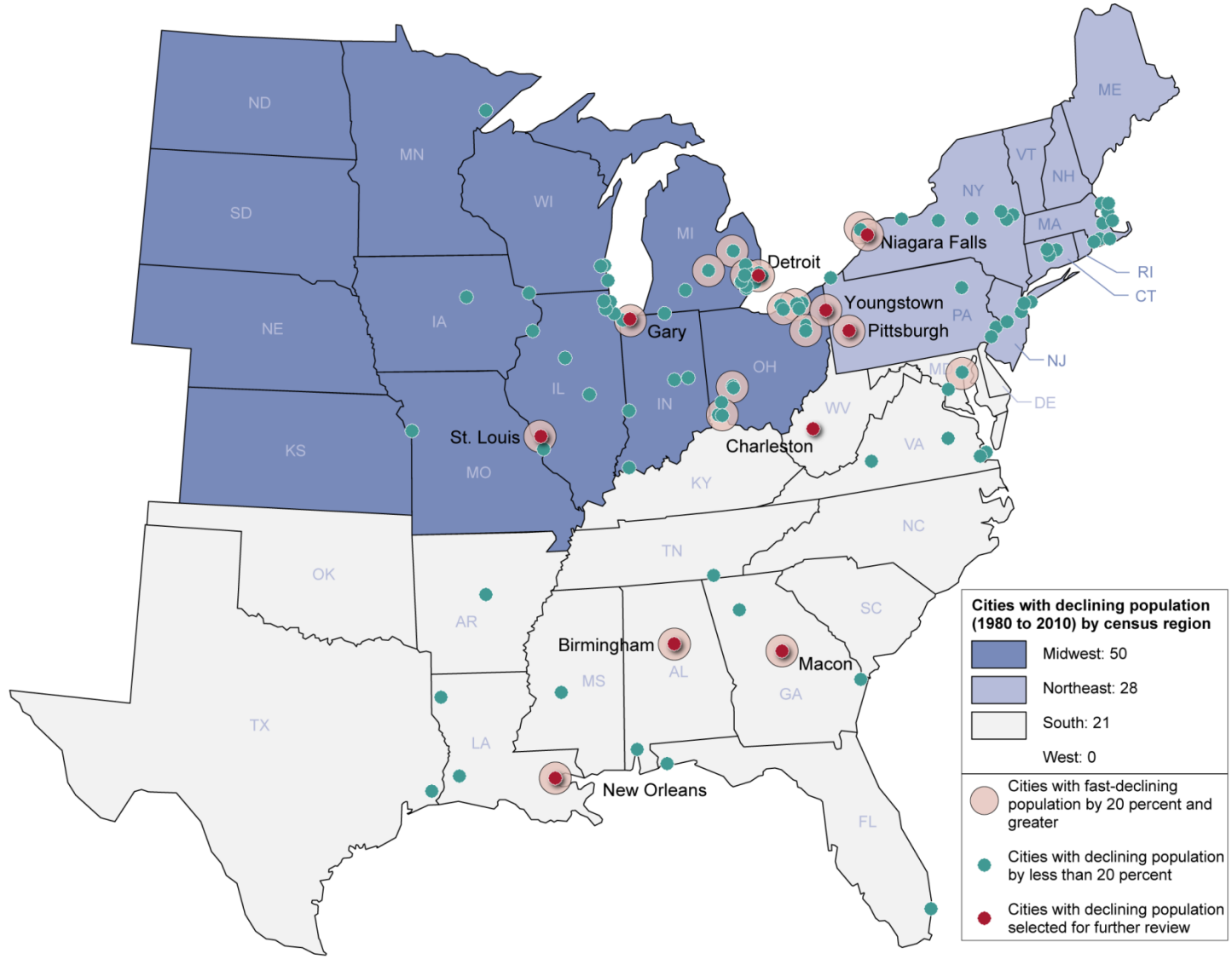
[42]S. 2848, 114th Cong. (2016).

[43]H.R. 4542, 114th Cong. (2016).

Midsize and Large Cities with Declining Populations Generally Have Higher Rates of Economic Distress Than Growing Cities

Of the 674 midsize and large cities across the nation that had a 2010 population greater than 50,000, 99 (15 percent) experienced some level of population decline from 1980 to 2010. As shown in figure 1, about half of these 99 midsize and large cities (50) are in the Midwest; 28 percent (28) are located in the Northeast; and 21 percent (21) are located in the South. None of these midsize and large cities with declining populations was located in the western states. Michigan and Ohio have the largest numbers of midsize and large cities with declining populations—each with 14 cities.

Figure 1: Location of U.S. Cities with 2010 Populations of 50,000 and Greater That Experienced a Decline in Population from 1980 to 2010



Source: GAO analysis of U.S. Census Bureau data. | GAO-16-785

Based on our analysis of the Census Bureau's American Community Survey data (5-year estimates for 2010 through 2014), cities with declining populations have had significantly higher rates of poverty and unemployment and lower household income—characteristics of economic

distress—compared with growing cities of the same size.[44] Compared with midsize and large cities that had growing populations over the same time, cities with declining populations had higher estimated poverty rates (23.6 percent compared with 16.5 percent), higher estimated levels of unemployment (12.5 percent compared with 9.2 percent), and lower estimated median household income ($40,993 compared with $57,729),as shown in table 1. These differences become more stark when cities with the greatest rates of population loss are compared with cities with the greatest rates of growth. Specifically, the 19 cities that lost 20 percent or more of their population had an average poverty rate of 31.4 percent compared with an average of 16.3 percent for cities with 20 percent or more growth.[45] Moreover, unemployment in cities with the greatest estimated population loss was 16.5 percent compared with 9.1 percent in highest growth cities, and median household income was $32,242 compared with $58,140.

[44]We analyzed economic, social, and demographic characteristics of cities with populations greater than 50,000 using Census Bureau American Community Survey data, specifically 5-year estimates, 2010 through 2014. To characterize economic distress, we analyzed the poverty rate, unemployment rate, median household income, and per capita income.

[45]Nine of the 10 midsize and large cities we selected for review are among the cities with population declines greater than 20 percent. These cities are Birmingham, Detroit, Gary, Macon, New Orleans, Niagara Falls, Pittsburgh, St. Louis, and Youngstown. We also selected Charleston for review, which had a population decline of 19.7 percent from 1980 to 2010. For a description of our selection process, see app. I. For a description of the economic and demographic characteristics of the 10 cities we selected, see app. II.

Table 1: Estimated Key Economic Characteristics of Midsize and Large Cities with Declining Populations Compared with Cities with Growing Populations

		Economic characteristics, 5-year estimates (2010 through 2014)							
Percentage of population change, 1980-2010	**Total cities with 2010 population greater than 50,000**	**Average percentage of poverty**	**Average percentage of unemployment**	**Average median household income (dollars)**	**Average per capita income (dollars)**	**Average percentage of vacant housing**	**Average median home value (dollars)**	**Average median year housing stock was built**	**Average percentage of households with food stamp benefits**
Growth									
Greater than 20.0	450	16.3	9.1	58,140	28,002	8.5	242,703	1980	12.7
10.0 to 19.9	61	16.7	9.7	57,150	30,601	8.9	320,688	1961	14.4
0 to 9.9	64	17.4	9.6	55,390	31,188	9.5	265,568	1958	16.4
All growth	**575**	**16.5**	**9.2**	**57,729**	**28,632**	**8.6**	**253,522**	**1976**	**13.3**
Decline									
0 to -9.9	53	20.5	11.1	45,139	25,527	11.7	169,931	1956	19.6
-10.0 to -19.9	27	24.5	12.7	38,689	21,893	12.9	109,268[a]	1953	23.7
-20.0 and greater	19	31.4	16.5	32,242	20,020[a]	19.7	83,066[a]	1948	31.0
All decline	**99**	**23.6**	**12.5**	**40,993**	**23,514**	**13.5**	**137,263**	**1954**	**22.8**

Source: GAO analysis of U.S. Census Bureau's American Community Survey data (5-year estimates, 2010 through 2014) and decennial census data. | GAO-16-785

Note: All 5-year American Community Survey percentage estimates presented have margins of error at the 90 percent confidence level of plus or minus 10 percentage points or less, unless otherwise noted. All non-percentage estimates presented using the 5-year American Community Survey had data within 20 percent of the estimate itself, unless otherwise noted.

[a]The 90 percent confidence intervals for percentage estimates are within +/- 20 percentage points.

Another distinguishing factor for cities with declining populations is high levels of vacant housing and low median home values. On average, cities with declining populations had 13.5 percent of their housing stock vacant, and growing cities had vacancy rates of 8.6 percent. Cities with the greatest population loss had nearly 20 percent vacant housing stock (19.7 percent), compared with 8.5 percent in cities with the most population growth. Cities with declining populations also had much older housing stock (average house being built in 1954 compared with 1976) and lower median home values ($137,263 compared with $253,522).

Cities with declining populations also had some significantly different demographic characteristics than cities with growing populations. The 99 cities with declining populations had a higher estimated share of African American residents than cities with growing populations (28.5 percent

compared with 11.1 percent) and a lower estimated share of the population with bachelor degrees (24.4 percent compared with 32.5 percent). (See table 2 for details on characteristics.)

Table 2: Estimated Demographic Characteristics of Midsize and Large Cities with Declining Populations Compared with Growing Cities

		Demographic characteristics, 5-year estimates (2010 through 2014)					
Percentage of population change, 1980-2010	**Total number of cities with 2010 population greater than 50,000**	**Average percentage white**	**Average percentage African American**	**Average percentage other race**	**Average percentage over 65 years old**	**Average percentage of population with at least a high school diploma**	**Average percentage of population with bachelor's degree**
Growth							
Greater than 20.0	450	53.0	10.2	36.5	11.5	85.7	32.2
10.0 to 19.9	61	49.5	12.4	38.0	13.4	84.5[a]	32.8
0 to 9.9	64	59.2	16.2	24.6	13.8	87.1[a]	34.6
All growth	**575**	**53.3**	**11.1**	**35.4**	**12.0**	**85.8**	**32.5**
Decline							
0 to -9.9	53	57.4	24.7	17.8	13.4	85.4[a]	27.0
-10.0 to -19.9	27	59.3	23.7	17.0	13.3	84.1[a]	21.9
-20.0 and greater	19	42.1	46.9	10.9	12.9	82.9[a]	20.4
All decline	**99**	**55.1**	**28.5**	**16.3**	**13.3**	**84.6[a]**	**24.4**

Source: GAO analysis of U.S. Census Bureau's American Community Survey data (5-year estimates, 2010 through 2014) and decennial census data. | GAO-16-785

Note: All 5-year American Community Survey percentage estimates presented have margins of error at the 90 percent confidence level of plus or minus 10 percentage points or less, unless otherwise noted. All non-percentage estimates presented using the 5-year American Community Survey had data within 20 percent of the estimate itself, unless otherwise noted.

[a]The 90 percent confidence intervals for percentage estimates are within +/- 36 percentage points.

The Water and Wastewater Needs of Selected Midsize and Large Cities Resemble Those of Cities Nationally, although Little Research Has Been Done on Those Needs

Academic research on U.S. cities with declining populations has been conducted for over a decade but has not focused on the water and wastewater infrastructure needs of these cities. The few studies and EPA reports we identified on water and wastewater infrastructure needs in cities with declining populations focused on the feasibility and challenges of rightsizing infrastructure, that is, downsizing or eliminating underutilized infrastructure to meet reduced demands.[46] Among other challenges to rightsizing infrastructure, the studies described significant capital costs in decommissioning existing infrastructure and physical difficulty in removing components in depopulated areas without affecting the entire water or wastewater system. These studies also provided information on other strategies for maintaining underutilized water infrastructure in cities with declining populations. These strategies include using asset management to establish maintenance priorities and repair schedules; coordinating projects for water, wastewater, road, and other infrastructure to gain cost efficiencies; and using vacant lands for stormwater management generally and to help control sewer overflows as part of rightsizing.[47] In addition, the studies highlighted the financial challenges of utilities managing water and wastewater infrastructure in cities with declining populations, resulting from decreasing revenues from fewer ratepayers, and personnel challenges of these utilities because of reductions in personnel to achieve cost savings.

[46]John Hoornbeek, and Terry Schwarz, *Sustainable Infrastructure in Shrinking Cities: Options for the Future* (Kent, Ohio: Center for Public Administration and Public Policy and Cleveland Urban Design Collaborative, Kent State University, July 2009); K. M. Faust, D. M. Abraham, and S. P. McElmurry, "Water and Wastewater Infrastructure Management in Shrinking Cities" *Public Works Management and Policy* (2015), 1-29,; Environmental Protection Agency, Office of Sustainable Communities, Smart Growth Program, *Managing Vacant and Abandoned Property in the Green Zone of Saginaw, Michigan* (Washington, D.C.: July 2014); Environmental Protection Agency, Region 5, *Workshop Summary Report: Retooling Infrastructure as a Strategy to Advance an Older Industrial City's Future Vision* (Chicago: September 2012); and Environmental Protection Agency, *Draft Report, Down to Scale: Retooling Infrastructure Systems in Legacy Cities* (June 2014).

[47]Asset management is a framework for providing the best level of service at the lowest appropriate cost, and involves identifying and prioritizing assets for routine repair or replacement (versus emergency repair). For water and wastewater utilities, key assets include pipelines, tanks, and pumps. GAO, *Water Infrastructure: EPA and USDA Are Helping Small Water Utilities with Asset Management; Opportunities Exist to Better Track Results*, GAO-16-237 (Washington, D.C.: Jan. 27, 2016).

While research on water and wastewater infrastructure in cities with declining populations may be sparse, EPA evaluates water and wastewater needs at the national level every 4 years. EPA most recently estimated drinking water needs for the nation at $384.2 billion (in 2011 dollars) in a 2013 report and wastewater needs at $271 billion (in 2012 dollars) in a 2016 report.[48] EPA needs surveys focus on water and wastewater needs at the national and state or treatment facility levels, making it difficult to identify the needs of specific cities, including cities with declining populations. As identified by the city officials and utility representatives we interviewed, the needs of the 10 selected cities we reviewed did, however, reflect the needs EPA identified for cities nationally. These needs were as follows:

Drinking Water Infrastructure Needs

EPA's 2011 drinking water needs survey found that nationally, the largest infrastructure needs identified, by estimated costs, addressed two areas: distribution and transmission systems and drinking water treatment infrastructure. Distribution and transmission systems include pipelines that carry drinking water from a water source to the treatment plant or from the treatment plant to the customer. Drinking water treatment infrastructure includes equipment that treats water or removes contaminants. Consistent with EPA's national estimates, representatives we interviewed from seven of nine drinking water utilities for the 10 cities identified pipeline repair and replacement as a major need.[49] For example, representatives from one utility told us that its distribution pipelines were approximately 80 years old and that within the next 15 to 20 years almost all of them will need to be updated. Representatives from another utility said that almost all 740 miles of the utility's pipelines need to be replaced. At roughly $100 per foot, replacing all pipelines will cost more than $390 million. Representatives from seven of the nine drinking water utilities said that their utilities had high leakage rates (sometimes reflected in estimates of nonrevenue water), ranging from about 18 to 60 percent, above the 10 to 15 percent maximum water loss considered acceptable in most states according to an EPA document and indicating

[48]Environmental Protection Agency, *Drinking Water Infrastructure Needs Survey and Assessment*, and *Clean Watersheds Needs Survey 2012*.

[49]In all, we interviewed representatives willing to speak with us from 12 of 14 utilities, which included utilities providing drinking water services and wastewater services to nine cities.

the need for pipeline repair or replacement.[50] (See app. III for details of utilities' drinking water infrastructure needs for the 10 cities.)

Of the 10 utilities we reviewed that were responsible for drinking water infrastructure, representatives from 6 noted that they were aware that some portions of their or their customer-owned portions of service lines connecting individual houses or apartment buildings to the main water lines contain or may contain lead, although most of these utilities did not express concern about the risk of lead in their water. In addition, representatives we interviewed from 5 drinking water utilities out of the 10 we reviewed named treatment plant repair and replacement as one of their greatest needs. Representatives from one utility told us that the utility's water treatment plant is over 100 years old and is in need of replacement or backup, which they said would cost an estimated $68.6 million. The clear well in the plant, that is, the storage tank used to disinfect filtered water, was built in 1908. If the tank fails, the main source of potable water for customers would be interrupted, leaving the community without water.

Wastewater Infrastructure Needs

EPA's 2012 wastewater needs survey found that the largest infrastructure needs for wastewater systems fell into three categories: combined sewer overflow correction (i.e., control of overflows in combined sewer systems); wastewater treatment, or infrastructure needed to meet treatment under EPA standards; and conveyance system repair, or the infrastructure needed to repair or replace sewer pipelines and connected components to maintain structural integrity of the system or to address inflow of groundwater into the sewer system.[51] Consistent with EPA's national estimates, utilities serving 7 of the 10 cities we reviewed face high costs to control combined sewer overflows.[52] (See app. IV for details of utilities'

[50]Nonrevenue water is treated water that is not sold to customers; it includes water lost to leakage as well as water used for fire protection, street cleaning, or other uses. Environmental Protection Agency, Office of Water, *Control and Mitigation of Drinking Water Losses in Distribution Systems*, EPA 816-R-10-019 (Washington, D.C.: November 2010).

[51]Old sewer pipelines leak and allow groundwater to infiltrate the pipelines, adding this groundwater to the amount of water treated—unnecessarily in this case—at the wastewater treatment plant.

[52]Cities we reviewed that are served by wastewater utilities that have combined sewer systems and require controls on combined sewer overflows are Charleston, Detroit, Gary, Niagara Falls, Pittsburgh, St. Louis, and Youngstown.

wastewater infrastructure needs for the 10 cities.) According to EPA's wastewater needs survey, estimated costs for infrastructure improvements to control combined sewer overflows for wastewater utilities serving 7 of the 10 cities we reviewed ranged from $7.1 million to $1.98 billion. In addition, representatives we interviewed from wastewater utilities that serve 5 of the 10 cities we reviewed said that they needed to repair or replace their treatment plants. For example, representatives from one utility said that 90 percent of the utility's original wastewater treatment plant, which was built in 1938, was still in place and required constant attention to keep it running. Finally, representatives we interviewed from wastewater utilities providing services to 9 of the 10 cities we reviewed discussed collection system repair as a major need. For example, representatives from one utility said that the city sewer lines date back to the mid-1800s. They recently replaced two blocks of the oldest section of sewer lines for $3 million.

Utilities in Selected Cities Have Been Raising Rates to Help Address Infrastructure Needs and Using Customer Assistance and Cost Control Strategies for Rate Affordability

Our sample of 14 utilities in the 10 cities we reviewed used the traditional strategy of raising rates to increase revenues to address their infrastructure needs, although representatives from half of them said that they had concerns about rate affordability and their future ability to raise rates. All utilities we reviewed also had developed one or more types of customer assistance programs, a strategy to help low-income customers pay their bills. In addition, most utilities were using or had plans to use one or more cost control strategies to address their infrastructure needs, such as asset management (i.e., identifying and prioritizing assets for routine repair or replacement versus emergency repair) or rightsizing to physically change infrastructure to meet current demands (e.g., reducing treatment capacity or decommissioning water lines and sewer lines in vacant areas).

Utilities in Selected Cities Have Raised Rates to Increase Revenues for Water and Wastewater Infrastructure Needs but Have Concerns about Keeping Rates Affordable

Our sample of 14 utilities in the 10 cities we reviewed used the traditional strategy of increasing revenue—raising rates as needed and selling bonds to pay for their infrastructure needs. Of the 14 utilities we reviewed, most raised rates annually, and all but 2 utilities had raised rates at least once since 2012. (See app. V for utilities' operating revenues, operating expenses, and rate changes.) In addition, according to our review of the utilities' financial statements, 11 of 14 experienced a decline in revenues in 1 of the years from 2012 through 2014, and over these years raised utility rates, which helped make up for lost revenues or cover increasing operation and maintenance costs. In contrast, the remaining 3 utilities for which we reviewed available financial statements had increasing

revenues over the same period. Of the 3 utilities, 2 also raised rates by more than 9 percent or greater in 2 or more consecutive years from 2012 through 2014; the other utility was privately owned and operated and maintained steady revenues with an overall increase of less than 1 percent.

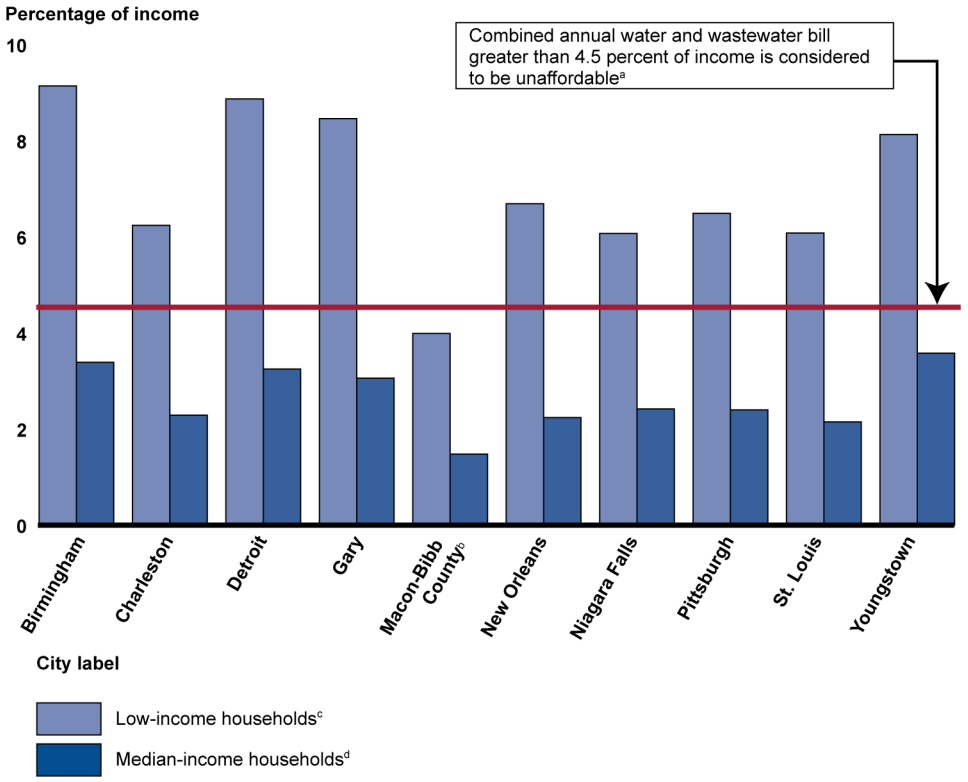
Most of the 14 utilities we reviewed used a common rate structure through which customers were charged a modest base rate plus a larger variable rate by volume of water used, according to studies conducted on utility rates. Such a rate structure produces reduced revenues as the amount of water used and sold decreases. In addition to the decline in water use and revenues that many utilities are experiencing nationally, utilities with declining populations are further affected by reduced water sales to fewer ratepayers and face additional declines in revenues. Furthermore, according to representatives we interviewed from some of the utilities, declining populations resulted in operational changes that increased operating costs for their utilities. For example, utility representatives told us that when water sits for extended periods, such as in storage, it may lose its chlorine residual, which allows bacteria and viruses to grow and multiply. For wastewater systems, reduced water flow during dry weather has resulted in stronger sewage sludge and solid deposits that require an adjustment of wastewater treatment processes, according to utility representatives.

Even with increased rates, many of the utilities we reviewed deferred planned repair and replacement projects and consequently expended resources on addressing emergencies, such as repairing water pipeline breaks. One water utility management professional estimated that emergency repairs can cost three to four times more than regular repairs. Specifically, representatives we interviewed from half of the utilities willing to speak with us (6 of 12) described themselves as being more reactive in repair and replacement of drinking water and wastewater infrastructure. Representatives from these utilities also told us that they do not have sufficient funding to meet their repair and replacement needs, and some noted large backlogs of planned repair and replacement projects. For example, representatives from one of the utilities we reviewed told us that the utility's current level of investment would result in the replacement of its water and wastewater infrastructure in 400 years, versus replacement within the industry standard of up to a100 years (or a replacement schedule at 1 percent of infrastructure per year). The 5-year capital plan for another utility we reviewed deferred nearly two-thirds of the listed capital improvement projects because of lack of funding. Representatives from another utility described plans to spend about $8 million to replace

water pipelines, but learned that they should be investing about twice as much to maintain their existing service levels, based on recent modeling of the system.

With increased rates, representatives we interviewed from more than half of the utilities willing to speak with us identified concerns with keeping customer rates affordable. Specifically, representatives we interviewed from 7 of 12 utilities expressed concern about the affordability of future rate increases for low-income households (i.e., those that have incomes in the lowest 20th percentile income level). Affordability of water and wastewater bills is commonly measured by the average residential bill as a percentage of median-income households. Our analysis of the water and wastewater rates charged in fiscal year 2015 by the 14 utilities we reviewed showed that rates for both water and wastewater bills were considered affordable for customers at or above median-income households. However, these rates were higher than the amount considered to be affordable for low-income customers in 9 of 10 cities we reviewed (see fig. 2). The U.S. Conference of Mayors estimated combined annual water and wastewater bills of more than 4.5 percent of income as unaffordable based on EPA policies. In 4 of the 10 cities we reviewed, the average water and wastewater bill was more than 8 percent of income for low-income households.

Figure 2: Estimated 2015 Combined Water and Wastewater Bills as a Share of Household Income for Low- and Median-Income Households in 10 Selected Cities



Source: GAO analysis of utility rate information and American Community Survey income data using 5-year estimates, 2010-2014. | GAO-16-785

Note: Data on average water and wastewater bills used in the calculations were compiled from data contained in utility documents or reported to us by the utilities serving these 10 cities, where available. For one city—Niagara Falls—these data were not available, and we estimated the average bill assuming a household with a 5/8 inch water meter and average usage of 9.24 hundred cubic feet (about 6,920 gallons) of water per month. All estimates, which are based on American Community Survey 5-year estimates of household income, have 90 percent confidence intervals that are within +/- 0.6 percentage points.

[a]The U.S. Conference of Mayors estimated a combined annual water and wastewater bill of more than 4.5 percent of income as unaffordable based on Environmental Protection Agency policies.

[b]Macon merged with Bibb County in 2014 to become Macon-Bibb County. Macon-Bibb County American Community Survey 5-year estimates, 2010 through 2014 income data, are used in this graphic.

[c]Average annual residential bill as a share of income for low-income households. Low-income households refer to households within the lowest income quintile (i.e., those that have incomes in the lowest 20th percentile income level) for the corresponding city.

[d]Average annual residential bill as a share of income for median-income households (i.e., those that have incomes in the 50th percentile income level) for the corresponding city.

While they are generally concerned about affordability of rates, representatives from few of the utilities we interviewed said that they planned to change their rate structures, although changes can generate a more reliable and predictable revenue stream to cover costs, according to a 2014 utility study.[53] Of the representatives we interviewed from 12 of the 14 utilities, representatives for 2 utilities said that they were interested in making rate structure changes that would increase cost recovery and that they planned to make incremental changes over time. In addition, 1 utility—Jefferson County, which provides wastewater services to Birmingham—had already made significant changes to its rate structure to stabilize revenues and to meet requirements for exiting bankruptcy. This utility replaced the minimum charge with a monthly base charge scaled by meter size for all customers. The utility also altered its rate structure for the volume of water used for residential customers from a flat fee per volume of water used to an increasing block rate structure where higher fees are charged for incremental blocks of increased water usage. A 2014 Water Resource Foundation study stated that utility representatives hesitate to make rate structure changes because of the potential to significantly alter customers' monthly bills, and highlighted the need for stakeholders and utility board members to undertake an education and communication strategy when making such changes.[54]

In addition to their concerns about the affordability of rates, a few representatives we interviewed said that they expect to have future challenges using bond funding because of the rate increases needed to pay for them. Specifically, representatives we interviewed from 2 of the 12 utilities willing to speak with us—Gary Sanitary District and the city of Youngstown—said that they expected the increased rates would be difficult to afford for residents of the two cities where the median household income is about half the national average and the poverty rate is above 37 percent. All 12 of the utilities whose representatives we interviewed have used bond funding to help finance their water and wastewater infrastructure needs. Of the 14 utilities we reviewed, 10 had strong to very strong ability to pay long-term debt as indicated by fiscal year 2014 debt service coverage ratios we calculated, 2 had moderate

[53]J. Hughes et al., *Defining a Resilient Business Model for Water Utilities* (Denver: Water Research Foundation, 2014).

[54]Hughes et al., *Defining a Resilient Business Model for Water Utilities*, 155.

ability, and 2 had poor or weak ability. In addition, for 8 of the 14 utilities, their bonds as of June 2016 were ranked within an A level range by the ratings agencies, indicating that they were expected to be able to cover the annual payments for these bonds (see app. VI for the utilities' financial indicators).[55]

All of the Utilities in the Selected Cities Developed Customer Assistance Programs as a Strategy for Addressing Concerns about Affordability of Water and Wastewater Rates

All 14 of the utilities we reviewed had developed one or more types of customer assistance programs as a strategy to make rates more affordable for customers who had financial difficulty paying their bills. For 5 of the 14 utilities we reviewed, more than 25 percent of their customers were late in paying their bills. Two of the utilities—Detroit Water and Sewerage Department and Gary Sanitary District—had particularly large numbers of customers who were unable to pay their bills, which was reflected in the lower estimated revenue collection rates of about 86 percent of in-city customers in Detroit and 69 percent of Gary Sanitary District customers, respectively, compared with collection rates averaging 98 percent by the other 8 utilities we reviewed where data were available. For both of these utilities, collecting payments from customers was a challenge, and shut off of water and wastewater services was not uncommon. For example, Detroit Water and Sewerage Department representatives told us that they were still struggling with collections and had lost from $40 million to $50 million in forgone revenues annually for the past few years because of the low collection rate, and had budgeted an additional $1.6 million in fiscal year 2016 to cover expenses related to collecting on delinquent accounts. Similarly, a Gary Sanitary District representative told us that even with rate increases of 30 percent in 2011, revenues had not increased correspondingly and water service shutoffs had increased because customers were unable to pay their bills. According to collections information provided by Gary Sanitary District, in

[55]A debt service coverage ratio indicates the amount of the utility's debt compared to its income and, indirectly, its ability to pay for more debt. The strength of the coverage ratio correlates, but not perfectly, with a utility's bond rating. While both are measures of overall credit quality, the coverage ratio is based strictly on quantitative historical financial data and assesses whether a utility's net income is sufficient to make current principal and interest payments. It must be interpreted in context. For example, utility systems with greater revenue stability can operate comfortably at lower coverage levels. In contrast, a rating draws on a broad set of information to evaluate credit quality, including quantitative historical financial data and information on a utility's service area, as well as qualitative factors associated with a utility's management.

fiscal year 2015, approximately 21 percent of accounts were shut off because of nonpayment. (See app. VII for details on rates and billing collections information for the 14 utilities we reviewed.)

At a minimum, nearly all of the utilities we reviewed (13 of 14) entered into payment plans or agreements with customers with unpaid bills (see table 3). In some cases, payment plan assistance was described as more informal or ad hoc, with flexibility to develop a plan that is agreeable to the customer and the utility, depending on the customer's ability to pay. Other utilities had formalized payment plan programs or policies, requiring a customer to make an initial minimum payment on the outstanding bills, and then accepting payment of the remaining amount in monthly installments over a period of time. In addition, overall, half of the utilities we reviewed (7 of 14) offered direct assistance to low-income, elderly, or disabled customers through bill discounts or assistance to eligible customers in good standing, short-term assistance with unpaid bills (e.g., credit for payment of outstanding water and wastewater bills) and with minor plumbing repairs (e.g., for leaks that can increase water use and monthly bills), or some combination of these three types of assistance.

Table 3: Customer Assistance Programs Used by Drinking Water and Wastewater Utilities of 10 Selected Midsize and Large Cities with Declining Populations as of June 2016

		Customer assistance programs				
City	Utility	Payment plans or agreements	Discounted bills or assistance for low-income, elderly, or disabled customers in good standing	Short-term assistance for low-income, elderly, or disabled customers with unpaid bills	Short-term assistance for low-income, elderly, or disabled customers with minor plumbing repairs	Lifeline rates (fixed base rates that include a minimum amount of water to cover basic needs)
Birmingham, Alabama	Birmingham Water Works Board	●*	○	●	●	●
	Jefferson County[a]	—	—	●[b]	●[b]	—
Charleston, West Virginia	West Virginia American Watera	●	●[c]	●	—	[d]
	Charleston Sanitary Board	●	○	○	○	[d]
Detroit, Michigan	Detroit Water and Sewerage Department	●	●	●	●	○
Gary, Indiana	Indiana American Water	●	○	○	○	○

City	Utility	Customer assistance programs				
		Payment plans or agreements	Discounted bills or assistance for low-income, elderly, or disabled customers in good standing	Short-term assistance for low-income, elderly, or disabled customers with unpaid bills	Short-term assistance for low-income, elderly, or disabled customers with minor plumbing repairs	Lifeline rates (fixed base rates that include a minimum amount of water to cover basic needs)
	Gary Sanitary District	●	○	○	○	○
Macon, Georgia	Macon Water Authority	●	○	●	○	○
Niagara Falls, New York	Niagara Falls Water Board	●*	○	○	○	○
New Orleans, Louisiana	Sewerage and Water Board of New Orleans	●	●	○	●	○
Pittsburgh, Pennsylvania	Pittsburgh Water and Sewer Authority	●	○	○	○	[d]
St. Louis, Missouri	St. Louis Water Divisions	●	○	○	○	○
	Metropolitan St. Louis Sewer District	●*	●	○	○	○
Youngstown, Ohio	City of Youngstown	●	○	○	○	○

Legend:

● = Customer assistance program used by the utility, includes formalized payment plans or policies

●* = Ad hoc use of payment plans, no formal program or policy

○ = Customer assistance program is not being used by the utility

— = Information was not provided by the utility

Source: GAO analysis of city and utility information and interviews with city officials and utility representatives. | GAO-16-785

[a]Information described is based on our review of the description of customer assistance on the utility's website.

[b]Jefferson County wastewater customers that are billed for both drinking water and wastewater service by Birmingham Water Works Board are eligible for assistance made available to Birmingham Water Works Board customers.

[c]A 20 percent discount on water bills for qualifying low-income customers is made possible through a state-based program. Under the program, the state reimburses the utility for special rates through a credit toward the utility's state business and occupation tax.

[d]Base rate includes a minimum amount of water but is not identified as a lifeline rate, a minimum amount of water at a specific rate to cover basic human needs.

Different rate structures, such as a lifeline rate or reducing fixed charges, can assist low-income or financially constrained customers, according to a 2010 Water Research Foundation Study and EPA's 2016 report on

customer assistance programs, but few of the 14 utilities we reviewed use such structures.[56] For example, through a lifeline rate, a utility can provide its customers with a minimum amount of water to cover basic needs at a fixed base charge. When a customer uses more water than the minimum allotment, the utility increases the rate charged, which in turn increases the customer's bill. Lifeline or other alternative rates may be targeted to low-income customers, but none of the utilities we reviewed provided special rates based on income. Representatives we interviewed from one utility said that they consciously revised the utility's rate structure to include lifeline rates to address the needs of customers who could not afford higher rates. An additional 3 of the 14 utilities we reviewed had rate structures that included some volume of water usage with their fixed base charge. Representatives we interviewed from a few utilities (3 of 12) told us that charging special rates for low-income customers is not an option because of local or state laws that do not allow the utilities to differentiate rates among customers. For example, Detroit's Blue Ribbon Panel on Affordability's February 2016 report noted potential legal constraints in the state of Michigan in implementing an income-based rate structure, where customers pay a percentage of their income toward their water bills.[57]

Most Utilities Were Using Cost Control and Efficiency Strategies to Address Their Water and Wastewater Infrastructure Needs

Most of the utilities (13 of 14) we reviewed were using or had plans to use one or more strategies to address their water and wastewater infrastructure needs by controlling costs or increasing the efficiency of the physical infrastructure or overall management of the utility. For example, asset management can help utilities more efficiently identify, prioritize, and plan for routine repair or replacement of its assets, versus facing costly emergency repairs. Table 4 shows the strategies used by the 14 utilities we reviewed, including asset management, major reorganization, and rightsizing physical infrastructure to meet current demands.

[56]Cromwell et al., *Best Practices in Customer Assistance Programs*, and Environmental Protection Agency*, Drinking Water and Wastewater Utility Customer Assistance Programs*.

[57]Galardi Rothstein Group, *City of Detroit Blue Ribbon Panel on Affordability Final Report* (Detroit: Feb. 3, 2016). This report was prepared for the Detroit City Council and the Detroit Water and Sewerage Department and its Board of Water Commissioners.

Table 4: Cost Control and Efficiency Strategies Used by Water and Wastewater Utilities of Selected Midsize and Large Cities with Declining Populations, as of June 2016

		Strategy				
City	Utility	Rightsizing water infrastructure[a]	Major reorganization	Expanding customer base	Public-private partnerships	Asset management
Birmingham, Alabama	Birmingham Water Works Board	◒	●	◒[b]	○	◒
	Jefferson County	—	—	[b]	—	◒[c]
Charleston, West Virginia	West Virginia American Water	—	—	[b]	●[d]	—
	Charleston Sanitary Board	○	○	○	○	●
Detroit, Michigan	Detroit Water and Sewerage Department	◒[e]	●	◒[b]	○	◒
Gary, Indiana	Indiana American Water	○	○	[b]	[d]	●
	Gary Sanitary District	◒[e]	○	◒	[f]	●
Macon, Georgia	Macon Water Authority	○	○	●[b]	○	●
Niagara Falls, New York	Niagara Falls Water Board	○	●	○	○	◒
New Orleans, Louisiana	Sewerage and Water Board of New Orleans	[e]	●	○	●	◒
Pittsburgh, Pennsylvania	Pittsburgh Water and Sewer Authority	[e]	●	◒	●	◒
St. Louis, Missouri	St. Louis Water Division	○	○	○	○	◒
	Metropolitan St. Louis Sewer District	[e]	○	[b]	○	◒
Youngstown, Ohio	City of Youngstown	○	○	○	○	○

Legend:

● = Strategy used by the utility

◒ = Strategy is incorporated into existing plans or partially implemented by the utility

○ = Strategy is not being used by the utility

— = Information was not provided by the utility

Source: GAO analysis of utility documents and interviews with city and utility officials. | GAO-16-785

[a]Rightsizing refers to changes made to drinking water and wastewater infrastructure to meet current demands, such as reducing treatment capacity or decommissioning water lines and sewer lines in vacant areas.

[b]These water utilities already provide drinking water or wastewater services, or both, to a regional area that is countywide or larger, and benefit from a larger customer base. These utilities may have expanded their customer base further, or may be considering doing so.

[c]Information described is based on review of Jefferson County's official statement.

[d]These utilities are privately owned.

[e]As part of rightsizing, the utility has incorporated in its plans or was considering using green infrastructure to help control sewer overflows from its wastewater system.

[f]Gary Sanitary District used public-private partnerships in the past. Specifically, it contracted utility operations to a private company from 1998 through 2010.

Overall, the most common cost control and efficiency strategy used by the 14 water and wastewater utilities we reviewed was asset management. Some of the utilities (4 of 14) had asset management programs in place, and most of the remaining utilities had plans for or were in initial stages of implementing the strategy. In contrast, we found that the other strategies—rightsizing, major reorganization, expanding the utility's customer base, and public-private partnerships—were used to a limited extent by the utilities we reviewed. In particular, rightsizing was among the least-used strategies. Many of the utility representatives we interviewed told us that rightsizing was not practical or feasible. For example, even with vacant housing averaging 21 percent in these cities, according to American Community Survey data (5-year estimates, 2010 through 2014), representatives of some utilities reviewed (6 of 14) told us that decommissioning water and sewer lines was not practical or feasible because they did not have entirely vacant blocks or needed to maintain lines to reach houses that were farther away. However, as part of rightsizing, representatives we interviewed for five wastewater utilities said that they have incorporated in their plans, or were considering using, vacant lands for green infrastructure to help control stormwater runoff that can lead to sewer overflows. Green infrastructure uses a range of controls, such as vegetated areas, stormwater collection, or permeable pavement, to enhance storage, infiltration, evapotranspiration, or reuse of stormwater on the site where it is generated.[58] (See app. VIII for information on utilities' use of cost control strategies).

[58]Infiltration is the process by which water soaks into and moves through soil and other porous materials. Evapotranspiration is a process by which water is transferred from the earth's surface to the atmosphere by evaporation of moisture from the soil surface and transpiration by plants.

Six Federal Programs and One Policy Could Assist Midsize and Large Cities with Declining Populations in Addressing Their Water Infrastructure Needs

While not specifically designed to address the water infrastructure needs of midsize and large cities with declining populations, six federal programs and one policy we reviewed could provide these cities with some assistance. As of June 2016, none of the six federal programs we reviewed administered by the four agencies that fund water and wastewater infrastructure needs were specifically designed to assist such cities in addressing their water infrastructure needs. Yet most of the 14 utilities we reviewed received funding from one or more of these programs for their water and wastewater infrastructure projects. In addition to these programs, under EPA's 1994 Combined Sewer Overflow Policy, cities or utilities meeting eligibility criteria can take a phased approach over an extended period to build the needed infrastructure to correct combined sewer overflows and comply with the Clean Water Act.

None of the Six Federal Programs We Reviewed Were Specifically Designed to Assist Cities with Declining Populations in Funding Water and Wastewater Infrastructure Needs

None of the six federal programs we reviewed that can fund water and wastewater infrastructure needs were specifically designed to provide funds to cities with declining populations for water and wastewater infrastructure projects. The programs are as follows:

- **Drinking Water and Clean Water SRF programs.** Under the Safe Drinking Water Act and Clean Water Act, EPA provides annual grants to states to capitalize their state-level Drinking Water and Clean Water SRF programs, and states can use the grants to provide funding assistance to utilities, including low- or no-interest loans, among other things. Overall, the state Drinking Water SRF and Clean Water SRF programs help reduce utilities' infrastructure costs, increase access to low-cost financing, and help keep customer rates affordable. The federal laws establishing the SRF programs do not specifically address cities with declining populations, although states are generally authorized to use a percentage of their capitalization grants to provide additional subsidies to disadvantaged communities. States provide additional subsidies in the form of principal forgiveness or negative interest rates, which reduce loan repayment amounts. The amounts that states set aside for additional subsidies vary from year to year based on requirements in annual appropriations acts and state funding decisions. Most of the 10 states in which the 10 cities in our review were located used median household income as one indicator

for disadvantaged communities for both Drinking Water and Clean Water SRF programs.[59]

- **HUD Community Development Block Grants.** HUD provides federal funding, through the Community Development Block Grant program, for housing, economic development, neighborhood revitalization, and other community development activities, including water and wastewater infrastructure. The department provides block grant funding to metropolitan cities and urban counties across the country, known as entitlement communities, and to states for distribution to non-entitlement communities.[60] Federal law requires that not less than 70 percent of the total Community Development Block Grant funding will be used for activities that benefit low- and moderate-income persons.[61] In 2015, HUD provided $2.3 billion in block grant funding to entitlement communities, including midsize and large cities. However, according to department officials we interviewed, entitlement communities choose to use only a small portion of the grant funding to support water and wastewater infrastructure projects. In fiscal year 2015, according to HUD data, about $43.8 million, or 1.9 percent of block grant funding provided to

[59]For the Drinking Water SRF, 6 of the 10 states used additional indicators, such as population trends and poverty rates, to identify disadvantaged communities. For the Clean Water SRF, all 10 states used additional indicators, such as income, unemployment data, and population trends, in their affordability criteria.

[60]Specifically, after funds are set aside for purposes such as Indian Community Development Block Grants and allocated to insular areas, the annual appropriation for Community Development Block Grant funding is split so that 70 percent is allocated among eligible metropolitan cities and urban counties (entitlement communities) and 30 percent is allocated among the states to serve non-entitlement communities. Entitlement communities are (1) principal cities of metropolitan areas, (2) other metropolitan cities with populations of at least 50,000, and (3) qualified urban counties with populations of at least 200,000 (excluding the populations of entitled cities).

[61]A common way in which water and sewer infrastructure projects can qualify as benefiting low- and moderate-income persons is if the activity serves a primarily residential area where at least 51 percent of the residents are of low or moderate income, and the benefits are available to all the residents of that area.

entitlement communities, including midsize and large cities, was used for water and wastewater infrastructure projects.[62]

- **Economic Development Administration Public Works program.**[63] The administration's Public Works program awards grants competitively to economically distressed areas, including cities that meet the eligibility criteria, to help rehabilitate, expand, and improve their public works facilities, among other things. A Public Works grant is awarded if, among other things, a project will improve opportunities for the successful establishment or expansion of industrial or commercial facilities, assist in the creation of additional long-term employment opportunities, or primarily benefit the long-term unemployed and members of low-income families in the region. In fiscal year 2015, according to Economic Development Administration data, the agency provided $101 million as Public Works grants, of which about $14.9 million or 14.7 percent was used for water or wastewater infrastructure projects. Agency officials told us that the program's main priority is enabling distressed communities to attract new industry, encourage business expansion, diversify local economies, and generate or retain long-term jobs in the private sector. As a result, projects funded with Public Works grants may include a water infrastructure project, but that water infrastructure project would be a secondary effect of an economic development project. Agency officials said that a common water and wastewater infrastructure project funded by Public Works program grants involves installing a main drinking water pipeline or sewer line to a new or renovated industrial park.
- **FEMA Public Assistance and Hazard Mitigation grant programs.** FEMA's Public Assistance and Hazard Mitigation grant programs may provide funding for water and wastewater infrastructure projects when the President has declared a major disaster, but these programs are

[62]In contrast, non-entitlement communities use more Community Development Block Grants to fund water and wastewater infrastructure projects. Specifically, states receiving Community Block Grant Funding distributed $289.6 million, or 34.5 percent of block grant funding, to non-entitlement communities in fiscal year 2015 for water and wastewater infrastructure projects.

[63]The Economic Development Administration provides federal funding and assistance to help economically distressed areas of the country through public infrastructure investment, technical assistance and research, and development and implementation of comprehensive economic development strategies.

not specifically designed to assist cities with declining populations. The agency's Public Assistance program provides grants to states and others for the repair, restoration, reconstruction, or replacement of public facilities, including water and wastewater infrastructure damaged or destroyed by such a disaster. In fiscal year 2015, FEMA awarded about $6.5 billion for public assistance projects; however, the agency was unable to determine the portion of public assistance funding that was used for water and wastewater infrastructure projects.[64] The agency's Hazard Mitigation grant program provides grants for certain hazard mitigation projects to substantially reduce the risk of future damage, hardship, loss, or suffering in any area affected by a major disaster. In fiscal year 2015, FEMA awarded about $1.2 billion in grants to states and communities for mitigation projects. Of that amount, about $8.1 million, or 0.7 percent, was awarded for water and wastewater mitigation projects, according to Hazard Mitigation grant program data. Hazard Mitigation grants do not need to be used for a project within the designated disaster area as long as the project has a beneficial effect on that area. The grants are competitively awarded to states, which identify in their applications the mitigation projects that would be funded with the grants. Cities, including those with declining populations, can submit applications to the state for Hazard Mitigation projects for their water and wastewater facilities, which the state may choose to include its Hazard Mitigation grant application to FEMA.

While these six programs were not specifically designed to provide funding to cities with declining populations, such cities or their related utilities can receive funding from these programs for water and wastewater infrastructure projects. Table 5 shows the funding that each of the utilities in our 10 selected cities received from the programs from fiscal years 2010 through 2015. In total, cities received almost $984 million from the federal agencies.

[64]The agency was unable to provide the amount of water and wastewater infrastructure funding because water and wastewater projects are not specifically tracked. FEMA does not track funding by specific facility type but uses a category system that may include many general types of facilities in each category (i.e., debris removal; emergency protective measures; restoration of roads/bridges; restoration of water control facilities; restoration of buildings/equipment; restoration of utilities; or restoration parks, recreational, and other facilities).

Table 5: Federal Funding Received by the 14 Water and Wastewater Utilities We Reviewed from Six Programs, Fiscal Years 2010 through 2015

Dollars in millions

City, utility (services provided)	Environmental Protection Agency		Department of Housing and Urban Development	Economic Development Administration	Federal Emergency Management Agency		
	Drinking Water State Revolving Fund	Clean Water State Revolving Fund	Community Development Block Grant	Public Works grant	Public Assistance grant	Hazard Mitigation grant	Total
Birmingham, Alabama							
Birmingham Water Works Board (DW)	11.6[c]	NA	0	0	0	0.1	**11.7**
Jefferson County (WW)	--	--	--	--	--	--	--
Charleston, West Virginia							
West Virginia American Water (DW)	--	--	--	--	--	--	--
Charleston Sanitary Board (WW)	NA	35.0	0	0	0.2	0	**35.2**
Detroit, Michigan							
Detroit Water and Sewerage Department (DW/WW)	0	150.5	0	0	0	0	**150.5**
Gary, Indiana							
Indiana American Water (DW)	6.7	NA	0	0	0	0	**6.7**
Gary Sanitary District (WW)	NA	0	0	0	0	0	**0**
Macon, Bibb-County, Georgia							
Macon Water Authority (DW/WW)	0	7.5	0	0	0[a]	0	**7.5**
New Orleans, Louisiana							
Sewerage and Water Board of New Orleans (DW/WW)	0	9.0	15.0	0	400.5[b]	62.3[b]	**486.9**
Niagara Falls, New York							
Niagara Falls Water Board (DW/WW)	8.5	36.4	0	0	0	0	**44.8**

City, utility (services provided)	Environmental Protection Agency		Department of Housing and Urban Development	Economic Development Administration	Federal Emergency Management Agency		
	Drinking Water State Revolving Fund	Clean Water State Revolving Fund	Community Development Block Grant	Public Works grant	Public Assistance grant	Hazard Mitigation grant	Total
Pittsburgh, Pennsylvania							
Pittsburgh Water and Sewer Authority (DW/WW)	6.5	7.5	0	0	0	0	**14.0**
St. Louis, Missouri							
St. Louis Water Division (DW)	9.5	NA	0	0	0	0	**9.5**
Metropolitan St. Louis Sewer District (WW)	NA	211.8	0	0	0	0	**211.8**
Youngstown, Ohio							
City of Youngstown (DW/WW)	0	5.3	0	0	0	0	**5.3**

Legend:

DW= drinking water services provided

WW = wastewater services provided

NA = not applicable, funding limited to drinking water or wastewater utilities

— = no information provided by the utility

Source: GAO analysis of data and information from city and utility officials. | GAO-16-785

Notes: Funding amounts were provided by water and wastewater utility officials. Dollars are nominal and not adjusted for inflation. Funding data may not add to totals as listed due to rounding.

[a]Macon Water Authority was awarded a Public Assistance grant of $93.5 million prior to 2010. The grant paid for the relocation and construction of a new drinking water treatment plant that was damaged by Tropical Storm Alberto in 1994.

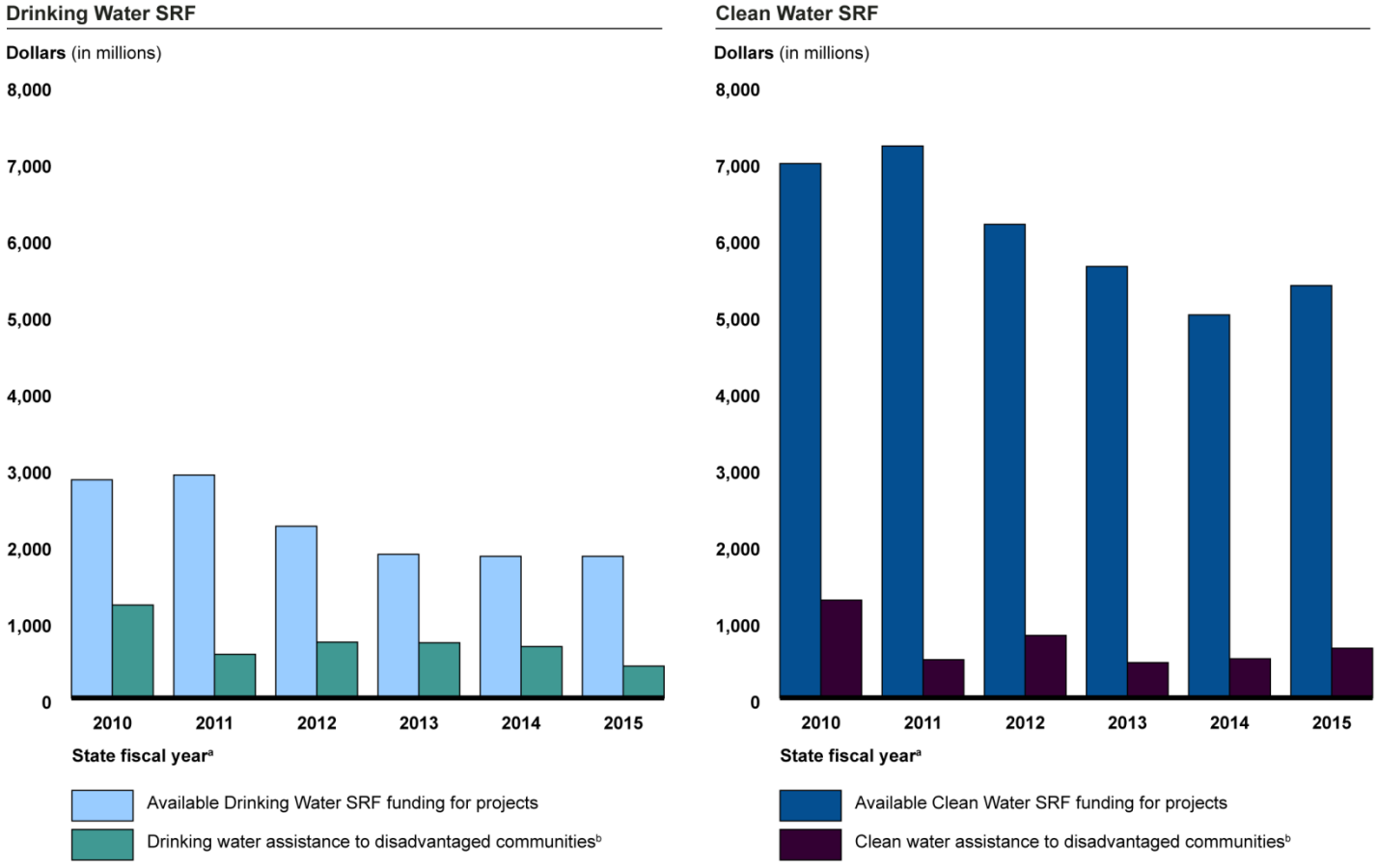
[b]The Sewerage and Water Board of New Orleans was awarded Public Assistance and Hazard Mitigation grants prior to 2010. Specifically, the utility was awarded $305.1 million for damage caused by Hurricane Katrina in 2005 and $573,496 for damage caused by Hurricane Gustav in 2008.

[c]The utility received additional subsidies in the form of principal forgiveness on its Drinking Water State Revolving Fund loans in 2011 and 2012 for green infrastructure projects. The utility also received principal forgiveness on its 2014 loan.

As shown in table 5, 11 of the 14 utilities we reviewed received Drinking Water or Clean Water SRF funding from fiscal years 2010 through 2015, and 1 utility was awarded additional subsidies. Specifically, the Birmingham Water Works Board received $1.7 million (out of $11.6 million) from the Drinking Water SRF program as an additional subsidy in the form of principal forgiveness for green projects, or water infrastructure

projects that include energy and water efficiency improvements, green infrastructure, or other environmentally innovative activities. According to most of the representatives we interviewed from 12 utilities, SRF funding is the most common federal funding they receive for water and wastewater infrastructure projects. Overall, in fiscal year 2015, 41 states provided about $416 million, or 23 percent, of their Drinking Water SRF program funds for water and wastewater infrastructure projects in disadvantaged communities, and 31 states provided about $648 million, or 12 percent, of their Clean Water SRF program funds for such projects (see fig. 3).

Figure 3: Total Available Drinking Water and Clean Water State Revolving Fund (SRF) Funding for Water and Wastewater Infrastructure Projects Compared with Funds Provided by States to Disadvantaged Communities, State Fiscal Years 2010 through 2015



Source: GAO analysis of Drinking Water SRF and Clean Water SRF National Information Management System reports, 2010 through 2015. | GAO-16-785

Note: The available funds includes federal funds, state matching funds, funds transferred between Drinking Water SRF and Clean Water SRF programs, funds repaid from past loans, interest on those

loans, issued bonds and leveraged bonds, interest on those bonds, and fees charged by states. Environmental Protection Agency (EPA) officials told us that as of June 2016, 28 states used leveraged bonds.

[a]Forty-six states have state fiscal years July through June. Alabama and Michigan's state fiscal years are October through August; New York's state fiscal year is April through March; and Texas's state fiscal year is September through August. Numbers may not add to totals because of rounding; dollars are nominal and are not adjusted for inflation.

[b]For the Drinking Water and Clean Water SRF programs, states develop criteria used to identify disadvantaged communities, so this categorization is not based on a single, nationwide definition. States have reported data for a total of 31 Clean Water SRF programs and 41 Drinking Water SRF programs for disadvantaged communities to EPA, but other states may provide additional subsidies for disadvantaged communities without reporting it to EPA.

Representatives we interviewed from some utilities said that it is difficult to use SRF funding because the total amount of funding available statewide is limited; states restrict the amount of funding available to individual projects; and states prioritize projects that address Safe Drinking Water Act and Clean Water Act compliance issues, such as acute violations of drinking water standards or health advisory levels.

Also shown in table 5, 1 of the 14 utilities we reviewed, the Sewerage and Water Board of New Orleans, received Community Development Block Grant funds for water and wastewater infrastructure projects from fiscal years 2010 through 2015. Officials in Youngstown, Ohio, also told us that some block grant funding was awarded to faith-based organizations to provide low-income residents with various types of housing and other assistance, which may include assistance with paying utility bills. None of the 14 utilities we reviewed received the Economic Development Administration's Public Works funding for water or wastewater infrastructure projects from fiscal years 2010 through 2015. The FEMA programs—Public Assistance and Hazard Mitigation—provided nearly 50 percent of total federal funding for water and wastewater infrastructure received by cities we reviewed in fiscal years 2010 through 2015.[65] Specifically, 2 of the 14 utilities we reviewed—the Sewerage and Water

[65]Prior to 2010, two utilities—the Macon Water Authority and the Sewerage and Water Board of New Orleans—were awarded substantial grants from FEMA programs. The Macon Water Authority received $93.5 million in Public Assistance grants from 1994 through 2003 to replace and relocate the Riverside Water Treatment Plant after Tropical Storm Alberto flooded the region in July 1994. The Sewerage and Water Board of New Orleans received $305.7 million in Public Assistance grants for permanent restoration and Hazard Mitigation grants for mitigation measures of water, wastewater, and drainage systems and facilities damaged during Hurricane Katrina in August 2005 and Hurricane Gustav in 2008.

Board of New Orleans and the Charleston Sanitary Board—received Public Assistance grants from FEMA after flood events in fiscal years 2010 through 2015.[66] In addition, 2 of the 14 utilities we reviewed—the Birmingham Water Works Board and the Sewerage and Water Board of New Orleans—received Hazard Mitigation grants.[67]

EPA's Combined Sewer Overflow Policy May Help Cities with Declining Populations

In addition to providing assistance through SRF funding, EPA has a policy—the Combined Sewer Overflow Policy—that could help cities with declining populations. The policy, adopted in 1994, allows a city or utility to extend its implementation schedule—the period of time it has to build the necessary infrastructure to control combined or sanitary sewer overflows—under consent decrees entered into with EPA or the state, or administrative orders issued by EPA or state permitting authorities.[68] An extended implementation schedule spreads the costs of planned infrastructure projects over time and helps make wastewater rate increases required to pay for the infrastructure projects more affordable for a utility and its customers. EPA's financial capability assessment guidance, issued in 1997, uses a two-phase approach to assess a city or utility's financial capability based on: (1) the combined impact of wastewater and combined sewer overflow control costs on individual households (residential indicator) and (2) the socioeconomic and financial

[66]The Sewerage and Water Board of New Orleans received about $400.5 million for permanent restoration of water, wastewater, and drainage systems and facilities damaged during Hurricane Katrina in August 2005, Hurricane Gustav in 2008, and Hurricane Isaac in 2012.The Charleston Sanitary Board also received $237,398 to address damages to its wastewater system from severe storms in 2012, Super Storm Sandy in 2013, and the Yeager Airport landslide in 2015.

[67]After Hurricane Katrina hit the Gulf Coast in 2005, the Birmingham Water Works Board received about $123,000 in 2011 for a new generator in its drinking water treatment plant to help ensure that drinking water can be treated and distributed to residents during future natural disasters. In 2012, 2014, and 2015, the Sewerage and Water Board of New Orleans also received about $62.3 million for sewer station mitigation and power plant protection and mitigation measures after Hurricanes Katrina and Hurricane Isaac damaged the facilities in 2005 and 2012, respectively.

[68]When Clean Water Act requirements have been violated, for example, when combined sewer overflows discharge raw sewage during large storm events, states and EPA and the relevant state may issue an administrative order or bring suit in court. The administrative order may be a consent order, which is an enforceable agreement among all parties involved, and the suit may result in a consent decree, which is also an enforceable agreement signed by all parties to the action.

conditions of a city or utility (financial capability indicator).[69] Each city or utility is ranked as low, medium, or high for the residential indictor and weak, midrange, or strong for the financial capability indicator. The combined indicators show the overall financial burden—low, medium, or high—resulting from the estimated costs for the planned infrastructure projects.[70] Cities or utilities with a high financial burden—those with a high residential indicator and low-to-midrange financial capability indicators—are generally expected to implement combined sewer overflow control projects within 15 years to 20 years of the consent decree.[71] EPA and states can also apply this two-phase approach to determine appropriate implementation schedules for cities or wastewater utilities to address other Clean Water Act requirements, including control of sanitary sewer overflows.

According to EPA officials, implementation schedules can be negotiated past 20 years if infrastructure projects are large and complex, or if the necessary user rate increases put too great a burden on customers with incomes below median household income. EPA issued a memorandum in 2012 that provided guidance on developing and implementing effective integrated planning for cities and utilities building wastewater and stormwater management programs. According to the 2012 memorandum, under integrated planning, cities and utilities prioritize the wastewater and stormwater infrastructure projects that should be completed first. According to EPA documents, cities and utilities may use integrated planning to prioritize required wastewater and stormwater projects over a potentially longer time frame, helping to keep customer rates more

[69]The residential indicator is the city's or utility's average cost per household for wastewater treatment and combined sewer overflow controls as a percentage of the local median household income. The financial capability indicator is an aggregate of six indicators that evaluate debt, socioeconomic, and financial conditions.

[70]EPA categorizes residential indicators as "low" (the average customer utility rate is less than 1 percent of median household income), "midrange" (the average customer utility rate is from 1 to 2 percent of median household income), or "high" (the average customer utility rate is greater than 2 percent of median household income). EPA categorizes financial capability indicators as "weak" (combined benchmark score below 1.5), "midrange" (combined benchmark score from 1.5 to 2.5), or "strong" (combined benchmark score above 2.5).

[71]Generally, cities or utilities with low burdens are expected to implement combined sewer overflow projects within the normal engineering or construction time frames. Cities or utilities with medium burdens are expected to implement control policies within 10 years.

affordable. Building on its 2012 memorandum, EPA issued a memorandum in 2014 to provide greater clarity on the flexibilities built into the existing financial capability guidance. The 2014 memorandum identifies key elements EPA uses in working with cities and utilities to evaluate how their financial capability should influence implementation schedules in both permits and enforcement actions. It also includes examples of additional information that may be submitted to provide a more accurate and complete picture of a city's or utility's financial capability.

Overall, 9 of the 14 utilities providing wastewater services to the 10 cities we reviewed are under consent decrees entered into with EPA or administrative orders from a state agency to address combined sewer overflows or sanitary sewer overflows, according to EPA, state, and utility officials. Specifically, according to these officials, 7 utilities are under consent decrees or administrative orders to address combined sewer overflows; some of these decrees or orders are also required to address sanitary sewer overflows. The remaining 2 utilities are under consent decrees to address sanitary sewer overflows, according to these officials. According to utility representatives we interviewed and documents we reviewed, these 9 utilities or the cities they serve expect to spend an estimated $10.5 billion to comply with consent decrees and administrative orders to enforce Clean Water Act requirements. According to EPA officials, 4 utilities we reviewed had consent decrees with EPA that fell within the high financial burden category and had implementation schedules extending more than 15 years: Pittsburgh's implementation schedule was for 19 years; Youngstown's schedule was for 31 years, St. Louis's schedule was for 23 years, and New Orleans' schedule was for 27 years. One of the 10 cities we reviewed, New Orleans, had a consent decree with integrated planning, and officials from 2 additional cities said that they were discussing the use of integrated planning with EPA.[72]

[72]According to EPA officials, as of June 2016, 15 of 98 cities or utilities with consent decrees for combined sewer overflows and separate sewer overflows faced high financial burdens to implement the wastewater infrastructure needed to comply with the Clean Water Act, and have implementation schedules for 20 years or more years. For example, as of June 2016, Youngstown had the longest EPA-approved implementation schedule at 31 years. In addition, according to EPA officials, 13 of the 98 cities or utilities included integrated planning in their consent decrees. Three communities had both implementation schedules for at least 20 years and integrated planning in their consent decrees.

Agency Comments

We provided a draft of this report to the Environmental Protection Agency, the Economic Development Administration, and the Department of Housing and Urban Development for review and comment. None of the agencies provided written comments or stated whether they agreed with the findings in the report, but all three agencies provided technical comments that we incorporated, as appropriate.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the appropriate congressional committees, the Administrator of the Environmental Protection Agency, the Administrator of the Economic Development Administration, the Secretary of Housing and Urban Development, and other interested parties. In addition, the report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or gomezj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff members who made key contributions to this report are listed in appendix IX.

Sincerely yours,

J. Alfredo Gómez
Director, Natural Resources and Environment

Appendix I: Objectives, Scope, and Methodology

Our objectives were to examine (1) what is known about the economic characteristics of midsize and large cities with declining populations and their drinking water and wastewater infrastructure needs; (2) strategies that selected midsize and large cities with declining populations and their associated utilities used to address their infrastructure needs and the affordability of their drinking water and wastewater rates; and (3) what existing federal programs and policies, if any, could assist midsize and large cities with declining populations, and their associated utilities, in addressing their water infrastructure needs.

To examine what is known about the economic characteristics of midsize and large cities with declining populations, we reviewed relevant studies and interviewed experts about cities that have experienced population declines and water and wastewater infrastructure needs. We identified the studies and experts through a literature review and referrals from Environmental Protection Agency (EPA) officials, representatives of water and wastewater industry associations, and academic and nonprofit experts. We contacted nine experts—individuals in academia and the nonprofit sector with expertise in water and wastewater utility management, finance, engineering, and urban planning.

For this report, we used U.S. Census Bureau and National League of Cities definitions for midsize cities—those with populations from 50,000 to 99,999—and large cities—those with populations of 100,000 and greater. We identified the number and size of midsize and large cities with sustained population declines by analyzing decennial census population data for midsize and large cities from 1980 through 2010, which we found to be the most extended period for reliable decennial census data related to our review of the consistency of data coding over time. To describe the economic and demographic characteristics of cities with declining populations, we analyzed the Census Bureau's American Community Survey 5-year estimates for 2010 through 2014, which according to the bureau contain the most precise and current data available for cities and communities of all population sizes.[1] We analyzed the survey data for all cities with population over 50,000 and compared the data for cities with declining populations to those for cities that did not experience a decline

[1]The 5-year estimates are based on data collected from a sample of households during 60 months of the 5 most recent calendar years to provide annually updated information.

during this period. To do this, we created categories of decline and growth, in increments of 9.9 percent or less, 10 to 19.9 percent, or 20 percent and greater, in order to have a minimum number of cities within each category, using decennial census population data.

To determine whether cities with declining populations experienced significantly greater levels of economic distress than cities with increasing populations,[2] we performed statistical comparisons of all key economic and demographic characteristics from the American Community Survey data (5-year estimates for 2010 through 2014), following American Community Survey methodology on statistical tests. Specific economic and demographic characteristics that we analyzed included the following: poverty rate percentage, percentage of unemployment, median household income, per capita income, percentage of vacant housing, median housing value, median year housing stock was built, percentage of households receiving Supplemental Nutrition Assistance Program benefits, percentage of white residents, percentage of African American residents, percentage of residents of other races, percentage of residents over 65 years old, percentage of residents with at least a high school diploma, and percentage of residents with a bachelor's degree. We reviewed Census Bureau documentation for data collection and quality, and determined the decennial data to be sufficiently reliable for our purposes of categorizing cities based on the extent of population growth or decline, and the American Community Survey data sufficiently reliable for analyzing economic and demographic data on midsize and large cities.

Because the American Community Survey 5-year data followed a probability procedure based on random selections, the sample selected is only one of a large number of samples that we might have drawn. Since each sample could have provided different estimates, we express our confidence in the precision of our particular sample's results as a 90 percent confidence interval. This is the interval that would contain the actual population value for 90 percent of the samples we could have drawn. All 5-year American Community Survey percentage estimates presented have margins of error at the 90 percent confidence level of plus

[2]To characterize economic distress, we analyzed the poverty rate, unemployment rate, median household income, and per capita income.

or minus 10 percentage points or less, unless otherwise noted. All non-percentage estimates presented using the 5-year American Community Survey had data within 20 percent of the estimate itself, unless otherwise noted.

As part of our work for all three objectives, we selected a nonprobability sample of 10 cities that experienced the greatest percentages of population decline from 1980 through 2010 for further review. Using our analysis of decennial census population data from 1980 through 2010, we selected the 10 cities with the greatest declines in population for that period, without repeating cities in any state to allow for geographic distribution. We also selected for size, choosing 5 midsize and 5 large cities. The 10 cities, their 2010 populations, and their percentage declines in population are listed in table 6. This sample of cities is not generalizable to all cities that experienced population declines over this period; however, it highlights the issues faced by a geographically diverse range of cities and corresponding utilities that have experienced the greatest population losses in recent decades.

Table 6: Cities with Declining Population Selected for Review

Selected city	1980 Population	2010 Population	Percentage of change in population, 1980-2010
Gary, Indiana	151,953	80,294	-47.2
Youngstown, Ohio	115,436	66,982	-42.0
Detroit, Michigan	1,203,339	713,777	-40.7
New Orleans, Louisiana	557,515	343,829	-38.3
Niagara Falls, New York	71,384	50,193	-29.7
St. Louis, Missouri	453,085	319,294	-29.5
Pittsburgh, Pennsylvania	423,938	305,704	-27.9
Birmingham, Alabama	284,413	212,237	-25.4
Macon, Georgia[a]	116,896	91,351	-21.9
Charleston, West Virginia	63,968	51,400	-19.6

Source: GAO analysis of decennial U.S. Census data. | GAO-16-785

[a]The city of Macon merged with Bibb County effective in January 2014 to form Macon-Bibb County. Population trends of the city and county differ. The city's population declined by nearly 22 percent from 1980 through 2010, and the county's population grew by about 3.5 percent over the same period.

To analyze information on water and wastewater needs for cities with declining populations, we compared national drinking water and wastewater needs data that EPA collected by to information on needs we

collected for the utilities providing services to the 10 cities we selected. Because cities may be served by multiple utilities, our sample included the 14 utilities from the 10 selected cities—the 6 that were responsible for both water and wastewater infrastructure, 4 that were responsible solely for drinking water infrastructure, and 4 others that were responsible solely for wastewater infrastructure.[3] We obtained EPA's data on drinking water infrastructure needs from its 2011 Drinking Water Infrastructure Needs Survey and Assessment and wastewater infrastructure needs from its 2012 Clean Watersheds Needs Survey. EPA obtains these data through surveys of the 50 states, the District of Columbia, and U.S. territories, which for the drinking water needs assessment involves collecting information from a sample of drinking water systems in each state. We assessed the reliability of these data by reviewing the methodologies that EPA used to conduct these surveys and by interviewing EPA officials to understand the appropriate use of the data. We determined that both the drinking water and wastewater needs identified at the national, or aggregate, level were sufficiently reliable for purpose of reporting national needs estimates.

However, the fact that some utilities serve multiple cities and counties, and that some cities are served by multiple utilities or multiple treatment facilities, prevented us from uniquely matching utilities and treatment facilities to cities. Therefore, we could not estimate the total drinking water and wastewater needs of utilities in cities with declining populations and instead identified the water and wastewater needs for each of the 14 utilities for the cities in our sample. To do this, we analyzed relevant utility documents, such as capital improvement plans and master plans, and conducted interviews with utility representatives, including executive directors, finance directors, and operations managers, about their water and wastewater infrastructure condition, their greatest infrastructure needs, and their top challenges in addressing their infrastructure needs. We also reviewed EPA wastewater needs data for utilities serving the 10 selected cities, which we found sufficiently reliable to report at the

[3]Utilities we reviewed were the Birmingham Water Works Board and Jefferson County in Alabama, West Virginia American Water and Charleston Sanitary Board in West Virginia, Detroit Water and Sewerage Department in Michigan, Indiana American Water and Gary Sanitary District in Indiana, Macon Water Authority in Georgia, Sewerage and Water Board of New Orleans in Louisiana, Niagara Falls Water Board in New York, Pittsburgh Water and Sewer Authority in Pennsylvania, St. Louis Water Division and the Metropolitan St. Louis Sewer District in Missouri, and City of Youngstown in Ohio.

individual utility level based on reviews of documentation and interviews with knowledgeable EPA officials. However, we were unable report EPA drinking water needs data at the individual utility level for the 10 selected cities because of the way that EPA and states collect and extrapolate the data: EPA uses a statistical cost modeling approach to calculate state and national estimates using local data; as a result, the local data may be a modeled result and not actual reported data.

To examine the strategies that selected midsize and large cities with declining populations, and their associated utilities, used to address their infrastructure needs, we reviewed relevant reports and studies on utility management and interviewed city and utility representatives for the 10 cities and 14 utilities in our sample.[4] We conducted semistructured interviews with representatives from 12 of the 14 drinking water and wastewater utilities willing to speak with us to gather information on changes in populations served and effects of declining population on system operations, if any; infrastructure needs and condition; financing and management strategies; challenges in managing water and wastewater infrastructure; and their perspectives on the research and assistance needed for utilities serving cities with declining populations. We also collected capital improvement plans, master plans, recent rate studies, and financial statements for fiscal years 2012 through 2014, which we analyzed to determine infrastructure condition, short-term and long-term capital needs, rate structure changes and rate increases, and changes in operating revenues and expenses. To help ensure that we collected the correct information for each city and utility, we clarified our understanding of these documents through interviews with utility officials,

[4]Environmental Protection Agency, Region 5, *Workshop Summary Report: Retooling Infrastructure as a Strategy to Advance an Older Industrial City's Future Vision* (Chicago: September 2012); Environmental Protection Agency, *Draft Report, Down to Scale: Retooling Infrastructure Systems in Legacy Cities* (June 2014); Environmental Protection Agency, Office of Sustainable Communities, Smart Growth Program, *Managing Vacant and Abandoned Property in the Green Zone of Saginaw, Michigan* (Washington, D.C.: July 2014); John Hoornbeek and Terry Schwarz, *Sustainable Infrastructure in Shrinking Cities: Options for the Future*. (Kent, Ohio: Center for Public Administration and Public Policy and Cleveland Urban Design Collaborative, Kent State University, July 2009); and K. M. Faust, D. M. Abraham, and S. P. McElmurry, "Water and Wastewater Infrastructure Management in Shrinking Cities," *Public Works Management and Policy* (2015) 1-29; J. Hughes et al., *Defining a Resilient Business Model for Water Utilities*, (Denver: Water Research Foundation, 2014).

follow-up correspondence, and review of draft materials provided by utility officials.

Nine of the selected 10 cities are under orders from EPA or the state to correct combined sewer overflows or sanitary sewer overflows (which result in discharge of raw sewage to streams and surrounding areas), or both, from their systems. For these cities, we collected any consent decrees they have with EPA and long-term plans to address their combined sewer overflow controls. We also collected written responses to questions from city officials on basic water and wastewater system information, including estimated population served, number of customer accounts and types of customers (e.g., residential versus industrial), average residential water rate, and billing collections information. For the 2 utilities that declined an interview with us, we reviewed publicly available documents and relevant websites. For all 10 cities, we interviewed city planning officials about population and demographic trends, land use planning, infrastructure planning and strategies, access to funding and resources, and challenges they face in managing their cities with declining populations and revenues. We conducted site visits to 6 of the 10 selected cities, considering geographic distribution and size of the cities, and conducted interviews with the remaining city and utility officials by telephone. Specifically, we visited Gary, Indiana; Youngstown, Ohio; Detroit, Michigan; New Orleans, Louisiana; Niagara Falls, New York; and Macon, Georgia. During site visits, we also interviewed city planning officials; water utility representatives; and relevant stakeholders, including officials from other city departments, such as representatives of Gary's Department of Environmental Affairs and Green Urbanism and New Orleans's Resiliency Office. We also met with representatives of nongovernmental organizations working with cities and utilities on water and wastewater infrastructure issues, including the Center for Community Progress, Detroit Future City, and the Greater New Orleans Foundation.

As part of our review of utilities and the strategies they used, we reviewed financial statements for fiscal years 2012, 2013, and 2014 for all 14 utilities. Specifically, we reviewed total operating revenues and total operating expenses, excluding depreciation over these 3 years. We then used these data to calculate several basic indicators of utility financial health. We calculated indicators that reflect each utility's ability to pay its long-term debt, sufficiency to cover operating costs and asset

depreciation, the remaining years of the utility's asset life, and its long-term debt per customer.[5] We selected these indicators based on our review of indicators used by rating agencies, including Moody's and Fitch, two agencies that rate utilities and the utility sector, and interviews with utility finance experts that EPA identified. We then compared these indicators to scoring systems and median indicators for water and wastewater utilities, used and gathered by Moody's and Fitch where available, to help describe the extent of existing long-term debt, strength of a utility's financial condition, and potential future capital needs.[6] In addition, to gauge the financial burden of water and wastewater utility bills for median-income households and low-income households in each of our 10 selected cities, we compared the average annual utility bill as a share of income to levels EPA and the U.S. Conference of Mayors have estimated are affordable.[7] We calculated rates as a share of income in the 10 selected cities using the average residential rate information reported by the cities' utilities and the median household income and income for the 20th percentile for that city reported in the American Community Survey data (5-year estimates for 2010 through 2014).

To examine the federal programs and policies that could be used by midsize and large cities with declining populations, and their associated utilities, to help address their water infrastructure needs, we reviewed

[5]Specifically we analyzed the following four financial indicators using utilities' fiscal year 2014 financial statements: (1) debt service coverage ratio, a measure of a utility's ability to pay its long term debts; (2) better operating ratio, a measure of a utility's self-sufficiency considering depreciation; (3) remaining years of useful asset life, a measure of the quality of existing capital assets and asset condition; and (4) long-term debt per customer, a measure of debt burden attributable to ratepayers. See app. VI for more information.

[6]Moody's Investors Service, *U.S. Water and Sewer Utilities FY2013 Medians: U.S. Municipal Water and Sewer Utilities Demonstrate Stable to Positive Trends* (New York: Sept. 29, 2015); Moody's Investors Service, *Rating Methodology, U.S. Municipal Utility Revenue Debt* (New York: Dec. 15, 2014); and Fitch Ratings, *2016 Water and Sewer Medians* (New York: Dec. 9, 2015).

[7]Environmental Protection Agency, Office of Water, *Variance Technology Findings for Contaminants Regulated Before 1996*, EPA-815-R-98-003 (Washington, D.C.: September 1998); Environmental Protection Agency, Office of Water, Office of Wastewater Management, *Combined Sewer Overflows—Guidance for Financial Capability Assessment and Schedule Development*, EPA 832-B-97-004 (Washington D.C.: February 1997); and U.S. Conference of Mayors, American Water Works Association and Water Environment Federation, *Affordability Assessment Tool for Federal Water Mandates* (Washington, D.C.: 2013).

relevant laws, regulations, and policies of the federal agencies that fund water and wastewater infrastructure needs. To identify the federal programs, we used our past reports that identified federal funding for water and wastewater infrastructure.[8] Specifically, we reviewed funding information and eligibility requirements for the following six federal programs: EPA's Drinking Water State Revolving Fund (SRF) program, EPA's Clean Water SRF program, the Department of Housing and Urban Development's (HUD) Community Development Block Grant program, the Economic Development Administration's Public Works program, and the Federal Emergency Management Agency's (FEMA) Public Assistance and Hazard Mitigation Grant Programs. Because we found that none of the programs was specifically designed to assist cities with declining populations, we reviewed program eligibility requirements to determine if funding assistance was awarded based on the cost of infrastructure projects and a project user's ability to pay for the projects. Under the Drinking Water and Clean Water SRF programs, states establish affordability criteria for eligibility to receive additional subsidization, and so we also reviewed states' intended use plans, the plans they develop annually to identify candidates for SRF loans. We also interviewed agency officials from EPA, HUD, and the Economic Development Administration about the programs, and gathered information from FEMA from another GAO team.

For each federal funding program we reviewed, we collected funding data for water and wastewater infrastructure projects from federal fiscal years 2010 through 2015, to the extent the data were available. Specifically, we reviewed congressional appropriations and congressional budget justifications for each federal agency to determine the total available funding for each program. To determine expenditures for water and wastewater infrastructure projects, we reviewed EPA's National Information Management System reports; HUD's Community Development Block Grant expenditure reports; the Economic Development Administration's annual reports to Congress; and data

[8]GAO, *Water Resources: Four Federal Agencies Provide Funding for Rural Water Supply and Wastewater Projects*, GAO-07-1094 (Washington, D.C.: Sept. 7, 2007); *Rural Water Infrastructure: Improved Coordination and Funding Processes Could Enhance Federal Efforts to Meet Needs in the U.S.-Mexico Border Region*, GAO-10-126 (Washington, D.C.: Dec. 18, 2009); and *Rural Water Infrastructure: Additional Coordination Can Help Avoid Potentially Duplicative Application Requirements*, GAO-13-111 (Washington, D.C.: Oct.16, 2012).

provided by FEMA from its Integrated Financial Management Information System. To assess the reliability of the data, we reviewed documentation and gathered information from knowledgeable agency officials about the reliability of the data and found them to be sufficiently reliable to characterize overall national expenditures. In addition to national data, we gathered information from our 10 selected cities and from 12 of the 14 drinking water and wastewater utilities on federal, state, and other funding they received to help address their water and wastewater infrastructure needs from state fiscal years 2010 through 2015.

In reviewing policies of the six federal agencies that could help cities and utilities address their water and wastewater needs, we identified EPA's Combined Sewer Overflow Control policy as one policy that could help wastewater utilities in cities with declining populations address their needs. Specifically, the policy allows a city or utility to phase in combined sewer overflow controls over time, which helps to keep customers' rates affordable. We reviewed EPA's policy, first issued in 1994 and updated in 2012 and 2014, to determine how the policy could help cities with declining populations and their wastewater utilities keep wastewater rates affordable. Nine of the 10 cities we reviewed had wastewater utilities under consent decrees or administrative orders to comply with specified Clean Water Act requirements. These include 7 utilities under consent decrees or administrative orders requiring them to address combined sewer overflows; some of these utilities are also required to address sanitary sewer overflows, and 2 utilities are under consent decrees requiring them to address sanitary sewer overflows, according to EPA, city, and utility officials. We collected information from these cities and their utilities on the use of extended implementation schedules and reviewed the consent decrees filed in federal court or administrative orders, and the long-term control plans that the cities developed to correct problems, to the extent the documents were available. We obtained information from city and utility officials on the estimated costs to comply with the consent decrees and administrative orders. We also obtained and reviewed EPA's list of cities that had consent decrees with extended implementation schedules.

We conducted this performance audit from July 2015 to September 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Economic and Demographic Characteristics of 10 Selected Cities

This appendix provides economic and demographic characteristics for the 10 cities in our review using the U.S. Census Bureau's American Community Survey 5-year estimates, 2010 through 2014, the most recently available data as of July 2016. Table 7 provides the economic characteristics of the 10 cities that we selected for review.

Table 7: Economic Characteristics of 10 Selected Cities

		Economic characteristics, 5-year estimates (2010 through 2014)							
Selected city	Percentage of population change, 1980-2010	Percentage of poverty	Percentage of unemployment	Median household income (dollars)	Per capita income (dollars)	Percentage of vacant housing	Median home value (dollars)	Median year housing stock was built	Percentage of households with food stamp benefits
Birmingham, AL	-25.4	31.0	14.5	$31,217	19,640	20.2	86,100	1963	25.7
Charleston, WV	-19.7	19.0	6.5	$48,959	34,944	11.8	142,800	1956	16.3
Detroit, MI	-40.7	39.8	27.2	$26,095	14,984	30.0	45,100	1947	42.7
Gary, IN	-47.2	38.7	18.8	$27,458	15,983	26.6	65,500	1955	36.1
Macon, GA[a]	-21.9	35.0[a]	8.9[a]	$25,773[a]	16,051[a]	22.5[a]	87,400[a]	1964[a]	30.2[a]
New Orleans, LA	-38.3	27.7	11.6	$36,964	27,255	21.4	184,100	1957	21.2
Niagara Falls, NY	-29.7	25.3	11.6	$33,009	20,643	19.2	67,600	1939	26.8
Pittsburgh, PA	-27.9	22.8	9.2	$40,009	27,435	14.6	91,500	1939	18.6
St. Louis, MO	-29.5	27.8	14.2	$34,800	23,244	20.5	118,600	1939	26.1
Youngstown, OH	-42.0	37.4	19.7	$24,361	14,742	21.2	45,400	1947	38.2

Source: GAO analysis of U.S. Census Bureau's American Community Survey data (5-year estimates, 2010 through 2014) and decennial census data. | GAO-16-785

[a]As a result of the city of Macon combining with Bibb County, in January 2014, U.S. Census Bureau data are unavailable for the city of Macon in 2014. All economic characteristics for the city are from 2013. Specifically, for this city, the bureau's American Community Survey 5-year estimates for 2009 through 2013 are listed.

Table 8 provides demographic characteristics for the 10 cities that we selected for review.

Table 8: Demographic Characteristics of 10 Selected Cities

			Demographic characteristics, 5-year estimates (2010 through 2014)					
Selected city	Percentage of population change, 1980-2010	2010 population	Percentage white	Percentage African American	Percentage other race	Percentage over 65 years old	Percentage of population with at least a high school diploma	Percentage of population with bachelor's degree
Birmingham, AL	-25.4	212,237	21.3	73.1	5.6	12.9	84.0	23.1
Charleston, WV	-19.7	51,400	81.5	8.3	10.2	16.9	90.9	39.3
Detroit, MI	-40.7	713,777	8.7	80.7	10.6	12.1	77.8	13.1
Gary, IN	-47.2	80,294	10.6	82.1	7.2	15.3	83.1	13.1
Macon, GA[a]	-21.9	91,351	29.4[a]	67.2[a]	4.4[a]	12.4[a]	32.3[a]	4.5[a]
New Orleans, LA	-38.3	343,829	30.7	59.2	10.1	11.5	84.8	34.4
Niagara Falls, NY	-29.7	50,193	70.4	23.0	6.6	14.9	85.5	16.5
Pittsburgh, PA	-27.9	305,704	65.1	24.3	10.6	14.0	91.0	37.2
St. Louis, MO	-29.5	319,294	42.8	47.9	9.2	11.1	83.2	30.4
Youngstown, OH	-42.0	66,982	43.0	42.6	14.4	16.0	81.4	11.5

Source: GAO analysis of U.S. Census Bureau's American Community Survey data (5-year estimates, 2010 through 2014) and decennial census data. | GAO-16-785

[a]As a result of the city of Macon combining with Bibb County, in January 2014, U.S. Census Bureau data are unavailable for the city of Macon in 2014. All demographic characteristics for the city are from 2013. Specifically, for this city, the bureau's American Community Survey 5-year estimates for 2009 through 2013 are listed.

Appendix III: Drinking Water Needs of Utilities Serving 10 Selected Cities

This appendix presents data on general system characteristics and infrastructure needs of drinking water utilities serving 10 selected cities with declining populations (see table 9). Data were compiled from written responses and oral responses from drinking water utility representatives, annual reports, planning documents, and capital improvement plans, when available.

Table 9: Description and Infrastructure Needs of Drinking Water Infrastructure in 10 Selected Cities with Declining Populations

	System characteristics						Need category		Estimated needs
City and utility	Estimated population served	No. of treatment plants	Treatment capacity (million gallons per day)	Average water produced (million gallons per day)	Miles of pipe	Water loss from leakage (percent)	Pipe replacement and repair	Treatment plant upgrades	5-year capital improvement needs for 2016 through 2020 (millions of dollars, unadjusted)
Birmingham, Alabama									
Birmingham Water Works Board	693,876	4	189.9	104.1	3,738	18.3	✓	✓	310.7
Charleston, West Virginia									
West Virginia American Water	—	—	—	—	—	—	—	—	—
Detroit, Michigan									
Detroit Water and Sewerage Department	3,784,222	5	1,720	550	3,840 (3,438 in-city)	30[a]	✓	✗	650.8
Gary, Indiana									
Indiana American Water	1,200,000	2	78	38	1,150	1.4	✓	✓	—
Macon-Bibb County, Georgia									
Macon Water Authority	153,691	1	60	23	1,664	19.9	✗	✗	17.7[b]
New Orleans, Louisiana									
Sewerage and Water Board of New Orleans	369,048	2	234	143	1,812	40	✗	✓	981.7[c] (10 years)
Niagara Falls, New York									
Niagara Falls Water Board	49,679	1	36	21.5	280	60	✓	✗	18.4[d]

City and utility	System characteristics: Estimated population served	No. of treatment plants	Treatment capacity (million gallons per day)	Average water produced (million gallons per day)	Miles of pipe	Water loss from leakage (percent)	Need category: Pipe replacement and repair	Need category: Treatment plant upgrades	Estimated needs: 5-year capital improvement needs for 2016 through 2020 (millions of dollars, unadjusted)
Pittsburgh, Pennsylvania									
Pittsburgh Water and Sewer Authority	310,000 (both water and sewer)	2	143	64	1,012	44[a]	✓	✓	398.7 (both water and sewer)
St. Louis, Missouri									
St. Louis Water Division	317,419	2	360	135	1,300	—	✓	✓	42.3[d]
Youngstown, Ohio									
City of Youngstown	130,000	—[e]	—[e]	—[e]	750	29[a]	✓	✗	—

Legend:

— = not available

✓ = utility has this need

✗ = not identified as a need by the utility

Source: GAO analysis of utility documents and interviews with utility officials. | GAO-16-785

[a]Nonrevenue water (treated water that is not sold to customers) is reported; it includes water lost to leakage as well as water used for fire protection, street cleaning, or other uses.

[b]Estimated 5-year capital improvement needs for 2017 through 2021.

[c]Estimated 10-year capital improvement needs for 2016 through 2025.

[d]Estimated 5-year capital improvement needs for 2015 through 2019.

[e]The city of Youngstown purchases its drinking water from the Mahoning Valley Sanitary District, a separate utility that owns and manages the treatment facility. We limited our review to the infrastructure directly owned and managed by Youngstown.

Appendix IV: Wastewater Needs of Utilities Serving 10 Selected Cities

This appendix presents data on general system characteristics and infrastructure needs of wastewater utilities serving 10 selected cities with declining populations (see table 10). Data were compiled from written responses and oral responses from wastewater utility officials; annual reports; planning documents; capital improvement plans; and the Environmental Protection Agency's Wastewater Needs Survey, when available.

Table 10: Description and Infrastructure Needs of Wastewater Infrastructure in 10 Selected Cities with Declining Populations

	System characteristics					Need category			Estimated needs	
City and utility	Estimated population served	No. of treatment plants	Treatment capacity, average dry weather flow/average wet weather flow (million gallons per day)	Estimated inflow and infiltration (percent)	Miles of pipe	Combined sewer over-flow control	Wastewater treatment	Collection system repair	5-year capital improvement needs for 2016 through 2020 (millions of dollars, unadjusted)	Total estimated 20-year needs documented in EPA's Clean Water Survey (millions of 2012 dollars)
Birmingham, Alabama										
Jefferson County	324,000[a]	9	343 204/—	—	3,145	—	—	—	840.5[b] (10 years)	204.7
Charleston, West Virginia										
Charleston Sanitary Board	50,404	1	28 10/28	—	300	✓	✗	✓	31.9[c] (1 year only)	229.7
Detroit, Michigan										
Detroit Water and Sewerage Department	2,807,000	1	1,700 485/800	—	3,300	✓	✓	✓	463.3	1,074.9
Gary, Indiana										
Gary Sanitary District	80,000	1	120 40/150	—	500	✓	✓	✓	81.2	228.7
Macon-Bibb County, Georgia										
Macon Water Authority	153,691	2	48 26/—	19.9	964	✗	✗	✓	52.3[d]	0[b]

	System characteristics					Need category			Estimated needs	
City and utility	Estimated population served	No. of treatment plants	Treatment capacity, average dry weather flow/average wet weather flow (million gallons per day)	Estimated inflow and infiltration (percent)	Miles of pipe	Combined sewer over-flow control	Wastewater treatment	Collection system repair	5-year capital improvement needs for 2016 through 2020 (millions of dollars, unadjusted)	Total estimated 20-year needs documented in EPA's Clean Water Survey (millions of 2012 dollars)
New Orleans, Louisiana										
Sewerage and Water Board of New Orleans	369,048	2	272 142/—	—	1,517	✗	✗	✓	673.8[e] (10 years)	923.9
Niagara Falls, New York										
Niagara Falls Water Board	50,193	1	85 26/—	65	280	✗	✓	✓	88.2[f]	23.3
Pittsburgh, Pennsylvania										
Pittsburgh Water and Sewer Authority	310,000 (both water and sewer)	0	—[g]	40-60	1,100	✓	✗	✓	398.7 (both water and sewer)	194.9
St. Louis, Missouri										
Metropolitan St. Louis Sewer District	1,319,295	7	538 197/340	50	6,450	✓	✓	✓	1,549.1[h] (4 years)	5,401.3
Youngstown, Ohio										
City of Youngstown	110,000	1	80[i] 35/90	—	350	✓	✓	✓	—	146

Legend:

EPA = Environmental Protection Agency

—- = not available

✓ = utility has this need

✗ = not identified as a need by the utility

Source: GAO analysis of utility documents and interviews with utility officials. | GAO-16-785

[a]Estimated population served based on number of residential customer accounts of the Jefferson County wastewater utility times the average number of persons per household in Jefferson County.

[b]Estimated 10-year capital improvement needs for 2013 through 2023.

[c]Estimated 1-year capital improvement needs for 2015.

[d]Estimated 5-year capital improvement needs for 2017 through 2021.

[e]Estimated 10-year capital improvement needs for 2016 through 2025.

[f]Estimated 5-year capital improvement needs for 2015 through 2019.

[g]Wastewater collected by the Pittsburgh Water and Sewer Authority is treated by Allegheny County Sanitary Authority, a separate utility that owns and manages the wastewater treatment facilities. We limited our review to the infrastructure directly owned and managed by the Pittsburgh Water and Sewer Authority.

[h]Estimated 4-year capital improvement needs for 2017 through 2020.

[i]As of June 2016, Youngstown had begun work on a capital improvement project that included increasing its wastewater treatment capacity from 80 million gallons per day to 157 million gallons per day to comply with combined sewer overflow requirements.

Appendix V: Operating Revenues, Operating Expenses, and Rate Increases

This appendix presents data on operating revenues and expenses for the 14 drinking water and wastewater utilities serving the 10 cities with declining populations that we selected for review (see table 11). Data are compiled from financial statements from fiscal years 2012 through 2014. In addition, information on frequency of rate increases and rate increases from 2012 through 2014 is provided.

Table 11: Operating Revenues, Operating Expenses, and Rate Increases for Water and Wastewater Utilities Serving Selected Midsize and Large Cities with Declining Populations, Fiscal Years 2012 through 2014

City and utility	FY 2014 operating revenues (millions of dollars)	Percentage change in operating revenues, FY 2012 through 2014	FY 2014 operating expenses[a] (millions of dollars)	Percentage change in operating expenses, FY 2012 through 2014	Frequency of rate increases Average annual rate increase, FY 2012 through 2014 (percent)
Birmingham, Alabama					
Birmingham Water Works Board	162.8	2012-2013: -0.1 2013-2014: 6.2 2012-2014: 6.1	87.8	2012-2013: 3.3 2013-2014: -4.0 2012-2014: -0.9	Annual increases. 4.23
Jefferson County	180.8	2012-2013: -0.7 2013-2014: 14.2 2012-2014: 13.3	53.0	2012-2013: -0.4 2013-2014: -8.3 2012-2014: -8.7	Annual increases. 4.91
Charleston, West Virginia					
West Virginia American Water	127.0	2012-2013: -0.6 2013-2014: 2.3 2012-2014: 1.6	—	—	—
Charleston Sanitary Board	21.7	2012-2013:16.4 2013-2014: -5.4 2012-2014:10.1	10.5	2012-2013: 4.9 2013-2014: 4.7 2012-2014: 9.8	Rate increases every 3 to 4 years. 11.10
Detroit, Michigan					
Detroit Water and Sewerage Department, drinking water	349.4	2012-2013: 5.8 2013-2014:-1.7 2012-2014: 3.9	174.3	2012-2013: 3.9 2013-2014: -6.9 2012-2014: -3.3	Annual increases. For in-city customers: 7.90
Wastewater	475.8	2012-2013: 0.7 2013-2014: 7.9 2012-2014: 8.7	229.2	2012-2013: 12.1 2013-2014: -12.0 2012-2014: -1.4	Annual increases. For in-city customers: 8.37
Gary, Indiana					
Indiana American Water	200.6	2012-2013: 0.2 2013-2014: 0.7 2012-2014: 0.9	124.8	2012-2013: 3.0 2013-2014: -3.1 2012-2014: -0.3	Annual increases. 1.60

City and utility	FY 2014 operating revenues (millions of dollars)	Percentage change in operating revenues, FY 2012 through 2014	FY 2014 operating expenses[a] (millions of dollars)	Percentage change in operating expenses, FY 2012 through 2014	Frequency of rate increases Average annual rate increase, FY 2012 through 2014 (percent)
Gary Sanitary District	25.5	2012-2013:-5.7 2013-2014: 5.9 2012-2014:-0.1	18.2	2012-2013: 4.5 2013-2014: 11.0 2012-2014: 16.0	Rate increases as needed. 0[b]
Macon-Bibb County, Georgia					
Macon Water Authority	47.4	2012-2013: -6.6 2013-2014:11.6 2012-2014: 4.2	28.7	2012-2013: 8.2 2013-2014: -2.4 2012-2014: 5.5	Annual increases. 6.97
New Orleans, Louisiana					
Sewerage and Water Board of New Orleans	163.1	2012-2013: 8.6 2013-2014: 9.7 2012-2014:19.1	148.0	2012-2013: 3.5 2013-2014: 2.6 2012-2014: 6.1	Annual increases. 6.67[c]
Niagara Falls, New York					
Niagara Falls Water Board	29.6	2012-2013: 20.2 2013-2014: -1.6 2012-2014: 18.3	20.5	2012-2013: 0.2 2013-2014: 4.6 2012-2014: 4.8	Annual increases, generally.[d] 3.20
Pittsburgh, Pennsylvania					
Pittsburgh Water and Sewer Authority	164.3	2012- 2013: -1.0 2013-2014:15.1 2012-2014:14.0	111.5	2012-2013: 2.7 2013-2014:16.3 2012-2014:19.5	Annual increases authorized in 2014. 5.10
St. Louis, Missouri					
St. Louis Water Department	55.8	2012-2013: -4.2 2013-2014: 0.6 2012-2014: -3.5	44.6	2012-2013: 6.5 2013-2014:10.0 2012-2014:17.1	Rate increases as needed. 0[e]
Metropolitan St. Louis Sewer District	265.8	2012-2013: 7.1 2013-2014: 9.8 2012-2014:17.6	167.2	2012-2013: 7.1 2013-2014: 4.4 2012-2014:11.8	Annual increases. 8.57
Youngstown, Ohio					
City of Youngstown	58.8	2012-2013: -0.2 2013-2014: 6.6 2012-2014: 6.3	45.7	2012-2013: -2.6 2013-2014: 3.9 2012-2014: 1.2	Annual increases. 9.75

Legend:

FY = fiscal year

—- = not available

Source: GAO analysis of utility financial statements and rate information. | GAO-16-785

[a]Operating expenses do not include depreciation.

[b]Gary Sanitary District's last rate increase, of 30 percent, occurred in 2011.

[c]The Sewerage and Water Board of New Orleans approved water and wastewater rate increases of 10 percent annually from 2013 through 2020.

[d]Niagara Falls Water Board increased rates annually in 2012 through 2014, and in most years (7 out of 10 years) from fiscal years 2006 through 2015.

[e]St. Louis Water Division's last rate increase, of about 12 percent, occurred in 2011.

Appendix VI: Financial Indicators of Utilities Serving Selected Cities

No single indicator or set of indicators is definitive in describing a utility's financial condition. Financial indicators that reflect the financial strength of a utility's operations, along with other primary factors—such as the size and health of the system, its service area, the state laws, municipal ordinances, and charters governing its management—and the strength of its rate management and its regulatory compliance drive a utility's financial condition. The three major rating agencies—Moody's, Standard and Poor, and Fitch—use many and varying quantitative and qualitative financial indicators to evaluate a utility's financial condition and associated bond rating. This appendix contains selected financial indicators for utilities serving 10 selected cities with declining populations. The indicators, shown in table 12, were calculated using data from the utilities' fiscal year 2014 financial statements. These indicators were selected to reflect current and future financial condition, considering current and future debt to address infrastructure needs. A description of each indicator and method of calculation is described below.

Debt service coverage ratio is a measure of a utility's ability to pay its long-term debts. This financial indicator is a key measure in evaluating a utility's revenue system and is used by all three rating agencies. According to the agencies, a debt service coverage ratio greater than 1.0 indicates that the utility has additional revenue available to cover additional debt payments, if needed. The magnitude by which net revenues are sufficient to cover additional debt, or debt service, indicates the utility's margin for tolerating business risks or declines in demand, while still assuring repayment of debt. For example, a higher debt service coverage level indicates greater flexibility to withstand customer resistance to higher rates. A debt coverage ratio less than 1.0 indicates that the utility has insufficient revenues to make annual principal and interest payments on long-term debt.

Formula: Annual net operating revenues (calculated by subtracting total operating expenses, excluding depreciation from total operating revenues) divided by the annual principal and interest payments (on all long-term debt).

Better operating ratio is a measure of a utility's ability to raise revenues to pay for its operating costs, including depreciation of existing infrastructure. Including depreciation means that a utility's ability to replace its infrastructure, or capital assets, as they depreciate is also part of the calculation. A better operating ratio greater than 1.0 indicates that the utility has revenues sufficient to cover operation and maintenance expenses, as well as the cost of replacing current capital assets.

Formula: Total operating revenues divided by the total operating expenses (including depreciation).

Remaining years of useful asset life is a measure of the quality of existing capital assets and overall asset condition.

Formula: Total asset useful life (calculated by asset value divided by depreciation) minus the age of the asset in years (calculated by total accumulative depreciation divided by annual depreciation).

Long-term debt per customer account is a measure of average debt burden per ratepayer. Utilities are taking on more debt than they have in previous years, according to a Water Research Foundation study.[1] Fitch's 2016 Water and Sewer Medians report also indicates an increasing trend in median long-term debt per customer for rated utilities over the last 10 years from 2007 through 2016 by 84 percent.[2]

Formula: Long-term debt divided by the total number of utility customers (for a combined utility, the aggregate number of water and sewer accounts are used).

Recent bond rating is an assessment by a rating agency of a utility's ability to repay new debt, using all the quantitative and qualitative information that the agency has gathered on the utility's financial and operating circumstances.[3] A rating is derived from quantitative factors, such as values of financial indicators of past financial condition, and from forecasts of future financial performance. It also depends on qualitative factors, such as utility management's success in rate setting, complying with environmental regulations, budgeting for annual expenditures, and planning for future capital spending. In addition, a utility's rating is affected by the rate covenants and debt service reserve requirements it has agreed to in order to issue bonds.

[1]J. Hughes et al., *Defining a Resilient Business Model for Water Utilities* (Denver: Water Research Foundation, 2014).

[2]Fitch Ratings, *2016 Water and Sewer Medians* (New York: Dec. 9, 2015).

[3]Agencies also rate the credit quality of already-existing debt.

Table 12: Financial Indicators of Water and Wastewater Utilities Serving Selected Midsize and Large Cities with Declining Populations, Fiscal Year 2014

City and utility	Services provided	Debt service coverage ratio (Moody's scoring)[a]	Better operating ratio	Remaining years of useful life	Long-term debt per customer account (dollars)	Most recent bond rating, as of June 2016[b]
Median value of financial indicator[c]		Fitch: 2.1 Moody's: 1.9		Moody's: 30	Fitch: 1,865	
Birmingham, Alabama						
Birmingham Water Works Board	DW	1.23[d] (Weak)	1.51	22.5	3,597	2015: Moody's, Aa2/Aa3
Jefferson County	WW	3.54 (Very strong)	0.97	3.6	12,803	2013: Fitch, BB+/BB 2013: Moody's, A2[e] 2013: S&P, BBB/BBB- 2013: S&P, AA-[e]
Charleston, West Virginia						
West Virginia American Water	DW	2.66[f] (Very strong)	1.50[f]	21.3[f]	—[f]	2015: Moody's, A3[f]
Charleston Sanitary Board	WW	1.82 (Strong)	1.43	13.1	3,761	—
Detroit, Michigan						
Detroit Water and Sewerage Department	DW	0.98 (Poor)	1.35	8.2	—[g]	2015: Fitch, BBB/ BBB- 2015: Moody's, Baa3/Ba1 2015: S&P, A-/ BBB+
	WW	1.10 (Weak)	1.37	10.8	—[g]	Same as above.
Gary, Indiana						
Indiana American Water	DW	2.66[f] (Very strong)	1.50[f]	21.3[f]	—[f]	2015: Moody's, A3[f]
Gary Sanitary District	WW	2.69[h] (Very strong)	1.40[h]	—	1,065[h]	2011: S&P, A-
Macon-Bibb County, Georgia						
Macon Water Authority	DW/WW	2.32 (Very strong)	1.09	-4.8	996	2015: Moody's, Aa1 2015: S&P, AA

City and utility	Services provided	Debt service coverage ratio (Moody's scoring)[a]	Better operating ratio	Remaining years of useful life	Long-term debt per customer account (dollars)	Most recent bond rating, as of June 2016[b]
New Orleans, Louisiana						
Sewerage and Water Board of New Orleans	DW/WW	Water: 2.69[i] (Very strong) Wastewater;2.24[i] (Very strong)	—	—	1,213	2015: S&P for water, A- 2015: S&P for sewer, A
Niagara Fall, New York						
Niagara Falls Water Board	DW/WW	1.58[j] (Moderate)	1.28	14.6	3,326	2013: S&P, AA
Pittsburgh, Pennsylvania						
Pittsburgh Water and Sewer Authority	DW/WW	1.54 (Moderate)	1.31	23.3	4,344	2015: Moody's, Aa2
St. Louis, Missouri						
St. Louis Water Division	DW	2.97 (Very strong)	1.13	0.6	8	—
Metropolitan St. Louis Sewer District	WW	2.07 (Very strong)	1.10	21.7	2,628	2015: Fitch, AA+ 2015: Moody's, Aa1 2015: S&P, AAA
Youngstown, Ohio						
City of Youngstown	DW/WW	5.45 (Very strong)	1.22	3.5	309	2015: Moody's, Baa1

Legend: — = not available

Source: GAO analysis of utility financial statements and information. | GAO-16-785

[a]Moody's scoring ranks key financial indicators, including the debt service coverage ratio in six categories from very poor to very strong. Moody's ranking categories for debt service coverage ratio shown in the table are as follows: very poor ratios range from less than or equal to 0.70, poor ratios range from 0.70 up to and equal to 1.00, weak ratios range from 1.00 up to and equal to 1.25, moderate ratios range from 1.25 up to and equal to 1.70, strong ratios range from 1.70 up to and equal to 2.00, and very strong ratios are greater than 2.00.

[b]Senior debt / subordinate debt, or senior debt alone, unless otherwise indicated.

[c]Fitch and Moody's calculate median values for some of the financial indicators for utilities that they rate. Data on medians for utilities rated by Fitch and Moody's from the following reports are provided: Fitch Ratings, *2016 Water and Sewer Medians* (New York: Dec. 9, 2015), and Moody's Investor Service, *US Water and Sewer Utilities 2013 Medians: US Municipal Water and Sewer Utilities Demonstrate Stable to Positive Trends*, (New York: Sept. 29, 2015).

[d]The listed debt service coverage ratio uses the formula defined and reported in Birmingham Water Works Board's official bond statement and, according to utility officials, is required by the utility's bond indenture covenant.

[e]Senior insured debt.

[f]Financial indicators and rating information for parent company American Water Works, Inc. and its financing subsidiary American Capital Corporation are provided.

[g]Prior to January 2016, the Detroit Water and Sewerage Department was a regional drinking water and wastewater utility that provided services to the city of Detroit as well as a large number of wholesale customers, 127 suburban communities for drinking water and 76 suburban communities for wastewater. Customer accounts for the surrounding community served are not available and long-term debt per customer was not calculated.

[h]The state of Indiana operates on a cash and investments basis of accounting, a basis of accounting other than accounting principles generally accepted in the United States. As a result, Gary Sanitary District does not produce generally accepted accounting principles-based financial statements. Receipts and expenditures data provided by representatives of Gary Sanitary District were used to conduct the analysis.

[i]The Sewerage and Water Board of New Orleans reports debt service coverage ratios separately for water and wastewater in its annual financial statement, as shown in the table.

[j]The listed debt service coverage ratio is based on analysis of the statement of cash flow reported in Niagara Falls Water Board 2014 financial statement, as has been historically reported in the utility's annual continuing disclosure report.

Appendix VII: Rates and Billing Collection Information

This appendix presents data on water and wastewater rates and billings collection information for 14 utilities we reviewed serving 10 selected cities with declining populations (see table 13). Data were compiled from data and information collected from utility officials and American Community Survey data.

Table 13: Utility Fiscal Year 2015 Water and Wastewater Rates and Billing Collection Rates of Utilities Serving Selected Midsize and Large Cities with Declining Populations

City and utility	Services provided	Primary utility service area	Poverty rate for the primary service area, 5-year estimate, 2010 through 2014 (percent)	FY 2015 average monthly residential utility rate (dollars)	FY 2015 annual estimated billing collection rate (percent)	FY 2015 estimated percentage of customers whose payments are 30 days or more past due	FY 2015 percentage of customer accounts shutoff
United States			**15.6**				
Birmingham, Alabama							
Birmingham Water Works Board	DW	Jefferson County	18.7	40.14	99	—	12.8[a]
Jefferson County	WW	Jefferson County	18.7	48.16	—	—	—
Charleston, West Virginia							
West Virginia American Water	DW	Statewide	18.1	41.88	—	—	—
Charleston Sanitary Board	WW	City of Charleston	19.0	51.80	—	41[b]	—
Detroit, Michigan							
Detroit Water and Sewerage Department	DW/WW	City of Detroit and surrounding communities	39.8[c]	70.67[c]	86[c]	40[c, d]	12[c]
Gary, Indiana							
Indiana American Water	DW	Statewide	15.5	40.84	99	—	—
Gary Sanitary District	WW	City of Gary	38.7	29.25	69	15[b]	21
Macon-Bibb County, Georgia							
Macon Water Authority	DW/WW	Macon-Bibb County	26.6	45.26	97	15[b]	2
New Orleans, Louisiana							
Sewerage and Water Board of New Orleans	DW/WW	City of New Orleans	27.7	69.20	99	10[b]	19[a]

City and utility	Services provided	Primary utility service area	Poverty rate for the primary service area, 5-year estimate, 2010 through 2014 (percent)	FY 2015 average monthly residential utility rate (dollars)	FY 2015 annual estimated billing collection rate (percent)	FY 2015 estimated percentage of customers whose payments are 30 days or more past due	FY 2015 percentage of customer accounts shutoff
Niagara Falls, New York							
Niagara Falls Water Board	DW/WW	City of Niagara Falls	25.3	66.75[e]	96	36	—
Pittsburgh, Pennsylvania							
Pittsburgh Water and Sewer Authority	DW/WW	City of Pittsburgh	22.8	80.00	—	—	—
St. Louis, Missouri							
St. Louis Water Division	DW	City of St. Louis	27.8	24.10	92f	27[f, g]	9[f]
Metropolitan St. Louis Sewer District	WW	St. Louis County	10.8	38.36	98	29[h]	0
Youngstown, Ohio							
City of Youngstown	DW/WW	City of Youngstown	37.4	72.75	100	18	13

Legend:

DW = drinking water

FY = fiscal year

WW = wastewater

— = not available

Source: GAO analysis of data and information from city and utility officials and U.S. Census Bureau's American Community Survey data (5-year estimates, 2010 through 2014). | GAO-16-785

[a]These numbers are for occasional turnoffs. A single account may have been turned off multiple times during the year.

[b]Percentage of customers late on payments 30 days or more after billed.

[c]Utility rate and billing collections information corresponds to the Detroit Water and Sewerage Department's in-city customers only. Prior to January 2016, the Detroit Water and Sewerage Department was a regional drinking water and wastewater utility that provided services to the city of Detroit as well as a large number of wholesale customers, 127 suburban communities for drinking water and 76 suburban communities for wastewater.

[d]Percentage of customers late on payments 60 days or more past the due date.

[e]Estimated residential rate, assuming residential household with a 5/8 inch meter usage and average usage of 9.24 hundred cubic feet (about 6,920 gallons) of water per month.

[f]Data reported in calendar year.

[g]Percentage of customers late on payments 20 days or more after billed.

[h]Percentage of customers late on payments 25 days or more after billed.

Appendix VIII: Cost Control Strategies Used by Water Utilities Serving 10 Selected Cities

This appendix describes the use of five cost control strategies by 14 water and wastewater utilities providing service to the 10 cities with declining populations that we reviewed.[1] The five strategies are rightsizing to meet current demands (i.e., reducing treatment capacity or decommissioning water lines and sewer lines in vacant areas), major reorganization, expanding the utility's customer base, public-private partnerships, and asset management. (See table 4 for corresponding summary table.)

Rightsizing Infrastructure to Meet Current Demands

Three of the 14 utilities we reviewed have undertaken rightsizing. Representatives we interviewed from 2 of those utilities—Detroit Water and Sewerage Department and Gary Sanitary District—said that they were considering large-scale rightsizing of their water infrastructure to more appropriately meet current demands. According to Environmental Protection Agency (EPA) reports, rightsizing can potentially improve the overall efficiency of the system and reduce long-term maintenance costs.[2] Detroit officials said that they were planning to downsize their water treatment capacity from 1,720 to 1,040 million gallons per day to address reduced water demand experienced in recent years. According to its 2015 updated water master plan, downsizing water treatment capacity will result in a life cycle cost savings of about $450 million to align with projected water demand, which declined by 32 percent from 2000 through 2014, in part because of population decline in the region. Detroit is also investigating selective retirement of water pipelines in vacant areas of the city as part of a long-term strategy to reduce system renewal and rehabilitation costs.

Similarly, according to city officials and a utility representative, the city of Gary, in collaboration with the Gary Sanitary District, was in the process

[1]We selected five midsize (50,000 to 99,999 population) and 5 large (100,000 population or more) cities. The 5 midsize cities we selected are Charleston, West Virginia; Gary, Indiana; Niagara Falls, New York; Macon, Georgia; and Youngstown, Ohio. The five large cities we selected are Birmingham, Alabama; Detroit, Michigan; New Orleans, Louisiana; Pittsburgh, Pennsylvania; and St. Louis, Missouri.

[2]Environmental Protection Agency, Office of Sustainable Communities, Smart Growth Program, *Managing Vacant and Abandoned Property in the Green Zone of Saginaw, Michigan* (Washington, D.C.: July 2014), and *Draft Report: Down to Scale, Retooling Infrastructure Systems in Legacy Cities* (June 2014).

of developing a new land use plan and city rezoning that will identify areas appropriate for decommissioning services, including wastewater services, to some neighborhoods with high vacancies. As of November 2015, of approximately 13,000 blighted properties in Gary, about 8,000 were vacant and occupied large portions of neighborhoods on the periphery of the city, according to city planning officials we interviewed. According to a utility representative we interviewed, some areas in the city were in obvious need of rightsizing, and the utility had already shut off water and wastewater service to some streets and city blocks.

Many of the utility representatives we interviewed told us that rightsizing was not practical or feasible, which is consistent with the findings from several studies and EPA reports on rightsizing that we identified.[3] For example, the representatives told us that they did not have entirely vacant blocks that would make decommissioning service lines possible—usually a few occupied houses remained. In addition, water and sewer lines must often be kept to maintain service to remaining houses that are further away. Utility and city planning officials we interviewed also noted the political challenges associated with any displacements necessary to decommission water or wastewater services to a neighborhood, or to reduce water infrastructure capacity in a way that might limit growth in the future.

As part of considering rightsizing their infrastructures, 5 wastewater utilities we reviewed—Detroit Water and Sewerage Department and Gary Sanitary District and 3 other wastewater utilities we reviewed—indicated that they have incorporated in their plans, or were considering using, green infrastructure to help reduce sewer overflows. Green infrastructure uses a range of controls, such as vegetated areas, stormwater collection, or permeable pavement, to enhance infiltration, evapotranspiration, or

[3]John Hoornbeek, and Terry Schwarz, *Sustainable Infrastructure in Shrinking Cities: Options for the Future* (Kent, Ohio: Center for Public Administration and Public Policy and Cleveland Urban Design Collaborative, Kent State University, July 2009); K. M. Faust, D. M. Abraham, and S. P. McElmurry, "Water and Wastewater Infrastructure Management in Shrinking Cities," *Public Works Management and Policy* (2015), 1-29; Environmental Protection Agency, Office of Sustainable Communities, Smart Growth Program, *Managing Vacant and Abandoned Property in the Green Zone of Saginaw, Michigan* (Washington, D.C.: July 2014); Environmental Protection Agency, Region 5, *Workshop Summary Report: Retooling Infrastructure as a Strategy to Advance an Older Industrial City's Future Vision* (Chicago: September 2012); and Environmental Protection Agency, *Draft Report: Down to Scale, Retooling Infrastructure Systems in Legacy Cities*.

reuse of stormwater on the site where it is generated.[4] The use of green infrastructure can help reduce the amount of stormwater that enters the sewer system, preventing sewer overflow events, and is a potentially less costly approach to helping control combined sewer overflows, according to Natural Resources Defense Council reports.[5] Some utility representatives and city planning officials we interviewed said that green infrastructure is an opportunity for improving blighted and vacant areas within their cities.

The 10 cities with declining populations we reviewed had housing vacancy rates averaging 21 percent, based on our analysis of American Community Survey data, 5-year estimates 2010 through 2014. According to a study we reviewed, placement of green infrastructure on vacant properties can provide environmental, social, and economic benefits and help address problems created by vacant housing, which when left undemolished contributes to blight, crime, and the further abandonment of neighboring properties and adds debris to the sewer system and contributes to the combined sewer overflow problem.[6] All 5 utilities that had incorporated green infrastructure in their plans to help control sewer overflows, or were considering using green infrastructure, were collaborating with city planners and others on implementation, and three of the 5 utilities collectively committed more than $150 million for green infrastructure, including funding for demolitions in areas targeted for green infrastructure, according to planning documents we reviewed. Challenges to implementing green infrastructure approaches, according to some representatives from utilities and city planning officials, include establishing responsibilities for and funding of maintenance of green

[4]Infiltration is the process by which water soaks into and moves through soil and other porous materials. Evapotranspiration is a process by which water is transferred from the earth's surface to the atmosphere by evaporation of moisture from the soil surface and transpiration by plants.

[5]Christopher Kloss and Crystal Calarusse, *Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows* (Washington, D.C.: Natural Resources Defense Council, 2006), and Noah Garrison and Karen Hobbs, *Rooftops to Rivers II: Green Strategies for Controlling Stormwater and Combined Sewer Overflows* (Washington, D.C.: Natural Resources Defense Council, 2011). The Natural Resources Defense Council is a nonprofit, international environmental advocacy organization.

[6]Megan Heckert, Joseph Schilling, and Fanny Carlet, *Greening Legacy Cities: Recent Research on Local Strategies for Reclaiming Vacant land*, Vacant Property Research Network Research and Policy Brief No. One (2015).

infrastructure; proving the effectiveness of green infrastructure approaches; and breaking silos of organizations (e.g., utilities, city departments, and community organizations) that may benefit from supporting green infrastructure. Funding for demolition is also needed to facilitate the repurposing of these properties for green infrastructure and to address the backlog of properties on current city demolition lists, according to a few of the city officials we interviewed.

Major Reorganization

Representatives we interviewed from some of the 14 utilities in our review described undertaking a major reorganization to reduce costs and improve management efficiencies, including the creation of new organizations to manage water and wastewater infrastructure and major staff reduction, and optimization efforts, such as revised organizational structure and job descriptions, within the existing organization. Specifically, 5 utilities we reviewed, undertook major reorganizations. Three of the reorganized utilities created entirely new organizations, independent from their city governments, to manage drinking water and wastewater infrastructure in cases where the cities faced financial challenges.

For example, in September 2014 the city of Detroit and surrounding counties entered into an agreement to establish the Great Lakes Water Authority to operate the water supply and sewage disposal system, which were owned by the city of Detroit and operated by the Detroit Water and Sewerage Department.[7] Under the agreement, the Detroit Water and Sewerage Department will operate and maintain the water and sewer lines that provide service to customers within the city boundaries. In addition, the Great Lakes Water Authority will pay the city of Detroit $50 million annually to lease the regional facilities it operates; the Detroit Water and Sewerage Department will use the funds for capital improvements to city-managed infrastructure, among other things. The Great Lakes Water Authority will also dedicate 0.5 percent of revenues annually to fund a regional water assistance program for low-income residents throughout the authority's service area. Two of the 14 utilities, including one that reorganized, downsized staffing by about 30 percent and 40 percent, respectively, after reorganizing to reduce operational

[7]The Great Lakes Regional Authority began operations in January 2016.

costs and create efficiencies. A fifth utility created a new organizational structure, among other things, to facilitate alignment of work processes between the utility and the city to more efficiently and cost effectively replace water, sewer, and drainage infrastructure alongside the rebuilding of roads.

Expanding the Utility's Customer Base

By expanding their customer bases, utilities can take advantage of excess treatment capacity to generate additional revenue. They can also take advantage of economies of scale to spread their costs across a greater number of customers, resulting in lower costs per customer and a stronger financial condition for the utility.[8] Representatives we interviewed from half of the utilities (7 of 14) we reviewed already served a regional area, with a correspondingly larger customer base, well beyond the boundaries of the cities that they serve—some provide service county-wide, some provide service across multiple counties, and a few provide service statewide. According to representatives we spoke with, some (5 of 14) of the utilities we reviewed were looking to expand their customer bases by widening their service areas (e.g., regionalizing), to attract commercial or industrial businesses to locate within their existing service areas, or both. Specifically, 2 utilities were actively seeking opportunities to expand their service areas. These 2 utilities had taken steps such as setting aside funding to support water and sewer packages and benefits for businesses or encouraging business placement within their service areas. One utility was using both approaches to expand its customer base.

Many utilities—including some that were already taking steps to expand their customer bases—noted various limitations to doing so. For instance, a few utilities noted competition from other cities trying to attract industry and commercial businesses. In addition, surrounding communities may already have their own water and wastewater infrastructure and utilities, so expanding service areas means convincing existing utilities and their customers of the benefits of receiving services from another utility. For example, one utility representative told us that the utility's board was discussing the possibility of providing service to a neighboring area, but

[8]J. Hughes et al., *Defining a Resilient Business Model for Water Utilities* (Denver: Water Research Foundation, 2014), 77.

the cost of connection is $12 million, more than the neighboring city would like to pay. A representative from another utility said that it had attempted to consolidate with neighboring communities but that there was a lack of interest on the part of other communities.

Public-Private Partnerships

Of the 14 utilities we reviewed, few used public-private partnerships as a strategy to help address infrastructure needs. Such partnerships typically involve a government agency contracting with a private partner to construct, operate, maintain, or manage a facility or system, in part or in whole, that provides a public service. Public-private partnerships can take different forms short of a private company purchasing the utility and its facilities, including long-term contractual agreements between a public and a private entity to provide day-to-day operational or management services of facilities or contracting for management consulting services.

Of the 14 utilities we reviewed, 4 had some experience with public-private partnerships. One utility had—over the last 25 years—an ongoing contract with a private company to manage the day-to-day operations of its wastewater facility. In the past, another utility had a similar contract with a private company to manage daily operations of its wastewater facility. The third utility hired a private company to work with the utility's management for several years to identify cost reduction opportunities. Finally, according to the 2015 annual report of its parent company, 1 of the 2 privately owned utilities we reviewed had a series of agreements with public entities for the construction and financing of utility infrastructure, which was leased to its public partners.

Of the remaining 10 utilities that did not have experience with public-private partnerships, a few shared varying perspectives on public-private partnerships. Representatives from 1 said that the utility was open to using the strategy. However, representatives from 2 others said that their utilities preferred to be self-reliant because of public perception that private contractors would not take as great care of the facility as the public utility. In addition, representatives from 1 of these privately owned utilities highlighted the benefit to the community of enhanced economies of scale and additional resources provided by a large private utility, such as its parent company, including investor support and shared laboratories for water quality testing.

Asset Management

Of the 12 utilities whose representatives we interviewed, representatives from 4 utilities told us that they had asset management systems in place.

Asset management is a framework for providing the best level of service at the lowest appropriate cost and involves identifying and prioritizing assets for routine repair or replacement (versus emergency repair). It is a widely recognized tool used across a variety of sectors to manage physical assets, such as highways, machinery, and buildings; in the case of water and wastewater infrastructure, key assets are pipelines, tanks, pumps, and other facilities.[9]

Representatives from 1 of the 12 utilities we interviewed, Macon Water Authority, said that it had fully integrated the use of asset management in physical and financial management of the utility. Macon representatives said that they integrated information from their asset management program into a 10-year long-range planning model used to estimate needed income and revenue requirements to manage day-to-day operations, fund replacement of infrastructure, fund normal repairs, and fund maintenance and upgrades. The utility has done this, according to the representatives, while keeping rates low, and representatives acknowledged that receiving a $93.5 million grant from the Federal Emergency Management Agency to replace the utility's drinking water treatment plant also helped to keep rates low.

Representatives we interviewed from 7 of the remaining utilities said that they had partially implemented or were in the initial stages of developing asset management inventories and plans. A few utility representatives we spoke with acknowledged the value of the strategy in identifying priorities for spending. One utility did not have an asset management plan and was not developing one because, according to its officials, it tracks locations of breaks and other maintenance needs and focuses resources on repairing those.

[9]In January 2016, we issued a report on small utilities in 10 selected states that were implementing some practices of asset management in which we reported that larger utilities were more likely to incorporate asset management. GAO, *Water Infrastructure: EPA and USDA Are Helping Small Water Utilities with Asset Management; Opportunities Exist to Better Track Results*, GAO-16-237 (Washington, D.C.: Jan. 27, 2016).

Appendix IX: GAO Contact and Staff Acknowledgments

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Staff Acknowledgments

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