Photo source: Pennsylvania Infrastructure Investment Authority

Financial Analysis of Drinking Water Systems in Shrinking Cities

A study of water infrastructure challenges in Pennsylvania

April 24, 2020

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Executive Summary

Many cities across the United States have declined in population over recent decades, creating numerous challenges in providing safe drinking water to their residents. Such "shrinking cities" are particularly prevalent in the Northeast and upper Midwest, (i.e., the "Rust Belt") where globalization of the economy, particularly manufacturing, has shifted employment opportunities away from these once vital centers of the American economy.

Drinking water systems serving cities with declining populations face the challenge of maintaining adequate service on smaller revenues. Fewer, poorer residents are left to pay for repairing and rebuilding infrastructure that was designed to support larger populations and commercial industries. As this infrastructure ages, increases in water rates to finance the necessary maintenance of these outsized systems may become unaffordable for many customers. Proper upkeep of a city's water infrastructure is critical to public health yet requires considerable funding that can be difficult to secure. The compounding nature of these challenges can lead to unsustainable and unaffordable water systems.

This report focuses on the challenges facing water utilities in areas where population has declined in the Commonwealth of Pennsylvania. A total of 16 water systems were broadly analyzed, with in-depth analyses of four municipal water systems in the cities of Altoona, Chester, Johnstown, and Reading. These four cases highlight some of the overall trends and complications faced by shrinking cities. Challenges to the utilities are explored and each system is quantified based on a set of financial indicators, credit rating assessments, rates and affordability metrics, borrowing behavior, and drinking water violations to fully capture current performance. An analysis of the incentives and impediments of current policies and agencies in place to assist water utilities in the financing of their endeavors is also included, as well as recommend policy modifications to better address water system challenges.

Key Findings

- **Industrial water customers are leaving more than any other customer group.** Water systems built to support these industries are now outsized and more costly to maintain for remaining residential customers.
- **Traditional financial metrics indicate that the financial strength of water systems is stronger than expected in the cities studied.** Despite downgraded bond ratings after the 2008 financial crisis, the metrics of these utilities indicate they have the capacity to take on additional debt.
- **There is a trilemma of tradeoffs between sustaining financial strength, water system affordability, and infrastructure condition.** Oftentimes, financial strength is prioritized over these other necessary indicators of water system stability.
- **The state SRF, PENNVEST, is currently awarding loans and grants to every system that applies**. PENNVEST has the capacity to issue more awards but has not had the demand to justify efforts to increase the availability of subsidized loans. If demand for loans increased, PENNVEST could leverage capital to increase the amount of grants and loans awarded, as done in 22 other states.
- **The water utilities primarily used municipal bonds to refinance existing debt rather than capital improvement projects.** Only 30% of bond funds were used for capital projects in the cities studied, while most funds were used to refinance existing debt at lower interest rates.
- **Pennsylvania is not utilizing the most effective strategies for encouraging consolidation.** There are seven types of policy tools other states have used to encourage consolidation of utilities. Pennsylvania currently uses the three least effective tools and will have difficulty implementing the three most effective, most notably takeover rules and regional planning.

Recommendations

1. **PENNVEST and other financing institutions should require alternative rate structures or implementation of a Customer Assistance Program in exchange for low interest capital where affordability is an issue.** If water systems are to finance replacements and maintenance of aging infrastructure as well as meet ever stricter regulations, their rates will continue to increase. Some systems, such as our Focus Systems of Altoona, Johnstown, and Reading, do not have the capacity to continue to raise their rates, as their household burden on customers is already high. Though rates must increase to match these rising costs, funders should consider requiring implementation of a customer assistance program when disbursing low interest capital. Water systems should also look to the examples set in Philadelphia and Baltimore to determine whether setting alternative rate structures to provide affordable water services is viable, as alternative rate structures can address affordability more directly than CAPs. The difference between the PENNVEST interest rates and the higher market interest rates would allow a water system to forego the extra revenue from increased rates for their lowest income customers.
2. **PENNVEST should leverage its capital to increase the number and size of low interest loans and grants available to drinking water systems.** Though all current applications have been funded, indicating a lack of demand for PENNVEST loans, many water systems use more expensive debt to fund PENNVEST eligible capital projects. Increasing the availability of low interest capital to drinking water utilities will be necessary to address the infrastructure condition of struggling utilities under ever stricter regulations.
3. **PENNVEST should work with small-system partners to understand why few are applying for funding and then provide resources to help systems overcome the barriers they identify.** Water utilities continue to use higher interest rate debt to finance capital projects eligible for PENNVEST financing. PENNVEST could get more small systems to apply by partnering with associations that water systems trust to investigate why so many underutilize PENNVEST funds. Identified barriers should then be address by, for example, facilitating the application process, especially for small systems with limited capacity, or providing resources to help systems identify projects that are eligible for PENNVEST funds.
4. **The Commonwealth or an outside funder should engage in water infrastructure planning at the regional level and require water infrastructure and urban planning at the municipal and county level.** Creating regions larger than counties but smaller than states would strengthen partnerships between neighboring water systems and increase resource-sharing potential in the region and make water system consolidation easier. Regional planning has worked in other states, and while it may be more challenging in Pennsylvania, it should be possible to make water-specific regional plans in the Commonwealth. To address sustainability and equity, comprehensive plans should focus on green infrastructure projects, affordable housing options, public spaces, and engagement of communities in the planning process to determine the city priorities.
5. **The Commonwealth or an outside institution should require that any water system receiving government-subsidized funding have an identified "backstop" or receiver if the system is no longer solvent or compliant.** The Commonwealth can create this backstop by legislating an explicit "takeover rule" or receivership clause. Alternatively, any funder can make funding conditional on systems self-identifying an outside power that will take over responsibility if the system fails.

1 Preface—Reading, Pennsylvania

Reading, Pennsylvania was founded in the mid-18th century, strategically positioned along the Schuylkill River that connected Eastern and Central Pennsylvania. As the river became a major transportation corridor, Reading thrived, serving as an important military base with a burgeoning iron production industry by the time of the Revolutionary War. Reading continued to prosper during the 19th century rise of the railroads, maintaining its manufacturing and industrial connection to Philadelphia with the founding of the Philadelphia and Reading Railroad in 1833. The shift to rail transportation allowed Reading to transition to a lucrative coal-based economy, and by the early 20th century, it was a major hub of the manufacturing industry and automobile boom. The city continued to grow in population, commerce, industry, and wealth into the 1930s, but by the 1970s, the decline of domestic production and manufacturing had devastated the region. Reading Railroad fell into bankruptcy in 1976, cutting the city off from Philadelphia and further isolating the city from broader regional and national commerce. Residents of Reading continued to leave the city, and by the early 2000s, the population had declined by 30% since its peak in the 1930s.

In 2011, the *New York Times* named Reading the poorest city in America, with 41% of the population living below the poverty line. The city is currently characterized by sharp racial divides, low median income, and low rates of high school graduation (Malone, 2016).

The problems of population loss, economic decline, and high poverty rates manifested themselves in the over-burdened and highly indebted water system. The bulk of Reading's water infrastructure was built between the 1920s and 1950s, with double the capacity needed today. The severity of problems that the city faces is extreme, but its overarching history is shared by many industrial cities in the Rust Belt region. How are these challenges being dealt with, and what options do water systems in cities like Reading, Pennsylvania have?

Figure 1-1. Downtown Reading, Pennsylvania was a bustling place in the 1930s. The historic Astor Theater was abandoned in 1975 and demolished in 1998 (Berks Nostalgia).

2 Introduction

Globalization trends over the past fifty years have shifted the landscape of domestic employment opportunities. While some select urban areas across the country have benefited from these developments and enjoy population growth and economic prosperity, many historically industrial cities have experienced a 30 to 60% decline in population, as once vital commercial enterprises have closed or relocated (Anderson, 2017). In total, 41% of U.S. counties have populations that are stagnant or declining, with the Northeast and Midwestern regions being some of the hardest hit (Figure 2-1) (Ozimek & Fikri, 2019).

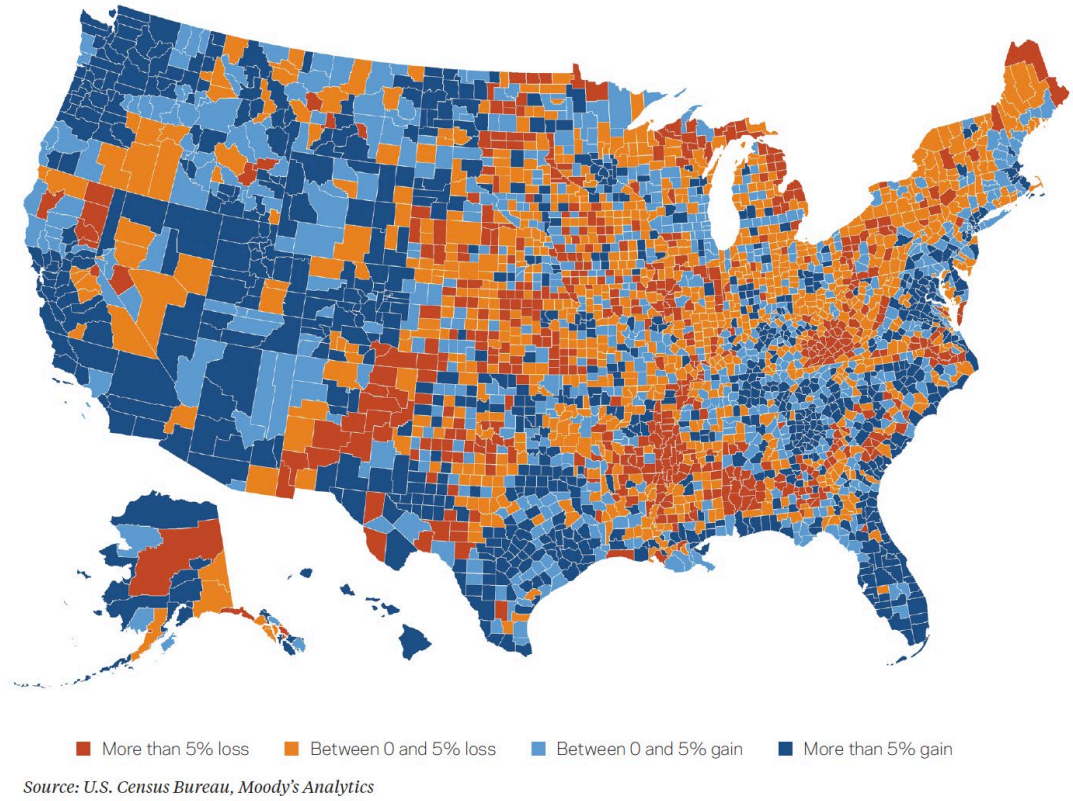

Figure 2-1. US Population Change, by County 2007 – 2017, (Economic Innovation Group, 2019 Heartland Visa's Report).

Over time, demographic decline can lead to a variety of challenges for communities. These resulting issues can include a shrinking economy as many residents in prime working years move elsewhere, high unemployment for those who remain, a decline in educational achievement, unstable local government finance, an increase in violent crime, and a strain on healthcare and public works systems (Ozimek & Fikri, 2019). A shrinking population is both a symptom and cause of economic decline, and if not managed properly, the interconnected effects of both are hard to reverse (Weaver, 2017).

The manufacturing-based industrial economy of the late 19th and 20th centuries spurred the growth of various Rust Belt cities, which are now in distress. Manufacturing today is much more globally integrated and efficient, so once growing and robust industries in the heart of America's industrial centers are experiencing profound decline. What were once major industrial towns located strategically on rivers

throughout Pennsylvania are increasingly declining, struggling cities. For example, the Johnstown metropolitan area was once a center of steel and coal industries. Since its peak in the 1930s, it has lost 70% of its population. Today, only 21% of its residents have a college degree and its real per-capita GDP is 53% of the national average at only $27,735 (Renn, 2019).

Of the many difficulties that emerge when a city[1] experiences population loss, challenges to their water utilities can often be overlooked. Water systems in shrinking cities may have outsized systems that are no longer appropriate for the current population size and are more costly to maintain. Further, the declining revenue base will decrease the fiscal security of the city and water system, making it difficult to secure necessary financing for general upkeep and capital improvements. Avoiding or postponing investments in infrastructure projects then risks the health and safety of populations dependent on this critical public service. Finally, the costs of distributing the same water services to customers increase when populations decline, a key challenge that further exacerbates the economic distress for struggling cities (GAO, 2016).

This report focuses on how population loss can affect drinking water systems and the way those systems finance essential infrastructure upkeep and investment. We start by further unpacking how demographic challenges in struggling cities affect water systems by identifying common challenges faced by any city or community with a declining population. Next, we lay out our area of focus, our data sources, and methods of analysis. We then focus on specific water systems' financial indicators, credit rating assessments, rates and affordability metrics, borrowing behavior, and drinking water violations to understand the relationships, weaknesses, and prioritization of these variables. Finally, we evaluate the policies that are in place today and what alternatives exist, before presenting recommendations and management strategies to better address the challenges that water systems face when population shrinks.

2.1 Summary of Challenges for Water Systems

When cities and towns shrink or remain stagnant, water authorities are faced with several challenges that affect their financial strength, affordability, infrastructure condition, and other factors.

Diminishing wealth base, declining revenue, and increasing water rates

There is a significant relationship between population decline and a diminishing wealth base (Weaver et al., 2017). Throughout the latter part of the 20th century, the decrease in manufacturing jobs in cities and rise of suburban development caused an economic mobility movement; wealthier households relocated and took their wealth and spending out of the city. Nationally, areas that experienced population shrinkage (where the total population decreased by 25% over four decades) also saw their median per capita income decline by $2,334 (Weaver et al., 2017). A decline in the wealth base of a city creates a downward spiral where "population shrinkage begets economic shrinkage, which begets additional economic shrinkage" (Weaver et al., 2017).

As the number of customers and metered connections decline in shrinking cities, there is a corresponding drop in utility revenue. A large portion of the revenue of water systems come when customers, or rate payers, pay their water bills. This collected revenue in turn is used by the utility to pay for the operations,

[1] The US Census bureau defines a city as a legally bounded entity, which are commonly referred to as an incorporated place. An incorporated place also includes towns, villages, and boroughs, with some exceptions (US Census Bureau). This report will define a city as a densely settled area with a defined set of administrative boundaries.

maintenance, and replacement costs of the system (typically using rate revenue to repay financing, see below). Between 2007 and 2017, 80% of US counties lost prime working age adults, the demographic that typically represents a region's taxable revenue base (Ozimek et al. 2019). Managing a system originally built for a larger population with a decreasing number of payers at consistent rates puts a substantial strain on utilities.

When the population of a water system's service area declines, the fixed costs become redistributed amongst fewer ratepayers (Boles, 2019). Since the capacity of the built infrastructure system cannot easily be adjusted when the demand for services decreases, utilities incur the costs to maintain these underutilized services. One common response to decreasing revenues or decreasing consumption is to raise the rates paid by the remaining customer base. Rates are also increased to pay for the cost of meeting more stringent regulations and needed improvements to aging infrastructure. For all these reasons, drinking water and sewer rates have generally increased faster than inflation from the 1980s to the present (Van Abs & Evans 2018). Over the past 20 years, this rate has risen to double the rate of inflation (Raucher, 2019).

Affordability

As water rates have risen sharply, the financial challenges water systems face have been shouldered by the remaining customers and acutely felt by the most vulnerable and disadvantaged segments of the population, especially in shrinking cities (Anderson, 2014). In order to determine allowable rate increases, regulatory agencies often use annual water rate as a percent of Median Household Income (MHI) as an affordability metric (Eskaf, 2013):

$$\frac{\text{total bills for one year for a residential customer}}{\text{median household income of all customers}}$$

This metric of percent of median household income (MHI) is currently the most popular affordability metric used in the U.S., primarily due to its simplicity and ease of calculation. The following lists common standards that different agencies use to compare their water rates:

- The State of California defines affordable drinking water as 1.5% of MHI.
- The US Environmental Protection Agency defines affordable drinking water at 2%-2.5% MHI.
- The United Nations Development Program measures affordable drinking water at 3% MHI (Pacific Institute 2013).

Despite the widespread use of percent MHI to assess affordability, there are many criticisms to using it as a metric at all. Studies show a need for more nuanced metrics in rate affordability, as percent MHI is particularly problematic for small communities of less than 20,000 people and for cities with a big disparity in wealth distribution (Eskaf, 2013; Walton, 2017). When utilities and agencies use percent MHI to determine affordability, lower income households are often not accounted for properly within the metric, thereby calculating an artificially inflated median household income. This standard has been generally misapplied and using percent MHI for evaluations of household water and sewer affordability can be both inaccurate and misleading (Teodoro, 2018). For example, the median household income in Raleigh, North Carolina in 2018 was $63,891 (U.S. Census, 2014-2018) while the federal poverty level for a four-person household was only $25,100 (NC 2-1-1). To address the issues with percent MHI, several utilities are beginning to use new metrics to determine affordability, such as federal poverty levels (FPL) and 20th percentile income (Eskaf, 2013; Teodoro, 2018).

Cities such as Detroit and Chicago, which have had population declines of 56% and 20% respectively since 1970, face rate increases for drinking water that disproportionately affect low-income households (World Population Review, 2020). Many are forced to spend far more than the recommended 2-2.5% of their income on drinking water bills (Gregory et al., 2017). When customers are unable to pay their water bills, cities and utilities often resort to disconnections or "shutoffs." In Philadelphia, one in five residents had their water disconnected at least once from 2012–2017, leaving already vulnerable households without access to basic services (Frederick, 2017). This becomes a human rights and environmental justice issue as poorer communities must confront the reality of trying to live without running water or basic sewer services; as a result, customers are put in a position to make difficult choices between paying their water bill or paying for other necessities, such as food or medicine (Anderson, 2017).

Aging infrastructure and drinking water quality

As previously noted, when cities shrink, the infrastructure and service areas that were originally designed for a larger population stay the same size, resulting in overbuilt systems that are increasingly difficult to maintain. The American Water Works Association recently announced that "the replacement rate era of water systems is upon us." Water infrastructure has a finite life; the average age of failing water mains is approximately 50 years old (ASCE, 2018). In Pennsylvania however, the average age of a replaced pipe is a staggering 125 years. Continuing to postpone infrastructure investments will substantially increase future costs and place risk on public health (ASCE, 2018).

As infrastructure ages and regulations on drinking water quality tighten, insufficient maintenance or upgrading of existing infrastructure may lead to lower drinking water quality and regulatory penalties. Water mains may break, pumps may fail, and boil orders may be declared, all endangering the public health of citizens while increasing costs on the water system due to the inherently higher costs of emergency maintenance.

Debt and cost of financing

In addition to these challenges, water utilities across the U.S. face high levels of debt obligations. Water systems often take on debt to secure upfront capital to fund necessary infrastructure projects. In a growing number of cases, water systems have difficulty adequately repaying this debt even with rate increases. Long-term debt per customer increased by 84% from 2007 to 2016 for rated utilities (GAO, 2016). Although the cost of borrowing has hit record lows in recent years, many utilities still do not have the capacity to take on more debt due to existing debt burdens they have already been trying to cover for decades. The low appetite to take on new debt is further complicated by large pension liabilities and the impact of the Great Recession (Puentes & Sabol, 2014). Additionally, credit rating agencies consider a utility's long-term debt in their rating calculations based on past financial conditions and future forecasted performance. The credit rating of a utility may go down due to the inability to maintain a sufficient debt service coverage ratio, further affecting their ability to obtain financing for capital improvements.

It is also important to note that much of the water services infrastructure in the U.S. was constructed during the mid-20th century, an era in which the federal government was a significant source of financial aid (ether through direct grants, state distribution programs, or subsidized loans). Currently, federal contribution for water infrastructure has dropped from more than 60% of total infrastructure spending in the 1970s to only about 9% in 2017 (Forstensen, 2017). This lack of support from the federal government causes water systems to take on individual debt in the form of municipal bonds or loans from the private capital markets which have higher costs.

2.2 Our Approach

While shrinking cities face these challenges across the U.S., this report focuses on shrinking cities in the Commonwealth of Pennsylvania. Although Pennsylvania has experienced some population growth near urban centers such as Philadelphia, the state has also experienced considerable post-industrial decline, especially in their mid-sized cities that were once centers of industrialization.

While Pennsylvania cities of all sizes have the propensity to shrink, our focus was on cities with a population between 10,000 and 100,000. Cities larger than these may experience similar problems from a decline in population, but they likely have access to more resources and assets that make general revival more possible (e.g., universities, such as University of Pittsburgh and Carnegie Mellon in Pittsburgh, are sources that draw new industry and income to the region). The suite of strategies and solutions for these large cities vary from small cities.

We had four primary approaches for this study:

- **Characterize financial challenges faced by Pennsylvania water systems.** The financial strength of a utility can be assessed using benchmarking tools to understand the utility's financial strength, stability, growth capabilities, and credit worthiness. A calculated metric that assesses some financial aspect can then be compared against target metrics to demonstrate the utility's strengths and weaknesses. Monitoring how key financial ratios track over time or compare to other water systems allows one to assess current and past performance.
- **Describe how financial strength influences the water system's rates, borrowing behavior, and infrastructure condition.** Water systems must address affordability and ensure reliable access to safe drinking water. By analyzing these characteristics, we can better determine the overall performance of a drinking water system.
- **Explore currently available policy and management solutions.** Pennsylvania has different policies and programs in place that aim to support water utilities in their goals of delivering affordable, safe drinking water to their customers. Understanding these policies' effectiveness is critical to improving water systems in Pennsylvania.
- **Recommend policy modifications to better address water system challenges.** Whether it is improving current programs or implementing new ones that have been effective elsewhere, Pennsylvania has the capacity to provide better financial and management support to utilities.

3 Area of Focus

This report focuses on Pennsylvania drinking water systems as case studies to illustrate the challenges of demographic decline. To narrow the focus of our study, a subset of water systems was identified that specifically serve shrinking cities.

3.1 Struggling Systems

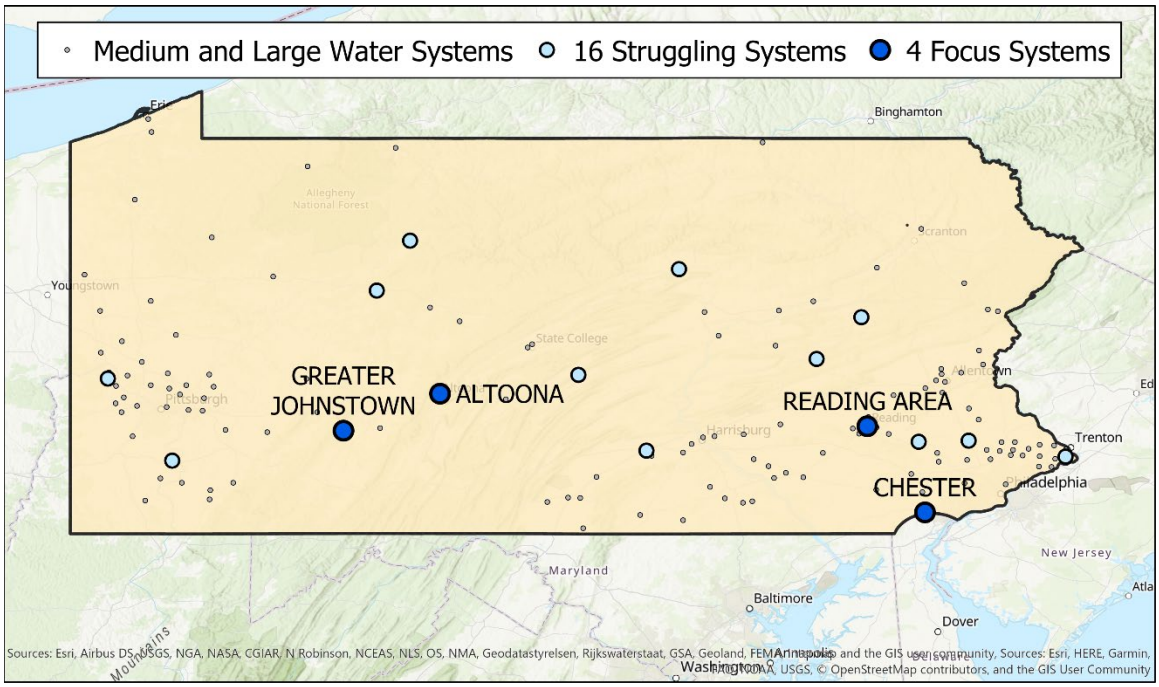

Figure 3-1. Locations of water systems in Pennsylvania serving more than 10,000 people, 16 Struggling Systems, and 4 Focus Systems.

Of the 146 drinking water systems in Pennsylvania that serve more than 10,000 people, 16 systems were selected for further study, referred to in this report as "Struggling Systems." These Struggling Systems were identified by:

1. Decline in population – cities either have a substantial decline in population since the peak population, or population has decreased in the Census Designated Place (CDP) since 1980 (Table 3-1). This population change does not reflect the population change of the drinking water system, rather the main city it serves.
2. Decline in the inflation adjusted Median Household Income (MHI) for the CDP since 1980.
3. Consent Decree issued to the corresponding sewer system – this indicates the existing need for large infrastructure investments in the area and may strain the finances of the city and customers.
4. Act 47 designation – this legislation allows cities to apply for state logistical and planning support. Presence on the Act 47 list is a sign of financial distress, and de-listing may indicate recovery.
5. Expert Interview with University of Pennsylvania Water Center – the Water Center has contextual knowledge of challenges facing cities that may not have been identified by other metrics.
6. Publicly available official bond statements – high granularity financial information was extracted from bond statements, so only systems with bond data were included in the analysis. Though

struggling, the finances of these systems may be stronger than systems that have not issued bonds over the same time period.

Table 3-1. Struggling Systems and the population change of the corresponding city from its peak.

Water Authority	Population change from peak (%)
Chester Water Authority	-48.7
Reading Area Water Authority	-20.4
Greater Johnstown Water Authority	-71.1
Altoona Water Authority	-46.7
Aliquippa Water Authority	-67.1
Hazleton Water Authority	-35.7
Schuylkill Water Authority	-39.7
Williamsport Water Authority	-38.0
Falls Township Water Authority	-6.6
Lewistown Municipal Authority	-41.5
Pittsburgh Water and Sewer Authority	-55.5
Borough of Charleroi Water Authority	-65.8
St. Mary's Area Water Authority	+53.2*
Carlisle Water Treatment Plant	0
North Penn Water Authority	-9.5
Plum Borough Water Authority	-1.1

St. Mary's exhibited an increase in population by absorbing the surrounding township of Benzinger in 1992. Population for most of these cities where the water authorities serve peaked in the 1920s to the 1950s.

Not all Struggling Systems met every criterion above; additionally, there are systems in Pennsylvania that did meet these criteria yet were not studied here.

3.2 Focus Systems

Four "Focus Systems" were selected for deeper investigation; they are Altoona, Chester, Johnstown, and Reading. These Focus Systems were selected from the Struggling Systems to illustrate the breadth of challenges resulting from population decline.

The system performance metrics of our Focus Systems demonstrate the diverse range of Struggling System attributes, varying in financial strength, affordability burden, population trends, infrastructure condition, and Act 47 status (Table 3-2). For example, Altoona's water system has received a high number of Safe Drinking Water Act violations. In contrast, Chester's water system has been able to avoid some of the challenges faced by other systems due to recent increases in the residential customer population, but the city is still under Act 47 designation, indicating that the larger municipality is struggling financially. The City of Johnstown has experienced the greatest population decline since its peak in 1920 and its sewer system under a consent decree. In 2011, Reading was named the "poorest city in America" by the New York Times and is still recovering from the Great Recession. Each system struggles in a different way and must therefore address their issues distinctly.

Table 3-2. Summary Metrics for Focus Systems

Water System	Under Consent Decree	Drinking Water Violation Severity	Population change from peak (Peak Year)	30-year Residential Customer Population Change	Act 47 Status	Population under federal poverty level
Johnstown	Yes	Low	-71.1% (1920)	-5.50%	Yes	38%
Chester	No	Low	-48.7% (1950)	47.90%	Yes	34%
Altoona	No	High	-46.7% (1930)	0.40%	Removed	23%
Reading	No	Moderate	-20.4% (1930)	-1.30%	Yes	35%

4 Data and Methods

4.1 Water System Performance

The first part of this study characterized the overall performance of each water system through four separate metrics, corresponding to the broad set of challenges faced by shrinking cities. Together, financial benchmarking metrics, trends in rates and customer base, the affordability of water, and infrastructure condition detail the distinct challenges faced by each Struggling System.

4.1.1 Financial Indicators

Six financial metrics were calculated for each Struggling System (n = 16) in all years for which data were available. We gleaned financial data from the financial disclosures contained within bond offering statements to determine overall financial strength. At least 70% of all water and wastewater utilities rely on municipal bonds to finance their infrastructure needs, and these documents contain substantial financial and operational data (GAO, 2016). The financial metrics were compared against benchmark metrics to assess the utility's financial strengths and weaknesses (Table 4-1).

Table 4-1. Financial Benchmarking Metrics used to characterize Struggling Systems' financial strength.

Indicator	**Definition**	**Benchmark[2]**
Credit Rating[3]	Measure that describes a system's credit quality and financial strength	Aa2/AA or above
Operating Ratio	Measure of operating revenues over operating expenses	High ratio (>1.0)
Debt Service Coverage Ratio	Measures ability to pay for debt service and day-to-day operating expenditures	High ratio (>1.2)
Days of Cash on Hand	Measures level of reserves utility maintains relative to day-to-day expenditures	At least 6 months, at the very least length of billing period
Asset Depreciation	Estimates the portion of the average expected life of the utility's physical assets that has already passed	Low percentage < 50%
Debt to Assets Ratio	Measure of the utility's assets that are financed by debt	Low-to-medium ratio (< 0.56)[4]

[2] Benchmarks come from UNC Environmental Finance Center Water Utilities Dashboard.

[3] The key factors Moody's used to examine the credit risk include: 1) regulatory environment and asset ownership model, 2) operational characteristics and asset risk, 3) stability of business model and financial structure, and 4) key credit metrics (Voelz, 2009).

[4] This benchmark was obtained from the 2016 Brookings report, "Investing in water: Comparing utility finances and economic concerns across U.S. cities". On average, the 97 drinking water utilities analyzed across the nation had debt-to-asset ratios of 56%.

Other financial strength indicators were considered, but many were not easily quantified due to missing or inconsistent financial reporting, and so were not included in this report. The inconsistency of financial reporting and classification also complicated the use of benchmarking metrics.

4.1.2 Rates, Revenues, and Affordability

The financial disclosures as part of bond offering documents were also used to monitor the number of residential, commercial, and industrial customers served by each water system over time. Though most customers are residential, each commercial or industrial customer typically uses far more water and contributes proportionally more to a water utility's revenue. Industrial customers include hospitals, medical centers, universities, factories, manufacturing, etc. (EMMA Pennsylvania Municipal Securities, 2020).

Additionally, drinking water systems choose how to structure rates among customer groups to incentivize or dis-incentivize certain activities or for revenue stability. Systems may use increasing block rate structures, decreasing block rate structures, or they may choose to charge the same rates regardless of customer or consumption amount (Andrews et al., 2017). Rate structure data were also retrieved from bond documents.

The Commonwealth of Pennsylvania uses MHI to both assess drinking water affordability and determine interest rates for loans, but our analysis focuses on alternative metrics because of the recent critiques of the use of MHI alone (Raucher, 2019). These recent analyses suggest a more holistic approach to affordability with both a household affordability component and system financial capability component. Rather than classifying rate structures as affordable if MHI is below 3% and unaffordable if above 3%, the two-component system examines both the ability of low-income households to afford their water bills and the ability of the water system to support these low-income households.

The first component of the affordability metric used here is the basic water cost as a percent of 20th percentile income, the Household Burden Index (HBI). Basic drinking water cost is defined as the cost of drinking water for a three-person household consuming 50 gallons of water per person per day. The second component is the percent of households in the service area under 200% of the federal poverty level, the Poverty Prevalence Index (PPI). Our analysis of affordability mirrored this approach and ranked drinking water affordability burden in our Struggling Systems from "very high" to "low" (Table 4-2).

Table 4-2. Drinking Water Affordability Burden is a combination of Household Burden Index (basic water cost as a percent of lowest quintile income) and Percent of Households below 200% the Federal Poverty Level, adapted from Raucher, 2019.

Household Burden Index – Basic Drinking Water Cost as percent of Lowest Quintile Income	**Poverty Prevalence Index – Percent of Households Below 200% FPL**		
	> 35%	20% to 35%	< 20%
> 5%	Very High Burden	High Burden	Moderate-High Burden
3.5% to 5%	High Burden	Moderate-High Burden	Moderate-Low Burden
< 3.5%	Moderate-High Burden	Moderate-Low Burden	Low Burden

Raucher et al. (2019) stressed the importance of calculating affordability using all water costs, generally including water, sewer, and stormwater charges. Our study focuses on drinking water systems, however, so the guidance levels for HBI were halved for our burden determinations. In the few systems where sewer rates were available, they typically mirrored drinking water rates, if not being slightly more expensive. Therefore, our assumptions of dividing the HBI burden cutoffs in half is conservative and may underestimate the total affordability burden in a community. It is also important to integrate the cost of other basic goods and services into affordability burden. These other costs are not included in the affordability metric here but should be included in individual system financial planning.

HBI and PPI were calculated using block group level income statistics retrieved from the National Historic Geographic Information System (NHGIS, Manson 2019). For each water system, all block groups that the 2019 service area boundary intersected were used for the affordability metrics.

The service areas of the Pennsylvania drinking water systems were retrieved from the Pennsylvania Spatial Data Access site. Though the boundaries of water systems do change over time, the 2019 boundaries were used for all systems for their high precision compared to historical data. Inaccuracies may exist in some cases because of reliance on these 2019 boundaries.

4.1.3 Infrastructure Condition and Drinking Water Quality

Infrastructure condition is difficult to quantify in the same way as financial metrics or affordability. This report uses the Safe Drinking Water Act (SDWA) Violations from the U.S. Environmental Protection Agency (EPA) as a proxy for infrastructure condition. A struggling water utility that possesses strong finances and affordable water rates may postpone infrastructure maintenance and upgrades, which could lead to SDWA violations.

Infrastructure condition is compared among systems using the violation severity index, which sums violations, weighting each health-based violation ten times more than other major violations. The violation severity index is based on a 2009 EPA memorandum on the Drinking Water Enforcement Response Policy that updates the EPA approach for prioritizing systems that are out of compliance with SDWA.

$$Violation\ Severity\ Index = \#Major\ Violations + 10 \times \#Health\ Based\ Violations$$

The diagnosis of infrastructure condition in this study only tracks major monitoring and reporting violations and all health-based violations. Monitoring and Reporting (MR) violations include failure to conduct monitoring and failure to report monitoring results in a timely fashion. Health-based violations include Maximum Contaminant Level (MCL), Maximum Residual Disinfectant Level (MRDL), and Treatment Technique (TT) violations (Safe Drinking Water Act). Health-based violations indicate the inability of the treatment system to successfully produce safe water and meet current drinking water regulations. Major monitoring and reporting violations may conversely indicate a lack of technical or human capacity within the water system. All SDWA violations were downloaded from the EPA's Safe Drinking Water Information System (SDWIS).

4.2 Policy and Management Alternatives

The second part of this study sought to explore the policy mechanisms available to address the distinct challenges faced by struggling water systems. In addition, existing policies and tools currently in use were evaluated for their effectiveness in improving water system performance.

4.2.1 The Pennsylvania Infrastructure Investment Authority (PENNVEST)

The mostly widely available tool to finance drinking water infrastructure at low cost is the Drinking Water State Revolving Fund (DWSRF), a partnership between EPA and the States (U.S. EPA 2020). The DWSRF was established as part of the 1996 Safe Drinking Water Act Amendments and functions primarily as a financial assistance program designed to help water systems achieve compliance with SDWA. Congress appropriates funding for the DWSRF, and the EPA is then responsible for awarding the capitalization grants to each state (U.S. EPA, 2020). The grants are placed into a revolving fund in order to provide loans and grants to eligible water systems. Every state has its own DWSRF, and in Pennsylvania, the program is managed by the Pennsylvania Infrastructure Investment Authority (PENNVEST).

Founded in 1988, PENNVEST provides grants and low interest loans for water infrastructure projects (PENNVEST Information 2020). These are financed through several sources[5] managed by PENNVEST, including Commonwealth funding, the Clean Water State Revolving Fund (CWSRF) for sewer and storm water projects, and the DWSRF for drinking water projects.

Pennsylvania utilizes a financial capability analysis (PACNIF) to prioritize applicants based on financial and socio-economic factors such as financial burden, financial capacity, percent of population below the poverty level, change in population, percent of population over the age of 65, and per capita income (Commonwealth of PA, 2014). PENNVEST targets projects and financing that would allow user rates to fall or remain between one and two percent of MHI. If the resulting user rate is higher than what similar systems pay, the interest rate can be adjusted as low as one percent and the repayment term can be extended up to 30 years (Commonwealth of PA, 2014).

Per federal regulations, state revolving funds may not be used to refinance existing debt. For such refinancing, systems often turn to municipal bonds, which have comparatively higher interest rates (i.e., market rates). Additionally, SRF funded projects must pay the prevailing wage rate, often called Davis-Bacon wages, and since 2014 must abide by American Iron and Steel (AIS) requirements. Both are regulatory hurdles that may change the contract price of the project.

4.2.2 Financing Options and Utility Behaviors

Municipal water revenue bonds and PENNVEST awards were compared among Struggling Systems to determine if PENNVEST awards were being fully utilized. Repayment periods, interest rates, and debt purpose were also compared to quantify available savings from using PENNVEST instead of bonds for infrastructure financing.

Data on the funding awarded to utilities from Pennsylvania's DWSRF were retrieved from the PENNVEST "Approved Projects" database (PENNVEST, 2020). Data and information on PENNVEST eligibility and project criteria were gathered from the Environmental Protection Agency. While DWSRF administration

[5] Commonwealth funding sources are established through state revenues from General Obligation Bonds to be additionally invested into the CWSRF and DWSRF (Commonwealth Funding). PENNVEST administers the CWSRF and the DWSRF pursuant to the federal Water Quality Act of 1987 and the 1996 Safe Drinking Water Act Amendments respectively (PENNVEST Funding Programs). Additionally, PENNVEST partners with the Pennsylvania Housing Finance Agency to provide funding for individual homeowners and the Growing Green Grant, which is awarded to applicable projects after applying for PENNVEST money.

varies from state to state, the basic tenants and criteria remain the same. DWSRF approved projects must address SDWS compliance and prioritize disadvantaged communities (U.S. EPA, 2017).

4.2.3 Consolidation Policies

One approach for meeting water systems' current and future needs is consolidation and regionalization. Consolidation and regionalization may address the challenges small or struggling systems face, providing economies of scale while avoiding privatization and possibly increasing monitoring and managerial capacity (Teodoro, 2019). Consolidation occurs when two or more water systems become one operating under the same governance, management, and financial functions (ASWA & EFC, 2019). Regionalization may not result in physical interconnection, but can assist with sharing resources, developing regional partnerships, and pooling technical expertise (ASWA & EFC, 2019).

The federal government and individual states have made promoting consolidation a priority as part of SDWA, and the EPA maintains an online list of state-level efforts to build capacity of drinking water systems, which may also incentivize consolidation. This list was captured in a guide published in 2017, called "Water System Partnerships: A Compendium of State Programs, Statutes, and Policies." These policies are divided into different categories, which allows for the comparison between states and formed the basis for policy analysis in this study. The guide lists 172 individual state-level policies aimed at stabilizing drinking water systems, grouped into six broad types. For this study, the subset of "state drinking water enforcement programs" that specifically order receivership are separated into a seventh category, "takeover rules" (Table 4-3). Records of legislation, rulemakings, and other publicly available documents were used to determine which year each of the 172 policies on the EPA's list went into effect.

Table 4-3. Seven categories of state-level policies analyzed for impacts on consolidation rates, adapted from the EPA.

Type	General summary
Development or Operator Certification Program	Mechanisms to address personnel challenges, such as allowing operators to work remotely, thereby allowing systems to share skilled workers, or providing small utilities with free engineering or financial services.
Emergency Planning	Mandating or supporting neighboring systems to create emergency plans to share workers or resources in times of emergency or disaster.
Funding Mechanism	Priority on water infrastructure financing for systems that have consolidated or are in the process of doing so.
Regional Planning	Laws or programs that allow several counties and water systems to create a regional water plan together.
State Drinking Water Enforcement Program	State-ordered consolidation, interconnection, or receivership if certain conditions are not met, driven either by financial insolvency or quality violations.
Takeover Rules	A subset of "State Drinking Water Enforcement Program" where the specific threat of receivership or state-ordered consolidation are explicitly stated.
State Legislation or Statute	Laws mandating that new systems consider interconnection with existing ones.

To analyze the efficacy of these policies in consolidating drinking water systems, yearly deactivation of public water service providers from 1978 to 2019 were used as a proxy for consolidation. Deactivation of a system strongly suggests consolidation with another system. Dates and numbers of system deactivations were retrieved from SDWIS. States and policies were compared on the number of systems deactivating each year divided by the number of total systems in the state in 2019.

Using these two metrics for each state—the year of implementation, if applicable, and the yearly deactivation rate-- four new data points were calculated for each policy category:

1. the average deactivation rate *before* the policy
2. the average deactivation rate *after* implementation
3. the average change in deactivation rates after the policy was implemented
4. the deactivation rate for states that did not implement that type of policy in the same years.

As a result, the impact of a certain type of policy on consolidation rates can be quantified.

5 Findings

5.1 Water System Performance

5.1.1 Financial Strength

All Struggling Systems took out municipal bonds between 1988 and 2018. Most utilities were given the best credit rating possible in the 1990s and early 2000s. After 2008, ratings agencies notably downgraded the credit of the utilities analyzed (Figure 5-1). Lewistown Water Authority's 2010 bond had an S&P rating of AAA, the highest possible, however it was noted that the rating had "a negative outlook". Moody rated that same 2010 bond as Aa3, three levels lower. This was the last bond to have been awarded the highest rating from either credit rating agency.

Five of the 16 Struggling Systems had an operating ratio of less than one at any point in time, but not since 2013 (Figure 5-2). The operating ratio of most utilities remained between 1.0 and 1.5, including the Focus Systems of Altoona, Johnstown, Reading, and Chester, who have all had an operating ratio greater than 1.0 since 2005.

Any utility in our dataset who self-reported a debt service coverage ratio in their financial statements had ratios well over 1.2. Both Chester and Altoona self-reported strong debt service coverage ratios for a majority of the 2000s, all over 1.0.

There was a large range of days of cash on hand across utilities during the recorded time period, and some water systems did not report enough information to calculate this metric (Figure 5-2). Many utilities often had fewer than six months of cash on hand, with Hazleton Water Authority reportedly having as low as six days in 2015. Over time, it appears that the spread of values has increased, with Schuylkill having as many of 641 days, and Pittsburgh having as few as 112 days in 2018.

Most utilities that reported line items needed to calculate the debt to asset ratio had ratios that performed well and fell below the suggested maximum benchmark. Reading, however, did not, and stood out with its sizeable debt load, where there was almost as much debt as there was current assets (Figure 5-2). Compared to a nation-wide debt-to-assets ratio of 0.56, most water utilities in this study were doing comparably well (Kane, 2016).

The percent of capital assets depreciated for many water systems was well below the maximum recommended benchmark of 35% throughout the period of record (Figure 5-2). While most of the systems' metric values even stayed below 35%, a general increasing trend of this metric was noted. Half of the Struggling Systems did not report accumulated depreciation, and so were not included in this metric.

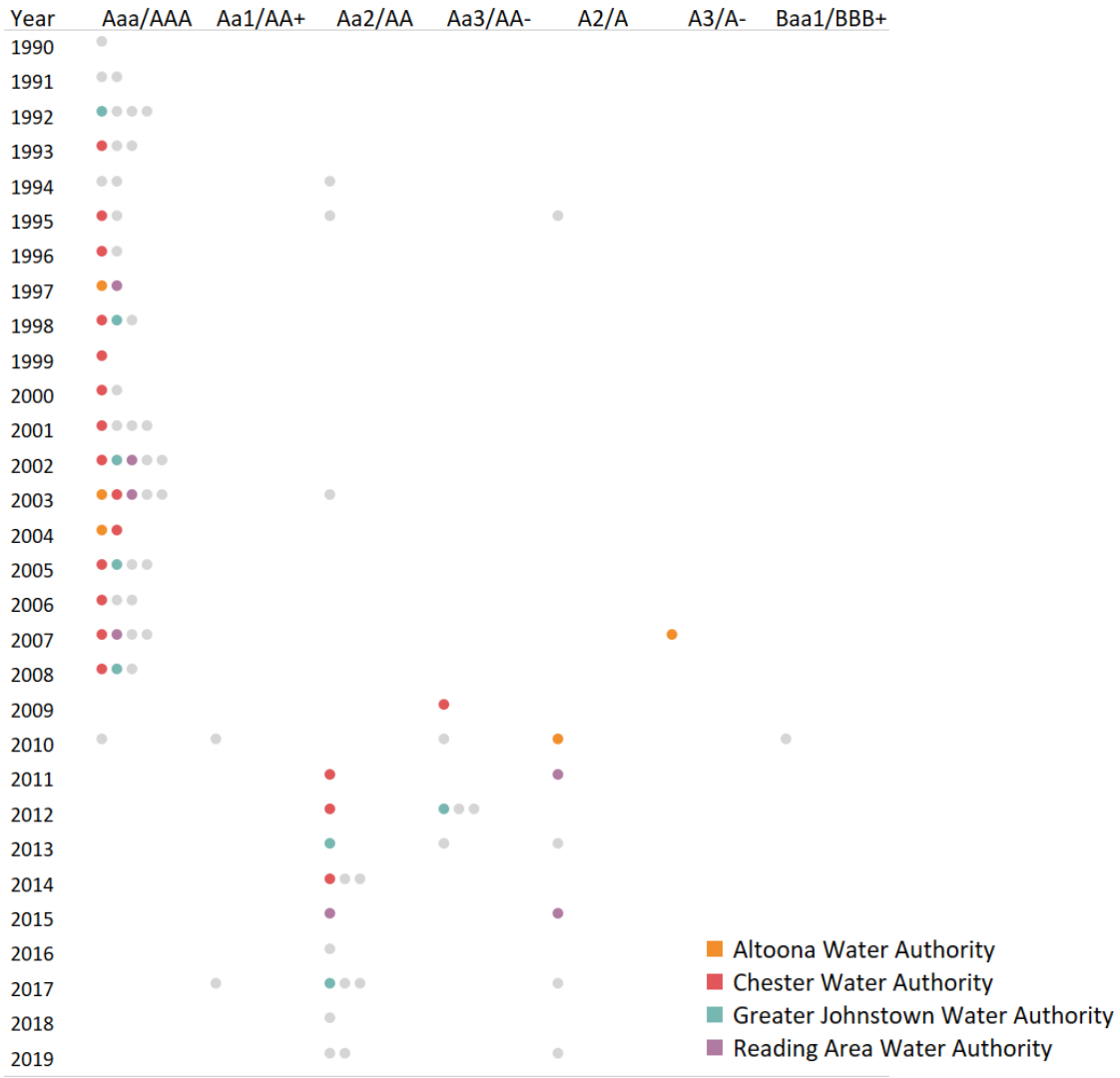

Figure 5-1. Municipal Bond credit ratings over time show an obvious decline in credit ratings after 2009. All 16 Struggling Systems are shown, with the 4 Focus Systems in color.

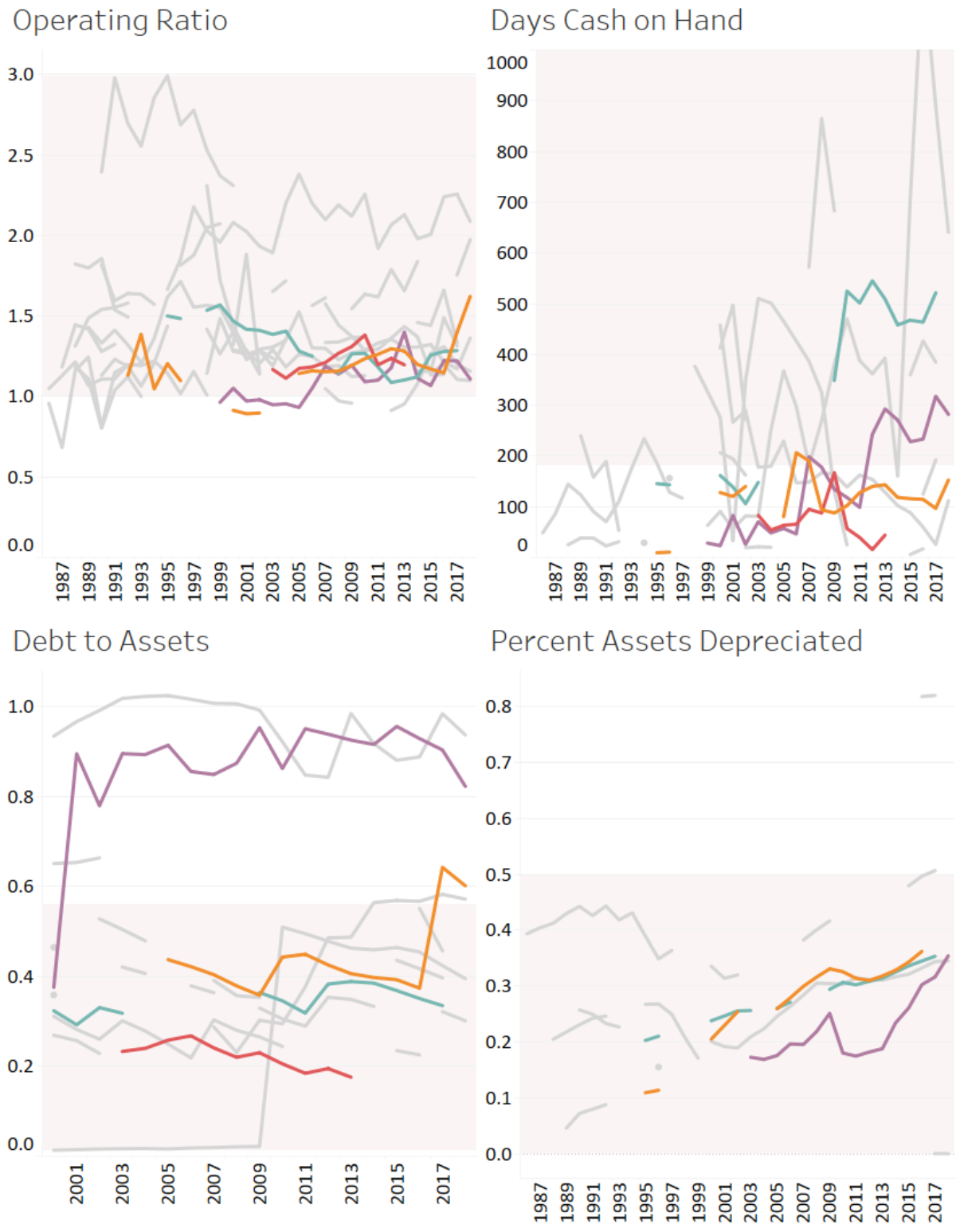

Figure 5-2. Selected financial metrics of all Struggling Systems. The suggested benchmark ranges are shaded in light red. The 4 Focus Systems are colored, where Altoona is orange, Chester is red, Johnstown is green, and Reading is purple.

5.1.2 Rates, Revenues, and Affordability

In all four Focus Systems, the percent decline in industrial customers is greater than the decline for any other customer group over the past 20-30 years. Chester lost more than half its industrial customers from 1990 to 2010, despite some of the lowest rates and increasing numbers of residential and commercial customers. Additionally, all Focus Systems have used decreasing block rate structures throughout the 30-year period of record.

Table 5-1. Residential and Industrial customer changes for Focus Systems.

Water System	30-year customer change	
	Residential	Industrial
Altoona	+0.4%	-12.5%
Chester	+36.7%	-62.6%
Greater Johnstown	-5.5%	-40.1%
Reading	-1.3%	-6.5%

The Struggling Systems have a broader distribution of affordability burden than the financial metrics presented above. Though some systems have low drinking water rates, the prevalence of poverty is above 20% in all Struggling Systems, so no Struggling Systems have a low affordability burden (Figure 5-3). Currently, three of the four water systems with high affordability burdens are the Focus Systems in Altoona, Johnstown, and Reading (Figure 5-4). Although these three systems had only moderately high affordability burdens in 2010, the burdens in each system increased to high burdens over the past 10 years as the cost of basic water increased by an average of 50%.

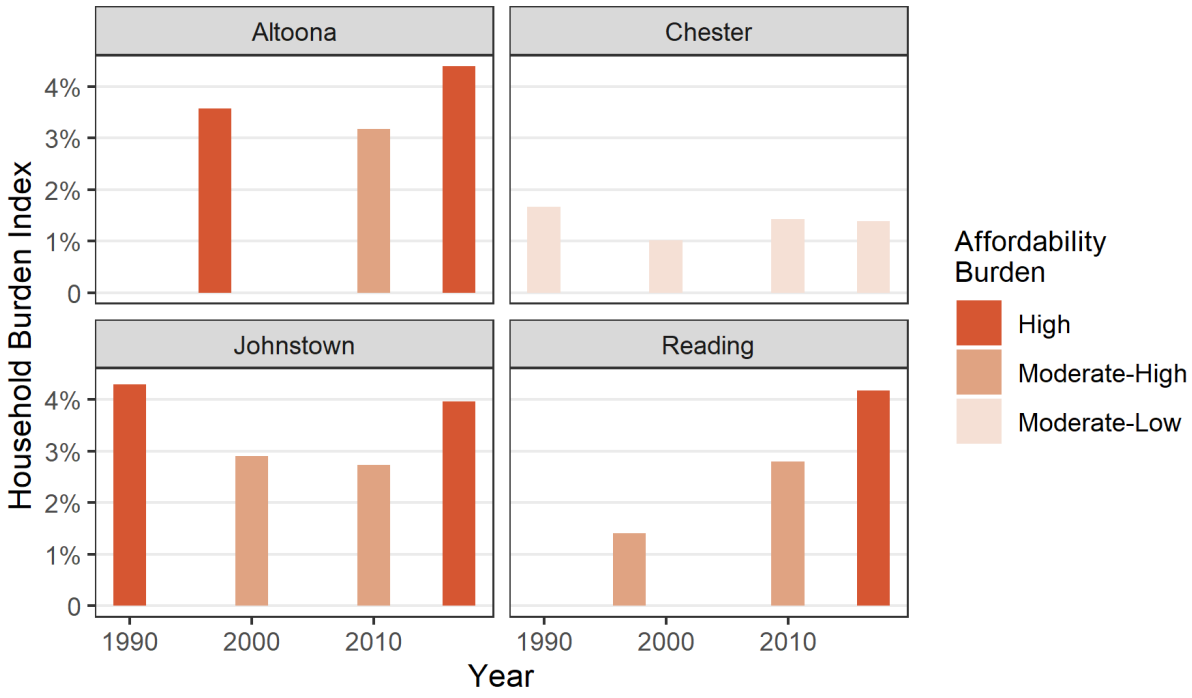

Figure 5-4. Household Burden Index and Affordability Burden for the four Focus Systems over time.

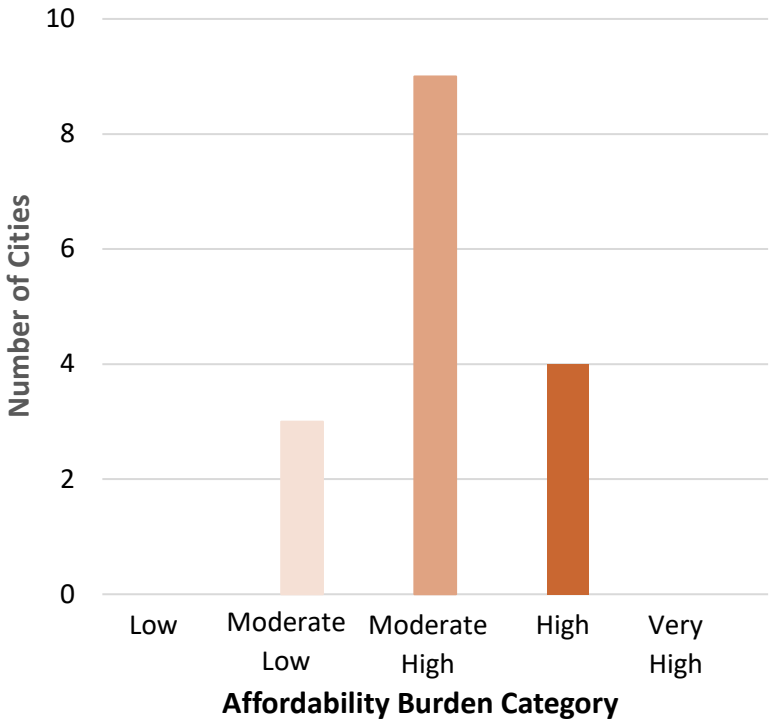

Figure 5-3. Distribution of Affordability Burden among all Struggling Systems (n=16). Altoona, Johnstown, and Reading are all in the High burden category, and Chester is in the Moderate-Low category.

5.1.3 Infrastructure Condition and Drinking Water Quality

Like affordability burden, the infrastructure condition of the Struggling Systems also had a broad range, as measured by the SDWA violation severity index. Some systems, like Chester and Johnstown, had few total violations and no health-based violations. Other systems, like Reading and Altoona, had both major violations and health-based violations. Of the Focus Systems, Altoona had the highest violation severity index, greater than the violation severity index of 75% of all drinking water utilities in the state.

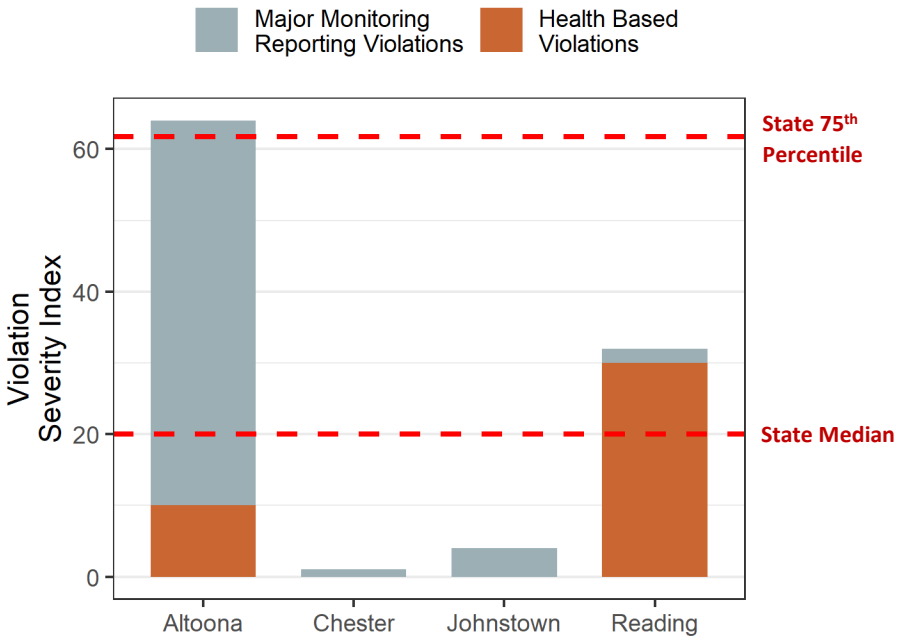

Figure 5-5. Violation Severity Index over the period of record for each of the Focus Systems.

5.2 Policy and Management Alternatives

5.2.1 Financing Options and Utility Behaviors

All Struggling Systems have access to both PENNVEST loans and the municipal bond market to fund any capital improvement projects. The Focus Systems vary on their use of both sources (Table 5-2), even though PENNVEST currently funds all eligible projects that apply for funding (R. Boos, personal communication, February 6, 2020).

Only 30% of bond funds were used for capital projects in Struggling Systems, while most funds were used to refinance old bonds to lower interest rates. 16% of the total debt issued by the Struggling Systems was in the form of PENNVEST awards, though the fraction of debt as PENNVEST awards for each city varies from 0 (Chester) to 74% (Hazleton) (Figure 5-6).

Table 5-2. Bonds issued and PENNVEST loans taken by each of the Focus Systems, in millions of dollars.

	Total Bonds	Bonds for Capital Projects	Percentage of Bonds used for Capital Projects	PENNVEST Loans and Grants
Johnstown	$131	$15	12%	$36
Altoona	$144	$32	22%	$58
Chester	$281	$113	40%	-
Reading	$121	$71	59%	$26

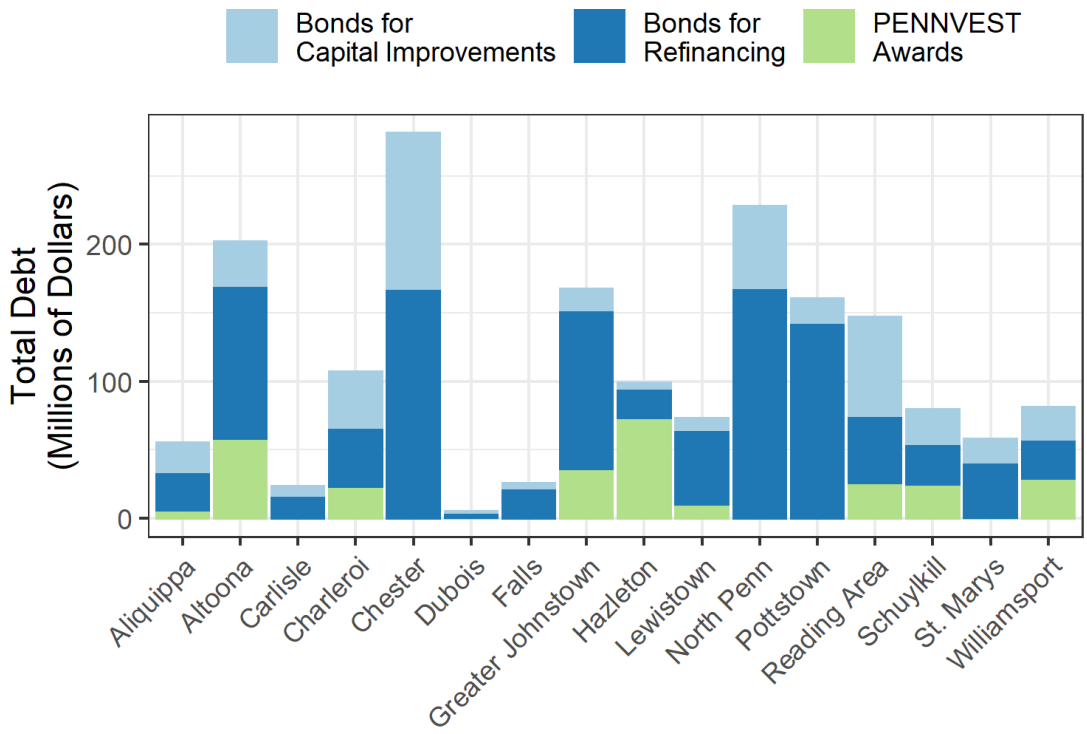

Figure 5-6. Total debt issued by Pennsylvania Struggling Systems in the form of PENNVEST awards and bonds. Bond debt is further divided by use for capital improvement projects or refinancing of existing debt.

5.2.2 Consolidation Policies

On average, 2.6% of all public water systems deactivate in each state each year. States see the greatest increase in average deactivation rates after implementing takeover rules (a 12.5% increase), followed by regional planning (4.99%), and funding mechanisms (2.97%) (Table 5-3). Before states implement takeover rules, they are deactivating an average of 2.45% of their systems per year. After they implement the policy, that average deactivation rises to 2.76%.

Table 5-3. Changes in deactivation rate before and after introduction of state policy types.

	Deactivation Rate Before Policy	Deactivation Rate After Policy	**Change caused by Policy**
Development or Operator Certification Program	2.59%	2.60%	**0.30%**
Emergency Planning	2.56%	2.58%	**0.62%**
Funding Mechanism	2.60%	2.67%	**2.97%**
Regional Planning	2.57%	2.70%	**4.99%**
State Drinking Water Enforcement Program	2.61%	2.56%	**-1.71%**
Takeover Rules	2.45%	2.76%	**12.50%**
State Legislation or Statute	2.70%	2.70%	**-0.02%**

6 Discussion: Pennsylvania Cities in Context

6.1 Financial Metrics

Many water systems, especially the four Focus Systems of Altoona, Chester, Johnstown, and Reading, had strong financial metrics that fell within the desired range. No overall trends over time were evident, but most Struggling Systems appeared stable over time. The desirable ratios (operating ratios > 1.0, debt service coverage ratio > 1.2, days of cash on hand > 6 months, and debt to assets ratio < 0.56) throughout time suggest that the systems have the financial capacity to continue to issue and payback debt. The number of Struggling Systems reporting strong debt-service coverage ratios above the suggested minimum benchmark is surprising. These strong ratios deviate from our initial assumption that most Struggling Systems had sizeable debt loads, and likely debt loads beyond what they would be able to easily service with their revenue base.

This stable revenue with respect to existing debt was reflected in the relatively positive credit ratings for the water systems, acknowledging the downgrading which has occurred since the 2008 financial crisis (Voelz, 2009).[6] In 2009, however, Moody's updated their rating methodology for regulated water utilities, and it is not clear whether it was simply the bond rating industry that caused the bond ratings to shift downward, or whether changed rating methodologies were also involved.

We were unable to find any documentation for the rationale for downgrading the specific Struggling Systems, although based on other reports of other utilities during a similar time window, it seemed to be a combination of multiple factors. Other components that may have come into play include the utility's rate flexibility, ability to absorb temporary financial shock, and ability to adapt to environmental regulation (Tiger, 2013). For example, if the utility has not raised rates over some period, it may reflect their political inflexibility, which could affect future ability to raise the revenue necessary to repay debtholders.

6.2 Tradeoffs: The Trilemma of Choices for Water Utilities in Shrinking Cities

The traditional financial metrics of the Struggling Systems cities identified in this study are surprisingly strong. It should be acknowledged, however, that all systems we examined already have the capacity to issue debt, indicating a certain level of financial strength as a starting point. A focus on strong financial

[6] The credit ratings attached to the municipal bonds are highly influenced by the presence of an insurance company that insures payments in the event that the bond issuer defaults. Part of the bond value is paid to the insurer by the municipal or authority issuing the bond. Bond insurers grew considerably in the early 2000s due to their involvement in residential mortgage debt. This exposure to other markets was legal according to states' financial guaranty insurance statutes. The financial crisis in 2008 precipitated considerable losses on insured securities, which were backed by residential mortgage loans and collateralized debt obligations. This caused the bond insurance industry to experience rating downgrades, value reductions, and consolidations among the insurers. Eventually, in the thick of the financial crisis, municipal bonds were being rated as if they were uninsured, effectively discounting the bond insurance (Bond Insurance, Wikipedia).

metrics (as evidenced in the Struggling Systems) may come at the expense of affordable water rates and infrastructure condition. That is to say that utilities must balance between three competing factors:

1. Stable financial strength (e.g., high revenue relative to expenses),
2. Affordable water rates for their customers,
3. Sustainable and high-functioning infrastructure.

A water system with growing revenue base may be able to sustain all three goals, but a system with declining revenue base cannot; it will likely only be able to prioritize two of the three. A water system can provide high functioning infrastructure with high quality water at affordable rates, but that would have very limited revenue for high costs and decrease its financial strength. Alternatively, a system could have affordable water and a high-performing financial condition by reducing expenditures considerably, but this would come at the expense of infrastructure quality and pose a risk to public health. If a system prioritizes financial strength and sustaining infrastructure, it may come at the cost of reduced water affordability.

Our four Focus Systems illustrate that while many financial metrics are within the desired range, other areas, including their rate structures, affordability, and infrastructure condition, display the potential for improvement. Based on our analysis, Struggling Systems are prioritizing their financial condition to the potential detriment of affordability and/or high-functioning infrastructure.

6.2.1 Rates, Revenues, and Affordability

Unlike their financial condition, our Struggling System's affordability metrics were more concerning. Affordability was shown to be an acute problem, with 13 of the 16 Struggling Systems having moderate-high and high affordability burdens. These results indicate that drinking water costs are already a burden to low-income populations served by these systems. It is worrisome because costs for maintaining and replacing aging infrastructure will continue to rise, further exacerbating affordability burdens. Options exist for systems with unaffordable water rates, however. Despite the rise in spending and decrease in federal funding, there have been innovative approaches to address water affordability with different types of Customer Assistance Programs (CAPs).

Some affordability programs use an application system for lower income households to receive a discount on water bills. Baltimore, for instance, created the *BH2O* program in 2019 for customers with a household income of less than or equal to 175% of FPL guidelines. This program discounts bills by 43% and removes additional stormwater fees (Baltimore Water Affordability Programs). Orange Water and Sewer Authority (OWASA) in Chapel Hill, North Carolina, developed a Care to Share Customer Assistance Program where ratepayers can donate or round up their monthly bills to help families in need pay for their water bills (OWASA, n.d.). Pittsburgh, another shrinking city in Pennsylvania, instituted a Water and Sewer Authority Hardship Program. Residents in Pittsburgh may apply for a one-time annual grant of up to $300 after already having an outstanding balance of $100. Applicants must be at or below 150% of the current Federal Poverty Guidelines (PWSA Hardship Program).

Another approach towards addressing affordability is to lower or remove fees for late water bill payments. Late fees disproportionately affect low-income households and increase financial stress. Furthermore,

water systems could consider having renegotiable payment plans to allow lower-income households to pay past-due bills in monthly installments (Recchie et al., 2019).

Manny Teodoro, a leading expert on utility management and finance, argues that implementing rate structures adjusted by income level is a better way than traditional CAPs to address water affordability. Rather than require customers to apply for discounts or rebates, a water system can establish a basic, affordable level of water and sewer services for low income households (Teodoro, 2020). The Philadelphia Water Department is the first water utility in the country to determine rates based on household income and federal poverty levels (FPL). Water bills are calculated as a percent of income, dependent on the FPL tier of the household (Table 6-1). For example, the FPL for a family of four is roughly $25,750 (Poverty Guidelines, 2015). Therefore, a family of four who makes this amount would pay no more than $54/month for their water bills (Walton, 2017).

Table 6-1. Federal Poverty Level tiers dictate the amount that should be charged for a water bill based on the monthly income.

FPL Tiers	Monthly Bill
0-50%	2% monthly income
51-100%	2.5% monthly income
101-150%	3% monthly income

Philadelphia's example holds promise for many cities and states whose water systems have yet to consider re-structuring their rates. Common concerns that prevent water systems from following Philadelphia's lead include perceived administrative barriers, assumptions that the rate structure change would lead to revenue loss, and the presence of specific laws in states and municipalities that expressly prohibit charging low-income customers lower rates than others (Bartlett et al., 2019).

Decreasing block rate structures are another tool many utilities use that may hinder water affordability. Plentiful water supplies in our four Focus Systems have allowed the systems to focus on attracting high volume users using a decreasing block rate. These structures charge a lower unit price to large industrial or commercial consumers at the expense of incentivizing water conservation, and potentially at the expense of affordable rates, in exchange for greater revenue stability (Switzer, 2019). Post-industrial cities in water-rich areas, like our Focus Systems, have the infrastructure capacity to supply more water than their customers demand. Combined with the low marginal cost of treating water, such water systems may not need to conserve water; rather, they may choose a rate structure to stabilize revenues and keep costs to industrial customers low.

Despite appealing rates, large industrial customers have continued to leave each of the four Focus Systems. This continued loss of industry likely indicates economic factors at play beyond water rates. Raising rates for industrial and commercial customers would generate more revenue than similarly raising rates for residential customers; however, shrinking cities may not want to risk contributing to industry loss by increasing these rates substantially. Unfortunately, the decision to keep rates low for larger water users effectively passes the costs of the water system to residential customers.

Regardless of metric or location, it is clear that water and sewer affordability is becoming a problem and the Struggling Systems do not yet have a method to address it. As of 2018, roughly 12% of homes in the U.S., or 14 million households, lived in areas where water and sewer bills cost more than 4.5% of the area MHI (Frostensen, 2017). The percentage of struggling households is only projected to increase in the coming years, as drinking water and sewer infrastructure upgrades continue.

Rather than resorting to late fees or shutting off water to households who do not (or cannot) pay, it is in the best financial interest of the utility to help all customers pay their water bills. When cities resort to shutoffs, this not only harms the customer, but also results in the utility not receiving any revenue from that customer. By instituting a Customer Assistance Program like Baltimore's, or adjusting pricing structures like Philadelphia, utilities could ensure a more reliable revenue (Teodoro, 2018).

6.2.2 Infrastructure Condition and Drinking Water Quality

The high violation severity index of many of our Struggling Systems, such as Altoona, indicates potentially poor infrastructure condition. It is important to note that the violation severity index is comparative, so residents of Altoona are not necessarily becoming acutely ill from their water. Instead, the metric indicates to both Altoona and Pennsylvania that infrastructure and managerial investments likely need to be prioritized in Altoona and similar systems to prevent potential public health risks. PENNVEST, as well as potential outside funders, should use the violation severity index in order to identify potential priorities for capital improvement projects.

6.2.3 What Can Be Done?

The Struggling Systems identified in this study for their shrinking populations and financial distress have surprisingly strong financial metrics. However, they are struggling to remain strong financially while revenues from their industrial customers decrease, affordability issues worsen, and infrastructure continues to slowly deteriorate. The trilemma caused by a declining customer base will only worsen if business continues as usual. Larger economic forces will cause customers to continue to leave, and infrastructure will need replacement and improvement to protect public health. To fund these capital projects, rates will continue to rise in cities where affordability is already an acute concern. Faced with this trilemma, shrinking cities and the Commonwealth of Pennsylvania face choices about whether to continue business as usual or to adapt their approaches.

6.3 Policy and Financing Options

To successfully address the challenges raised by declining populations, municipalities and water systems must find additional help. Financial institutions, foundations, and associations can offer some assistance, but in the U.S., state governments *should* be the first line of support for towns and cities. However, municipalities and local governments do not always trust larger state or federal entities and are reluctant to cede their autonomy to these higher levels of government. Nonetheless, while city-state relationships are complex and vary depending upon location, all municipalities must lean on the state government eventually, and states have a vested interest in ensuring that municipalities keep their commitments despite financial shortcomings.

Different states use different financial and policy tools to support their municipalities, and some states have had more success at preventing financial issues in municipalities and municipal water authorities

than others. Pennsylvania's current toolset is not as robust as many of its neighbors, and the lack of trust between local and state government may make state level policies less effective. The forthcoming section will examine what current policies and practices have been adopted and implemented in Pennsylvania as well as how other states are using financial and policy tools to build financial stability of municipal water systems.

6.3.1 Pennsylvania's Current Approach

Finance: PENNVEST Policies

According to the EPA's "Sixth Drinking Water Infrastructure Needs Survey and Assessment," the largest quantity of funding needed in Pennsylvania is for distribution and transmission (U.S. EPA, 2018). The 20-year projected need (in January 2015 dollars) showed that $11.1 billion was reportedly needed in Pennsylvania to replace or refurbish aging or deteriorating pipelines, $2.79 billion to construct, expand, or rehabilitate infrastructure to reduce contamination, $617 million to construct, rehabilitate or cover water storage reservoirs, and $1.88 billion to construct or rehabilitate intake structures, wells and spring collectors (EPA Assessment, 2018). The state looks primarily to municipal bonds and the SRFs to fund the necessary infrastructure projects.

PENNVEST'S DWSRF benefits systems by providing lower interest loans and more flexible terms than municipal bonds. Additionally, PENNVEST can choose to distribute funding in the form of grants. However, to receive DWSRF assistance, the water system must demonstrate that it has the technical, managerial, and financial capability to ensure SDWA compliance (U.S. EPA, 2014), and the communities must participate in a formal Planning Consultation meeting. This meeting must include the community project sponsors, the engineer, PENNVEST and DEP staff, as well as local planning representatives (PENNVEST Information). These terms can be challenging, particularly for smaller systems. These systems may lack the resources to comply with SDWA or could be hampered by the inability to engage with all the necessary staff. Additionally, the lack of trust between local and state governments can also manifest drinking water systems being hesitant to partner with state programs.

Once a system decides to apply for funding, assistance from PENNVEST cannot total more than $11,000,000 per project, except for projects that serve more than one municipality, for which assistance can reach up to $20,000,000. However, the board of directors can vote to authorize loans in excess of $20,000,000 for comprehensive projects providing or proposing consolidation services to a region encompassing all or parts of four or more municipalities (Pennsylvania Infrastructure Investment Authority). Pennsylvania systems can use PENNVEST to fund expensive consolidation or regionalization projects with neighboring systems that serve multiple municipalities by purchasing systems or building interconnection infrastructure. It is not clear whether systems are taking advantage of this opportunity.

DWSRF "set-aside" funds can also be used to support planning and analysis needed for partnerships that may not involve physical consolidation, such as evaluating and developing shared billing or system managements (U.S. EPA, 2020). The 1996 SDWA Amendments required states to implement Capacity Development Programs. This program is known in Pennsylvania as the Capability Enhancement Program (CEP) and is designed to address technical, managerial, and financial burdens faced by the state's public drinking water systems (Governor's Report, 2017). DWSRF set-aside funds are used by Pennsylvania's

Department of Environmental Protection to implement the CEP. The CEP maintains databases on priority drinking water systems and provides additional funding for PENNVEST recipients.[7]

In 2019, 35.3% of total assistance provided by Pennsylvania's DWSRF went to disadvantaged communities (U.S. EPA, 2019). Disadvantaged communities are defined as having residential water rates higher than similar communities, particularly if rates are higher than 2% of MHI (State Revolving Fund Intended Use Plan). Additionally, if it is determined by PENNVEST that the water system does not have the financial capability to repay a loan, PENNVEST can determine that the applicant fits the definition of a disadvantaged system (Pennsylvania Infrastructure Investment Authority). This may result in even lower interest rates, or the decision to present the community with a grant in place of a loan.

Since 2014, any capital project funded by an SRF must use American Iron and Steel (AIS) for construction (U.S. EPA, 2020). This requirement increases the cost of capital projects and may offset some of the cost savings from a low-interest PENNVEST loan. Compliance with the AIS provision must also be documented throughout the construction process, a small but not insignificant extra hurdle for low-interest financing. Though the EPA provides guidance on AIS compliance, the responsibility is ultimately on the award recipient (U.S. EPA, 2020). The other large cost associated with an SRF financed project is paying the prevailing wage rate, often called Davis-Bacon wages (Congressional Research Service, 2008). Davis-Bacon wages are estimated to increase labor costs by nearly 20%, but studies differ on the impact on the total contract cost. Some studies even estimate that total contract cost does not increase and is offset by higher efficiency and more skilled labor (Mahalia, 2008). The perception of higher project costs and the reality of compliance documentation hurdles may together contribute to the underutilization of PENNVEST funding and should be addressed by PENNVEST.

The 16 Struggling Systems in this report have issued a total of $457 million in bonds for capital projects that could have been funded by PENNVEST awards instead (Figure 5-6). If these bonds had instead been low-interest PENNVEST awards, the difference in interest rates could have saved the customers of these Struggling Systems up to $90 million dollars, depending on AIS and prevailing wage compliance costs. Beyond the hurdles mentioned above, it is unclear why PENNVEST financing is not fully utilized for capital projects. Due to the additional requirements attached to PENNVEST funding and logistical difficulties in applying, some cities may find it easier to simply issue familiar bonds, even if they are higher cost. There may also be a stigma attached to approaching the state government for help.

Policy: Pennsylvania Utility Management

In addition to PENNVEST, Pennsylvania uses three of the policy tools categorized by the EPA to build drinking water capacity: 1) emergency planning; 2) development or operator certification programs; and

[7] For example, water system partnership funding under the CEP was provided to Hazleton, Pennsylvania. The Village of Stockton in Hazle Township was Pennsylvania's top violator of federal and state drinking water laws due to an unfiltered water system (Office of Ground Water and Drinking Water, 2017). Hazleton City Authority received federal assistance in the form of a $2.2 million grant to connect the Village of Stockton with potable water, and Stockton's existing water system was abandoned (Approved Projects).

3) state legislation or statute. Our findings suggest that these three types of tools are the least effective for promoting consolidation.

Emergency Planning: Pennsylvania utilities may voluntarily participate in the Pennsylvania Water and Wastewater Agency Response Network (PaWARN), a mutual aid agreement that allows utilities throughout the state to share personnel, resources, and equipment in the face of an emergency or disaster. Pennsylvania was a relatively early adopter of this program, the eleventh in the nation, starting in 2007. Currently, 44 utilities in the Commonwealth have signed up, covering 59% of the state's population ("WARN Regions").

Development or Operator Certification Program: Pennsylvania utilities can receive professional support with consolidation and regionalization planning through the Pennsylvania DWSRF's Capability Enhancement Program, and some DWSRF funds are set aside specifically for private engineering and legal consultants for small systems considering consolidation.

State Legislation or Statute: The Pennsylvania Utility Commission uses PENNVEST to create incentives for viable utilities to take over nonviable ones, including favorable interest rates and offsets of costs for the viable system. (U.S. EPA, 2015).

The Commonwealth also relies on Act 47 to support financially distressed cities. The act attempts to give more autonomy to cities than similar legislation in other states, by allowing cities to apply for state support in the form of logistical advice and planning. While there are some indicators that can identify a city as eligible for enrollment on the list, municipal governments or voters must request Act 47 support—the state cannot impose it externally. Act 47 has had mixed success, with only 15 of 31 cities successfully leaving the program, and certain cities having been on the list since its creation (Pew, 2013, updated information from Act 47 website). More recent amendments to Act 47, called Act 199, clarified the pathway to receivership or dissolution, but these conflict with other Pennsylvania laws and so are not used in practice (Anderson, 2017). As a result, Act 47 cannot be considered a takeover rule.

In recent years, the Commonwealth has also passed legislation that makes it more tempting for municipalities to sell their water systems to private companies. In 2016, Pennsylvania passed Act 12, which is intended to make it easier to sell struggling systems to private investors. Act 12 designates that investor-owned utilities can use a higher value for its newly acquired assets, based on either the negotiated price or fair market value, rather than the original price of the assets minus depreciation. This means that private companies can offer higher prices for struggling public systems and eventually set higher rates for customers. (Lewis, 2016). Advocates are concerned that this new law could mean that private companies will take over more public utilities, and charge higher rates (Lewis, 2016).

In some ways, Pennsylvania's various policies wind up cancelling out paths to consolidation. Emergency planning and operator sharing are crucial in times of crisis, but they are not meant to address a utility's long-term financial strength. While the CEP can give a system the resources needed to begin consolidation, it can also improve a utility's ability to continue operating on its own, and avoid merging with other systems. PENNVEST's efforts to incentivize consolidation are hampered by the fact that the fund itself is underutilized. Similarly, Act 47 is limited in its ability to support struggling municipalities because the state cannot step in preemptively, and Pennsylvania municipal-county structures prevent municipalities from dissolving when necessary. Laws like Act 12 increase the attractiveness of privatization and diminish the appeal of consolidation, thereby limiting the options available to cities.

Cities face the choice to maintain the status quo, sell their systems to private water companies, or consolidate or regionalize with other systems. Of these, consolidation may have the most promise to

address affordability, infrastructure, and financial strength at the same time. Each option brings with it unique benefits and challenges, and the state government and outside funders can play a crucial role in supporting cities as they attempt to move forward. Pennsylvania's state government is not using effective policies for consolidation and can improve outcomes for municipal systems by developing stronger ones or following the examples of other states.

6.3.2 Approaches Adopted by Other States

Finance: Leveraging of State Revolving Fund

One of the primary ways that other states increase the financial resources available to water systems is through "leveraging" – using federal SRF capitalization grants as security for bonds. The proceeds of these bonds are then re-deposited in the SRF (Environmental Financial Advisory Board [EFAB], 2008). State SRF programs lend the bond proceeds to communities to continue their development of wastewater and drinking water infrastructure. The use of bond proceeds permits the amount of loans or grants to exceed the amount of SRF equity. If a state leverages their SRFs, this creates additional funds available for drinking and wastewater infrastructure improvements.

The Environmental Financial Advisory Board (EFAB) reports that state programs that leverage their state revolving funds have provided greater assistance as a percentage of their capitalization grants than those that use the direct loan approach (EFAB, 2008). Currently, Pennsylvania's CWSRF and DWSRF are not being leveraged. This is a potentially large amount of funds not being utilized by Pennsylvania, though PENNVEST is currently funding every drinking water project that applies with available funds (R. Boos, personal communication, February 6, 2020). PENNVEST may not view the need to leverage their SRFs, despite many Struggling Systems using high-interest bonds for capital projects.

Since 1994, rating agencies have consistently granted top ratings to SRF bond issues. This indicates a low risk of missed payments or defaults (EFAB 2014). Furthermore, Fitch Ratings has assessed historical default rate on water and sewer loans to be only 0.04% (Arndt, 2016). The absence of defaults points to the safe nature of SRF investments. Under PENNVEST itself, only one system has ever defaulted since its inception at a modest amount of roughly $35,000 (Boos, 2020). Therefore, leveraging of funds remains a safe and viable options for Pennsylvania.

States, such as Pennsylvania, that do not leverage their federal capitalization grants, have effectively turned every $1 of federal money into $1.26 of DWSRF loans, while those states implementing "High Leverage" have turned every $1 into $2.91 of DWSRF loans (EFAB, 2008). This is a large amount of un-used money that PA could be accessing. For a leverage loan approach, the capacity of the SRF to make loans for qualifying projects will exceed the amount of the SRF's equity (EFAB, 2008). According to both the National Resources Defense Council and Bond Buyer, states are missing out on the opportunity to generate new funding for water systems by not using more innovative financing practices such as SRF leveraging (Moore, 2018 & Tumulty, 2018). Pennsylvania can look to its neighboring state of New York, which runs the nation's most active SRF program by implementing "High Leverage" of DWSRF funds (Vedachalam & Geddes, 2016). However, Pennsylvania could also be more conservative while still leveraging its DWSRF, like Illinois, Maine, or New Jersey (EFAB, 2008).

Addressing Capacity Barriers: As stated earlier, one of the main reasons PENNVEST is underutilized appears to be the technical or managerial capacity of systems. Many systems simply cannot afford to

devote an employee full time to go through the intricacies of filing an application for a low-interest loan or grant from PENNVEST, even if they qualify, and so may issue bonds because they can simply repeat the process from the last time. Systems may also simply not know about the CEP or set-aside funds. Many states have the same challenge, and several have experimented with different solutions. The Texas Water Development Board has created the "CFO to Go" program, where the state agency contracts with accounting firms to provide certified public accountants to small systems facing budgetary or financial challenges (Texas Water Development Board, 2019). The accounting services and financial guidance are free to the systems that apply, and systems are under no obligation to use them. The program is in its pilot stage but may help mitigate the risks of limited human capital, scarce financial resources, or reporting issues. A similar program in Pennsylvania might increase small systems' ability to apply for PENNVEST funds while strengthening their long-term financial know-how, beyond the current CEP.

States also have partnered with third-party associations to help build capacity. Illinois and Florida have contracted with their state-level Rural Water Associations to create tools and checklists for systems looking to begin operator sharing, making the contracting process easier and fairer for all parties, and Texas contracts with the Texas Rural Water Association to provide consolidation assessments for systems (U.S. EPA, 2017). Several states, including Pennsylvania, participate in state-level WARNs (Water/ Wastewater Agency Response Networks), which are facilitated by the American Water Works Association at the national level, and allows systems to build up their emergency management capacity (U.S. EPA, 2017). Many small systems in Pennsylvania are part of the PaWARN network, demonstrating their trust in the organization and their fellow utilities ("WARN Regions.") PENNVEST might be able to leverage partnerships with these intermediary organizations to build trust and closer ties with smaller systems.

Policy: State-Level Intervention

The technical and financial capacity challenges above may also be addressed more structurally at the water system level through regionalization or consolidation with other drinking water systems. As previously mentioned, consolidation and regionalization can result in physical interconnection, but they also can facilitate sharing resources, developing regional partnerships, and pooling technical expertise (ASWA & EFC, 2019). Consolidating water systems often results in greater economies of scale, and with improved resource sharing potential (ASWA & EFC, 2019).

Our findings suggest that the three most effective policy types for increasing the rates of consolidation are takeover rules, regional planning, and funding mechanisms, with takeover rules having the greatest effect. This is not particularly surprising. Funding mechanisms beyond State Revolving Funds are the traditional "carrots" and can be used to incentivize consolidation activity, or support communities facing affordability or quality challenges. Takeover rules are the "sticks" and add a level of threat and accountability that may force public systems that have been on the fence to finally deactivate and consolidate. Takeover rules also provide failing systems with an option of last resort, so that they have a backstop that keeps them from simply continuing to deliver undrinkable or unaffordable water. However, states may be reluctant to implement a takeover rule, as the process transfers power from local governments to the state. Regional planning allows struggling systems to have a natural partner for consolidation.

In our analysis, state legislation or statutes led to practically no change in consolidation rates, likely because they create incentives within existing SRF structures, and if the SRF is underutilized to begin with, additional consolidation incentives may have no effect. Enforcement programs that encompass takeover

rules *and* forced interconnections create a small decrease in consolidation rates—likely because state-ordered interconnections prop up struggling systems that would otherwise consolidate.

These results make a strong case for policies that promote accountability and supportive networks, rather than incentives. Pennsylvania relies on relatively weak incentives, while other states have more aggressive interventionist polices, including both comprehensive regional planning and aggressive takeover rules. Furthermore, other cities across the country are currently experimenting with new infrastructure planning approaches, which may have applications for Pennsylvania.

Takeover Rules: North Carolina's Local Government Commission has been successful in preventing municipal financial crises. The Commission was created in response to the Great Depression and keeps a consistent and close watch on the finances of municipalities. When a municipality shows warning signs or is not able to address its own financial distress, the Commission can and does step in immediately and take over the financial operation of the city (Pew, 2013). No North Carolina municipality has defaulted on an obligation bond in the nearly 80 years since the Commission was established, resulting in the highest possible bond rating for all state municipalities, despite shrinking populations in most counties (Pew, 2013). Recently, the state was able to intervene quickly in the town of Eureka, preventing the town from defaulting on its sewage bills, and creating financial crises in the two nearby cities which supply its water and treat its sewage (Long, 2019).

Regional Planning: Kentucky was one of the earliest states to adopt a consolidation strategy and has successfully exhibited some of the most innovative solutions, using regional planning as its main tool. In 1999, Kentucky developed a strategic water resource development plan, creating Area Water Management Councils within each of its Area Development Districts. Each Area Development District encompass multiple counties. Since the creation of the plan and the specific water regions, the number of public water systems in the state has gone from approximately 700 to 400, as smaller systems consolidate with larger ones (US EPA, 2017). Regional planning like Kentucky's can also facilitate the strengthening of other tools. For instance, if a system is forced to consolidate or dissolve, having a pre-existing Regional Plan greatly reduces the work needed to complete the process.

Municipal Planning: In addition to regional planning, comprehensive and innovative municipal planning is happening in struggling cities across the country. "Rightsizing" is a planning approach being undertaken specifically within shrinking cities. Rightsizing is still more of a theory and refers to a yet-proven process of bringing cities down to some "correct" size. This refers to a size that is proportionate to the city government's ability to pay for itself (Hummel, 2015). There exists potential for rightsizing to occur in shrinking cities, but it has not yet been documented in Pennsylvania. The five main cities experimenting with rightsizing within the United States are in Ohio (Youngstown and Cleveland), Michigan (Detroit and Flint), and New York (Buffalo). These five cities all have declining populations, post-industrial sites, with expensive infrastructure systems and a lack of municipal financial resources to pay for social services. These cities have all experimented with elements of rightsizing in different ways and to different extents. The main aspects of rightsizing include building demolitions, service consolidation, urban green initiatives, and the provision of incentives for residents to move out of abandoned or degraded areas. This last aspect primarily involves the reduction or removal of public services, which functions to force residents out of such neighborhoods.

Many cities, particularly in our focus state of Pennsylvania, were built for populations that were double or triple what they are now. These cities now have an unmanageable and expensive system of streets,

public building, parks, housing, and most importantly to this discussion, sewer and drinking water infrastructure (Hummel, 2015). Erie, Pennsylvania is one of the few Pennsylvania cities to have begun embarking on a process of rightsizing. Although the population of Erie was too large to be included in this analysis (>100,000 residents), the city's population has also declined by almost 30% since its peak. In order to combat its declining populations, increase in crime, and decrease in tax revenue, Erie created its own Comprehensive Plan to address their issues (McDevitt, 2015). Under the Pennsylvania Municipalities Planning Code, state counties are required to come up with comprehensive plans, but city planners highly recommend them for municipalities as well (McDevitt, 2015). In the case of shrinking cities, municipalities and utilities would benefit from a set of plans that could include options for public private partnerships, organized demolitions, downtown reinvestments, and redistribution of public services (Rink, 2016).

Rightsizing can disproportionately affect disadvantaged communities, many of which have protested rightsizing efforts, particularly in Detroit (Kiertzner, 2016). If rightsizing is to be attempted in shrinking cities going forward, there is a need for community engagement and inclusion for it to be successful and equitable (Hummel, 2015).

7 Recommendations

Given our analysis of the 16 Struggling Systems, Pennsylvania's current policy approaches, and effective practices elsewhere, we end with five recommendations the Commonwealth of Pennsylvania, investors, and struggling water systems should consider.

7.1 New Rate Structures and Customer Assistance Programs (CAPs)

PENNVEST and other financing institutions should require alternative rate structures or implementation of a Customer Assistance Program in exchange for low interest capital where affordability is an issue. If water systems are to finance replacements and maintenance of aging infrastructure as well as meet ever stricter regulations, their rates will continue to increase. Some systems, such as our Focus Systems of Altoona, Johnstown, and Reading, do not have the capacity to continue to raise their rates, as their household burden on customers is already high. Though rates must increase to match these rising costs, funders should consider requiring implementation of a customer assistance program when disbursing low interest capital. Water systems should also look to the examples set in Philadelphia and Baltimore to determine whether setting alternative rate structures to provide affordable water services is viable, as alternative rate structures can address affordability more directly than CAPs. The difference between the PENNVEST interest rates and the higher market interest rates would allow a water system to forego the extra revenue from increased rates for their lowest income customers.

As an example, the Reading Area Water Authority has used both bonds and PENNVEST loans to fund capital projects. If the all the system's bonds used for capital projects since 1997 were instead supplied by PENNVEST at typical PENNVEST interest rates, Reading could have saved up to $28 million. Used to lower rates for the lowest quintile of households, each household could have saved 40% on their water bills over the last 20 years, reducing the system's HBI from 4.2 % to 2.5%.

7.2 PENNVEST Leveraging

PENNVEST should leverage its capital to increase the number and size of low interest loans and grants available to drinking water systems. Though all current applications have been funded, indicating a lack of demand for PENNVEST loans, many water systems use more expensive debt to fund PENNVEST eligible capital projects. Increasing the availability of low interest capital to drinking water utilities will be

necessary to address the infrastructure condition of struggling utilities under ever stricter regulations. Only one small loan has defaulted in the history of PENNVEST, indicating the safe ability to leverage at a low level and still substantially increase funding to water systems. Leveraging of the SRF could also allow more funding to be given out as grants, instead of loans, to disadvantaged systems.

7.3 Reduce Barriers to Access SRF Financing

PENNVEST should work with small-system partners to understand why few are applying for funding and then provide resources to help systems overcome the barriers they identify. PENNVEST can only use leveraging successfully if more water systems start applying for increased funding. There are many possible reasons why water systems are financing capital with higher interest debt, so PENNVEST should begin by conducting outreach and public education events with small systems. To address potential state-municipality relationship issues, they could partner with trusted intermediary organizations like the Pennsylvania Rural Water Association, the Rural Community Assistance Partnership, or the PaWARN network to build trust and responsiveness within small systems. PENNVEST may also consider sending out brief surveys to utilities once it has a qualitative understanding of the issues and close enough relationships to ensure a decent response rate. Based on the responses from small systems, PENNVEST should make improvements to the CEP, develop programs that encourage small systems to apply for funding, particularly for uses or projects that are able to be funded under PENNVEST set-asides, and provide education and tangible resources like personnel to help systems apply.

7.4 Comprehensive Regional Planning

The Commonwealth or an outside funder should engage in water infrastructure planning at the regional level and require water infrastructure and urban planning at the municipal and county level. Creating regions larger than counties but smaller than states would strengthen partnerships between neighboring water systems and increase resource-sharing potential in the region. It would also allow for easier consolidation of water systems. Creating a regional system has improved outcomes for Kentucky, as well as other states like North Dakota. Pennsylvania law currently makes it very difficult for small and struggling systems to find partners when they seek to consolidate. Creating a network of regional authorities would provide these systems with a clear first choice and an easier path to consolidation. The power granted to regional authorities can be limited without interfering with their ability to deliver the service of consolidation and regionalization.

Shrinking cities themselves would benefit from creating comprehensive plans outlining steps the city government can take to improve their city. These plans should be created in partnership with communities and address priorities identified by residents. Plans should focus on establishing equity and sustainability by maintaining public engagement throughout the planning process, ensuring affordable housing options, and creating community-supported green infrastructure projects and accessible public spaces. City and regional planners can also control and correct the abandonment and decline of city centers and introduce elements of “rightsizing,” whether by demolitions of abandoned blocks, consolidations of city services, urban green initiatives, or equitable incentives encouraging residents to move out of abandoned areas. The Commonwealth or an outside funder could promote these steps by making funding conditional on the implementation of a plan, and by offering technical support for systems that lack their own planning capacity.

7.5 Mandated Backstops

The Commonwealth or an outside institution should require that any system receiving government-subsidized funding have an identified "backstop" or receiver if the system is no longer solvent or compliant. The Commonwealth could pass legislation to formally delineate when a water system would be taken over or placed under receivership. Our findings show that doing so increases the amounts of consolidation. However, the creation of an explicit takeover rule is likely to face strong political opposition from local governments and would likely take several rounds of negotiation. Alternatively, legislators could adapt the receivership process from Act 47 or 199 specifically to water utilities, setting clear criteria for what constitutes a recovering utility, and at the outset, setting state-mandated consolidation or receivership as the consequence if those criteria are not met. Since water utility boundaries are more flexible than those of municipalities, the process could work more easily than it currently does.

Private funders can achieve some of the same results of a takeover rule even if the state declines to create a de jure one. A funder can set conditions of investment or a low-interest loan where the recipient must outline specific holistic system goals to ensure its continued health, complete a detailed plan for reaching those goals, and designate a pre-arranged backstop or receiver if it fails to do so.

8 References

Altoona Water Authority (2017). *AWA Capital Infrastructure Renewal Fee*. Retrieved from https://www.altoonawater.com/project/capital-infrastructure-renewal-fee

American Society of Civil Engineers (2018). Report Card for Pennsylvania's Infrastructure. *Pennsylvania State Council of the American Society of Civil Engineers.* https://www.infrastructurereportcard.org/state-item/pennsylvania/

American Water Works Association (n.d.). *WARN Regions*. Retrieved January 3, 2020 from https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Wastewater-Agency-Response-Network/WARN-Regions#7600426-region-3

Anderson, M.W. (2014). The New Minimal Cities. *Yale Law Journal*. *123*(5). Retrieved October 30, 2019, from https://www.yalelawjournal.org/article/the-new-minimal-cities

Anderson, M. W. (2017). Losing the War of Attrition: Mobility, Chronic Decline, and Infrastructure. *The Yale Law Journal Forum*, 127, 522-542. Retrieved from: http://www.yalelawjournal.org/forum/losing-the-war-of-attrition

Anderson, M.W. (2015). Who Needs Local Government Anyway: Dissolution in Pennsylvania's Distressed Cities. *Widener Law Journal* 24(1) 149-ii.

Andrews, A., Harkins, A., Eskaf, S. & Nida, C. (2017). Water and Wastewater Rates and Rate Structures in North Carolina. *NC League of Municipalities* and *UNC Environmental Finance Center.* Retrieved April 9, 2020 from https://efc.sog.unc.edu/sites/default/files/2017/NCLM_EFC_Annual_Rates_Report_2017.pdf

Arndt, A. (2016). *The Federal role in keeping water and wastewater affordable.* Presented before the Senate Committee on Environment and Public Works on April 7, 2016. Retrieved January 29, 2020, from https://www.epw.senate.gov/public/_cache/files/e/1/e128a828-3758-49a4-901c-2ebc37ed3465/D24EBB522FC7F4A2F3C31A978BFE4DC2.arndt-testimony.pdf

Baltimore City Department of Public Works (2019, Aug 6). *Baltimore Water Affordability Programs*. Retrieved from https://publicworks.baltimorecity.gov/Baltimore%20Water%20Affordability%20Programs

Bartlett, S., Cisneros, H., Decker, P., Heartwell, G., Warnock, A., Nellenbach, M., Kline, S., Winkler, A., Varn, J., & Campanelli, B. (2019). *Executive Council on Infrastructure Water Task Force*. 52.

Boles, S. (2019). *First These Kentuckians Couldn't Drink The Water. Now They Can't Afford It.* National Public Radio. Retrieved November 1, 2019, from NPR.org website: https://www.npr.org/2019/10/31/772677717/first-these-kentuckians-couldnt-drink-the-water-now-they-can-t-afford-it

Boos, R. (2020), Personal Communication, February 6, 2020

Congressional Research Service. (2008). *Davis-Bacon Act Coverage and the State Revolving Fund Program Under the Clean Water Act.* (2008, March 26). Retrieved from https://www.everycrsreport.com/files/20080326_RL31491_2ba69c2753e10b6fad1439fdac3fd92afe6abc69.pdf

City of Reading, Pennsylvania (2020). *History of Reading, PA*. Retrieved March 2, 2020, from https://www.readingpa.gov/content/history-reading

Department of Environmental Protection (n.d.). *State Revolving Fund Intended Use Plan*. Retrieved January 15, 2020, from https://www.dep.pa.gov:443/Business/Water/CleanWater/InfrastructureFinance/Pages/State-Revolving-Fund.aspx

EMMA Pennsylvania Municipal Securities. *Municipal Securities Rulemaking Board*. Retrieved February 16, 2020, from https://emma.msrb.org/IssuerHomePage/State?state=PA

Environmental Finance Center [EFC] (2020), Water Rates Utility Dashboard. Retrieved from https://efc.sog.unc.edu/library-item-classification/dashboard

Environmental Financial Advisory Board [EFAB] (2008, August 28). *EFAB Report: Relative Benefits of Direct and Leveraged Loans in State Revolving Loan Fund Programs*. National Service Center for Environmental Publications (NSCEP). Retrieved from https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100AA7K.txt

Environmental Financial Advisory Board (2014). *Utilizing SRF Funding for Green Infrastructure Projects.* Retrieved January 29, 2020, from https://www.epa.gov/sites/production/files/2014-04/documents/efab_report_srf_funding_for_greeninfra_projects.pdf.

Eskaf, S. (2013, January 9). *Percent MHI as an Indicator of Affordability of Residential Rates: Using the U.S. Census Bureau's Median Household Income Data*. Retrieved February 20, 2019, from http://efc.web.unc.edu/2013/01/09/percent-mhi-indicator-ofaffordability-of-residential-rates-using-the-u-s-census-bureaus-median-householdincome-data/

Faust, K. M., Abraham, D. M., & McElmurry, S. P. (2016). *Water and Wastewater Infrastructure Management in Shrinking Cities*. Public Works Management & Policy, 21(2), 128–156. https://doi.org/10.1177/1087724X15606737

Frederick, R. (2017). *Water as a Human Right: How Philadelphia Is Preventing Shut-Offs and Ensuring Affordability*. Retrieved October 14, 2019, from Center for American Progress website: https://www.americanprogress.org/issues/poverty/news/2017/11/08/441834/water-human-rightphiladelphia-preventing-shut-offs-ensuring-affordability/

Frostenson, S. (2017). *America has a water crisis no one is talking about.* Retrieved November 2, 2019, from *Vox* website: https://www.vox.com/science-and-health/2017/5/9/15183330/america-water-crisis-affordability-millions

Government Accountability Office. (2016). *Water Infrastructure: Information on Selected Midsize and Large Cities with Declining Populations*. Retrieved from https://www.gao.gov/products/gao-16-785

Governor's Report. (2017). Department of Environmental Protection. Retrieved February 10, 2020, from https://www.dep.pa.gov:443/Business/Water/BureauSafeDrinkingWater/CapabilityEnhancement/Pages/Governor's-Report.aspx

Gregory, T., Reyes, C., O'Connell, P., & Caputo, A. (2017). Same Lake, Unequal Rates*: Why our water rates are surging-and why black and poor suburbs pay more.* Chicago Tribute Investigation: The Water Drain, 1–30. Retrieved October 30, 2019, from http://graphics.chicagotribune.com/news/lake-michigan-drinking-water-rates/index.html

Hummel, D. (2015). *Right-Sizing Cities: A Look at Five Cities*. Public Budgeting & Finance, 35(2), 1–18. https://doi.org/10.1111/pbaf.12056

Kane, J. (2016). Investing in water: *Comparing utility finances and economic concerns across U.S. cities.* Brookings Institute. Retrieved February 12, 2020 from https://www.brookings.edu/research/investing-in-water-comparing-utility-finances-and-economic-concerns-across-u-s-cities/

Kiertzner, J. (2016). *Several Detroit pastors planning protests over expensive sewer fees.* WXYZ Detroit. Retrieved February 22, 2020, from https://www.wxyz.com/news/region/detroit/several-detroit-pastors-planning-protests-over-expensive-sewer-fees

Lewis, C. (May 2016). *New PA Law Gives Boost to Investor-Owned Acquisitions of Municipal Water and Wastewater Systems*. BlankRome. https://www.blankrome.com/publications/new-pa-law-gives-boost-investor-owned-acquisitions-municipal-water-and-wastewater

Long, T. (September 15, 2019) *With Town of Eureka Drowning in Sewage Bills, State Takes Control.* News & Observer. https://www.newsobserver.com/news/politics-government/article233635952.html

Malone, C. (2016). *One Pennsylvania County Sees The Future, And Not Everyone Likes It*. FiveThirtyEight. https://fivethirtyeight.com/features/one-pennsylvania-county-sees-the-future-and-not-everyone-likes-it/

Manson S., Schroeder J., Van Riper D., and Ruggles S.. IPUMS National Historical Geographic Information System: Version 14.0 [Database]. Minneapolis, MN: IPUMS. 2019. https://urldefense.proofpoint.com/v2/url?u=http-3A__doi.org_10.18128_D050.V14.0&d=DwICaQ&c=imBPVzF25OnBgGmVOlcsiEgHoG1i6YHLR0Sj_gZ4adc&r=K2aU4rtqZVWhHWXXmjBRNujJxqUJ1Uty3I02V7h9VtI&m=JxKPvkwqwzNfGbla1OnLAMCJuRHkoWd6x3BdaSOuwT8&s=7nMbAKN0yLTXELchHGYMH0LneN7-YIaqvUXh2g734cw&e=

McDevitt, R. (2015). *In Erie's big plan, it's a matter of rightsizing.* WHYY. Retrieved February 22, 2020, from https://whyy.org/articles/in-eries-big-plan-its-a-matter-of-rightsizing/

Moody's, *Moody's new rating methodology for regulated water utilities*, December, 2009. https://www.moodys.com/research/Moodys-new-rating-methodology-for-regulated-water-utilities--PR_191994

Moore, R. (2018). *States Need to Go Back to the Well and Leverage SRF Dollars*. NRDC. Retrieved January 16, 2020, from https://www.nrdc.org/experts/rob-moore/states-need-go-back-well-and-leverage-srf-dollars

Morel, D. (2018). *Takeover: Race, Education, and American Democracy.* Why Take Over?: State Centralization and the Conservative Education Logic. Oxford University Press. https://www-oxfordscholarship-com.proxy.lib.duke.edu/view/10.1093/oso/9780190678975.001.0001/oso-9780190678975-chapter-4

Office of Ground Water and Drinking Water (2017). *Drinking Water State Revolving Fund Eligibility Handbook*. 73.

Orange Water and Sewer Authority [OWASA] (2020). *Care to Share Customer Assistance Program*. Retrieved November 2, 2019, from https://www.owasa.org/help-my-neighbor/

Ozimek, A. & Fikri, K. (2019). *From managing decline to building the future: Could a heartland visa help struggling regions?* Economic Innovation Group. Retrieved from https://eig.org/wp-content/uploads/2019/04/Heartland-Visas-Report.pdf

Pennsylvania Code—Title 25 Environmental Protection. (n.d.). Retrieved January 15, 2020, from http://www.pacodeandbulletin.gov/Display/pacode?titleNumber=025&file=/secure/pacode/data/025/025toc.html&searchunitkeywords=&operator=OR&title=null

Pennsylvania Infrastructure Investment Authority [PENNVEST] (2014). *PA Infrastructure Investment Authority and PA Department of Environmental Protection: Drinking Water State Revolving Fund Intended Use Plan.* Retrieved January 28, 2020, from https://www.pennvest.pa.gov/migration/Documents/DW_IUP_2014_Final.pdf

PENNVEST (2020). *PA Department of Community & Economic Development*. Retrieved January 15, 2020, from https://dced.pa.gov/programs/pennsylvania-infrastructure-investment-authority-pennvest/

PENNVEST (2020). Retrieved January 15, 2020, from https://www.pennvest.pa.gov:443/Pages/default.aspx

PENNVEST (2020). *Commonwealth Funding.* Retrieved January 28, 2020, from https://www.pennvest.pa.gov/Information/Funding-Programs/Pages/Commonwealth-Funding.aspx

PENNVEST (2020). Approved Projects. Retrieved January 15, 2020, from https://www.pennvest.pa.gov:443/Information/Pages/Approved-Projects.aspx

Pennsylvania Report Card (2018). *ASCE's 2017 Infrastructure Report Card*. Retrieved January 16, 2020, from https://www.infrastructurereportcard.org/state-item/pennsylvania/

Pew Charitable Trusts (July 2013). *The State Role in Local Government Financial Distress*. https://www.pewtrusts.org/-/media/assets/2016/04/pew_state_role_in_local_government_financial_distress.pdf?la=en&hash=6EC45797B4FDBF08B4F7F1C9B16FF85A4F7D4C14

Pittsburgh Water and Sewer Authority Hardship Program (2020). *Dollar Energy*. Retrieved February 22, 2020, from https://www.dollarenergy.org/need-help/pennsylvania/pittsburgh-water-and-sewer-authority-hardship-program/

Puentes, R. & Sabol, P. (2014). *Why Isn't Cheap Debt Supporting More Infrastructure Investment?* Brookings Institute. https://www.brookings.edu/blog/the-avenue/2014/10/30/why-isnt-cheap-debt-supporting-more-infrastructure-investment/

Raucher, R., Clements, J., Rothstein, E., Mastracchio, J., & Green, Z. (2019). Developing a New Framework for Household Affordability and Financial Capability Assessment in the Water Sector. Retrieved December 11, 2019 from https://www.acwa-us.org/wp-content/uploads/2019/05/Developing-New-Framework-for-Affordability-Report-Final.pdf

Reading Area Water Authority (2020). *About Reading Area Water Authority*. Retrieved March 2, 2020, from https://www.readingareawater.com/about-us/

Recchie, J., Recchie, A., Powell, J.A., Lyons, L., Hardaway, P., Ake, W. (2019). *Water Equity and Security in Detroit's Water & Sewer District*. Haas Institute for a Fair and Inclusive Society, University of California, Berkeley: Berkeley, CA. Retrieved April 16, 2020 from https://belonging.berkeley.edu/detroitwaterequity

Rose, A. (February, 20, 2019). *Aqua once again mulling 'options' in Chester Water Authority deal*. Delaware County Daily Times. Retrieved February 19, 2020 from https://www.delcotimes.com/news/aqua-once-again-mulling-options-in-chester-water-authority-deal/article_aa15f38a-348e-11e9-8179-87b60f84ed5f.html

Stebbens, S. (2019). *America's fastest shrinking cities often have unemployment, crime as concerns*. USA Today. Retrieved February 1, 2020 from https://www.usatoday.com/story/money/2019/05/05/americas-fastest-shrinking-cities-face-unemployment-crime-issues/39436365/

Sutor, D. (2018). Tilting at windmills: Water authority mulls ways to generate $20M for upgrades | News. *The Tribune Democrat*. Retrieved February 16, 2020, from https://www.tribdem.com/news/tilting-at-windmills-water-authority-mulls-ways-to-generate-m/article_8b8000c8-ff5a-11e8-a32f-b3e516b26130.html

Switzer, D. "Introducing a New Measure of Residential Water Rate Progressivity." *AWWA Water Science* 1, no. 2 (March 2019): e1132. https://doi.org/10.1002/aws2.1132.

Teodoro, M. P. (2010). *The institutional politics of water conservation*. Journal - AWWA, 102(2), 98–111. Retrieved from https://doi.org/10.1002/j.1551-8833.2010.tb10055.x

Teodoro, M. (2018). *Measuring Household Affordability for Water and Sewer Utilities.* Journal - American Water Works Association, 110(1), 13–24. https://doi.org/10.5942/jawwa.2018.110.0002

Teodoro, M. (2019, June 27). *Grow to Shrink, Shrink to Grow*. Blog post referencing multiple studies by the author. Retrieved November 1, 2019, from http://mannyteodoro.com/?p=1050

Teodoro, M. (2020, April 5). *Two cheers...or maybe just one.* Blog post referencing multiple studies by the author. Retrieved April 15, 2020, from http://mannyteodoro.com/?cat=35

Texas Water Development Board (2019). Personal Interview. September 18, 2019

Tiger, M. (2013). *More than Meets the Metric: Credit Rating Considerations for Water Utilities.* Environmental Finance Center. http://efc.web.unc.edu/2013/11/26/more-than-meets-the-metric-credit-rating-considerations-for-water-utilities/

Tiemann, M. (2018). *Drinking Water State Revolving Fund (DWSRF): Overview, Issues, and Legislation*. 25. Congressional Research Service-Federation of American Scientists. Retrieved from https://fas.org/sgp/crs/misc/R45304.pdf

Tumulty, B. (2018). *Why states should issue bonds to leverage more funds for SRF programs | Bond Buyer*. Retrieved January 16, 2020, from https://www.bondbuyer.com/news/why-states-should-issue-bonds-to-leverage-more-funds-for-srf-programs

U.S. Census Bureau (2019). *QuickFacts: Johnstown City, Pennsylvania*. Retrieved February 20, 2020, from https://www.census.gov/quickfacts/altoonacitypennsylvania

U.S. Census Bureau (2019). *QuickFacts: Altoona City, Pennsylvania*. Retrieved February 16, 2020, from https://www.census.gov/quickfacts/altoonacitypennsylvania

U.S. Census Bureau (2019). *QuickFacts: Raleigh, North Carolina*. Retrieved April 20, 2020, from https://www.census.gov/quickfacts/raleighcitynorthcarolina

U.S. Census Bureau (2019). *QuickFacts: Reading City, Pennsylvania*. Retrieved February 20, 2020, from https://www.census.gov/quickfacts/readingcitypennsylvania

U.S. Department of Health and Human Services (2015). *Poverty Guidelines*. Office of the Assistant Secretary for Planning and Evaluation. Retrieved November 2, 2019, from https://aspe.hhs.gov/poverty-guidelines

U.S. Environmental Protection Agency [U.S. EPA] (2015, September 24). *Drinking Water State Revolving Fund Program Information for the State of Pennsylvania* [Data and Tools]. Retrieved from https://www.epa.gov/dwsrf/drinking-water-state-revolving-fund-program-information-state-pennsylvania

U.S. EPA (2017, June 13). *DWSRF Eligibility Handbook* [Policies and Guidance]. Retrieved from https://www.epa.gov/dwsrf/dwsrf-eligibility-handbook

U.S. EPA (2017, June 29). *Building the Capacity of Drinking Water Systems: Kentucky.* [Overviews and Factsheets]. Retrieved from https://www.epa.gov/dwcapacity/kentucky

U.S. EPA (2017, August). *Water System Partnerships: State Programs and Policies Supporting Cooperative Approaches For Drinking Water Systems.* Retrieved from https://www.epa.gov/sites/production/files/2017-08/documents/water_system_partnerships_guide_0.pdf

U.S. EPA (2018, October 31). *WIFIA FY 2018 Selected Projects—Summary Factsheets* [Overviews and Factsheets]. Retrieved from https://www.epa.gov/wifia/wifia-fy-2018-selected-projects-summary-factsheets

U.S. EPA (2018). *EPA's 6th Drinking Water Infrastructure Needs Survey and Assessment | Drinking Water State Revolving Fund (DWSRF).* Retrieved January 15, 2020, from https://www.epa.gov/dwsrf/epas-6th-drinking-water-infrastructure-needs-survey-and-assessment

U.S. EPA (2020). *How the Drinking Water State Revolving Fund Works*. Retrieved April 19, 2020, from https://www.epa.gov/dwsrf/how-drinking-water-state-revolving-fund-works

U.S. EPA (2020). *Safe Drinking Water Act Resources and FAQs*. Enforcement and Compliance History Online. Retrieved from https://echo.epa.gov/help/sdwa-faqs

U.S. EPA (n.d.). Civil Cases and Settlements by Statute. Retrieved February 23, 2020, from https://cfpub.epa.gov/enforcement/cases/index.cfm?templatePage=12&ID=3&sortby=&stat=Clean Water Act

U.S. EPA (n.d.). *Information about Public Water Systems*. [Overviews and Factsheets]. Retrieved from https://www.epa.gov/dwreginfo/information-about-public-water-systems

USWA & EFC (2019). *Strengthening Utilities Through Consolidation: The Financial Impact.* US Water Alliance and UNC Environmental Finance Center. Retrieved April 10, 2020 from *http://uswateralliance.org/sites/uswateralliance.org/files/publications/Final_Utility%20Consolidation%20Financial%20Impact%20Report_022019.pdf*.

Van Abs, D. J., & Evans, T. *Assessing the Affordability of Water and Sewer Utility Costs in New Jersey.* Jersey Water Works. Final Report: September 2018. Retrieved from: https://www.jerseywaterworks.org/wp-content/uploads/2018/09/Van-Abs-and-Evans-2018.09.09-Assessing-Water-Sewer-Utility-Costs.pdf

Vedachalam, S., and Geddes, R. (2016). *The Water Infrastructure and Finance Innovation Act of 2014: Structure and Effects.* Johns Hopkins Water Institute & Department of Policy Analysis and Management at Cornell University.

Voelz, S. (2009). Moody's: new rating methodology for regulated water utilities. Moody's. Retrieved April, 2020 from https://www.moodys.com/research/Moodys-new-rating-methodology-for-regulated-water-utilities--PR_191994

Walton, B. (2017, May). Philadelphia Water Rate Links Payments to Household Income. *Circle of Blue*. https://www.circleofblue.org/2017/water-management/pricing/philadelphia-water-rate-links-payments-household-income/

Walton, B. (2017, August). When It Comes To Water Service How Expensive Is Too Expensive? *WaterNews – Circle of Blue*. Retrieved February 20, 2019, from https://www.circleofblue.org/2017/water-management/comes-water-service-expensiveexpensive/

Walton, B. (2019, November). Baltimore Council Approves Income-Based Water Bills. *Circle of Blue*. https://www.circleofblue.org/2019/world/baltimore-council-approves-income-based-water-bills/

Water Rates: Water Affordability (2013). Need to Know. *Pacific Institute.* Retrieved October 23, 2019, from https://pacinst.org/wp-content/uploads/2013/01/water-rates-affordability.pdf

Wikipedia contributors. (2020, March 1). *Bond insurance*. In Wikipedia, The Free Encyclopedia. Retrieved April 16, 2020, from https://en.wikipedia.org/w/index.php?title=Bond_insurance&oldid=943283541

World Population Review (2020). *World Population Review.* Retrieved April 21, 2020, from https://worldpopulationreview.com/

World Population Review (2020). *Cities in the United States by Population.* Retrieved February 16, 2020, from http://worldpopulationreview.com/us-cities/

9 Appendices

9.1 Study Limitations

One major difference between states which could directly impact the effectiveness of different policies is their approach to municipal control. This is often summarized as "home rule." In "home rule states," municipalities that choose to issue their own charters are given more freedom to raise taxes and manage their own finances. In states that have not explicitly declared home rule, the state is the ultimate authority on municipal actions like negotiating public pensions or mandating that all residential water customers must pay the same rate, regardless of income. Most states are not home rule states, and so technically qualify as "Dillon's rule" states, named for the federal precedent which spells out that cities are beholden to the state. North Carolina, Pennsylvania, and Kentucky are all not home rule states, but they all apply Dillon's rule differently depending on whether they are working with cities or counties (Richardson, 2003). It is possible then that different regional attitudes shape how comfortable institutions are with close oversight of municipal affairs and how likely they are to engage with statewide programs.

States also intervene in municipal affairs for political rather than pragmatic reasons. For example, there is evidence that states that do not apply a uniform rationale for taking over school districts. Morel (2018) finds that the only significant indicators that states will take over a municipal school district are the number of Black city council members and the poverty level of the school district. Performance metrics like test scores, attendance, and graduation rates do not significantly indicate that the state will take over. The state of Michigan may have used similar biases when it selectively chose to install emergency managers in Flint and Detroit, creating water crises in both cities (Recchie, 2019). When looking at state policies which force specific actions on municipalities like emergency managers or mandatory consolidation, it is important to consider the role politics plays in how selectively those policies are enforced.

It is nearly impossible to conclusively show that a certain policy on its own is responsible for changing rates in consolidation. Most states implement several policies over the course of the years, and our analysis does not consider how different policy types work together. However, studying changes in deactivation correlated to policy changes for every state helps to normalize factors unique to the individual states and at least suggests which general types of policies are effective.

As suggested earlier, Pennsylvania's Act 47 has come under considerable scrutiny and attempts to amend it. An additional set of amendments known as Act 199 passed in 2014 and outlines the process for how municipalities may choose or be forced to dissolve. Act 199 refined the Act 47 process to only last for five years, and to only end in one of five outcomes:

1. A municipality exits the Act 47 list because it has entered financial recovery
2. The municipality volunteers to disincorporate
3. The municipality declares a fiscal emergency and is placed in a receivership
4. Create a three-year exit plan
5. Declare bankruptcy and enter state receivership (Anderson, 2015)

Unfortunately, the option of municipal dissolution seems to have been a non-starter. Anderson (171) points out that dissolution/disincorporation is a valuable tool, but Pennsylvania's administrative setup makes it impossible for the tool to work. Unlike other states, Pennsylvania cities that dissolve do not have a unit to automatically dissolve *into*. Unincorporated communities do not fall under the management of

the counties that surround them, and unless a city finds another community to combine with, there is no possibility to merge into something larger.

Pennsylvania's political history and culture make it unlikely that a new aggressive takeover rule would pass. Similar attempts have failed, like HB 2431, which tried to eliminate 2,500+ small local governments and set up the county as the administrative unit (Anderson 162). Pennsylvania historically is reluctant to give control to the state, which is part of why Act 47 is weaker than its analogues, and the commonwealth's funding is already spread thin. However, merging water systems is less controversial. Water systems are not subject to the same constraints as municipalities, and funders for water utilities can set conditional grant making.

9.1.1 Rate Structures

There are five main basic types of water rate structures (Switzer, 2019). Flat rates charge all customers the same price, regardless of water consumed. Uniform rates charge all customers the same price per unit of water. Decreasing block rates charge higher prices per unit for lower volume users. Increasing block rates, also known as progressive rates, charge higher prices per unit as consumption increases. Any of these rate structures can be supplemented by seasonal rates that charge higher prices during times of high demand or low supply (Teodoro, 2010). Seasonal and increasing block rates are typically associated with water conservation, i.e., using price signals to reduce water use.

There was a recent proposed $1.5 billion in water assistance that followed the COVID-19 crisis and is modeled after LIHEAP (Walton, 2020). LIHEAP is a federal aid program for domestic energy bills and has been established for almost four decades. To date, there has been no water bill equivalent. In order to have been eligible, households must be below 150% of the FPL or must include those have been laid off, furloughed, or have lost their main income since February 29, 2020 (Walton, 2020). As of the end of March, this assistance has not yet been approved. While this aid would clearly be better than nothing, barriers remain to this sort of aid program or to any sort of similar CAP (Teodoro, 2020). This type of assistance program is expensive to administer and burdensome for customers to receive. LIHEAP itself has only reached about 16% of eligible households, leaving more than 80% of needy households without assistance.

9.2 Other Policy Options

9.2.1 Future Funding Needs

According to the EPA, the total amount of project funding needed in Pennsylvania for the next twenty years (beginning in 2015) is $16.77 billion (EPA Assessment, 2018). While there are other options for funding such as municipal bonds, WIFIA, WIIN, etc., it is clear that there is not enough funding coming from Pennsylvania's DWSRF to cover necessary drinking water infrastructure needs (Table 10-1). If the annual DWSRF assistance is averaged from 1998 to the present ($51.3 million/year), there remains a deficit of roughly $16 billion from now until 2035 (US EPA, 2015). The $16.77 billion deficit value was calculated by the EPA from 2015-2035, so the deficit was re-calculated by subtracting the assistance that has already been provided from 2016-2019. Since annual assistance is only in the millions of dollars, the deficit of funding from 2020-2035 is still calculated at roughly $16 billion. Even when the assistance that has been provided from 2016-present, the deficit remains. Assistance from the DWSRF is thus contributing a tiny percentage of total assistance needed by drinking water systems.

Table 10-1. The total deficit of funds faced by PA water utilities using the estimated over $16 billion need provided by the EPA (EPA Assessment 2018). Total SRF Assistance provided by the EPA (2019).

AVERAGE ANNUAL DWSRF ASSISTANCE PROVIDED	**$51,294,311**
Total DWSRF Assistance Estimated (present-2025)	$768,414,677
Total PA Estimated Need (2015-2035)	$167,000,00
Annual Estimated Need (total/20 years)	$8,350,000
Less Assistance Provided So Far (2016-2019)	$166,878,986
Deficit	$16,610,957,132

Similarly, the American Society of Civil Engineers (ASCE) states that the drinking water gap over the next 10 years is roughly $10.2 billion, with PENNVEST only expected to provide $800 million over the same time period (Pennsylvania Report Card, 2018). Projected out to 2035, the gap calculated by ASCE grows to $15-16 billion. Even after adding additional funding from organizations such as the U.S. Department of Agriculture, U.S. Department of Housing and Urban Development Community Development Block Grants, and Appalachian Region Commission Grants, total funds available from now until 2035 only reaches $900 million. Pennsylvania must face this looming gap by altering its current approach. Various alternatives and recommendations have been explained and provided above. PENNVEST can increase their funding by leveraging their SRFs and by utilizing more innovative finance techniques. Since PENNVEST has been able to provide funding for all systems that apply, yet there are still millions of dollars of infrastructure upgrades needed, the Commonwealth of Pennsylvania should focus on educating utilities on the different funding uses and requirements of PENNVEST funds to increase participation in the funding programs.

9.2.2 Federal Drinking Water Funding Policies

Federal spending on drinking water infrastructure represents a small portion of total spending compared to federal, state, and local governments (Tiemann, 2018). The federal share of total public spending on water and wastewater utilities was reported to be 4% as of 2014, while state and local government expenditures accounted for roughly 94% of all infrastructure public spending. Often, water systems must address infrastructure requirements that are ineligible for DWSRF assistance. This can include future growth, ongoing rehabilitation, and operation and maintenance of systems. Additional needs such as these can result in communities seeking alternative funding options, aside from DWSRF or CWSRF (Tiemann, 2018). New programs, such as the Water Infrastructure Finance and Innovation Act of 2014 (WIFIA), have been designed to complement SRF programs, rather than replace them. WIFIA is not primarily focused on regulatory compliance and therefore can be used to fund projects that may be ineligible under SRF programs. In 2018, Congress provided $20.0 million for the EPA to begin providing loan guarantees under WIFIA and an additional $63 million in the Consolidated Appropriations Act in 2018 (Governor's Report, 2017). The EPA has estimated that the ~60 million appropriation will allow approximately $6 billion to be available for long-term, low-cost water and wastewater infrastructure finance. WIFIA is managed cooperatively between the EPA and the Army Corps of Engineers (Governor's Report, 2017).

The Water Infrastructure Improvements for the Nation (WIIN) Act is an additional program enacted in 2016. Rather than becoming a separate funding program, the WIIN Act rewrote portions the DWSRF program and the SDWA. America's Water Infrastructure Act (AWIA) of 2018 reauthorized appropriations for SDWA programs and DWSRF grants. AWIA increased the amount of DWSRF funding that states could

use to assist disadvantaged communities and authorized states to extend the loan repayment period. Additionally, AWIA authorized states to require system owners or operators, in certain circumstances, to assess options for consolidation, transfer of ownership, or other actions to achieve compliance (Tiemann, 2018).

A 2016 analysis showed that WIFIA financing offers the lowest debt-service cost compared to SRFs and tax-exempt municipal bonds (Vedachalam & Geddes, 2016). However, the lowest financing available to water system ultimately depends upon the spread between U.S. Treasury rates and borrowing rates of the SRF administrating agency, PENNVEST. SRF programs remain the most reliable and common financing mechanisms available to municipalities. SRFs are additionally often augmented by municipal bond issues. Since it is likely that WIFIA will remain the most appealing option among qualifying applicants, PA drinking water systems should be educated on the eligibility and application requirements for this form of funding. WIFIA can only be used to support up to 49% of project cost, with overall federal assistance limited at 80% for any one project (Vedachalam & Geddes, 2016). Thus, it is apparent that water systems must use a combination of financing mechanisms to support large-scale drinking water improvements.

SRF financing is generally used for smaller projects, while projects under WIFIA must be $20 million or greater (or $5 million or greater for rural communities with population less than 25,000) to be eligible. Municipalities without a triple A rating may be more interested in the WIFIA program as those interest rates tend to be lower than the current tax-exempt borrowing rate (Vedachalam & Geddes, 2016). Typically, municipal bonds offer the highest interest rates out of these three financing options. A combination of WIFIA and SRF financing can result in the lowest debt service coverage (Vedachalam & Geddes, 2016). WIFIA is still gaining traction and in Fiscal Year 2018, 39 projects were selected. The single WIFIA approved Pennsylvania project was located in Lancaster, PA at the loan amount of $22 million for a wastewater project. Based on this analysis, WIFIA has not proved to be a substantial financing program for drinking water systems in the Commonwealth of Pennsylvania (U.S. EPA, 2018).

9.3 Supplementary Figures

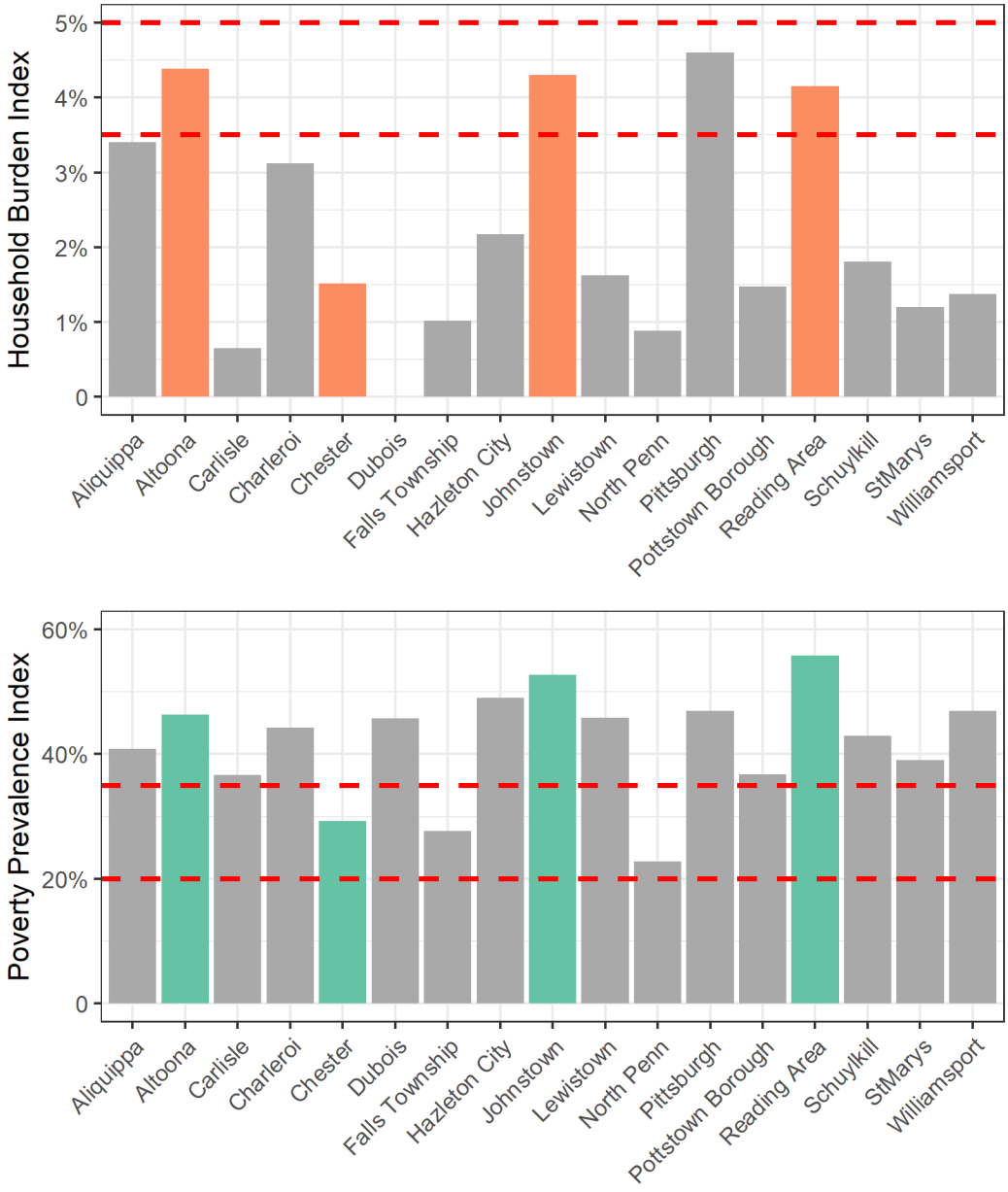

Figure 10-1. Affordability Burden - Household Burden Index and Poverty Prevalence Index for all Struggling Systems.