EJ Metrics

Water & Sewer Service Affordability in Ohio
Assessment & Opportunities for State Policy

Report to the Alliance for the Great Lakes & Ohio Environmental Council

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Executive summary

Ohio communities face significant costs to replace and upgrade aging water and sewer infrastructure while maintaining health and environmental quality—a challenge that mirrors national trends. As these costs drive increasing utility prices, Ohio leaders are interested in ensuring that the economically vulnerable can afford to pay for these essential services. To that end, this study assesses the affordability of basic drinking water and sewer utility service for low-income households in the state of Ohio, identifies important correlates of affordability, describes current state-level efforts to address water affordability across the United States, and outlines avenues for policy development aimed at water and sewer affordability.

Method. A total of 1,187 community water systems currently operate in Ohio. This study uses a stratified, randomized, and representative survey of water and sewer rates from 300 Ohio water systems to gauge low-income affordability with two metrics: the *Affordability Ratio* at the 20th income percentile (AR_{20}) and basic service price expressed as *Hours at Minimum Wage* (*HM*). AR_{20} measures basic water and sewer price as a percentage of disposable household income for a family of four at the local 20th income percentile. Affordability is also measured as the hours of labor at minimum wage that would be necessary to pay for basic water and sewer service. The resulting assessment provides a snapshot of current affordability conditions in Ohio and allows analysis of the community-level correlates of affordability.

Affordability in Ohio. Ohio utilities charge an average of $47.73 per month for water and $48.73 for sewer service to a four-person, single-family residential household that uses 50 gallons per person per day. Because prices are generally higher in smaller systems, these monthly averages are lower when weighted by population: $38.67 for water and $46.76 for sewer. The population-weighted average AR_{20} value in Ohio is 10.6, meaning that basic water and sewer service cost an average of 10.6% of disposable income for households at the 20th income percentile. *HM* ranges from 1.8 to 26.6, with a weighted average of 10.0; that is, basic water and sewer service requires the equivalent of ten hours of minimum wage labor. Figure ES1 shows the distribution of affordability in Ohio.

At current rates, a 4-person Ohio household at the 20th income percentile must pay an average of 10.6% of its disposable income and/or work ten hours at minimum wage to pay for a month of basic water and sewer service.

Patterns of affordability. Analysis of affordability statewide reveals that basic water and sewer prices are negatively correlated with utility size, which likely reflects significant economies of scale. Figure ES2 shows this relationship, with prices depicted in *HM* units. However, this relationship disappears when affordability is measured with AR_{20}, suggesting that the affordability challenge in Ohio is not specific to urban, suburban, or rural communities. Average affordability is roughly similar across different types of utility, with no significant differences in average *HM* or AR_{20} between municipal, special district, and investor-owned systems. Basic water and sewer prices also do not vary significantly across communities by their racial, ethnic, or socioeconomic conditions. Although race and ethnicity undoubtedly inform socioeconomics in many communities, there is no evidence that water and sewer affordability is a fundamentally a racial or ethnic issue in Ohio.

Figure ES1. Water & Sewer Affordability in Ohio, 2019

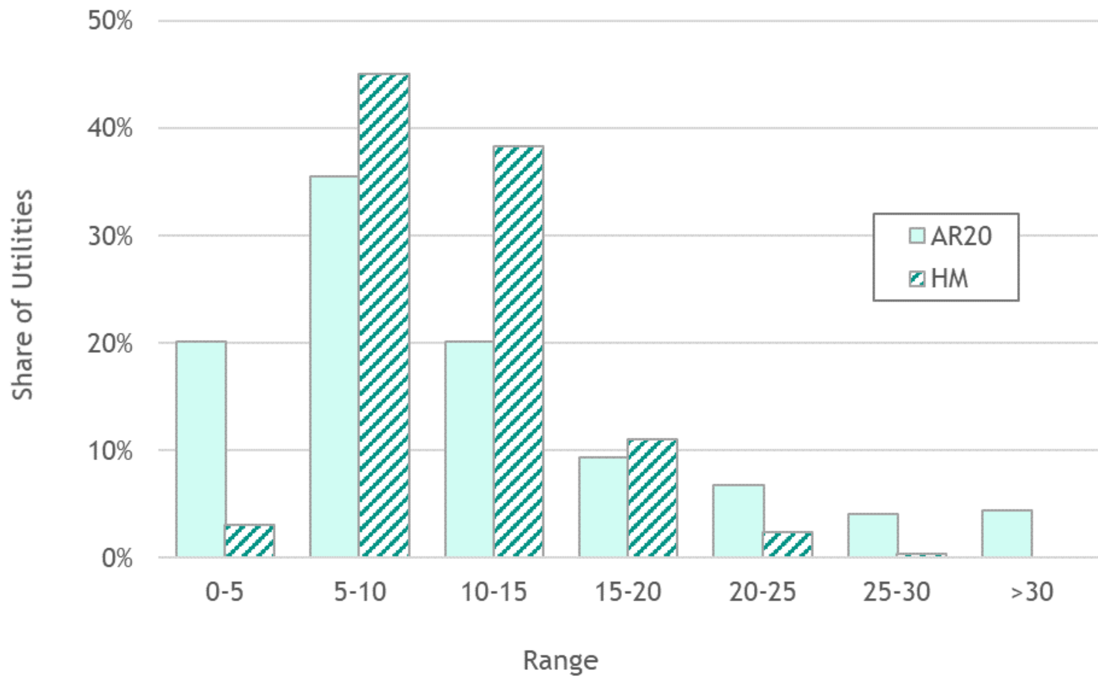
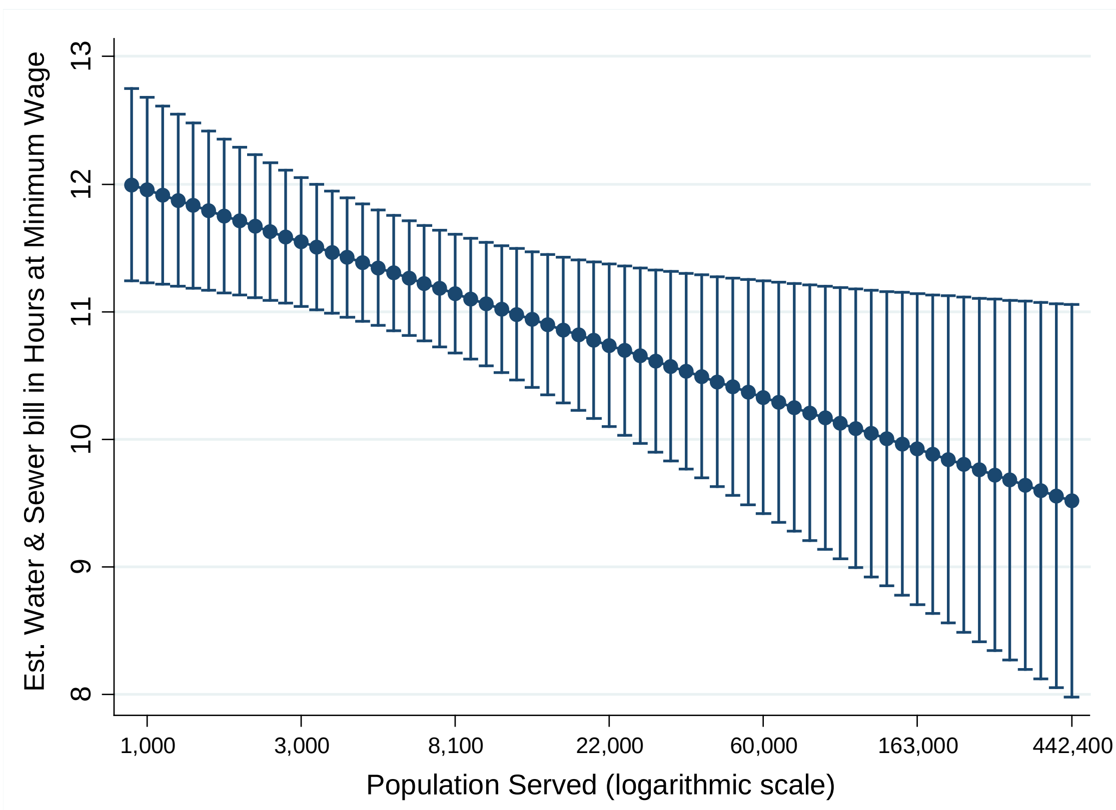


Figure ES2. Estimated *HM* by population served, 2019.



Note: Spikes represent 95% confidence intervals.

However, affordability is strongly correlated with income inequality, indicating that much of Ohio's water and sewer affordability challenge follows from a skewed distribution of income *within* communities—a finding that mirrors national conditions.

Is water affordable in Ohio? This study measures water and sewer affordability across Ohio, but cannot determine what is "affordable." When confronting affordability, leaders are grappling with fundamental values: what *sacrifices are reasonable to expect low-income households to make in order to pay water and sewer bills?* The analysis here indicates that in nearly 80 percent of Ohio communities a month of basic water and sewer service requires more than eight hours of labor at minimum wage. In about 45 percent of Ohio communities a household at the 20^{th} income percentile must pay more than ten percent of disposable income for basic water and sewer service. These figures reflect the real tradeoffs that low-income households face.

What economic sacrifices are reasonable to expect low-income households to make in order to pay water and sewer bills?

State-level affordability policies elsewhere. At present, state government efforts to ameliorate water and sewer affordability problems are mostly limited to utility-level grant and low-interest loan programs that benefit water and sewer *systems,* but not necessarily low-income *customers.* At the time of this writing, no U.S. state has a fully operational, state-level water and sewer Customer Assistance Program (CAP) or other customer-focused affordability policy. Many utilities run CAPs for their own customers under state laws. A majority of states—including Ohio—do not provide express authority for CAPs, and so utilities that pursue them must navigate the law carefully.

Three states have proposed statewide CAPs in some stage of development. Legislators in Massachusetts and Pennsylvania have introduced bills for CAPs similar to the federal Low-Income Home Energy Assistance Program, but neither state has enacted such a program. California is the only state that has passed legislation for development of a statewide CAP for water service: the 2015 Low-Income Water Rate Assistance Act (W-LIRA). The California State Water Board has been developing W-LIRA over the past four years, culminating in a draft plan published earlier this year. In its proposed form, W-LIRA would cost $606 million annually and provide assistance to residential customers that are below 200 percent of the Federal Poverty Limit. W-LIRA benefits would vary according to water expenses, income and household size.

Avenues for policy development. Some promising elements of a comprehensive, statewide water/sewer affordability strategy are discussed here. First, Ohio may seek to build economies of scale and organizational capacity through utility consolidation. Reducing the number of systems and increasing their average size is likely to both reduce prices and improve water quality. Second, the state may improve affordability through rate design by encouraging rate structures that feature low fixed charges and/or progressive volumetric pricing. Addressing affordability through rate design can improve affordability without placing additional administrative costs on utilities or burdens on customers. Third, the state could encourage water/sewer CAPs and other community-level programs through clearer enabling legislation for local utilities. Finally, Ohio might develop a statewide means-tested CAP to be administered independently or in conjunction with local utilities.

Contents

1 | Introduction

In light of rising costs, infrastructure replacement needs, and uneven economic growth, Ohio leaders are interested in ensuring that the economically vulnerable can afford to pay for essential water and sewer services. Valid assessment of water and sewer affordability is a key step toward maintaining service to all Ohioans while simultaneously raising the revenue necessary to maintain and advance public health, development, and environmental goals. To that end, this study assesses the affordability of drinking water and sewer utility service in the state of Ohio, identifies important correlates of affordability, catalogues and categorizes current state efforts to address water affordability in other U.S. states, and outlines broad avenues for policy development aimed at affordability.

Specifically, this study measures the affordability of basic water service for low-income households in Ohio using innovative analytical methods and an original, representative survey of rates from 300 water utilities and their associated sewer systems. Using data from the US Census, the US EPA's Safe Drinking Water Information System, and other sources, this study develops a series of statistical models to analyze the relationships between water affordability and key community-level and utility-level characteristics. The affordability assessment provides a snapshot of current affordability conditions in Ohio. In addition to its overall depiction of low-income affordability, this assessment and scan of other states' efforts toward water and sewer affordability provide a point of departure for development and evaluation of policies to address affordability in the Buckeye State.

This report describes the methodology used to measure water and sewer affordability, characterizes overall affordability conditions in Ohio, and analyzes key organizational, economic, and demographic correlates of affordability. A review of other states' water affordability policy efforts follows. The report closes with a discussion of avenues for potential policy development to address affordability.

2 | Methodology

This study uses two metrics to assess affordability: the *Affordability Ratio* (*AR*) and basic service costs expressed as *Hours at Minimum Wage* (*HM*). In so doing, this study departs from the analytical methods traditionally used in water affordability discussions. This section briefly discusses the flawed conventional methodology and then details the *AR* and *HM* methods.

2.1 | Flawed conventional metrics

The conventional approach to measuring water affordability is to calculate the average cost of water and sewer service as a percentage of that community's Median Household Income (%MHI), with combined water and sewer values of less than 4.0 or 4.5 percent deemed "affordable." Originally intended as a means of gauging a community's overall financial capability for purposes of negotiating regulatory compliance, this standard has been widely misapplied to household affordability. There are at least four basic reasons why the conventional %MHI approach is inappropriate for evaluating household-level water and sewer affordability[1]:

- **Average vs. essential water use.** Average residential demand as a basis for affordability analysis inflates the price of water for purposes of affordability analysis because a great deal of water demand that composes the average is discretionary water use (e.g., lawn irrigation, car washing).

- **Median vs. low income.** The conventional standard's focus on median income misses the real subject of affordability concerns: low-income households (Rubin 2001; Baird 2010; Stratus Consulting 2013). Measuring affordability as a function of an entire community's median household income obscures the impacts of rate setting on low-income customers, who likely face the greatest affordability challenges.

- **Essential costs of living.** Housing, food, health care, home energy, and other essential goods and services can affect water and sewer affordability to the extent that they constrain households' financial flexibility. These non-water costs vary widely across communities.

- **Arbitrary, binary standard.** The 4.0% or 4.5% MHI standard has no theoretical or empirical basis. Reliance on this standard can preclude or preempt careful consideration of affordability conditions and potential responses to them.

In light of these flaws, the present study employs the new, improved metrics recommended by Teodoro (2018) to assess affordability. These metrics are briefly outlined here.

2.2 | Affordability Ratio

The *AR* measures household-level affordability as the percentage or ratio of basic water costs to disposable household income for low-income customers. The present study calculates this metric for 299 Ohio utilities, but it may be calculated for an individual customer or aggregated statistically for any defined group of customers. For a given customer *c*, the Affordability Ratio (AR_c) is:

$$AR_c = \frac{p_c(W+S)}{I_c - E_c} \tag{1}$$

where *I* is household income, *E* is essential household expenses (other than water and sewer services), *p* is the number of persons in the household, and *W* and *S* are the per-capita prices of

[1] For a detailed discussion on the problems with %MHI as a measure of low-income water affordability, see Teodoro (2018).

basic water and sewer service, respectively. The numerator in eq. 1 is the price of basic service to customer *c*, which varies according to the water volume considered necessary to maintain health, the utility's rates, and the number of people in the household. The denominator is *c*'s disposable income, which depends upon the customer's income and the cost of essential non-water household expenses. The resulting AR_c reflects the economic tradeoffs that customer *c* faces due to the costs of basic water service.

Analytical assumptions. The assumptions underlying the basic *AR* methodology are adaptable to varying community conditions, and can be adjusted to suit different analytical purposes. The present study calculates *AR* for a 30-day monthly period. The analysis also assumes a four-person household and 50 gallons per capita per day (gpcd) water consumption. This level of demand represents basic indoor water needs for drinking, cooking, cleaning, and sanitation. This assumption is relatively conservative, significantly less than the average 94 gpcd demand in Cincinnati[2], but greater than the 35.6 gpcd standard that Chenoweth (2008) identifies as the "minimum water requirement for social and economic development." This assumption aligns with the indoor water use standards established by the State of California as an efficiency goal, and the Texas Water Development Board's 2004 report to the Texas legislature.[3] A 50 gpcd analytical assumption also conveniently aligns with Teodoro's analyses of affordability in 25 large US cities (2018) and national data (2019). With a four-person household, 50 gpcd demand over a 30-day month yields an assumed volume of 6,000 gallons (8.02 ccf or 22,712 liters).

As noted earlier, *AR* can be calculated for any customer, group of customers, or hypothetical customer. An assessment of *AR* at the 20th income percentile (AR_{20}) in a given community provides a meaningful look at affordability for low-income customers. This focus on the 20th percentile household aligns with mainstream assessments of welfare economics, which typically identify the 20th percentile as the lower boundary of the middle class. At this income level, "working poor" households have very limited financial resources, but may not qualify for many income assistance programs in some jurisdictions. As analytical results will show, absolute incomes at the 20th percentile vary widely across Ohio.

The present study is meant to depict affordability conditions statewide. Affordability analyses targeted at individual utilities might employ different data sources or choose to focus on a different income percentile or volume when assessing affordability.

2.3 | Hours at Minimum Wage

As a complement to *AR*, affordability is also measured as the number of hours of labor at minimum wage that would be necessary to pay for basic water service. As with the *AR*, the *HM*

[2] Greater Cincinnati Water Works reports average quarterly single-family water use at 18,700 gallons. The 2017 American Community Survey puts Cincinnati's average household size at 2.2, so this demand is equivalent to 93.9 gpcd.

[3] See California Assembly Bill 1668 and Senate Bill 606 (May 2018) and Texas Water Development Board, *Water Conservation Implementation Task Force Report to the 79th Legislature*, Austin, TX (2004).

may be calculated for an individual customer, or aggregated statistically for any defined group of customers. For a given customer *c,* basic service costs as Hours at Minimum Wage (HM_c) is:

$$HM_c = \frac{p_c(W+S)}{A} \tag{2}$$

where p is the number of persons in the household, W and S are the per-capita prices of basic water and sewer service, and A is the minimum wage in the c's labor market.

HM represents in more concrete terms the cost of basic water service for low-income households, many of whom labor at or near the minimum wage. *HM* offers a less complete picture of affordability than *AR* because it is insensitive to essential non-water costs, but it is intuitively appealing because minimum wage is a familiar economic touchstone. *HM* provides an especially useful counterpoint to AR_{20} in the present analysis because income stratification also varies considerably across Ohio; the AR_{20} may obscure affordability conditions in communities where the 20th percentile income is quite high. For example, the American Community Survey's 2017 five-year estimate puts the 20th percentile income in the Village of Indian Hill at $94,030. As a labor-based metric, *HM* reflects the experiences of very low-income populations that reside in otherwise affluent communities.

The minimum wage in Ohio is currently fixed at $8.55 statewide; at the time of this writing, local governments in the state have not established local minimum wage laws. Therefore, in this study *HM* is effectively a transformation of monthly water and sewer prices into units of labor. Evaluating affordability with *HM* remains useful nonetheless because it provides a means of evaluating affordability in Ohio relative to water and sewer prices in other parts of the country or the world, and helps provide context to trends in prices over time.

2.4 | Data: Rates Survey

The main source of data for this study is an original survey of water and sewer rates in Ohio. This section describes the survey's methodology, which was designed to yield accurate, replicable, representative data on water and sewer prices across the state.

Sampling. The U.S. Environmental Protection Agency's Safe Drinking Water Information System (SDWIS) served as the sampling frame. The SDWIS is a federal government database that contains records for every community water system in the United States. A total of 1,187 community water systems currently operate in Ohio; these systems vary in many ways. A large majority (74%) of these systems are small, serving populations of under 3,300. Collectively, these small utilities serve about 647,000 (about 6%) of Ohioans. Meanwhile, the largest 26 systems in Ohio serve a total population of more than 5.7 million, more than half of the state's population that receives drinking water utility service. Ownership is similarly skewed in Ohio: nearly half of the state's water systems are privately-owned, but the vast majority of those private systems are quite small, collectively serving less than two percent of the state's population. Table 1 shows the distribution of Ohio community water systems and service population by size.

Table 1. Ohio Community Water Systems

Service Population	Local Government				Private / Investor-Owned			
	Systems		Population		Systems		Population	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
100,000+	11	1.7	4,685,335	51.7	1	0.2	141,407	12.1
50,000-99,999	11	1.7	618,370	7.5	3	0.6	236,117	20.3
10,000-49,999	111	26.0	2,358,390	26.0	20	3.7	540,496	46.4
3,300-9,999	146	22.4	874,425	9.7	9	1.7	56,255	4.8
Less than 3,300	372	73.7	646,581	6.3	503	93.8	191,549	16.4
Total	651	100.0	9,054,552	100.0	536	100.0	1,165,824	100.0

Source: EPA Safe Drinking Water Information System, January 2019.

This skewed distribution is a challenge for depicting affordability accurately. Collecting rates data for all 1,187 utilities in a timely manner is practically impossible, especially for the very small systems that have little or no online presence or full-time staff. Simple random sampling would result in a sample composed of mostly small systems, which would not adequately reflect the experiences of the majority of Ohioans. On the other hand, focusing on only large systems would capture the data most relevant for the largest populations, but would exclude the smallest systems. Research on national data indicates that small systems often face the most acute infrastructure and affordability challenges, and so excluding small systems would also yield insufficient data for sound policymaking.

To overcome these difficulties, this study used a randomized, stratified sampling strategy to capture data that are representative of all of Ohio. We collected data for all 155 Ohio water systems that serve populations greater than 10,000, and then drew a randomized sample of 150 systems that serve populations below 10,000. The sample was stratified by ownership to ensure adequate data from public and private systems. The total sample was 305 water systems. 300 of the sampled water systems serve communities that also have sanitary sewer systems; in 81.4 percent of cases, a single organization provided both drinking water and sewer services (e.g., a local government that operates both water and sewer utilities). In the remaining 18.6 percent of water systems, sewer service is provided by a different organization (e.g., a city government or private water utility with sewer service provided by a special district). In a handful of cases the research team confirmed that a utility provided water service in an area that has no sanitary sewer utility. The resulting sample included utilities that serve over 90 percent of the state's population.[4] Overall, this sampling strategy ensures that findings are representative of the state's utilities and population as a whole. *Unless otherwise noted, all prices, affordability metrics, and other analytical results in this report are adjusted statistically to account for this non-random selection procedure.*

Data collection. In the interest of accuracy and consistency, the study team collected data actively. That is, the research team gathered data directly through websites, public documents, and/or via telephone. Most rate surveys gather data passively, sending out questionnaires and relying on utility personnel to report information accurately and in a timely manner. Passive data collection can suffer from inaccuracies and significant non-response bias. The active data collection approach used in the present study is labor-intensive, but results a flexible dataset with high accuracy and low bias.

The research team began collecting rates data on July 1 and continued through end of August, 2019. In each case, the research team determined the water and sewer rates in effect on the day that the utility was contacted or observed. For each utility, data gathering began with a simple Internet search. Rates information was available online through the utility's website or other online sources in 79.3 percent of cases. When rates information was not available online, the research team used contact information from the utility's website to inquire about rates through email and telephone calls. An average of 1.1 phone calls was needed to secure rate information for these utilities. In one case (Youngstown) water rates data were not available online and repeated email and telephone inquiries went unanswered, so the research team contacted the utility through Ohio Environmental Council staff. Ultimately the research team secured water rate information for 303 and sewer rate information for 299 of the 305 sampled utilities—an extraordinary 98.0 percent success rate.[5]

2.5 | Other Data

The present study employs data from additional sources to calculate AR_{20} and to analyze correlates of affordability.

Income and expenses. Ideally, the *AR*'s denominator would be calculated using a comprehensive household-level consumer survey of each utility's customer base. Since such data are unavailable, this analysis develops estimates of household income and expenditures using publicly available data.

Income distribution data were drawn from the 2017 American Community Survey's (ACS) five-year estimates. Essential non-water expenses were estimated based on the Bureau of Labor Statistics' 2016 and 2017 Consumer Expenditure Surveys (CEX), which capture household

[4] Appendix B lists all of the utilities included in the final sample.

[5] Teodoro's (2019) national survey yielded a 91.4 percent response rate from a 360 utility sample; the 2017 American Water Works Association (AWWA) national survey includes data from 264 non-randomly sampled utilities and does not report its sample size.

expenditure data for a probability-weighed national sample. The two-year CEX's 2,450 Ohio households are used to develop the estimates here. Usefully for present purposes, both the ACS and CEX data include public assistance programs in determining net income. These data were used to develop a regression model that estimates essential expenditures—that is, taxes, health care, food, housing, and home energy—for low-income households.[6] The CEX includes income from all sources, including public assistance programs. Coefficients from the resulting models were combined with parameters for each individual utility, and then essential expenditures were estimated at each city's 20th income percentile, assuming a four-person household and a single-family home. The approach is useful for identifying overall affordability patterns in the state, but not for any one household or any one community.

Minimum wages. The legal minimum wages in each utility's political jurisdiction were used to calculate HM. As noted earlier, the current minimum wage in Ohio is $8.55 statewide.

Utility characteristics. Some aspects of utility organization and operations might be expected to correlate with affordability. Specifically, past research with national data have identified significant relationships between affordability and utility size and ownership (Teodoro 2019). Source water (groundwater, surface water, or wholesale supply) and past regulatory compliance might also be correlated with affordability. To evaluate these relationships, data on these variables from SDWIS were matched with water and sewer rates.

Notably, several local government water systems were incorrectly classified as private in SDWIS. Where such misclassification was observed, the research team reclassified systems for analytical purposes.[7]

Community characteristics. In order to explore demographic and socioeconomic correlates of affordability in Ohio, data for cities served by each utility were drawn from the U.S. Census Bureau's 2017 American Community Survey (ACS) 5-year estimates. Accurately matching demographic and income data to special district, county, and private utility jurisdictions is challenging because utility service areas do not always correspond perfectly with municipal boundaries. Where utilities served multiple cities, the city identified with the city's mailing address in SDWIS was used.

2.6 | Analysis

Analysis of affordability proceeds in two steps. First, the research team calculated prices for basic water and sewer service in each utility in order to develop a snapshot of current water and sewer affordability in Ohio. Second, the research team used statistical regression to identify correlates of affordability.

[6] The regression model is reported in Appendix A, Table A1.

[7] The ownership misclassifications identified in the SDWIS sample were all local government utilities that had been coded incorrectly as private. We did not identify any private systems that had been misclassified as local governments.

Prices. Monthly single-family residential drinking water service prices at 6,000 gallons (8.02 ccf) were calculated for each water and sewer utility. Nearly 90 percent of Ohio water and sewer utilities bill customers monthly; the rest send bills bimonthly, quarterly, or semi-annually. For analytical purposes all bill calculations are converted to monthly prices. Importantly, *prices do not reflect any customer assistance programs* because the analytical goal is to measure affordability in the absence of any policy intervention.

Table 2. Water & sewer rate structures in Ohio

	Water	Sewer
Fixed only	0.0%	8.0%
Uniform	29.4	43.0
Inclining block	45.2	41.7
Declining block	39.6	19.7
Total utilities	303	300

Note: Percentages total to greater than 100.0 because some rate structures feature both inclining and declining block elements. Percentages reflect utility-level post-stratification weighting.

Rate structures vary considerably across the state. Most of the systems apply fixed periodic charges plus volumetric charges; that is, customers pay a fixed price, plus a unit price for each unit of water. For water service, 45.2 percent of systems used inclined block rates, which charge progressively higher marginal prices as volume increased. About 36.5 percent of systems use declining block rates, which charge lower marginal prices as volumes increase. About 29.8% of systems apply uniform volumetric charges, applying the same volumetric price to each unit of water, regardless of the volume consumed.[8] For sewer service, 43.8 percent of systems use inclining block rates, 18.6 percent use declining block rates, and 40.0 percent apply uniform rates. Prices are entirely fixed in 8.8 percent of sewer systems (i.e., there is no volumetric component to the rate). Table 2 summarizes the structure of water and sewer rates in Ohio.

There are two ways to consider what constitutes an "average" monthly water and sewer bill in Ohio. Typically, analysts average bills across utilities, which is useful for understanding relationships and trends across utilities, but effectively treats each utility as an equal analytical unit, regardless of the size of the population it serves. If the analytical goal is to depict statewide affordability at the household-level, then calculations of average bills should weight utility rates according to the size: rates in the City of Akron (service population 280,000) affect more people than rate in the Village of Minster (service population 2,850). Since each approach is useful for

[8] The sum of these proportions is greater than 100.0% because some utilities' rate structures are inclining over some ranges of consumption but declining over others.

different purposes, Table 3 reports monthly water, sewer, and combined bills averaged across utilities and weighted by population.

Table 3. Average monthly water & sewer prices in Ohio

	Monthly Price	95% Confidence Interval
Utility-weighted		
Water	$47.73	[$45.04, $50.42]
Sewer	48.73	[45.47, 51.99]
Combined water + sewer	96.45	[91.83, 101.06]
Population-weighted		
Water	$38.67	[$35.29, 42.05]
Sewer	46.76	[43.09, 50.44]
Combined water + sewer	85.43	[79.94, 90.92]

Note: Combined bill may be different from the total of water and sewer bills because weightings vary for customers that receive water and sewer services from separate organizations. Averages reflect post-stratification weighting.

As Table 3 shows, 6,000 gallon monthly water bills average $47.73 and sewer bills average $48.73 across utilities. Population-weighted monthly averages are somewhat lower at $38.67 for water and $46.76 for sewer. These results are notable in at least two ways. First, population-weighting reduces average prices because prices are generally higher in smaller systems. Second, whether averaged across utilities or population, average sewer prices are higher than water prices. Since most water customers also pay for sewer services, any meaningful assessment of and policy response to water affordability must also address sewer costs.

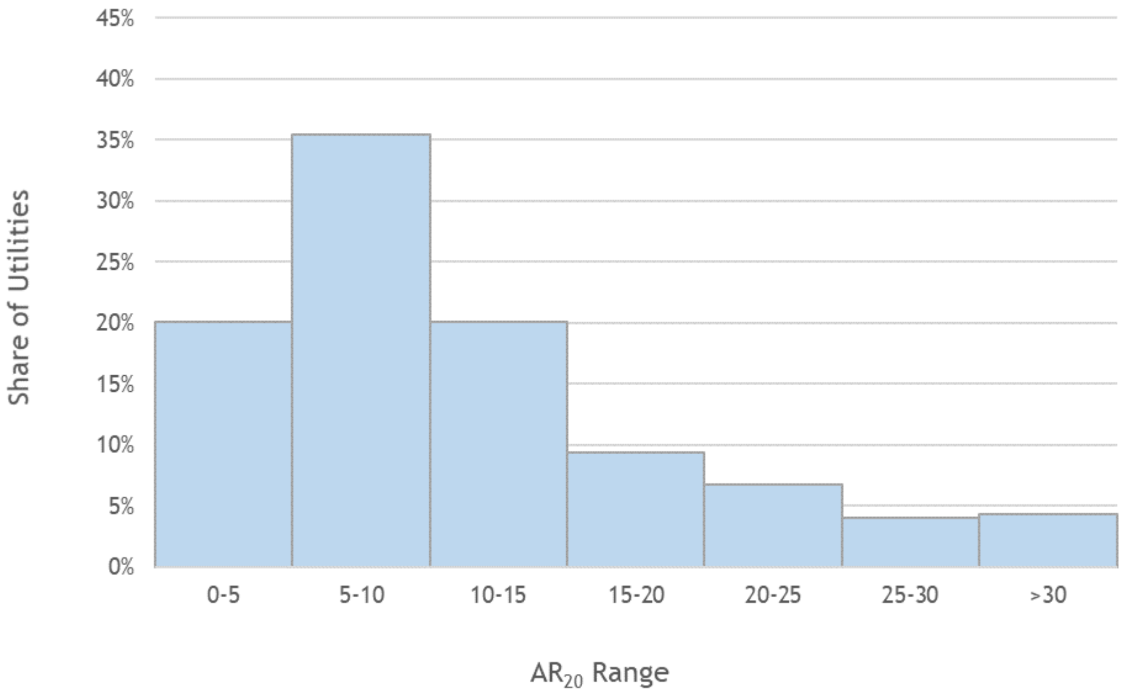
3 | Results: water & sewer affordability in Ohio

Presentation of findings begins with an overall depiction of affordability averaged across Ohio.

3.1 | Affordability snapshot

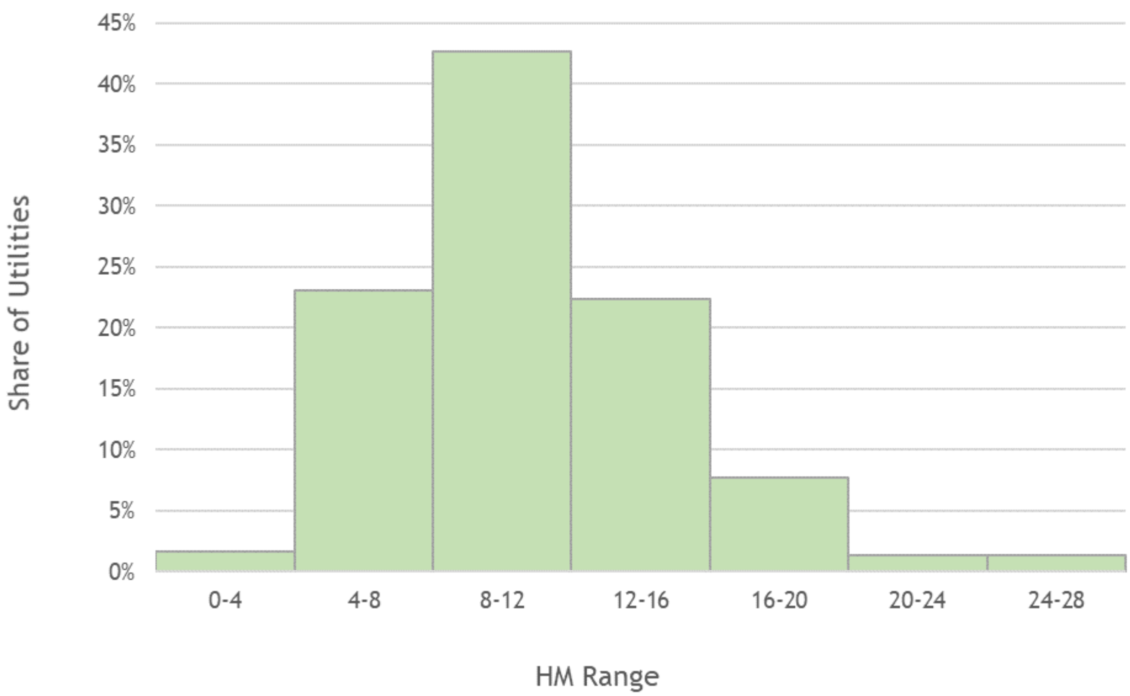
Figures 1 and 2 illustrate the simple distributions of water and sewer affordability measured by AR_{20} and *HM*, respectively.

Figure 1. Single-family residential Affordability Ratio at the 20th income percentile (AR_{20}) in Ohio, 2019.



Note: Simple histogram; does not reflect post-stratification weighting.

Figure 2. Basic single-family residential water & sewer price in hours of minimum wage labor (*HM*) in Ohio, 2019.



Note: Simple histogram; does not reflect post-stratification weighting.

AR_{20} values range from 1.3 to 74.6, with a weighted mean of 11.4 and a population-weighted mean of 10.6.[9] In substantive terms, these results indicate that basic water and sewer service in Ohio costs an average of 10.6 percent of disposable income for households at the 20th income percentile. *HM* ranges from 1.8 to 26.6, with a weighted mean of 11.2 and a population-weighted mean of 10.0. Substantively, these results mean that basic water and sewer service requires the equivalent of ten hours of minimum wage labor in Ohio. Table 4 summarizes these results.

Table 4. Average water and sewer affordability in Ohio, 2019

	Value	95% Confidence Interval
Utility-weighted		
AR_{20}	11.4	[10.1, 12.6]
HM	11.2	[10.7, 11.8]
Population-weighted		
AR_{20}	10.6	[9.2, 11.9]
HM	10.0	[9.3, 10.6]

Note: Averages reflect post-stratification weighting. Average AR_{20} values exclude the Cities of Athens and Oxford.

Table 5. Average water and sewer affordability in Ohio for urban and rural communities, 2019

	Value	95% Confidence Interval
Urban (257 systems)		
AR_{20}	11.5	[10.1, 12.8]
HM	11.3	[10.7, 11.9]
Rural (37 systems)		
AR_{20}	10.6	[7.3, 14.0]
HM	10.8	[9.6, 12.1]

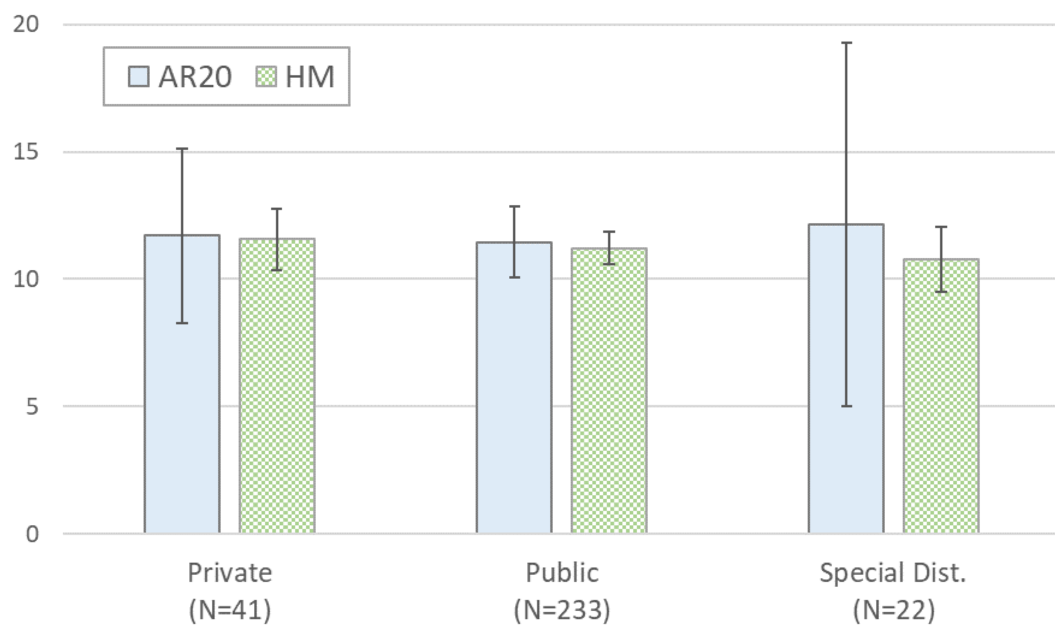
Note: Averages reflect utility-level post-stratification weighting. Average AR_{20} values exclude the Cities of Athens and Oxford.

[9] These figures exclude the cities of Athens and Oxford, where unusual population demographics make meaningful AR_{20} calculations difficult. Home to Ohio University and Miami University, respectively, these "college towns" serve large populations of full-time students who have very low or negative income.

Urban and rural systems. Table 5 shows average affordability for rural and urban communities. The 2010 decennial census provides urban and rural populations for each community in the sample, but nearly all of these percentages cluster near zero and 100. To simplify analysis, each community in the sample is classified as *urban* if the urban share of its population is greater than 50 percent and *rural* if it is less than 50 percent. As Table 5 shows, weighted average AR_{20} and *HM* are higher in urban areas, but the difference is not statistically significant by conventional standards, owing to the wide range of affordability conditions in both urban and rural areas.

The underlying causes of affordability concerns may vary considerably in urban and rural settings. In urban areas, socioeconomic disparities are likely the most direct causes of affordability problems. In rural settings, a combination of expensive, small-scale utilities and socioeconomic conditions raise affordability concerns. Some small systems are relatively affluent, even at the 20th percentile, while others are relatively less well-off. For example, household income at the 20th percentile is just $8,773 in the Village of Rio Grande (pop. 830), but $35,861 in the Village of Amanda (pop. 737). Water and sewer bills are relatively high in both villages, but the affordability impact is much greater in Rio Grande.

Figure 3. Mean AR_{20} & HM by system ownership in Ohio, 2019.



Note: Vertical spikes represent 95% confidence intervals. Mean values reflect post-stratification weighting.

Ownership. Differences in rates between publicly-owned and investor-owned utilities are subjects of frequent interest. Figure 3 depicts weighted average AR_{20} and *HM* by three types of ownership: 1) private, investor-owned utilities; 2) municipal government utilities; and 3) special district utilities. As Figure 3 indicates, water and sewer affordability in Ohio does not vary significantly by ownership, whether measured by AR_{20} or *HM.* Thirty-five of the sample's 42 private water systems do not provide sewer service in their areas. Instead, local governments provide sewer services in those areas. Interestingly, private water prices are significantly higher than public-sector utility prices, but these differences disappear when water and sewer prices are considered in combination. The policy implications of this pattern are unclear, but highlight the importance of analyzing water and sewer prices together, since both contribute to the customer's overall cost burden.

3.2 | Correlates of affordability in Ohio

This representative set of data on water and sewer affordability provides an opportunity to investigate empirically the relationship between affordability and various organizational, demographic, and economic variables across Ohio. To that end, a series of Ordinary Least Squares (OLS) statistical models are used here to analyze the relationship between water affordability and key community-level and utility-level characteristics. All models employ post-stratification weighting.

Variables. Utility size is measured as the natural log of the population served by the utility.[10] A logarithmic transformation is important because the effects of scale on affordability are expected to be nonlinear, with the greatest effects at the lower end of the size distribution. For example, the substantive difference between a utility that serves a population of 10,000 and one that serves 50,000 is greater than the difference between utilities that serve 250,000 and 290,000. Primary water source and ownership are entered with a series of dummy variables (0/1). *Groundwater* is coded 1 for utilities that employ local ground water as their main source, and *purchased water* for systems that purchase wholesale supply from other systems; surface water is coded as zero and serves as the reference category. Similarly, *special district* and *private* or investor-owned utilities are coded as 1, with municipal utilities as the reference category. Regulatory compliance is coded as the natural log of all-time Safe Drinking Water Act (SDWA) violations reported in SDWIS.[11]

Some community-level economic and demographic variables from the 2017 American Community Survey are also analyzed. Some estimates include the community's *median income.* Income inequality is measured with the Gini coefficient, which ranges from zero (perfectly equal) to one (perfectly unequal). The Gini coefficient was multiplied by 100 when entered into the models in order to ease interpretation. Median income offers an indication of overall community financial resources, and the Gini coefficient shows how those resources are distributed across the population.

Some models include community-level demographic data, including the *percent Black, percent Hispanic,* and *percent Asian* population. Community education levels and median income are combined using factor analysis to generate a regression-based, standardized *socioeconomic status*

[10] Models that measure size using total number of service connections yield very similar results, as connections correlate very highly with service population (ϱ=95).

[11] A descriptive summary of all these variables is reported in Appendix A, Table A2.

score for each utility (mean 0.0, standard deviation 1.0).[12] Estimates also include a binary indicator for *urban* areas (coded 1) with rural areas as a reference category.

HM. As noted earlier, Ohio's uniform $8.55 minimum wage makes *HM* a simple transformation of basic service price into hourly labor units. Model A estimates *HM* as a function of size, ownership, primary water source, and regulatory compliance. Model B adds socioeconomic status and demographic variables to show how basic water and sewer prices vary across communities of varying economic and demographic composition.

Table 6. Correlates of *HM* in Ohio, 2019

OLS regression	Model A	Model B
Log population	-.25 (.20)	-.37 (.07)
Groundwater	-2.05 (.01)	-2.42 (<.01)
Purchased water	-1.06 (.26)	-1.31 (.19)
Private	.62 (.40)	.45 (.52)
Special district	-.48 (.52)	-.27 (.72)
Log SDWA violations	.10 (.70)	.11 (.64)
Urban	.12 (.88)	-.04 (.96)
Socioeconomic status		.02 (.96)
%Black population		.04 (.16)
%Hispanic population		-.06 (.40)
%Asian population		.20 (.17)
Constant	14.46 (<.01)	15.67 (<.01)
N	300	300
R^2	.04	.05
AIC	1700.34	1698.96

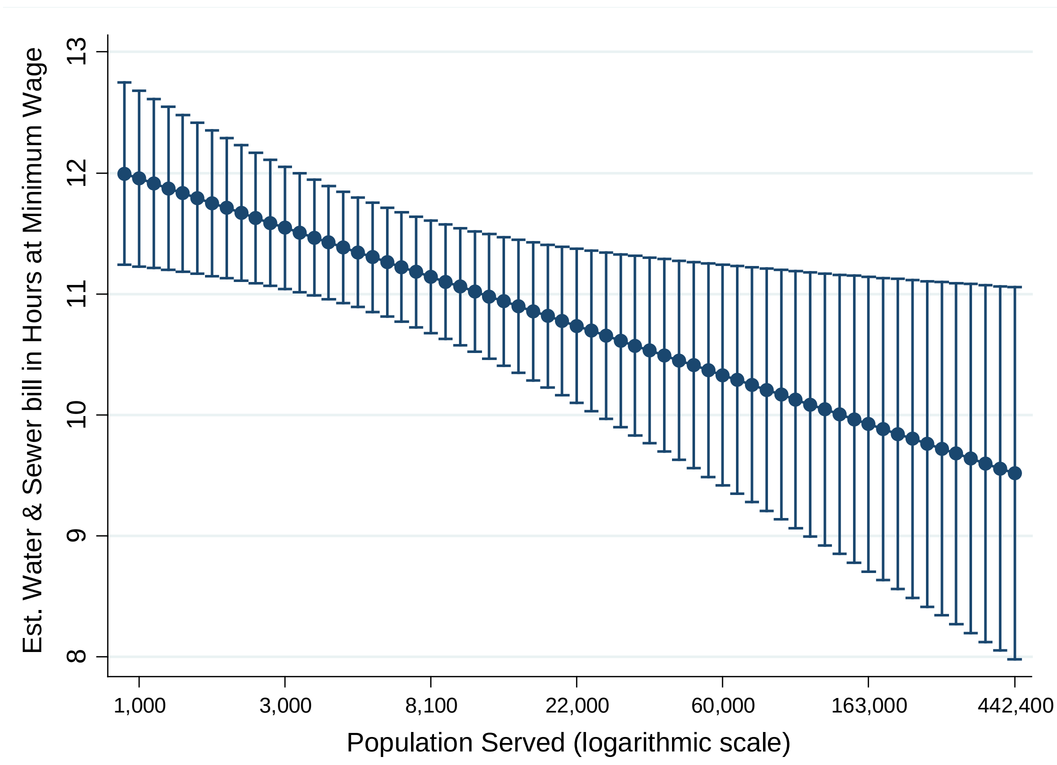
Note: Cells contain coefficients from OLS models (p-values in parentheses). Estimates calculated with post-stratification weighting and robust standard errors.

[12] The socioeconomic status factor analysis is reported in the Appendix A, Table A3.

Table 6 reports estimation results from these three models of *HM*. Just one variable, *groundwater* supply, emerges as a strong, statistically significant predictor of *HM* in Model A: all else equal, basic water and sewer service in a utility that relies on local groundwater as its primary supply source costs about two fewer hours of labor at minimum wage, compared with utilities that use surface water primarily. The relationship between *HM* and *groundwater* supply persists in Model B when demographic and socioeconomic variables are included.

Moreover, the addition of these social variables strengthens and clarifies a negative relationship between *HM* and utility size, which likely reflects the significant economies of scale associated with water and sewer infrastructure. According to Model B, all else equal, *HM* for a utility that serves a population of 1,000 is 12.0, while *HM* in a utility that serves 100,000 is 10.1. At the current Ohio minimum wage, that translates to a $16.25 difference in monthly price. Figure 4 illustrates this negative relationship.

Figure 4. Estimated HM by community water system population served, 2019.



Note: Estimates generated by Model B. Spikes represent 95% confidence intervals.

However, just as notable in Table 6 are the very weak correlations between *HM* and community-level race, ethnicity, and socioeconomic status. These "non-findings" indicate that *basic water and sewer prices do not vary considerably across communities by their racial, ethnic, or socioeconomic conditions.* Put another way, water and sewer affordability concerns are similar across communities, regardless of their demographic profiles. Although race and ethnicity undoubtedly inform socioeconomic conditions in many communities, there is no evidence that water and sewer affordability is a fundamentally a racial or ethnic issue in Ohio.

AR_{20}. Two models estimating AR_{20} are fitted here and presented in Table 7. Model C estimates AR_{20} as a function of size, ownership, primary water source, and regulatory compliance. Model E adds each community's *logged median household income* and *income inequality*, measured with the Gini coefficient. Both models exclude cases where AR_{20} is greater than 75.0, as these extreme outliers are unique cases that are not readily generalizable.[13] Race, ethnicity, and socioeconomic status are not included in these models because those variables are included in the calculation of AR_{20}, and so are implicitly included in the essential expenditures and income measures.

Table 7. Correlates of AR_{20} in Ohio, 2019

OLS regression	Model C	Model D
Log population	.27 (.55)	-.29 (.41)
Groundwater	-1.27 (.47)	-.06 (.96)
Purchased water	-1.29 (.65)	1.22 (.51)
Private	.75 (.72)	-.22 (.89)
Special district	-2.56 (.29)	-1.51 (.25)
Log SDWA violations	.84 (.21)	-.18 (.72)
Urban	.13 (.95)	-.07 (.96)
Log median income		-16.71 (<.01)
Income inequality		.41 (<.01)
Constant	7.85 (.12)	177.98 (<.01)
N	295	295
R^2	.02	.50
AIC	2154.44	1958.47

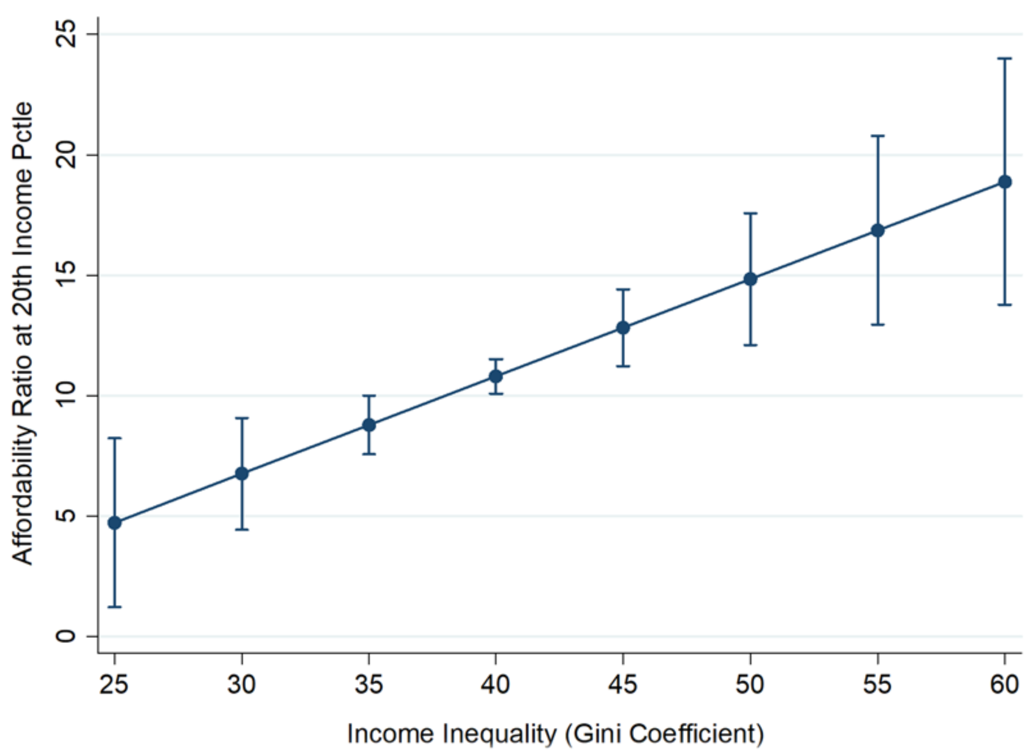
Note: Cells contain coefficients from OLS models (p-values in parentheses). Estimates calculated with post-stratification weighting and robust standard errors.

[13] The excluded outliers are the cities of Athens, Oxford, and Le-Ax Water District, which serve large student populations, and Scioto County Regional Water District, which serves the Southern Ohio Correctional Facility. These institutions include unusual populations that artificially depress reported 20th percentile income.

Two notable results emerge from Model C. First, the estimate that includes utility characteristics only offers very little predictive value (R^2=.02), indicating that affordability bears little relationship with utility-level variables alone. Second, the weak, statistically insignificant relationship between utility size and affordability is inconsistent with the national affordability data, which show a strong negative relationship between utility size and AR_{20} (Teodoro 2019). Together with the small, statistically insignificant differences between AR_{20} and *urban* vs. rural systems, "non-finding" in the present analysis indicates that the water and sewer affordability challenge in Ohio is not specific to urban or rural communities, or utilities with one type of ownership or another.

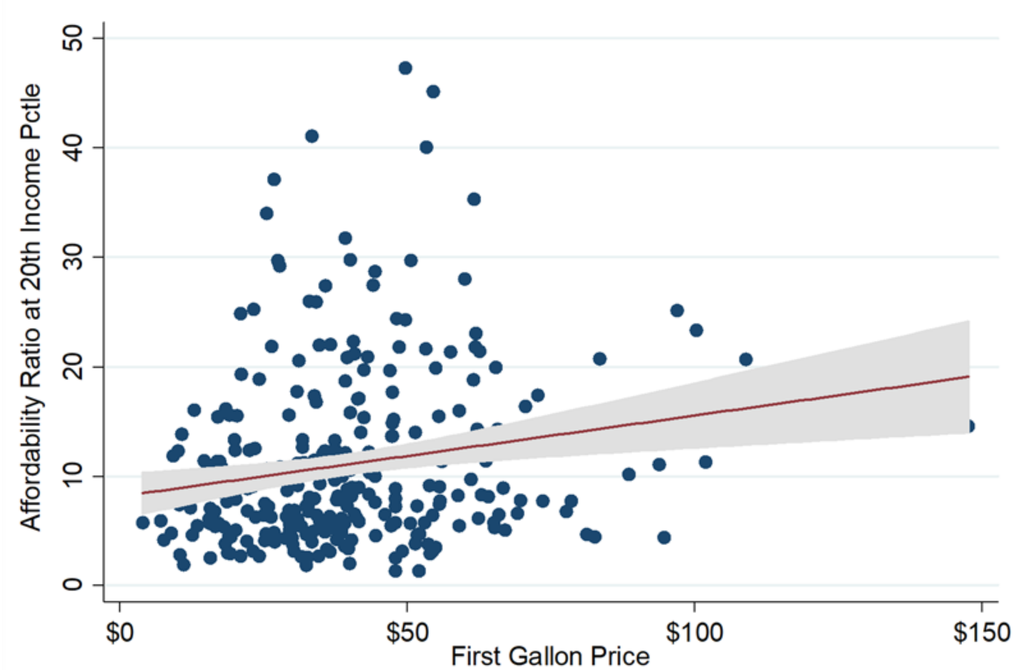
Model D's inclusion of *median income* and *inequality* generates much stronger model fit (R^2=.50), and yields a striking relationship between income inequality and affordability (Figure 5). The strong, negative correlation between *median income* and AR_{20} is unsurprising, as communities with overall higher levels of income are likely to have greater disposable income at the 20th income percentile, as well. However, the very strong positive correlation between *inequality* and AR_{20} indicates that much of Ohio's water and sewer affordability challenge follows from a skewed distribution of income within communities. This finding mirrors national conditions (Teodoro 2019). More detailed analysis of affordability within communities requires analysis of household-level demographic and socioeconomic data, and so is beyond the scope of the present study.

Figure 5. Estimated AR_{20} and income inequality in Ohio, 2019.



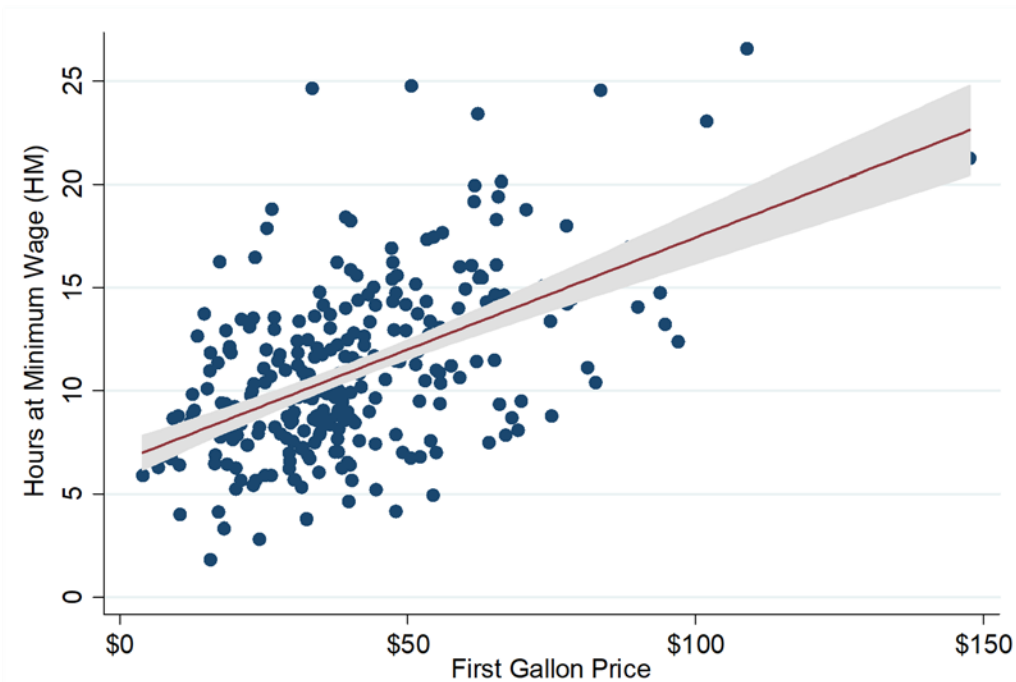
Note: Estimates generated by Model E. Spikes represent 95% confidence intervals.

Figure 6. AR_{20} by first gallon price in Ohio, 2019.



Note: Red line represents average bivariate regression line. Shaded area represents 95% confidence interval.

Figure 7. *HM* by first gallon price in Ohio, 2019.

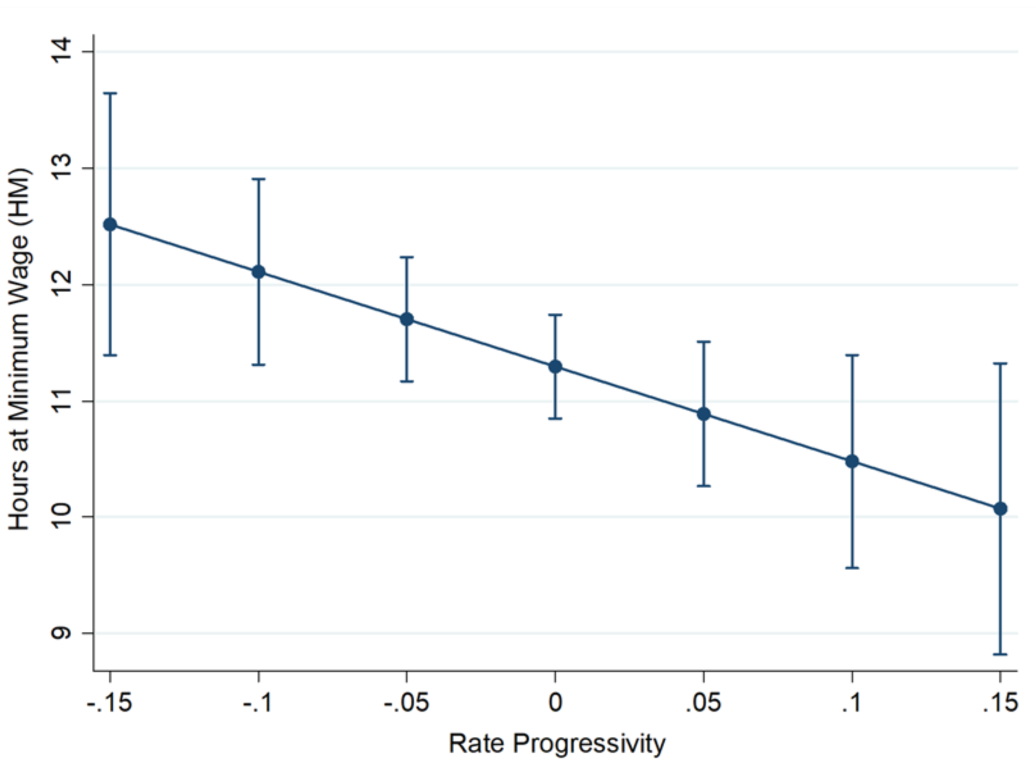


Note: Red line represents average bivariate regression line. Shaded area represents 95% confidence interval.

First gallon price. As an illustration of the relationship between affordability and rate design, for each utility we calculated a *first gallon price*, which is the fixed water and sewer charges plus the first volumetric unit price for combined water and sewer service. The *first gallon price* is effectively the minimum amount that any customer of a utility must pay in order to receive any service at all. Put another way, this is the unavoidable price of service. Figure 6 shows relationship between AR_{20} and *first gallon price*; Figure 7 shows the relationship between *HM* and *first gallon price.* As these figures indicate, the price of the first gallon of water and sewer service strongly predicts affordability, whether measured as AR_{20} or *HM.*

Progressivity. Another way to evaluate the effect of rate design on affordability is to analyze the relationship between affordability and *progressivity*, or how marginal prices increase as volume increases. To that end, *progressivity* is measured using Switzer's (2019) regression-based approach, which measures the slope of marginal prices at various volumes from zero to 30,000 gallons monthly. Theoretically this value can range from -1.0 to +1.0. Under declining block rates, the slope is negative (prices decline as volume increases); under inclining block rates, the slope is positive (prices increase as volume increases). Under purely fixed or uniform volumetric rates, *progressivity* is zero. After controlling for *first gallon price, HM* is strongly and negatively correlated with *progressivity* (Figure 8). This finding indicates that *affordability improves as rates become more progressive, with utilities distributing more of their costs to high-volume customers.*

Figure 8. *HM* by rate progressivity in Ohio, 2019.



Note: Spikes represent 95% confidence interval.

3.3 | Is water affordable in Ohio?

Water and sewer affordability are matters of community priorities. When confronting affordability, citizens, policymakers, and utility leaders are taking up questions about fundamental values: how much is reasonable to expect households of limited means to pay for essential services? What economic sacrifices are reasonable to expect low-income households to make in order to pay water and sewer bills?

This study depicts low-income affordability conditions across Ohio, but it cannot determine what is affordable. As noted earlier, one of the main weaknesses of conventional affordability analysis is that it declares water "unaffordable" or "affordable" because it falls above or below a 4.0% or 4.5% MHI threshold—an arbitrary standard with no underlying rationale. The metrics developed in this study can facilitate clear thinking and meaningful discussion about affordability, but ultimately what is "affordable" depends on Ohioans' values. Just as incomes and essential expenditures vary from one community to another, so do values.

Rules of thumb. Bearing in mind the dangers of arbitrary standards, some simple rules of thumb for ensuring water affordability are suggested here as a point of departure for discussion of affordability policy for the state of Ohio:

1. An AR_{20} value of no more than ten percent, so that a four-person household at the 20th income percentile pays no more than ten percent of its disposable income on water service; and

2. An *HM* value of no more than 8.0, so that a four-person household's basic monthly bill requires no more than eight hours of labor at minimum wage.

These guidelines are not rooted in any theory of welfare economics, law, or philosophy; they simply provide an intuitive answer to the normative questions implied by an interest in affordability. The intuition behind them is that water and sewer are essential services, and so it is reasonable to ask low-income customers to pay up to ten percent of disposable income and/or work up to a day at minimum wage to pay for them. Beyond these levels, water and sewer costs may begin to constrain significantly the welfare and economic opportunities of low-income households. Reasonable people can disagree about the merits of these rules of thumb and the analytical assumptions that underlie the AR_{20} and *HM* calculations; the point of advancing them is to facilitate deliberation, not to declare them as universal truths. [14]

According to these rules-of-thumb, and assuming a four-person household at 50 gpcd, 55.5 percent of Ohio utilities are currently affordable as measured by AR_{20}. Only 20.7 percent meet the labor-based *HM* affordability rule-of-thumb, in part because Ohio's minimum wage is

[14] For example, in 2018 the City of Phoenix, AZ's Water Rate Advisory Board adopted a combined water and sewer AR_{20} of 10% and *HM* of 8.0 as standards for evaluating water and sewer affordability. The City of Austin, TX adopted an AR_{20} guideline of 5%.

relatively low.[15] Population-weighting changes these figures somewhat; adjusted for population, 57.3 percent of Ohio systems meet the AR_{20} and 34.1 percent meet the *HM* rules-of-thumb. Whether these conditions merit a public policy response is a matter of government priorities. *Ohio utility leaders and policymakers should set affordability goals and guidelines using careful measurement and based on Ohioans' values, not arbitrary standards developed elsewhere.*

4 | State programs for customer-level water and sewer affordability

In order to facilitate policy development in Ohio, this report identifies and categorizes current efforts to address water affordability in other U.S. states using information from state websites, media reporting, and published legislation. The focus here is programs and policies aimed specifically at alleviating prices for low-income households, as opposed to assistance targeted at utilities. That is, state grants, low-interest loans, and other subsidies that aid the construction, maintenance, or operation of entire water or sewer systems are not included in this review. Rather, this study summarizes state-wide Customer Assistance Programs (CAP) for water and/or sewer service. For purposes of this study CAPs include all means-tested programs aimed at reducing or offsetting low-income customers' water and/or sewer bills.

At the time of this writing, no U.S. state has a fully operational, state-level CAP for water or sewer services. Thus, this summary offers an overview of the current state legal frameworks for CAPs at the utility level. Next, the report describes California's Water Low-Income Rate Assistance Program (W-LIRA), the most developed state-wide program to date. Discussion then turns to state legislation that has been introduced, but not passed. The present review is meant as a scan of the state-level landscape on low-income water assistance programs to help inform policymakers in Ohio; analysis and evaluation of specific policies or approaches are beyond the scope of this study.

4.1 | Legal frameworks for CAPs

State laws governing funding for utility CAPs are key determinants in whether utilities in a state will offer a CAP. States vary considerably in the degree to which rate revenues may be used to provide means-tested assistance. In 2017 the Environmental Finance Center (EFC) at the University of North Carolina compiled an excellent review of state laws on the use of rate revenue by commission-regulated and municipal water systems (2017). Figures 9 and 10, adapted from the EFC report, show the distribution of legal frameworks that apply to rate-funded CAPs for local government utilities (Figure 9) regulated private utilities (Figure 10).

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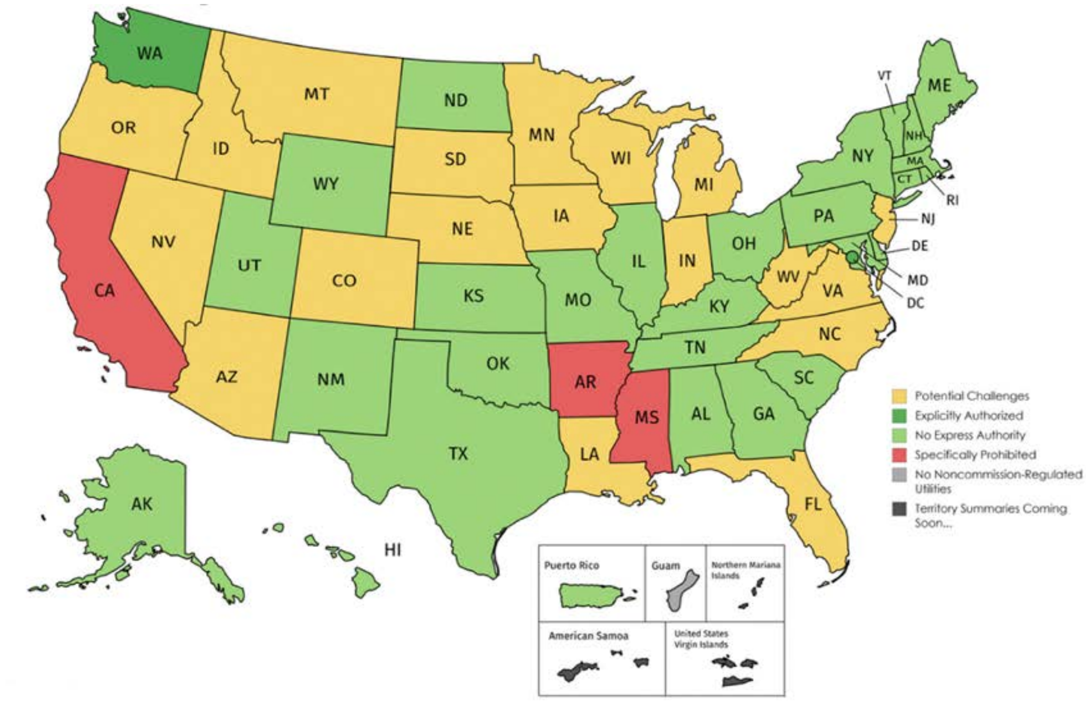
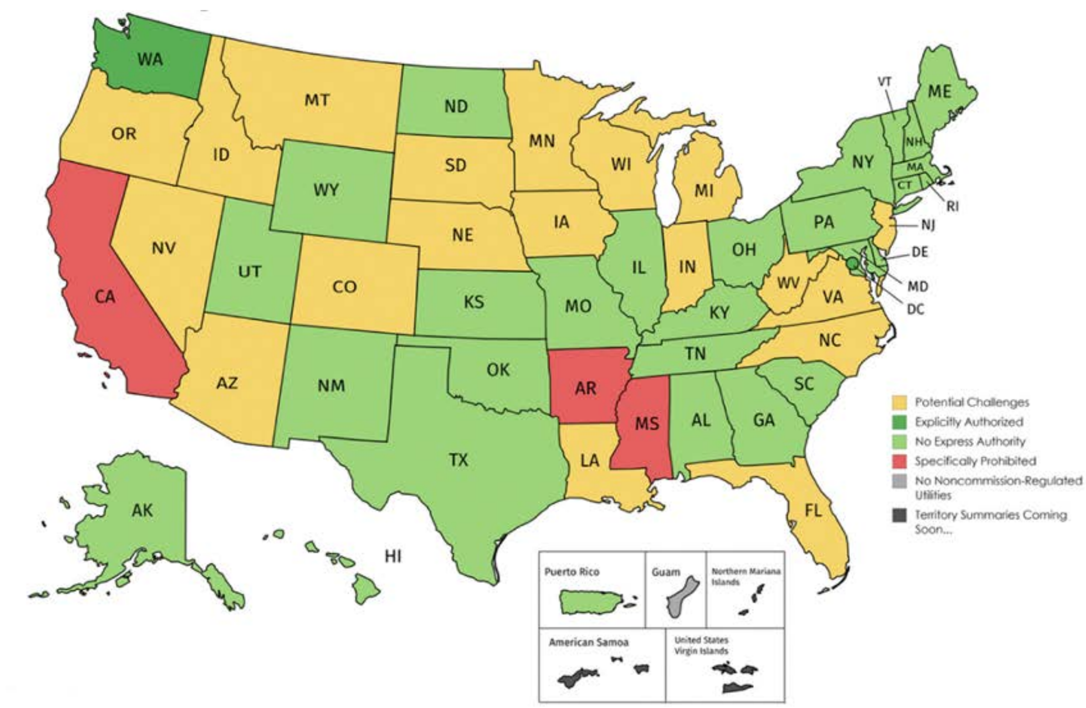
[15] Ohio's current $8.55 hourly minimum wage is higher than the federally-mandated $7.25 per hour, but lower than most other states that have adopted state minimum wages.

Figure 9. Legal status of rate-funded CAPs for local government utilities.



Source: Environmental Finance Center, 2017.

Figure 10. Legal status of rate-funded CAPs for regulated private utilities.



Source: Environmental Finance Center, 2017.

States that expressly prohibit using rate revenues to fund CAPs create significant barriers to the creation of local CAPs; in those states, CAP funding must come from tax revenue or external grants. The only state to expressly authorize both public and regulated private utilities to offer rate-funded CAPs is Washington, and the only one to prohibit this practice for both is Arkansas. The remaining 48 states and territories are complicated mix, where commission-regulated and non-commission-regulated utilities are governed by different sets of statutes ranging from expressly prohibiting ratepayer funded CAPs to expressly allowing ratepayer funded CAPs.

A majority of states—including Ohio—do not provide express authority and/or feature ambiguous language regarding CAPs. Thus, Ohio utilities that pursue CAPs must navigate the law carefully and are potentially vulnerable to legal challenges.[16] *Explicit statutory guidelines could facilitate broader adoption of utility-level CAPs.*

4.2 | California's W-LIRA

To date, California is the only state that has passed legislation for development of a State-wide CAP for water service. California's proposed statewide W-LIRA grows out of that state's 2012 Human Right to Water Act, which declared that "every human being has the right to safe, clean, affordable, and accessible water."[17] Pursuant to that declaration, California Legislature enacted the Low-Income Water Rate Assistance Act in 2015. Since 2015 the State Water Board has been developing California's W-LIRA though a series of public meetings and internal consultation processes, culminating in a draft plan and call for comments released in early 2019.[18]

In its currently proposed form, W-LIRA would provide three tiers of benefits to residential customers that are below 200 percent of the Federal Poverty Limit (FPL). Table 8 summarizes the currently proposed benefit levels. The projected cost for the proposed scenario is $606 million in the first year[3]. California's W-LIRA does not specifically provide assistance for sewer service.

The California State Water Board has proposed multiple avenues for administering W-LIRA. Options include piggy-backing onto existing benefits programs such as CalFresh (a food assistance program run by the Department of Social Services), distribution through tax credits, developing a completely new benefits distribution system, and administering the benefits

[16]Environmental Finance Center at UNC. (2017). Navigating Legal Pathways to Rate-Funded Customer Assistance Programs: A Guide for Water and Wastewater Utilities (Rep.). Retrieved August 7, 2019, from UNC Environmental Finance Center website: https://efc.sog.unc.edu/sites/default/files/Pathways to Rate-Funded CAPs.pdf

[17] Human Right to Water Act, Assembly Bill No. 685 2012, c. 91. http://www.leginfo.ca.gov/pub/11-12/bill/asm/ab_0651-0700/ab_685_bill_20120925_chaptered.pdf

[18]Yang, M. (2019, April 30). Water Conservation Portal - Low-Income Water Rate Assistance Program. Retrieved August 4, 2019, from https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/assistance/

through individual utility's billing systems[19]. The State Water Board proposed funding the program through a sales tax on bottled water and 0.25 percent tax on annual incomes over one million dollars.[3]

Table 8. Proposed California W-LIRA tiered discount system

Discount	Requirements	Monthly water service expenditure	Percent of Households meeting that requirement
20%	Incomes below 200% FPL	Below $90	14%
35%	Incomes below 200% FPL	$90.01-120	24%
50%	Incomes below 200% FPL	Above $120	34%

The public comments regarding the draft plan have been generally favorable, although stakeholders have articulated some concerns in comments to the State Water Board. These concerns include ensuring that customers are not double taxed by both the utility and the state in support of W-LIRA. The volume of subsidized water included in the W-LIRA—currently proposed at 12 ccf (about 9,000 gallons)—has also drawn criticism as far more than necessary for basic human health and sanitation.[20] As of August 2019 it appears that the State Water Board is moving forward W-LIRA development, although no other benchmark deadlines have been announced by the State Legislature or Water Board.

4.3 | Proposed legislation in other states

Although California is the only state to have passed a statewide water CAP legislation, legislators in Massachusetts and Pennsylvania have introduced bills directing the development statewide water CAPs. These legislative introductions have received little media coverage, so it is unclear how seriously these introductions are being considered by leaders in those states.

Interestingly, it does not appear that Pennsylvania's or Massachusetts' proposed legislation is modeled on California's W-LIRA. Indeed, the Pennsylvania and Massachusetts bills are more closely related to each other than to California's W-LIRA. Perhaps coincidentally, California,

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[19] S. (2019). Options for Implementation of a Statewide Low-Income Water Rate Assistance Program(pp. 1-27, Working paper). CA. https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/assistance/docs/2019/draft_report_ab401.pdf

[20] California State Water Resources Control Board. (2019, February 1). Public Comments regarding Low-Income Water Rate Assistance Draft Report. Retrieved August 4, 2019, from https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/assistance/ab401_public_comments_20190201.html

Massachusetts, and Pennsylvania are the only three states to enshrine a right to water in their state laws—in 2012, 1972, and 1971, respectively.

Pennsylvania H.B. 292. In the Pennsylvania, Representative Austin Davis recently proposed the *Low-Income Water and Wastewater Assistance Act* (H.B. 292, 2019), which would create a program similar to the Low-Income Home Energy Assistance Program (LIHEAP) for Pennsylvania residents whose incomes are at or below the FPL. Under this program residential customers that meet these income requirements would receive an annual grant to offset the cost of water and sewer service[21]. The annual payment would be based on household income, with the lowest income households receiving the greatest benefits and ranging from $100 – 500 dollars. Although this bill was introduced in January 2019, some version of this bill has been introduced in every Pennsylvania House of Representatives session since 2015, with a different sponsor each time. As of September 2019 there has been no further action on this bill aside from its introduction.

Massachusetts S.807. In Massachusetts, Senator Mark Montigny and a number of cosponsors introduced *An Act to Provide Sewer and Water Rate Relief* (S.807, 2019), which would provide household-level relief for water and sewer costs similar to Pennsylvania H.B. 292. Like its Pennsylvanian cousin, Massachusetts S.807 would use LIHEAP as a model and administrative heuristic: all residents eligible for LIHEAP would automatically be eligible for the proposed water and sewer CAP, and would receive a discount of no more than 25 percent of their total annual water and sewer service bill. The Massachusetts bill would require residents that receive benefits under this program to participate in any free demand-side water conservation programs available to them. A nearly identical version of this bill was proposed by Senator Montigny in the previous session. Hearings on the bill were held during the summer of 2019, but no final action has been taken on it at the time of this writing.[22]

5 | Avenues for policy development

This study's findings point to several potential avenues for policy development aimed at improving household-level water and sewer affordability for low-income households in Ohio. Detailed design, evaluation, and/or recommendations of specific tools or approaches are beyond the scope of this study. Rather, the present discussion outlines general approaches that merit exploration and possible development at the state level. Three such approaches are discussed here: 1) building economies of scale and organizational capacity through utility *consolidation*; 2) encouraging greater residential water and sewer affordability through *rate*

[21] Davis, A. M. (2019, January 3). H.B. 292 2019 - House Co-Sponsorship Memoranda - Low-Income Water and Wastewater Assistance Act. Retrieved August 2, 2019, from https://www.legis.state.pa.us/cfdocs/Legis/CSM/showMemoPublic.cfm?chamber=H&SPick=20190&cosponId=27328

[22] Montigny, M. C. (2019, January 22). Bill S.807 191st - An Act to provide sewer and water rate relief. Retrieved August 1, 2019, from https://malegislature.gov/Bills/191/S807

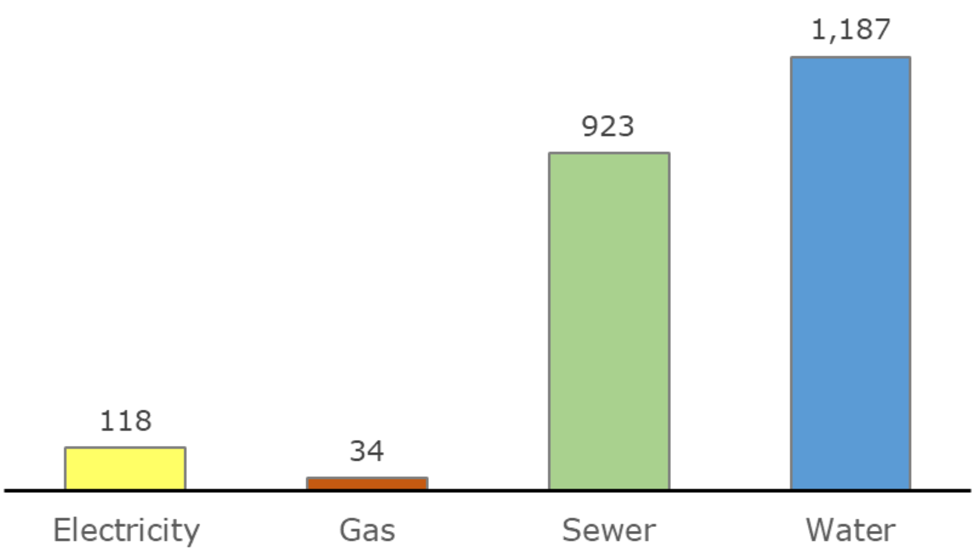
design; and 3) development of a statewide *customer assistance program*. Whatever alternatives the state chooses to pursue, efforts at improving affordability are likely to be most successful when viewed as part of a comprehensive affordability strategy that encompasses many aspects of utility operations, finance, and pricing.

5.1 | Consolidation

One way in which Ohio's water and sewer sectors mirror national trends is the large number of utilities that operate in the state. The Ohio energy sector provides a useful comparison. Figure 11 shows total Ohio electricity, gas, sewer, and water systems in 2019. Ohio households receive retail service from a total of 118 electrical utilities and 34 gas utilities, including investor-owned systems, municipal systems, and rural cooperatives. Water and sewer systems outnumber energy utilities by an order of magnitude: 1,187 water utilities and 923 sewer treatment facilities operate in Ohio.

As reported in Table 1, nearly three quarters (73.7 percent) of Ohio water systems serve populations of fewer than 3,300. Collectively, these 875 water systems serve just 8.2 percent of the state's population that receives water service. Meanwhile, more than half (55.6 percent) of the state's population receives water service from the 26 largest systems.

Figure 11. Total Ohio utilities by sector, 2019



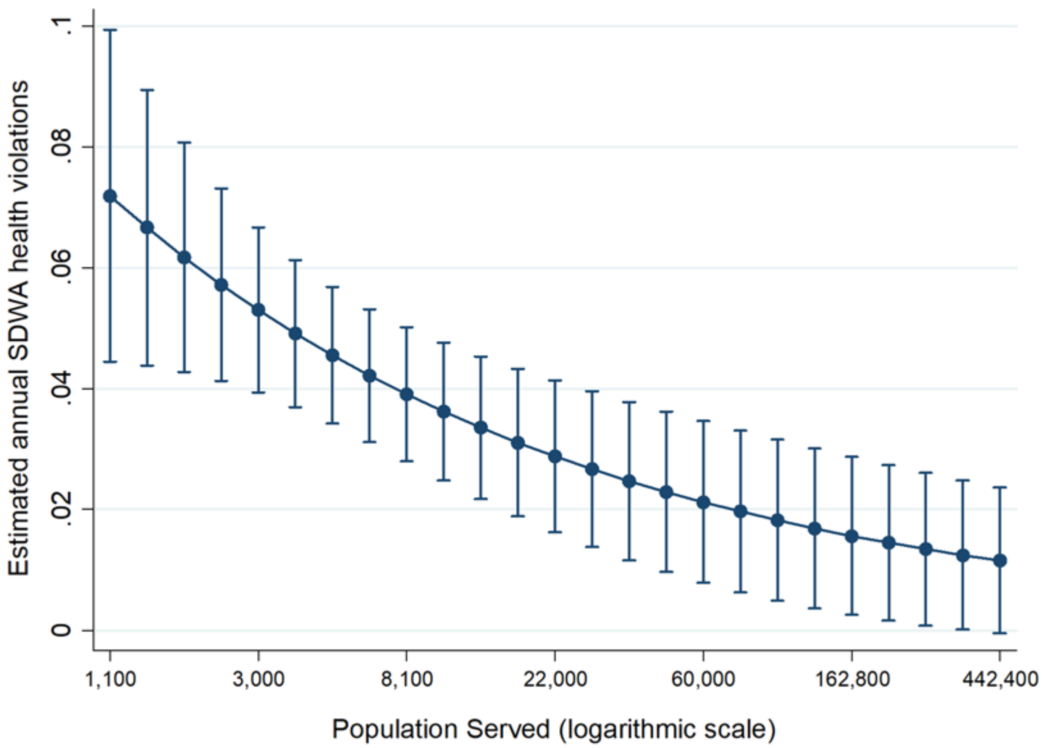
Sources: Ohio Public Utilities Commission, EPA ECHO, EPA SDWIS.

Economies of scale. The present analysis finds that, consistent with national trends (Teodoro 2019), basic water and sewer prices in Ohio are negatively correlated with system size (see Figure 4). As natural monopolies with substantial fixed costs and high human capital needs, water and sewer utilities are examples of industries that enjoy significant economies of scale.

That is, the average cost of providing these services falls as firms increase in size, with physical capital, equipment, and specialized personnel shared across larger numbers of customers. Larger utilities can access financial capital at a lower cost, and can withstand seasonal and macroeconomic revenue fluctuations more easily than smaller utilities. The result is both lower price and improved performance as utilities increase in size.

Several past studies on regulatory compliance find that Clean Water Act (CWA) and SDWA compliance are strongly related to system size (Teodoro & Switzer 2016; Teodoro, Haider & Switzer 2018; Allaire, Wu & Lall 2018; Schaider, et al. 2019). This pattern holds in Ohio, where analysis of SDWA health violations from 2010-2013 show that the frequency of violations falls significantly as systems increase in size (see Figure 12).

Figure 12. SDWA health violations by water system size in Ohio, 2010-2013



Sources: Original analysis of SDWIS data. Spikes represent 95% confidence intervals.

Less obviously, the fragmentation of water and sewer services creates a serious, practical regulatory challenge. From the state's perspective, each of Ohio's 1,187 water systems and 923 sewer treatment facilities must be monitored and regulated by the Ohio Environmental Protection Agency (O-EPA).

Finally, administration of any a statewide CAP would be hampered by the fragmented administration water and sewer services in Ohio (discussed further, below). Effective administration of LIHEAP is possible in part because energy utilities large organizations have the capacity to manage an assistance program on their own or in cooperation with social service organizations. By contrast, a large majority of the water and sewer systems in Ohio are severely limited in their capacity to manage any potential assistance program.

Consolidation. *Reducing the number of water and sewer systems operating in Ohio by an order of magnitude could improve the affordability and quality of these services across the state.* Consolidation can occur through the merger of multiple systems into a larger organization, or the creation of new regional water-sewer authorities. Effective consolidation can also occur when large, investor-owned firms acquire smaller systems (e.g., Aqua Ohio operates several small systems in the state). Formation of large nonprofit organizations to run regional water and sewer systems is another potential means of consolidation. The optimal consolidation approach is likely to vary from one place to another.

Physically integrated utility systems are probably best for taking advantage of economies of scale where physical integration is practicable. However, small systems can be folded into larger organizations even when they're physically separate. That is, multiple small systems can be operated by a single organization; government and investor-owned utilities already operate under this model. Recognizing the potential benefits of consolidation, state governments including California and Connecticut, have taken steps to encourage consolidation. State laws in Kentucky, Missouri, and Virginia also grant state agencies authority to compel consolidation of certain smaller water systems (USEPA 2017).

Reducing the number of water and sewer systems operating in Ohio through consolidation is likely to improve affordability by reducing or controlling the growth in overall prices. At the same time, consolidation is likely to improve water quality and customer service, providing net benefits for customers of all income levels. Moreover, significant consolidation of the water sector in Ohio will facilitate administration local and/or statewide CAP efforts.

5.2 | Rate design

Rate structures that feature low fixed charges, a minimum volume allowance, and/or progressive volumetric pricing all contribute to greater affordability. An important advantage of rate design as part of an affordability strategy is that it places no additional administrative costs on the utility and no administrative burden on customers. Today a majority of Ohio water systems employ either uniform or declining block rate structures; a shift to inclining block rates could immediately improve affordability in these systems.

The chief practical barrier to affordability through rate design is that shifting cost recovery to high-volume customers raises the specter of revenue volatility (Beecher 2010; Chesnutt, McSpadden & Christianson 1996). Water and sewer systems operate with high fixed capital and operating costs, which can leave them short of revenue if demand fluctuates due to environmental or other conditions. This combination of cost stability and potential revenue volatility presents utilities with a financial risk. Concern for revenue volatility has grown in recent years as improvements in indoor water use efficiency have led to overall declines in per capita water demands across the United States (DeOreo, et al. 2016).

Promoting affordability through rate design. The State of Ohio might promote affordability through rate design in a number of ways. First, as noted earlier, consolidation provides a measure of financial stability by virtue of expanding and diversifying each utility's overall customer base. This greater stability can allow utilities to shift to more progressive rate structures with less danger of revenue instability.

From a financial management perspective, the customary way to guard against revenue volatility due to fluctuating demand is to maintain financial reserves sufficient to maintain rate stability during periods of low demand. However, utilities' capacity to carry significant cash reserves varies. For regulated, investor-owned systems, *the Ohio Public Utilities Commission (PUC) could establish pricing guidelines and require that regulated utilities maintain adequate cash reserves to manage reasonable revenue fluctuations. The PUC could also move to a policy of rate decoupling in water, as it has for energy utilities.* To date, only California and New York have extended decoupling to the water sector.

The state may be able to help local government water and sewer utilities maintain affordable rate structures by helping to manage their financial risk. The state could build and maintain dedicated financial reserves that would function as stabilization accounts for the state's local utilities. These reserves could be built gradually during years of moderate-to-high demand, and then drawn down as needed to cover revenue shortfalls during periods of fluctuating retail demand. Such reserves could be maintained separately for each utility, or combined to create a *de facto* insurance pool for the state's water systems. Participation in such a reserve program could be made conditional on utilities meeting specific affordability benchmarks, such as AR_{20}, *HM*, or first gallon price.

5.3 | Customer assistance programs

State policy options for customer-focused CAPs vary in scope and intensity, from clarifying utility authority for use of rate revenues to creation of a statewide low-income assistance program for water and sewer customers. As noted earlier, for purposes of this study, CAPs include all means-tested programs aimed at reducing or offsetting low-income customers' water and/or sewer bills. CAPs can take many forms, from simple fixed amount or percentage discounts to income-adjusted bills.

Enabling legislation for utility CAPs. The legal landscape for rate revenue-funded CAPs in Ohio is unclear, according to the Environmental Finance Center's 2017 review of state laws. For PUC-regulated utilities in particular, statues appear to prohibit charging different prices for identical services, which could preclude means-tested CAPs. At the same time, Ohio Revised Code §4905.34 makes an exception "for charitable purposes" that might allow for low-income assistance programs for PUC-regulated systems. The Environmental Finance Center report

(2017) indicates that, as a Home Rule state, Ohio affords local government utilities relatively broad authority to offer CAPs or even provide water and sewer service free of charge. However, it appears that no statute explicitly authorizes local governments to provide CAPs for water and sewer service.

The State of Ohio could facilitate local efforts to develop CAPs by clarifying laws governing rate design and the use of rate revenue. Such clarification could be especially important investor-owned, PUC-regulated utilities. *Clearer statutes would provide utility leaders, PUC commissioners, and local policymakers who are interested in CAPs defensible guidelines for development.*

Statewide Customer Assistance Program. *Creating a means-tested statewide CAP would be a bold move to help address water and sewer affordability for low-income customers in Ohio.* The federal LIHEAP program for energy assistance offers elements of a template for extension to the water and sewer sector. A similar program for water would require careful policy design and investment in administrative capacity, as well significant new revenue to fund benefits. At a minimum, a statewide low-income water and sewer affordability assistance program must address the following elements:

- **Eligibility.** Who should qualify for benefits? How can a CAP reach customers who live in rental or multifamily housing and may not receive a direct water/sewer bill? Will customers who receive water service but rely on septic systems for wastewater management be eligible for benefits?

- **Benefits.** What volume of water and sewer service should be subsidized through a CAP? What should the benefit be? Will a single benefit level apply statewide, or will benefits be adjusted to reflect local economic conditions? Will benefit levels be determined by water and sewer bills, customer income/wealth, and/or household size? Will benefits go to customers as direct cash payments, or to utilities as bill discounts?

- **Revenue source.** How much will the CAP cost? How will the state raise revenue to fund CAP benefits? Will the cost burden fall disproportionately on low-income households that the CAP is meant to help?

- **Administrative processes.** Who will determine eligibility for a water/sewer CAP? How often will benefit eligibility be reviewed for renewal? Will benefits be administered by utilities, social service organizations, or existing government agencies? If statewide CAPs are administered by utilities, how will small systems and utilities with limited administrative capacity manage CAPs? If a statewide CAP is to be administered by third parties, how will they coordinate with utilities' billing and finance staff? Who will handle eligibility or benefits appeals? Who will audit administrative systems to guard against waste and fraud?

- **Administrative burden.** How will customers learn about the state CAP? Are there significant language or cultural barriers to participation in government assistance programs? What information will customers be required to share with the state in order to qualify? How often will customers be required to renew their eligibility status?

- **Perverse incentives.** Will a CAP encourage utilities to increase the prices of basic services through more regressive rate structures, in order to secure greater CAP funding? Since water and sewer prices are, on average, higher in smaller systems, will a statewide CAP have the unintended effect of discouraging consolidation?

The State of California's ongoing efforts in crafting W-LIRA are instructive, as it addresses many of these elements. Delivering assistance to customers who do not receive a bill directly from a water or sewer utility (e.g., renters in multifamily housing where utilities are included in rents) may require unconventional administrative mechanisms. For example, multifamily residents served by Seattle Public Utilities who pay for water and sewer service through their rent may receive a credit for a portion of those services from Seattle City Light, that city's electrical utility. Income-qualified multifamily residents might instead receive a periodic cash rebate that reflects a share of water and sewer bills. More generally, the administrative dimensions of any statewide CAP are likely to be complicated as long as Ohio's water and sewer services are fragmented across more than a thousand, mostly small, utility organizations. For this reason, significant consolidation would greatly enhance the effectiveness of any statewide assistance program.

Although a statewide CAP can be an important part of efforts to improve water and sewer affordability, decades of experience with LIHEAP administration suggests that a water CAP would, at best, reach a small minority of potentially eligible households. Over the past 20 years, LIHEAP participation has averaged around 16 percent of eligible households, and has never been greater than 22 percent (Perl 2018). Thus, *any statewide CAP should be viewed as part of a comprehensive affordability strategy that includes structural improvements to the water and sewer sector in Ohio.*

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Appendix A | Statistical tables

Table A1. Essential expenditure estimate

Ordinary Least Squares Regression	Coefficient	Robust Standard Error
Family size	-.0142	.0152
Single-family residence	.0440	.0610
High school graduate	.1767	.0718
College graduate	.3494	.0377
Married	.3791	.0405
Black/African American	-.0750	.0512
Native American	-.6151	.1439
Asian / Pacific Islander	-.4622	.2156
Multiple races	.3415	.0902
Hispanic / Latino	.0551	.0717
Log household income	.3485	.0340
Homeowner	.1298	.0463
Intercept	2.8452	.3273
N	2,450	

Note: Dependent variable is log essential non-water utility expenditures. Based on 2016 and 2017 Consumer Expenditure Survey, Ohio sample. Estimates include Bureau of Labor Statistics post-stratification sample weights.

Table A2. Descriptive summary of data

Variable	N	Mean	95% Confidence Interval	Min	Max
Service population	305	15,334	[9,527-21,140]	532	1,308,955
Groundwater	305	.63	[.57-.69]	0	1
Purchased water	305	.20	[.15-.25]	0	1
Private	305	.16	[.10-.21]	0	1
Special district	305	.06	[.03-.08]	0	1
SDWA violations	305	21.97	[18.36-25.58]	0	243
Median income ($)	304	51,448	[49,042-53,854]	20,183	215,679
20^{th} pctle income ($)	304	23,812	[22,568-25,057]	4,125	94,030
%High school education	305	38.89	[37.50-40.27]	4.0	67.9
%College education	305	13.58	[12.55-14.62]	0.0	43.1
%Black population	305	4.63	[3.53-5.74]	0.0	68.5
%Hispanic population	305	2.88	[2.45-3.30]	0.0	29.4
%Asian population	305	0.87	[.70-1.04]	0.0	9.0
Rate progressivity, 0-30,000 gallons	305	0.01	[.00-.02]	-0.17	.60

Note: mean values and confidence intervals reflect post-stratification weighting.

Table A3. Socioeconomic status factor analysis

Variable	Factor Loadings		Uniqueness
	Factor 1	Factor2	
Median income ($)	.87	.41	.06
20^{th} percentile income ($)	.92	.24	.09
%High school education	-.28	-.80	.27
%College education	.44	.79	.18
Eigenvalue	2.89	0.52	

Note: N=304. Rotated Factor 1 loadings were used to generate standardized, regression-based scores for socioeconomic status (mean=0, standard deviation=1).

Appendix B | Sampled utilities

AKRON CITY
ALBANY VILLAGE
ALGER VILLAGE
ALLIANCE CITY
AMANDA VILLAGE
AMHERST CITY
ANDOVER-CAMPLANDS WATER
ANNA
AQUA OHIO - ASHTABULA
AQUA OHIO - AURORA E
AQUA OHIO - BEECHCREST
AQUA OHIO - BLACKLICK
AQUA OHIO - LAKE DARBY
AQUA OHIO - LAKE WHITE
AQUA OHIO - LAWRENCE COUNTY
AQUA OHIO - MANSFIELD SYSTEM #02
AQUA OHIO - MARION
AQUA OHIO - MASSILLON
AQUA OHIO - MASURY
AQUA OHIO - MENTOR
AQUA OHIO - MOHAWK
AQUA OHIO - SENECA
AQUA OHIO - SHEPARD HILLS
AQUA OHIO - STRUTHERS
AQUA OHIO - TIFFIN
AQUA OHIO - TIMBERBROOK PW
AQUA OHIO - TOMAHAWK UTILITIES
AQUA OHIO - VILLAGE OF JEFFERSON
ARCHBOLD VILLAGE
ASHLAND CITY
ASHTABULA COUNTY WATER SYSTEM
ASHVILLE VILLAGE
ATHENS
ATTICA VILLAGE
AURORA CITY - CLEVELAND
AVON CITY
AVON LAKE CITY
BARBERTON CITY
BATAVIA VILLAGE
BEACH CITY VILLAGE
BEDFORD CITY
BELLEFONTAINE CITY
BELMONT CO. SANITARY DISTRICT 3
BELPRE CITY
BEREA CITY
BETHEL VILLAGE
BEVERLY VILLAGE
BEXLEY CITY
BOWLING GREEN CITY
BREWSTER VILLAGE
BROWN COUNTY RURAL WATER
BRYAN CITY
BUCYRUS CITY
BUTLER CO. WATER DISTRICT 2
BYESVILLE
CADIZ VILLAGE
CALDWELL VILLAGE
CAMBRIDGE, CITY OF
CANTON PUBLIC WATER SYSTEM
CARROLLTON VILLAGE
CELINA CITY
CHAGRIN FALLS VILLAGE
CHARDON CITY
CHILLICOTHE CITY
CINCINNATI PUBLIC WATER SYSTEM
CIRCLEVILLE CITY
CITY OF HEATH
CLERMONT PUBLIC WATER SYSTEM
CLEVELAND PUBLIC WATER SYSTEM
CLYDE CITY
COAL GROVE
COLDWATER VILLAGE
COLUMBUS GROVE VILLAGE
COLUMBUS PUBLIC WATER SYSTEM
COMMERCIAL POINT VILLAGE
CONNEAUT
CORTLAND CITY
COSHOCTON
CRESTLINE VILLAGE
CRIDERSVILLE VILLAGE WATER
CUYAHOGA FALLS CITY
DALTON VILLAGE

DAYTON PUBLIC WATER SYSTEM
DEFIANCE CITY
DELAWARE CITY
DEL-CO WATER COMPANY, INC.
DELPHOS CITY
DOVER CITY
DOYLESTOWN VILLAGE
EARNHART HILL WATER DISTRICT
EAST LIVERPOOL CITY
EAST PALESTINE VILLAGE
EDGERTON VILLAGE
ELIDA VILLAGE
ELMORE VILLAGE
ELYRIA WATER DEPARTMENT
ENGLEWOOD CITY
ERIE CO HURON EAST DISTRICT
ERIE CO MARGARETTA DISTRICT
ERIE CO PERKINS DISTRICT
FAIRBORN PUBLIC WATER SYSTEM
FAIRFIELD CITY
FAIRFIELD COUNTY UTILITIES
FARMERSVILLE VILLAGE
FAYETTE VILLAGE
FINDLAY CITY
FOSTORIA CITY
FRANKLIN PUBLIC WATER SYSTEM
FREMONT CITY
GAHANNA CITY
GALION CITY
GALLIA CO RURAL WATER ASSOCIATION
GAMBIER VILLAGE
GENEVA CITY
GEORGETOWN VILLAGE
GERMANTOWN CITY
GLANDORF VILLAGE
GNADENHUTTEN
GRANVILLE, VILLAGE OF
GREENE CO.-NORTHWEST REG WATER
GREENE COUNTY - DAY
GREENE COUNTY - FAIRBORN
GREENE COUNTY EASTERN REGIONAL
GREENFIELD CITY
GREENVILLE CITY
GROVEPORT
GUERNSEY CO. WATER DEPT.
HAMILTON PUBLIC WATER SYSTEM
HARRISON CITY
HEBRON VILLAGE
HECLA WATER ASSOCIATION-PLANT
HIGHLAND COUNTY WATER COMPANY, INC.
HILLSBORO CITY
HUBBARD CITY
HUBER HEIGHTS PUBLIC WATER SYSTEM
HUDSON CITY
HURON CITY
INDIAN HILL CITY
IRONTON
JACKSON CENTER VILLAGE
JACKSON CO. WATER COMPANY-WTP
JACKSON, CITY OF
JACKSON/MILTON METRO WATER DISTRICT
JEFFERSON CO W AND S DISTRICT - M
JOHNSTOWN VILLAGE
KENT CITY
KNOX COUNTY WATER AND WASTEWATER
LAGRANGE VILLAGE
LAKE COUNTY EAST WATER SUBDISTRICT
LAKE COUNTY WEST WATER SUBDISTRICT
LAKEWOOD CITY
LANCASTER CITY
LE-AX REGIONAL WATER DISTRICT
LEBANON CITY
LEESBURG VILLAGE
LIMA CITY
LOCKLAND VILLAGE
LOGAN, CITY OF
LORAIN CITY
LOUDONVILLE VILLAGE
LOVELAND CITY

MALTA VILLAGE
MALVERN VILLAGE
MANSFIELD CITY
MARIETTA CITY
MARYSVILLE CITY
MAUMEE CITY
MEDINA CITY
MEDINA CO/NORTHWEST
MEDINA CO/SOUTHERN WATER DIST
MIAMISBURG CITY
MIDDLEFIELD VILLAGE
MIDDLETOWN CITY
MIDVALE VILLAGE
MILAN VILLAGE
MILLERSPORT VILLAGE
MINSTER VILLAGE
MONROE CITY
MONROEVILLE VILLAGE
MONTGOMERY COUNTY WATER SERVICES 1
MONTGOMERY COUNTY WATER SERVICES 2
MOUNT ORAB VILLAGE
MOUNT STERLING VILLAGE
MOUNT VERNON CITY
MT GILEAD VILLAGE
MUNROE FALLS CITY
MUSKINGUM COUNTY WATER - SE
NAWA
NEW LEBANON VILLAGE
NEW LEXINGTON
NEW PHILADELPHIA CITY
NEWARK CITY
NEWCOMERSTOWN VILLAGE
NEWTON FALLS CITY
NILES CITY
NORTH CANTON CITY
NORTH RIDGEVILLE CITY
NORTHERN OHIO RURAL WATER
NORTHERN OHIO RURAL WATER - NW DISTRICT
NORTHWEST REGIONAL WATER DISTRICT
NORTHWESTERN W AND SD -TOLEDO SVCE AREA
NORWALK CITY
NORWOOD CITY
OAK HARBOR VILLAGE
OAKWOOD CITY
OAKWOOD VILLAGE
ONTARIO CITY
OREGON CITY
ORRVILLE CITY
OTTAWA COUNTY REGIONAL WATER DISTRICT
OTTOVILLE VILLAGE
OXFORD CITY
PAINESVILLE CITY
PATASKALA CITY
PAULDING VILLAGE
PEMBERVILLE VILLAGE
PERRYSBURG CITY WATER
PHEASANT RUN ASSOCIATION
PICKERINGTON CITY
PIKE WATER, INC.-PLANT
PIKETON VILLAGE
PIQUA CITY
PORT CLINTON CITY
PORTSMOUTH PUBLIC WATER SYSTEM
PUTNAM COMMUNITY WATER ASSOCIATION
QUINCY VILLAGE
RAVENNA CITY
RAWSON VILLAGE WATER
REYNOLDSBURG CITY
RIO GRANDE
ROCKFORD VILLAGE
ROSS COUNTY WATER CO INC
RURAL LORAIN CO. WATER A
SALEM CITY
SANDUSKY CITY
SCIOTO CO. REGIONAL WATER DISTRICT #1
SCIOTO WATER, INC.-ROSE HILL
SEBRING VILLAGE
SEVILLE VILLAGE

SHEFFIELD LAKE CITY
SHELBY CITY
SIDNEY CITY
SILVER LAKE VILLAGE
SMITHVILLE VILLAGE
SOUTH BLOOMFIELD VILLAGE
SOUTH LEBANON VILLAGE
SOUTH POINT VILLAGE
SOUTHWEST LICKING COMMUNITY WATER
SPENCER, VILLAGE OF
SPRINGBORO
SPRINGFIELD CITY
ST. CLAIRSVILLE CITY
STEUBENVILLE, CITY OF
STOW PUBLIC WATER SYSTEM
STREETSBORO CITY
SWANTON VILLAGE
SYLVANIA CITY
TALLMADGE CITY
TATE-MONROE WATER ASSOCIATION
TCMSD-WILKSHIRE HILLS
TOLEDO, CITY OF
TORONTO
TRENTON CITY
TROTWOOD CITY
TROY CITY
TRUMBULL CO.-SOUTHEAST
TUPPER PLAINS/CHESTER WATER DISTRICT
UNION CITY
UPPER SANDUSKY CITY
URBANA CITY
VAN WERT CITY
VERMILION CITY
VILLAGE OF THORNVILLE
WADSWORTH CITY
WAPAKONETA CITY
WARREN CITY
WARREN CO. FRANKLIN AREA
WARREN CO. RICHARD RENNEKER
WARREN CO. SOCIALVILLE
WASHINGTON COURT HOUSE
WATERVILLE CITY
WAYNESBURG VILLAGE
WELLINGTON VILLAGE
WEST CARROLLTON CITY
WEST MILTON VILLAGE
WEST UNION PUBLIC WATER SYSTEM
WEST UNITY VILLAGE
WESTERN WATER COMPANY
WESTERVILLE CITY
WHITEHOUSE VILLAGE
WILMINGTON CITY
WINDHAM VILLAGE
WINTERSVILLE VILLAGE
WOOSTER CITY
WYOMING CITY
XENIA CITY
YOUNGSTOWN CITY
ZANESVILLE