WATER AND WASTEWATER RATE HIKES OUTPACE CPI

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DISCLAIMER

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SUMMARY

Water and wastewater treatment and delivery is the most capital-intensive of all utility services. Historically underpriced, water and wastewater rates have exhibited unprecedented growth in the past fifteen years. Steep annual increases in water and wastewater rates that outpace the Consumer Price Index (CPI) have increasingly become the norm across the United States. In this paper, we analyze water and wastewater rates across U.S. census regions between 2000 and 2014. We also examine some of the driving factors behind these rate increases, including drought, water source, required infrastructure investment, population patterns, and conservation effects. Our results demonstrate that water and wastewater prices have consistently increased and have outstripped CPI throughout the study period nationwide, as well as within each census region. Further, evaluation of the current and upcoming challenges facing water and wastewater utilities suggests that sharp rate increases are likely to continue in the foreseeable future.

1. INTRODUCTION

Water utilities have historically priced treatment and delivery at artificially low levels.[1] Low water and wastewater rates for consumers across the United States, enabled by delayed capital improvements and formerly generous government grant programs, have prompted the widespread perception of potable water as a relatively cheap commodity. Between 2001 and 2013, however, water and wastewater rates[a] rose considerably across the United States, outpacing the Consumer Price Index (CPI)[b] by two and a half times.[2] Although rates have risen in the past, the sustained, steep rate increases observed in recent years have exceeded previous trends.

Water utilities face challenges of drought, source switching and diversification, aging infrastructure that often requires substantial capital investment, population growth, and declining demand resulting from conservation efforts and technologies. These financial demands are reflected in rising rates, which are beginning to indicate the actual economic cost of delivered potable water. Financially sustainable rates must (1) enable the utility to recover expenditures through revenues, and (2) be affordable to consumers so they can continue to support utility infrastructure.[c,3] Despite recent rate hikes, however, an estimated 64 percent of water utilities still do not generate enough revenue to cover all financial obligations,[4] and only 9 percent report that no changes are required to provide for cost recovery.[5] Ultimately, the long-term and mounting financial pressures on U.S water utilities signal that recent patterns of steep rate increases that considerably exceed the economic inflation rate are not temporary.

In exploring recent trends in residential water and wastewater rates, this paper (1) discusses rate trends in the existing literature; (2) examines some of the factors driving recent rate increases, including drought, available water sources, infrastructure needs, population growth, and conservation efforts and technology; (3) surveys patterns in underlying rate structures; and (4) analyzes rate trends in comparison to the CPI. Throughout this paper we refer to potable water from the drinking water system as "water," and sewage or other effluent as "wastewater."

2. BACKGROUND

With an estimated 54,000 community water systems, 14,780 wastewater treatment facilities, and 19,739 wastewater pipe systems[6] in the United States, the water industry is operationally dispersed. Although most communities have experienced rising water rates during the past decade, both nominal rates and rate increases demonstrate great variability. For the 50 largest cities in the United States, the cost (in 2013$) for a monthly consumption of 7,500 gallons of water by residential users in 2013 ranged from a low of $14.74 in Memphis to a high of $61.43 in Seattle.[2] Wastewater rates for the same 7,500 gallon amount demonstrated a wider range, from a low of $12.72 in Memphis to a high of $139.46 in Atlanta.[2] High water rates in a region do not always signify high wastewater rates, and vice versa. Of 50 cities studied, Jacksonville ranked 13th for water and 41st for wastewater rates (where a higher rank indicates higher rates).[2] The pace of rate adjustments is similarly varied. From 2013 to 2014 water rates for use of 100 gallons per person per day ranged from no change in the cities of Phoenix, Santa Fe, Jacksonville, Columbus, and Atlanta to as much as a 43.1 percent increase in Fresno.[7] The disparities stem from the fact that water and wastewater rates are largely a function of local circumstances, including structural factors such as utility size, population growth, rate structure, current and projected debt, and water source, among others.

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[a] For a residential household consuming 7,500 gallons per month.

[b] CPI data available here: http://www.bls.gov/cpi/data.htm.

[c] Underpricing can lead to financial difficulty for the utility and overconsumption by the consumer; overpricing can result in water bills that place a hardship on some consumers.

3. LITERATURE REVIEW

This section summarizes findings from a review of the water and wastewater rate literature and how increases in rates compare to the overall CPI.[d] In the past few decades, the United States has moved from an era of water resource development to one of allocation, while total demand for new water has exceeded new supply in parts of the country.[8, 9] Population migration trends generally have been toward more arid regions and toward urban centers, and protecting stream flows for recreation and wildlife has become more customary to include in water source planning. Meanwhile, options to develop new or alternative water supplies, such as new dams, desalination plants, or long-distance transfers, come at a higher cost. Ongoing and deferred maintenance and expansion of existing infrastructure has also strained financial resources. Such broader factors underlie a recent boost in rates for both raw and delivered water; on average, rates for delivered water have increased five to ten percent per year throughout the past decade, with the annual growth rate increasing over time. One report predicts this trend will continue to accelerate, as regional scenarios show that "sharply increasing water prices that we can empirically observe today in a few selected water-deficient regions are likely to be predictive of trends that will develop in many other parts of the world tomorrow."[8]

Several reports provide more evidence of recent jumps in water tariffs. The Water and Wastewater Rate Survey by the American Water Works Association and Raftelis Financial Consultants, Inc. (AWWA/RFC) of 318 water utilities and 231 wastewater utilities nationwide identified an average rate increase between July 2012 and July 2014 of 9.5 percent (water) and 9.7 percent (wastewater) for consumption of 1,000 cubic feet/month.[5] The surveys also show that from 1996 to 2012, the average residential price of water climbed 4.9 percent per year compared to an annual growth of 2.5 percent in general CPI. In some areas annual growth rates for water prices have reached 12 percent.[5] *Circle of Blue*[7] has performed annual surveys of water rates for single-family residences in the nation's 20 largest cities plus 10 regionally representative cities, tracking trends since 2010. Water costs for a "medium consumption" scenario of a family of four each using 100 gallons per day[e] rose on average 6 percent between 2014 and 2015, and climbed by 41 percent since 2010.[10,11] Black & Veatch's 2012/2013 survey estimated a 5.6 percent compound average annual increase in water bills and a 6.1 percent increase in wastewater bills for residential consumers from 2001 to 2013, compared to a 2.4 percent average increase in CPI for the same period.[2] Fitch Ratings contends that water prices will continue to exceed inflation.[12] *USA TODAY* reporters expanded on the Black & Veatch and AWWA/RFC surveys by obtaining similar data from dozens of additional municipalities to cover a total of 100 water utilities, representing a mix of small and large utilities in all 50 states. They found that since 2000, water rates have at least doubled in 29 percent of the municipalities examined.[13]

Similarly, another study finds that recent water and sewer services show marked and consistent price inflation relative to the general CPI, outpacing other utilities like telephone services, electricity, natural gas, and postage.[14] The CPI specific to water and sewerage services increased from an indexed value of 50 in 1975, diverging abruptly from general CPI around 1990 to reach roughly 220 in 2000 and 400 in 2010. A

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[d] The CPI is one measure of inflation, as consumers experience it in their day-to-day expenses. It is defined by the Bureau of Labor Statistics as "a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services" (http://www.bls.gov/cpi/cpifaq.htm). The goods and services included in calculating CPI are from recent *Consumer Expenditure Surveys* of around 7,000 families. Major groups are food and beverages; housing; apparel; transportation; medical care; recreation; education and communication; and other goods and services (*e.g.* tobacco products, haircuts). Also included are government-charged fees, like vehicle registration or utility fees, and taxes directly correlated with prices of goods, like sales taxes. The CPI is continually revised along with shifts in demographics and consumer buying habits, and advances in statistical methods.

[e] That per capita daily consumption is higher than the U.S. Geological Survey's estimated average of 89 gallons.[7, 11]

plot of water and sewerage CPI since 1983 shows an inflection point around 2002 to 2003, after which the CPI increases more sharply than before (Figure 3.1).

Table 3.1 summarizes rate increases compared to CPI for various study periods.

These studies together suggest that during the past decade, water price increases have eclipsed historical prices of a market basket of goods and services.
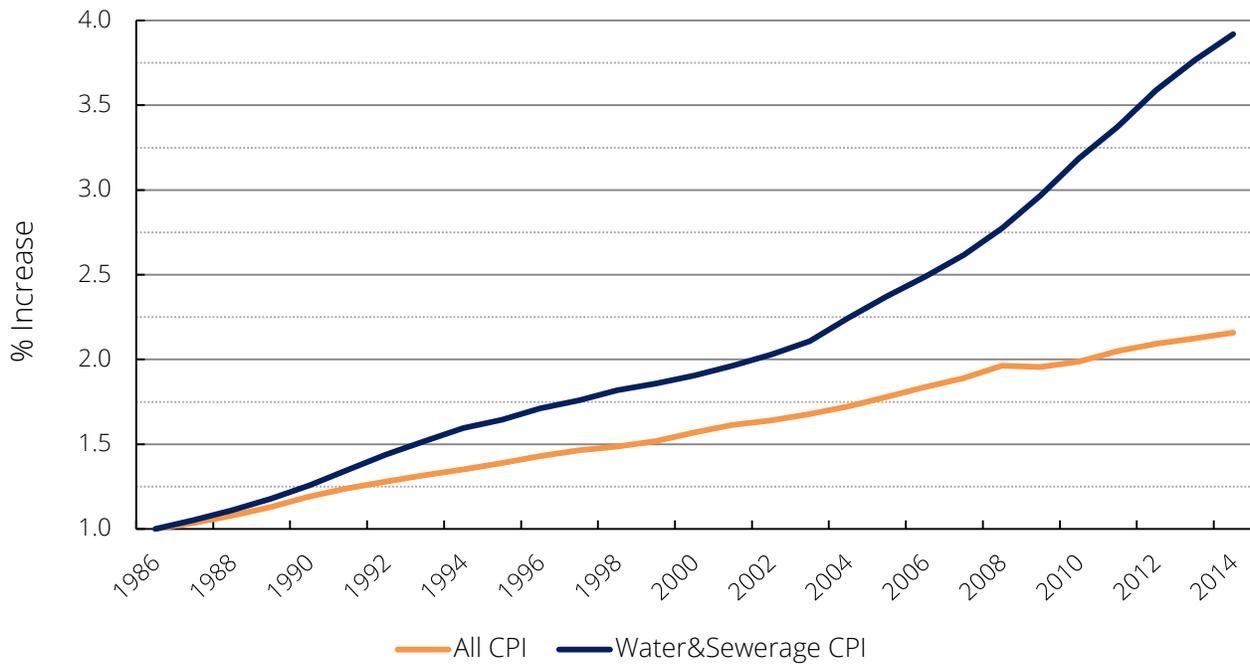
Figure 3.1 CPI for Water Rates versus CPI for All Items
Source: U.S. Bureau of Labor Statistics, http://www.bls.gov/cpi/data.htm

Table 3.1 Summary of Rate Increases from the Existing Literature

Study	Years	Monthly Consumption	Water Rate Increase	Wastewater Rate Increase	% Increase CPI
Circle of Blue	2010-2015	100 g/p/d, family of 4	41%	-	-
	2014-2015		6%	-	-
Black & Veatch	2001-2013	7,500 gallons	5.6%	6.1%	2.4%
AWWA & RFC	2006-2008	7,480 gallons	12.3%	15.1%	10.9%
	2008-2010		13.6%	8.6%	-0.9%
	2010-2012		13.7%	14.8%	5.1%
	2012-2014		9.5%	9.7%	4.0%

These trends are expected to continue in the foreseeable future. Over half (55 percent) of water and wastewater utilities project that annual rate increases of at least five percent are necessary over the next ten years.[4] Water and wastewater utilities reported the projected annual rate hikes are necessary to fully cover services and ensure funding sufficiency over the next decade, including operation and maintenance, debt service, replacement and renewal, capital improvements, and sufficient reserve funding.[4] Figure 3.2 indicates that while these projections have declined slightly as compared to 2014, utilities still view rate increases as an imperative for future financial stability.
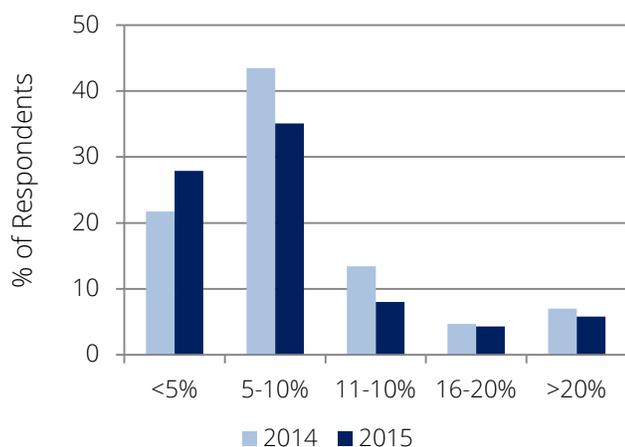
Figure 3.2 Annual Rate Increases Required for Funding Sufficiency

Source: Black & Veatch, S*trategic Directions: U.S. Water Industry Report*

4. FACTORS DRIVING RATE INCREASES

The varied characteristics of water utilities within the U.S. water supply industry and the unique set of challenges that face each utility make it difficult to summarize the underlying drivers of rate increases or to develop mitigation strategies. From increasing operating expenses resulting from rising commodity

prices (such as for electricity[f] and treatment chemicals) to compliance with national clean-water standards, many factors are potentially implicated in the decade-long spike in water prices.[13] Although an extensive analysis of rate increases in the context of all relevant variables is outside the scope of this study, the following sections examine five major drivers behind the recent pattern of sharp, sustained rate increases: (1) drought, (2) available water sources, (3) capital needs for infrastructure investment, (4) population patterns, and (5) conservation efforts and technology.

4.1   DROUGHT

Given legal constraints, political pressures, and low estimates of price elasticity, water utilities generally have resisted marginal[g] cost pricing, instead setting rates to meet average costs.[15] Instead of raising prices during droughts, municipal water utilities typically respond by limiting residential outdoor use via time-of-day or day-of-week restrictions, outright bans on car washing or using water to clean hardscapes, requiring hose shutoff valves, or rationing via an allotment system.[h] Enforcement varies by

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[f] A recent study of 11 utilities collectively serving 20 million customers in all regions of the country revealed the energy required to convey, treat, and distribute drinking water to be 1,500–3,500 kWh/million gallons (mean = 2,300); Young, R. "A Survey of Energy Use in Water Companies." American Council for an Energy-Efficient Economy. 2015. http://aceee.org/sites/default/files/water-company-energy-use.pdf.

[g] Marginal water cost pricing refers to the cost increment between volume cost ranges.

[h] Examples abound as of August 2015. Denver, CO residents may only water between 6 p.m.-10 a.m. three days per week (http://www.denverwater.org/Conservation/WaterUseRulesRegulations/SummerWateringRules/). San Francisco, CA residents must avoid watering outdoor landscapes in a manner that causes runoff to hardscapes (http://sfwater.org/index.aspx?page=872), while those in San Diego, CA with standard sprinklers may water only five minutes per day, two days per week, with residents using drip and micro-irrigation systems still limited to two days. (http://www.sandiego.gov/water/conservation/drought/prohibitions.shtml). Santa Cruz, CA allots 1000 ft^3 to SFRs. (http://www.cityofsantacruz.com/departments/water/drought/residential-drought-requirements). Statewide, Californians may not irrigate within 48 hours of rainfall, nor may they use tap water to wash

municipality. Average-cost prices—unreflective of water's status as a scarce resource—historically have proven to be a disincentive to conservation as well as to investment in infrastructure and technological or policy innovation.

Recent studies have confirmed the strong potential for drought pricing to reduce urban water use. Using metered data disaggregated into end uses from more than 1,000 households in 11 municipalities, Mansur and Olmstead determined that using equilibrium prices in lieu of water rationing would reduce deadweight loss and thereby increase welfare[i] by $96 per household during a lawn-watering season, or almost 30 percent of what sample households pay annually for water.[16] The authors concluded that outdoor water use is more price-elastic, or sensitive to changes in price, than is indoor consumption, and recommended that drought pricing be coupled with consumer rebates to effectively cut water demand while addressing issues of equity. In practice, the 1987–1991 California drought furnished some evidence for drought pricing strategies. Relatively steep price jumps across an increasing block rate structure established by the Alameda County Water District in July 1991 led to a 16 percent drop in residential water consumption from 1990 to 1991, as well as an increase in revenue—despite small estimated demand elasticities.[15] Other water utilities in California that instead implemented quantity restrictions experienced revenue losses that required them to raise rates after the drought ended.[15] As the Water Research Foundation put it, "Because the

majority of the utilities' expenses, at least in the short-run, are fixed while the majority of revenues are obtained from the commodity charges," conservation efforts often result in revenues declining more rapidly than expenses.[17]

Widespread droughts are common in the United States, especially in the country's western half, where per-capita consumption is highest largely because of domestic irrigation. While 2014 witnessed atypically dry or drought conditions in more than half the country, droughts covering 40 percent or more of U.S. land area have occurred at least once per decade in eight of the past nine decades.[18] Figure 4.1 shows the percent area of the country that fall into the following U.S. Department of Agriculture Drought Monitor[19] categories: no drought, abnormally dry (D0), moderate drought (D1), severe drought (D2), extreme drought (D3), and exceptional drought (D4).

Looking ahead, continued demographic shifts westward and a changing climate likely will find more Americans living under drought conditions. Populations in the two most arid U.S. Census divisions, Mountain and Pacific, are expected to grow by 45 percent and 33 percent, respectively, between 2010 and 204018, while variability in water supply will increase as the planet warms.[20] Those trends, combined with the economic rationale behind raising water tariffs to lessen demand or meet the marginal costs of supply, mean that drought pricing—and the potential for marginal cost pricing in drought's absence—should be factored into projections of water rates for the next 30 years.

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driveways or sidewalks.
(http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/fs_conservreg_032715.pdf). In Austin, TX, residents may only water one day per week, and washing vehicles outside of commercial carwash facilities is prohibited (http://www.austintexas.gov/department/stage-2-watering-restrictions).

[i] Deadweight loss can be thought of as an inefficient allocation of goods and services via distortions of a perfectly competitive market, such as quantity or price restrictions, externalities, or the imposition of subsidies or taxes. Decreasing deadweight loss reduces this excess burden and augments welfare, used in microeconomics to signify economic well-being.
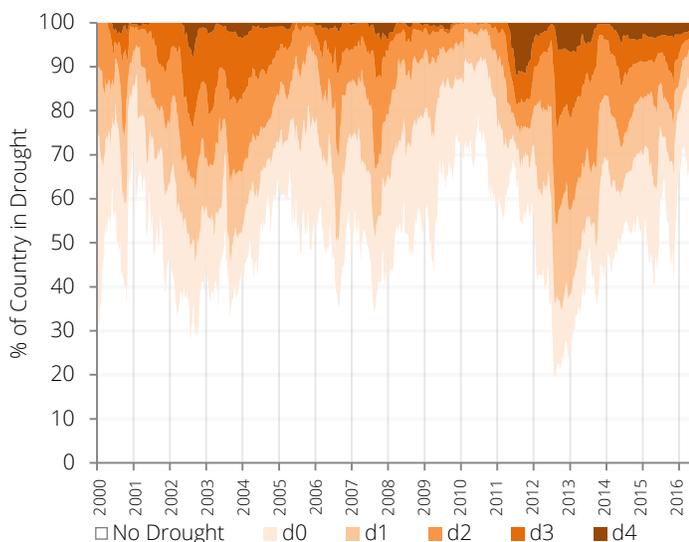
Figure 4.1 Drought in the U.S., 2000-2016
Source: U.S. Drought Monitor, droughtmonitor.unl.edu

4.2 WATER SOURCES

During a drought, a utility may find itself unable to obtain water supplies from surface or ground water, which are usually among the least expensive sources. Utilities traditionally rely on their primary (cheapest) source to the greatest extent possible, followed by other sources in order of increasing price.[21] Supply scarcity has become an imminent threat for many utilities; over 60 percent of utilities cite it as the most significant of four different climate change issues.[4] Recently, utilities (particularly in the West) have had to turn to new or alternative water supplies, such as new dams, desalination plants, or long-distance transfers, which engender high costs.[4] Water source is a key cost indicator for utilities, and inevitably a factor in rate determination.21 The following section examines trends between water source and rates, as well as the impact of source diversification on water prices.

The 2012 AWWA/RFC survey developed weighted averages for the sources tapped by water utilities: 31 percent groundwater, 50 percent surface water, and 16 percent purchased/other water.[22] One study analyzed the AWWA/RFC 2010 survey data to determine water rates by source, and found that water prices were cheapest for utilities that utilized groundwater, followed by surface water, and then purchased water.[21] Analysis of the 2014 AWWA/RFC survey data indicates these trends have persisted.

Figure 4.2 provides average and median rates for water utilities[j] by water source for consumption of 7,480 gallons. The analysis determined rates for utilities that reported obtaining at least 75 percent of their water supply from the specified source. The average rates were $29.41 for groundwater, $34.71 for surface water, $33.69 for other,[k] and $41.38 for purchased water. The Environmental Protection Agency's (EPA) 2006 Community Water System Survey found that the number of utilities that rely on purchased water increased by 9 percent between 2000 and 2006, representing 18 percent of all systems.[23] One study developed a cost recovery ratio (determined by dividing monthly charges by the sum of operating expenses and interest accrued from debt[l]), and concluded that utilities that relied primarily on groundwater held the highest cost recovery ratio.[21]
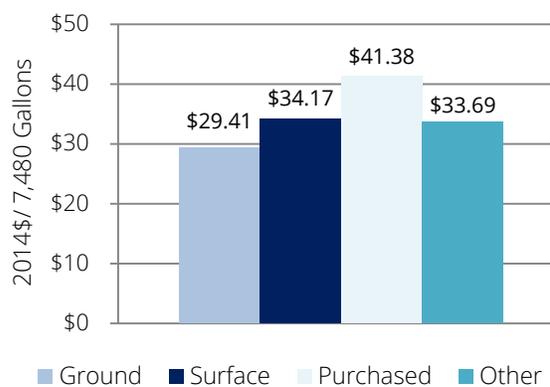

Figure 4.2 Water Rates by Source
Source: AWWA/RFC (2014), *Water and Wastewater Rate Survey*

Utilities engaged in source diversity (defined as not utilizing a single source for more than 60

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[j] Such data were not provided for wastewater utilities.
[k] Not specified.
[l] Data on actual debt payment were unavailable.

percent of supply)[m] incur additional costs. This trend is growing, particularly in water-scarce areas.[21] In 2012, 10 percent of utilities reported using more than one primary water source, compared to 6.7 percent in 2010. Split-source utilities have higher rates than both surface and groundwater utilities, a trend mirrored by higher minimum operating expenses compared to providers with a single primary source.[21] Additionally, utilities engaged in source diversification "tend to be very large utilities located in areas with the lowest annual precipitation, suggesting that water scarcity can push utilities to diversify their sources, resulting in higher costs to the utility and higher rates for the consumer."[21] Exploration of the 2014 AWWA/RFC Water and Wastewater Rate Survey confirms this trend. The average monthly bill for a residential user (assuming consumption of 7,480 gallons) for utilities that do not rely on a single source for more than 50% of their water supply was relatively high, at $38.76.[5]

There is no nationally representative available information regarding the distribution of water supply sources for wastewater utilities, average rates by source, or average rates for split-source utilities. We assume that supply source influences costs for wastewater utilities in a similar manner because wastewater use is directly correlated with water use in the vast majority of utilities, with divided wastewater and storm water systems.

4.3 INFRASTRUCTURE NEEDS

The water and wastewater infrastructure throughout the United States is reaching the end of its service life,[24] with pipes laid in the 1890s, 1920s, and 1950s requiring replacement in the next 30 to 40 years.[n] Substantial capital investment is needed both

for infrastructure replacement and expansion to accommodate growing populations. Among the range of challenges facing the industry, utility employees surveyed in the AWWA's *State of the Water Industry Survey* ranked the "renewal and replacement of aging water and wastewater infrastructure" as the most critically important, followed by "financing for capital improvements."[5] Out of five possible capital improvement plan drivers (infrastructure repair/rehabilitation, infrastructure replacement, expansion, new facilities, and upgrades for new regulations), water and wastewater service providers identified repair/rehabilitation and replacement as the most important, followed by expansion.[5] Further, utilities identified "maintaining or expanding asset life" as the most significant sustainability issue.[4]

The total cost burden is great, with costs for fixed assets an estimated five times that of operating expenses.[21] Cost predictions for infrastructure replacement, renewal, and expansion vary (estimates range from $195 billion for water and wastewater combined from 2010–2040,[6] to a high of $1 trillion for drinking water alone from 2011–2035[25]). These discrepancies are largely indicative of different methodologies, study periods, and assumptions regarding pipe replacement. Between 2002 and 2010, the long-term debt of water utilities, much of it attributable to capital infrastructure projects, increased by a median of 23 percent.[21] Despite its importance, infrastructure is critically underfunded; one estimate concludes that should current spending patterns persist, only about a quarter of 30-year (2010–2040) capital needs for maintaining and expanding water delivery systems, wastewater treatment plants, and sanitary and storm sewer systems will be funded.[6] Another study found that based on current spending patterns, the total investment need for water infrastructure that is funded will likely decline—from approximately 57 percent in 2011 to 49 percent in 2020 and to 40 percent in 2040.[26]

The amount an individual utility will have to invest in infrastructure depends on many factors, including the age and material of the infrastructure, population

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[m] Definition provided by the 2012 AWWA/RFC *Water and Wastewater Rate Survey.* The 2014 survey did not provide an update to these figures.

[n] Pipes laid during World War II, which commonly incorporated inferior materials, often require earlier replacement than those laid at the end of the 19th century.

and projected population growth, and the size of the utility. Many utilities have delayed incorporating pending infrastructure costs into their tariffs and fees in favor of maintaining lower rates. With the useful lifetimes of many systems drawing to a close, however, utilities increasingly are left with no choice but to integrate the high costs of infrastructure renewal and replacement into their rates and fees to ensure full-cost pricing,[o] resulting in sharp rate increases to consumers.[5] Currently, only 17 percent of utilities report they are "fully able" to recover all the costs of providing service (including infrastructure needs) through customer rates; fewer than 15 percent project they will be able to do so in the future.[5] With Congressional appropriations representing only a fraction of the investment need, the public will play a large role in financing infrastructure investments through increased rates or taxes.[26] Thus, there are concerns regarding the ability of utilities to use their rates to finance the necessary capital expenditures while ensuring affordability and minimizing rate shock.[26]

4.3.1 Water Infrastructure Needs

The AWWA estimated that infrastructure costs by themselves could triple drinking water bills in the most affected communities.[6] The EPA developed 20-year cost estimates for drinking water renewal, replacement, and expansion (beginning in 2011) of $384 billion.[p,27] Conversion of a number of assessments for 20-year needs in 2011 (billions of dollars) yielded estimates of $331 to $572, $412, and $570.[27] AWWA's assessment of water infrastructure replacement and expansion funding requirements outstrip these estimates,

projecting costs of $1.0 trillion from 2011–2035[q] and $1.8 trillion from 2011–2050.[25] The AWWA study disaggregates funding requirements by U.S. Census region (see Figure 4.3). U.S. Census regions (outlined in Table 4.1) are used throughout the paper when discussing trends and presenting analytical results.

Table 4.1 States in Each U.S. Census Region

REGION	STATES
Midwest	Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, North Dakota, Nebraska, Ohio, South Dakota, and Wisconsin.
South	Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.
Northeast	Connecticut, Massachusetts, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.
West	Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming.

Source: U.S. Census Bureau, *Census Bureau Regions and Divisions with State FIPS Codes*, http://www2.census.gov/geo/docs/maps-data/maps/reg_div.txt

Figure 4.3 below indicates the percentage of infrastructure investment needs for each census region for potable water. The South requires the greatest investment in infrastructure—approximately half of the total national need.[25] As of 2014, the South had the lowest average water rates out of the census regions, but is projected to incur the highest infrastructure renewal costs per household.[25]

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[o] According to the AWWA/RFC 2014 Water and Wastewater Rate Survey, doing so entails "charging rates and fees that reflect the full cost of providing water—[which] must include renewal or replacement costs of treatment, storage, distribution, and collection systems."

[p] Represents the need associated with thousands of miles of pipe, thousands of treatment plant and source projects, and billions of gallons of storage. Did not factor in population growth.

[q] Estimates are in 2010 dollars. This study period is five years longer than previously listed estimates.
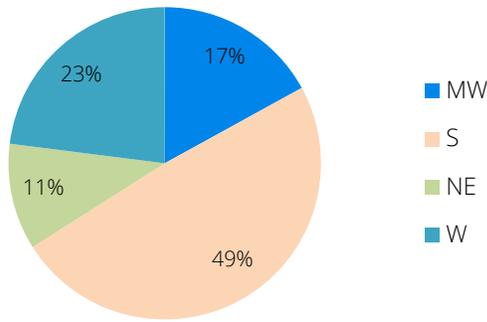
Figure 4.3 Total Projected Water Infrastructure Need by Region, 2011-2035
Source: AWWA (2012), *Buried No Longer: Confronting America's Water Infrastructure Challenge*

Table 4.2 shows the percent of projected drinking water infrastructure costs to be allocated to replacement or to growth within each census region from 2011 to 2050.[25] Investment needs attributable to population growth are most prominent in the West, followed by the South. This projected growth is a major driver behind the high costs the South and West are expected to incur. Both the Northeast and Midwest, in contrast, are projected to require substantially less investment overall, as well relatively little investment attributable to expansion. Nationwide, replacing existing pipes accounted for 54 percent of needs; growth accounted for 46 percent.[25]

Table 4.2 Percent of Total Projected Infrastructure Costs Allocated to Replacement and Growth by Census Region, (2011-2015)

Region	Replacement %	Growth %
Midwest	87%	13%
South	44%	56%
Northeast	87%	13%
West	39%	61%
Nationwide	54%	46%

Source: AWWA (2012), *Buried No Longer: Confronting America's Water Infrastructure Challenge*

Medium-sized water utilities[r] appear to require nearly half (44 percent) of the total national projected capital investment, though this is proportional with the percent of U.S. population they serve (46 percent).[27] Larger water utilities are estimated to serve about 46 percent of the population but require only 39 percent of total investment. Water utilities defined as small by the EPA will disproportionately require 17 percent of the national estimated capital investment while serving only 8 percent of the population.[27] Smaller utilities may also be unable to utilize economies of scale, given that they may have more pipe miles per customer.

4.3.2 Wastewater Infrastructure Needs

In 2012 the EPA estimated addressing the needs of wastewater infrastructure and treatment will require approximately $271 billion over the next 20 years.[28,s] While this is a decline from the estimate of $338 billion made in the 2008 report, infrastructure investment needs remain high and underfunded. Investment for wastewater treatment ($102 billion) and pipe repair/new replacement ($96 billion) account for the majority of wastewater funding needs, representing 73 percent. Remaining needs include combined sewer overflow ($48 billion), storm water management ($19 billion), and recycled water distribution (6 billion).[28] The spending gap between wastewater infrastructure investment need and spending is evident—projections made in 2007 estimated 28 percent of necessary infrastructure investment would be funded in 2011, 23 percent in 2020, and only 18 percent in 2040.[6]

While no data on regional wastewater infrastructure investment needs were identified, one study estimated funding needs for all 50 states. California, New Jersey, and New York were identified

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[r] The EPA defines large as >100,000 customers, medium as 3,301-100,000 customers, and small as <3,300 customers.
[s] Projected investment need has increased by greater than 100 percent for some states since the 2004, indicating that an updated projection would likely yield higher total investment needs.

as requiring the most funding (close to $25 billion each).[28] Regional need was calculated by grouping state needs into their respective census regions. Based on these calculations, wastewater infrastructure funding needs appear to be fairly evenly distributed across the four census regions, as shown in Figure 4.4. Another study determined that out of eight[t] U.S. regions, the Mid-Atlantic had the highest projected wastewater and storm water needs at over $1,800 per capita.[6]
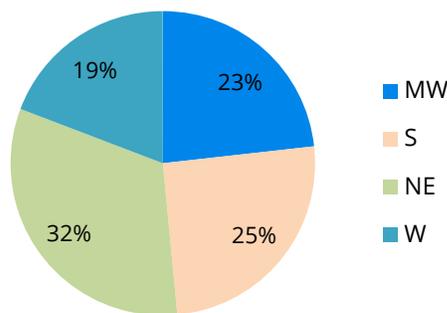

Figure 4.4 Total Projected Wastewater Infrastructure Need by Region, 2007-2027
Source: EPA (2008), *Clean Watersheds Needs Survey Report to Congress*

4.4   POPULATION PATTERNS

Of the 69 utilities in the 2012 AWWA/RFC survey that provided customer account and sales information, 60 (87 percent) showed a net positive gain of water customers that year compared to 2004.[17] Although new customers pay connection fees, those do not offset the long-term costs of serving additional customers, given the increased demand on supplies or the expansion projects that might be required. As previously mentioned, the greatest population shifts and growth has occurred in water-strapped areas or urban centers.[8] The four states with the greatest total population growth from 2000 to 2010 are mostly desert

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[t] Far West, Great Lakes, Mid-Atlantic, New England, Plains, Rocky Mountain, Southeast and Southwest.

or semi-arid and located in the West (Nevada, Arizona, Utah, and Idaho, with growth rates between 21 and 35 percent), followed closely by Texas in the South, which has large swathes of semi-arid and arid climate zones.[29] These states must not only satisfy increased water demand, but often must do so using supplies that can be less secure because of drought. Many utilities must diversify water supplies (typically involving more expensive, purchased water) while simultaneously undertaking expensive infrastructure expansion projects.

Figure 4.5 indicates new housing construction (completion) trends in each of the Census regions throughout the study period.[30] All regions exhibit a significant decline in new construction housing completions in the wake of the 2008 mortgage crisis and ensuing recession. The figure shows that the South maintains the highest level of new construction (followed by the West), and that completions have increased every year for the past five years. Data on new homes sold from the National Association of Home Builders (NAHB) corroborates these trends.[31]
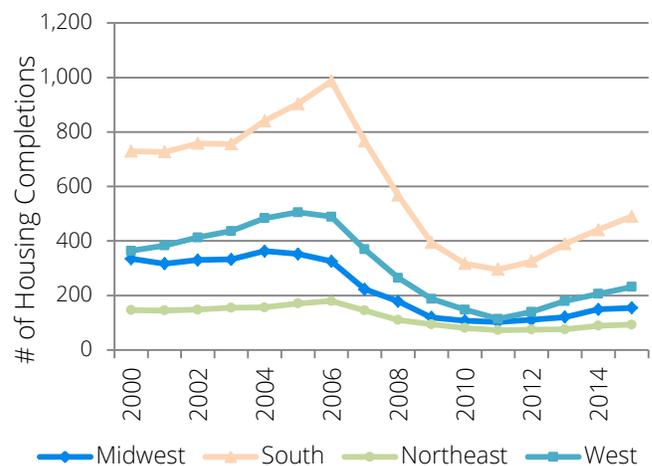

Figure 4.5   New Residential Housing Construction by Region
Source: U.S. Census Bureau (2016) *New Residential Construction,* www.census.gov/construction/nrc/historical_data/index.html

Regions that experience shrinking or stagnant populations—many in the Midwest and Northeast—

also face financial instability due to dwindling customer bases.[25] 30 percent of utilities in the Northeast and 23 percent of utilities in the Midwest cited population decline as negatively affecting revenue streams over the past five years.[4] If expectations for population growth are not realized, water utilities can be left paying off debt incurred from long-term infrastructure expansion while their revenue base diminishes.[17]

4.5 CONSERVATION EFFECTS

The promotion of conservation strategies, including both publicity to change behavior and conservation pricing, does influence utility revenues. When listing factors that negatively affect utility revenue streams, water and wastewater utilities list changes in water use behaviors (second most-pressing issue at 45%) and more efficient water-using devices (fourth most-pressing issue at 35%) of a top seven items of concern.[4] However, conservation strategies are often required to qualify for infrastructure funding and for additional water resources.[32,33] Water utility organizations, such as the Alliance for Water Efficiency (AWE), assist water utilities to balance conservation requirements with revenue needs. AWE has a program focused specifically on sustainable rates and includes on its website case studies on the long term benefits of efficiency in regards to infrastructure.[u] Water utilities may increasingly look to the experiences of electric utilities in innovating rate structures to preserve incentives for conservation. Cutting the linkage between sales and profit through a decoupled rate structure is one option that holds promise to avoid revenue loss with increased water conservation. Under decoupling, utilities can recover the shortfall between actual and anticipated revenues by balancing accounts that store excess funds or by implementing a "true-up" mechanism that periodically adjusts rates.[34] In 2008, the California Public Utilities

Commission adopted decoupling policies for investor-owned water utilities, with some success in enabling these utilities to escape negative budget impacts through customer surcharges authorized by a Water Revenue Adjustment Mechanism.[34]

5. TRENDS IN WATER AND WASTEWATER RATES

This section analyzes historical water and wastewater rate structures and rates obtained from the eight AWWA/RFC water and wastewater surveys performed every even-numbered year between 2000 and 2014. The biennial survey covers a large and diverse sample of water and wastewater utilities, from those with fewer than 500 consumers to those that serve more than nine million. The water utilities that responded to the 2014 survey serve approximately 38 percent of the U.S. population; responding wastewater utilities serve about 26 percent.[5] Nearly all participating utilities report a municipal governance model: 97 percent and 99 percent of respondents for water and wastewater utilities, respectively.[5] The AWWA/RFC surveys analyze the water and wastewater industries separately. The water survey asks utility respondents to provide the cost consumers pay for a given volume of water. The total consumer cost is divided into fixed and volumetric charges; separate examination of these two components is outside the scope of this study, but section 5.2 explores patterns in rate structures across time and census regions. The survey reports utilities by state and region, with geographic groupings similar to that of the U.S. Census regions, with the exception that the District of Columbia and Delaware are grouped in the Northeast, rather than the South. For this analysis, the U.S. Census region groupings were used. Table 4.1 in section 4.3.1 (page 8) details the states encompassed in each census region.

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[u] More information on the AWE program can be found at this website http://www.financingsustainablewater.org.

5.1 METHODOLOGY AND DATA CONSIDERATIONS

We calculated water and wastewater prices from the AWWA/RFC surveys using the steps outlined below. Our methodology was nearly identical for water and wastewater prices, but the wastewater charge does not include peak pricing as there are no peak rates for wastewater.

1. Ensure all rates are reported in the same units, dollars per thousand gallons ($/thous-gal).
2. For water rates, peak prices were incorporated into the price using the following equation:
   $Water\ Charge = [(\frac{2}{3} \times WaterPrice_{year-round}) + (\frac{1}{3} \times WaterPrice_{peak})]$.
   Year-round values are used without weighting.
3. Multiply residential total water/wastewater charge by number of residential accounts for each respective utility. Exclude records where number of residential accounts is missing.
4. Sum by state and region weighted residential water/wastewater charges.
5. Weight by the summed regional state census populations.
6. Report for each census region.

The AWWA/RFC survey is the most comprehensive and robust publicly available survey of water rates to date. However, several considerations must be kept in mind when viewing the results. First, as the survey has evolved, the participant pool has grown. Earlier survey years generally had fewer participants; thus, data from later survey years are more comprehensive. Additionally, the survey is not designed to be nationally representative. Certain regions are better represented in the survey, with larger samples of utilities: the South is particularly well-represented, and the Northeast under-represented. Our national and regional results in section 5.3 are weighted by utilities' corresponding state and regional populations to account for unequal representation. While there is no assurance that the participating utilities are necessarily representative of an entire state, the diverse mix of participating utilities (large/small and urban/rural) in the sample should contribute to dependable results.

One characteristic of the AWWA/RFC survey is variability of which utilities are sampled for each year of the survey. While many utilities have participated in the majority (in some cases all) of the surveys, each survey year is composed of a mix of different utilities. The primary purpose of this paper is to examine how water and wastewater rates have changed throughout the past 14 years, and how these adjustments have outpaced CPI. We acknowledge that an evolving sample can produce trends that are not solely reflective of the rate changes throughout the study period, but are also potentially influenced by utilities with generally higher or lower rates entering or exiting the sample year to year. In order to mitigate and gauge the impact the inconsistencies had in sampling between survey years had on water and wastewater price trends, we took two actions. First, in instances where regional trends diverge significantly from national trends, we examined changes in the utility sample between survey years more closely to determine whether changes in the sample may have contributed to anomalous rates. Second, we developed water rates for a subsample of water utilities that consistently participated in the AWWA/RFC surveys. Trends for each subsample (National, Midwest, Northeast, South, and West) were compared to the larger trends in order to gain insight into the effects sample variability may have had. These efforts are detailed further in section 5.3.2.

Lastly, it is important to note that because all rates are adjusted to 2014 dollars, if rates remained constant between two survey years, they would actually appear as a slight dip (given inflation). Thus, very minor decreases in rates (one to three percent) are likely to be a function of the adjustment to 2014 dollars, and are expected to represent rate stability.

5.2 UNDERLYING RATE STRUCTURE

Water and wastewater utilities distribute total costs among residential customers in a variety of ways that reflect expenditures, priorities (*e.g.*, affordability, conservation, revenue stability, and equity), institutional capacity, and/or billing system technology. Most residential water bills are broken down into two separate types of charges: fixed and variable. Fixed charges, otherwise known as base, minimum, monthly, or meter charges, are not dependent on the amount of water used, and typically include costs associated with meter reading, billing, and collection. The variable portion of the bill is volumetric; that is, dependent upon the amount of water metered at each connection per billing period. Although the greater part of water and wastewater costs are fixed in the short term, billing by volume enables utilities to cover costs that vary with treatment volume (*e.g.*, chemicals and energy) and may permit the prevention of future fixed costs by lessening water and wastewater flows in the longer run. A small proportion of utilities have no variable charges, instead relying upon a *flat charge* for water that does not vary with the amount used.

Typically, variable charges for utilities are structured as: (1) *uniform volumetric rates*, where the unit price of water does not change with use but the total price increases as customers use additional units of water; (2) *decreasing block rates*, where customers are charged a lower unit price as their water use rises; or (3) *increasing block rates*, where the unit price of water grows along with its consumption, sending a price signal to conserve water. *Increasing/decreasing block rates*, a combination of increasing and decreasing block rates, are seen more rarely. Water service providers that implement *seasonal rates* atop of any of these rate structures to promote conservation can apply a higher price per unit of water used during certain times of the year, characteristically during the summer months of higher outdoor irrigation.

Figure 5.1 and Figure 5.2 present residential water rate structures from AWWA/RFC survey samples from 2000 through 2014. Because utilities that charge seasonal rates ranged between only 10–15% of the sample over this time period, the figures encompass year-round residential water rate structures, including the normal year portion for those utilities that also charge seasonal rates. As the AWWA/RFC samples are not representative, we present unweighted data that show the prevalence of rate structures among participating utilities nationally (Figure 5.1) and regionally (Figure 5.2), excluding non-responses (coded N/A, N/R, or "other").
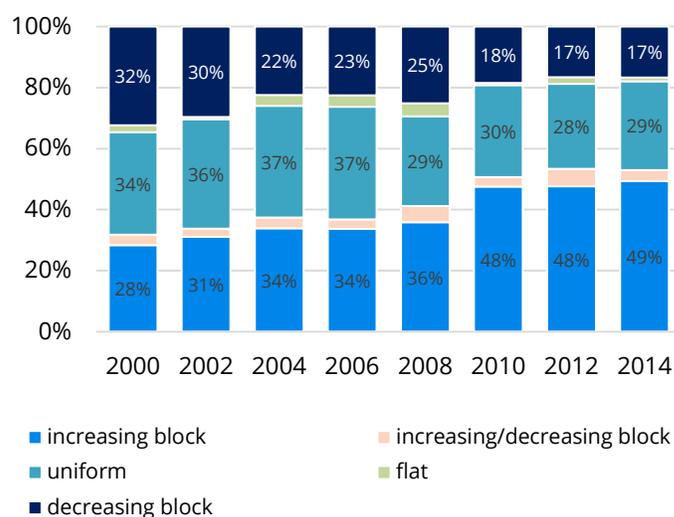
Figure 5.1 Residential Water Rate Structure among National Sample of Utilities

Figure 5.1 demonstrates that the proportion of water service providers relying on a decreasing block rate structure steadily diminishes from 2000–2014, almost by half. The share of utilities employing a uniform volumetric rate structure is fairly consistent around one third, and those with flat and increasing/decreasing block rates are relatively negligible. Water utilities with an increasing block rate structure make up three tenths of the sample in early years, rising to almost one half in 2010–2014. This significant shift is likely to be a product of water utility objectives to raise revenue to meet infrastructure

needs, encourage efficient use in the face of drought and diminishing supplies relative to population growth, improved billing system technology, or a combination of these.

While Figure 5.1 shows the rate structures in the national AWWA/RFC sample over time, Figure 5.2 reveals the variation in rate structures across census regions over the survey period. In the Northeast and Midwest, sampled water utilities with decreasing block and uniform volumetric rate structures predominate, while increasing block rate structures are uncommon. In contrast, water utilities in the South and West rely principally upon increasing block rates, followed by uniform volumetric rates. Very few utilities in the West employ decreasing block rate structures, in accordance with drought, infrastructure, and population pattern pressures discussed in section 4.
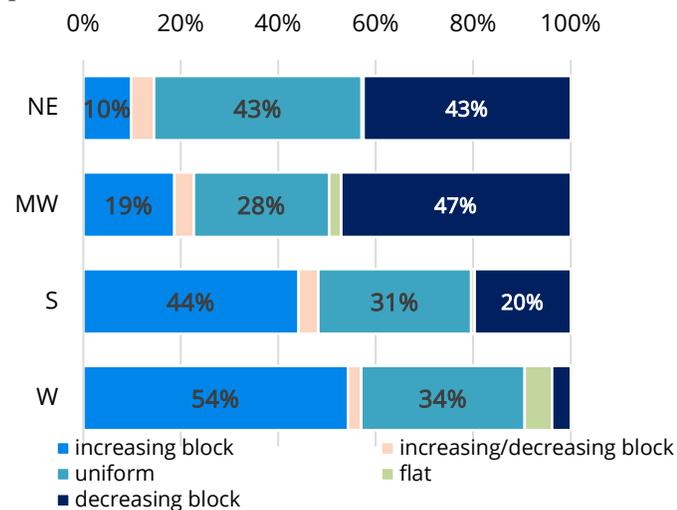

Figure 5.2 Residential Water Rate Structure among Utilities by Region, Averaged 2000–2014

Next, Figure 5.3 indicates that for wastewater service providers in AWWA/RFC's national sample, uniform volumetric rates are by far the most common, followed by flat charges. Decreasing block wastewater charges exhibit a slight decrease over time, while their converse—increasing block rates—show a small uptick in prevalence in recent years relative to 2000–2002. We note that volumetric pricing for wastewater is

typically based upon the water meter readings for months when outdoor water use is at its lowest.
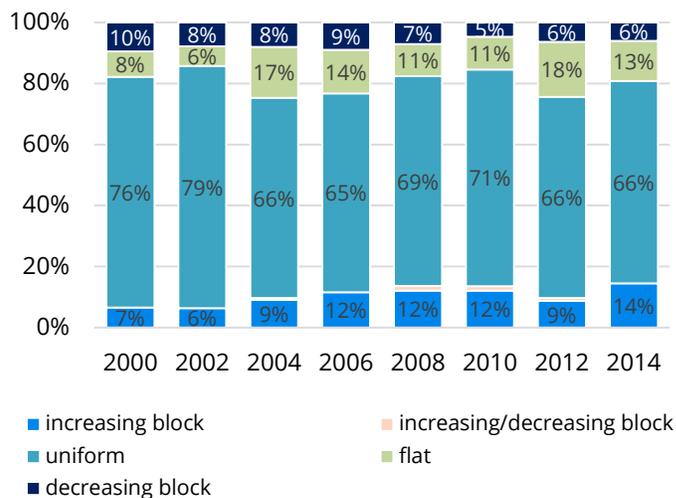
Figure 5.3 Residential Wastewater Rate Structure among National Sample of Utilities

5.3 WATER TRENDS DISCUSSION

Figure 5.4 (page 15) presents historical costs for residential water by region as determined by the AWWA/RFC surveys.[5,22,35,36,37,38,39,40] The price units for all survey years are 2014 dollars per thousand gallons (2014$/tg) using CPI data from the Bureau of Labor Statistics.[41] Utility water prices are first weighted by their service population within each state to provide an estimate of the state water prices, and then the state water prices are weighted by state population within each of the four regions to obtain the regional water price estimation. Results are not necessarily representative of a given census region due to the number and variation of utilities participating across the survey years. Historically speaking, the West and Northeast have higher water rates (typically exceeding the national average). The South has the third highest rates. Water rates were lowest in the Midwest for all survey years except the most recent one (2014), in which rates were higher than those in the South by only a narrow margin.

Figure 5.5 displays another view of national and regional water rate trends for each of the eight Raftelis surveys, while Table 5.1 presents the percent change in water rates between each Raftelis survey for the nation and each census region. In accordance with the literature, the national water rate trend consistently rises year to year. Nationally, in the early survey years (2000–2006), rate increases are relatively subtle. The trend becomes notably steeper after 2008, with rate increases between 2008–2010 estimated at 13 percent and 2010–2012 at 10 percent. While national prices continued to rise through 2014, the rate of change tapers off slightly compared to the previous few surveys, with an observed rate increase of 6 percent between the 2012 and 2014 surveys.

Examination of regional rate changes reveals that all four census regions demonstrate a marked overall increase in water rates, yet they have also experienced isolated periods of rate decline. All census regions also exhibit at least one significant rate hike (defined as an increase of at least 15 percent). Rates do not climb equally across regions for the same time periods. For example, between 2002 and 2004, rates in the Northeast climbed by 28 percent, while simultaneously decreasing by 9 percent in the West.

	2000	2002	2004	2006	2008	2010	2012	2014
Midwest	$2.60	$2.43	$2.38	$2.98	$2.89	$3.33	$3.63	$4.26
South	$2.83	$2.84	$3.19	$3.02	$3.15	$3.43	$4.03	$4.24
Northeast	$2.97	$3.05	$3.90	$3.48	$3.92	$4.46	$4.56	$4.51
West	$3.27	$3.52	$3.21	$3.46	$3.95	$4.58	$4.89	$5.06
National	$2.90	$2.94	$3.12	$3.19	$3.40	$3.84	$4.22	$4.49
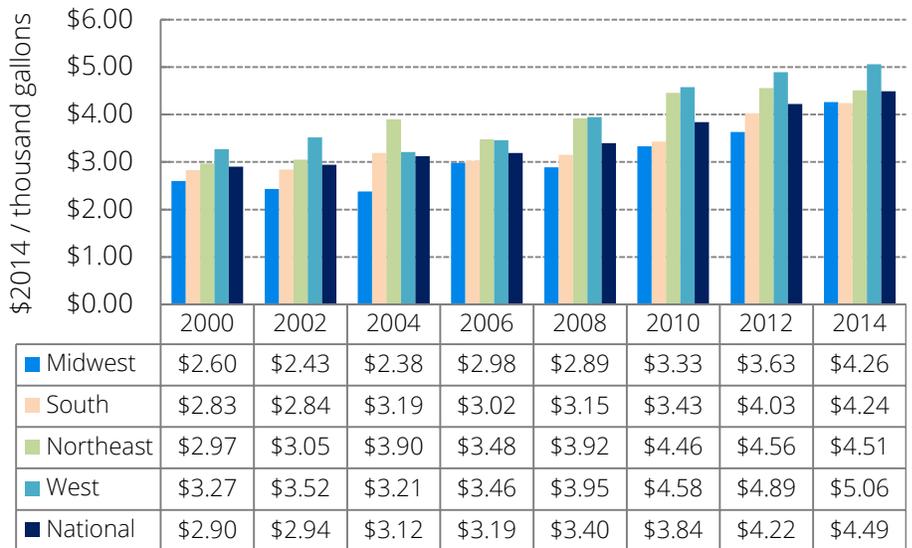
Figure 5.4 Historical Residential Water Costs, 2000-2014
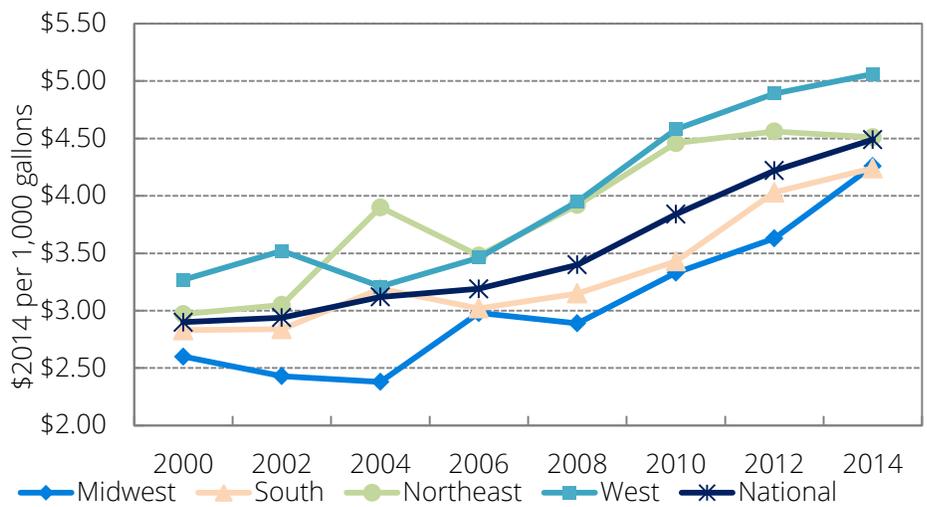
Figure 5.5 Historical Residential Water Price Trends, 2000-2014

Table 5.1 Change (%) in Water Rates between Survey Years

Survey Year	REGION				
	MW	S	NE	W	Nat'l
2000–2002	-7%	0%	3%	8%	1%
2002–2004	-2%	12%	28%	-9%	6%
2004–2006	25%	-5%	-11%	8%	2%
2006–2008	-3%	4%	13%	14%	7%
2008–2010	15%	9%	14%	16%	13%
2010–2012	9%	17%	2%	7%	10%
2012–2014	17%	5%	-1%	3%	6%

Figure 5.6 below indicates the average annual rate increase for each census region over two time periods: the entire study period (2000–2014), and another for 2006–2014. Despite the variability in rate adjustments in Figure 5.6, average annual water rate increases were largely similar across the regions, but the recent scenario measure indicates more drastic rate increases over the past decade for all regions except the Northeast. This observation is in line with the data presented in Figure 3.1 on page 3, which shows a steeper slope for water and sewerage CPI in more recent years.
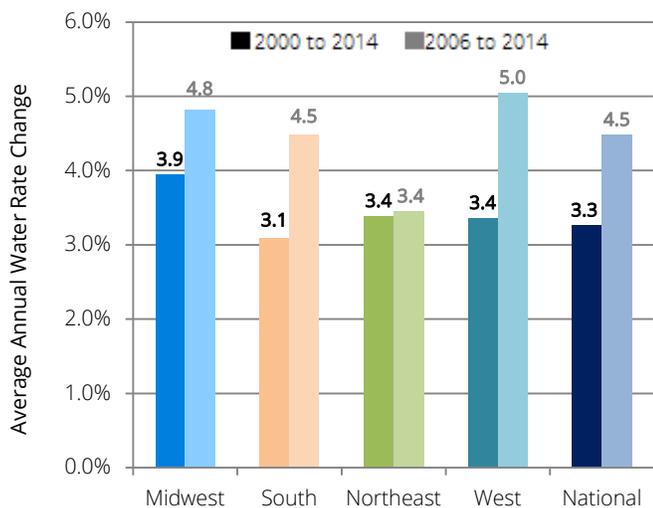

Figure 5.6 Average Annual Regional Water Rate Increases (%)

5.3.1 Exploration of Rate Decline

Observed rate declines were typically more moderate than rate increases, ranging from 1 to 11 percent. Rate declines—particularly those that were more severe—occurred in earlier survey years and have become less common. After 2006, the rate declines occurring are minor and are a function of inflation adjustment: three percent in the Midwest and one percent in the West. In 2004–2006 and 2002–2004, we investigated two of the more prominent rate

declines (11 percent in the Northeast in 2004–2006, and 9 percent in the West in 2002–2004). The Northeast exhibited the most volatile water rates of the entire sample, with a 28 percent increase between the 2002 and 2004 surveys and an 11 percent decrease between the 2004 and 2006 surveys. As mentioned previously, the Northeast was made up of the smallest sample sizes (some survey years had fewer than 20 participating utilities), making it particularly susceptible to variability of the changing utility mix in the sample. Examination of the Northeast samples revealed that variability in the sample may explain the rate volatility surrounding the 2004 survey year.

The number of Northeastern utilities participating in the survey more than doubled between 2002 and 2004 (from 18 to 38), with only 11 utilities participating in both. While most utilities that participated in both survey years increased their rates (in some cases quite drastically), the significant change in the sample likely contributes to the magnitude of the 28% average rate increase in the Northeast between 2002 and 2004. The sample changed notably once again in 2006; it was composed of about half of the 2004 utilities as well as a few additions. While our analysis showed an 11% decline in rates between 2004 and 2006, examination of rates for utilities that participated in both surveys indicated that the majority maintained or raised rates between the surveys—only a handful actually lowered them. Additionally, a few of the utilities that participated in 2004 but not 2006 had higher rates and larger service populations; thus, their rates held more weight when calculating the regional average. The volatility of the Northeast utility sample largely drove the unexpected rate fluctuations between 2002 to 2004 and 2004 to 2006.

Next, we further explored the nine percent decline in water rates in the West between 2002 and 2004. The sample in the West also changed significantly between these years; it more than doubled, with 32 utilities in 2002 and 78 in 2004. Of the 22 utilities that participated in both surveys, nearly all raised their rates, and only two decreased their rates. Thus, it

appears the decline in the West between 2002 and 2004 is chiefly a manifestation of the sample volatility, and that rates generally did increase during this time period.

5.3.2 Water Rate Subsample Results

In order to gauge the impact of the fluctuating sample on the results, we calculated water rates for subsamples of utilities that consistently participated in the surveys using the same calculation methodology. While a consistent sample of utilities that participated in all eight surveys is ideal for the subsample, the resulting small sample size would have compromised other aspects of the analysis. Thus, subsamples were expanded to include all water utilities that had participated in at least six of the eight surveys, or 93 nationally. Results from these subsamples are at times from small sample sizes (particularly for the Northeast), and they are not intended to be representative of each census region. The subsamples are a service-population weighted average of water rates from a consistent sample of utilities in a given region. They are included only with the intention to provide a check against initial results, as well as perspective on how the fluctuating samples may have influenced results. Table 5.2 below summarizes the subsample sizes relative to the total survey sample size.

Table 5.2 Comparison of Sample Size by Year

Survey Year	Total Sample Size	Subsample Size
2000	176	65
2002	147	61
2004	265	89
2006	230	87
2008	280	88
2010	308	89
2012	290	87
2014	318	76

Results for the regional and national subsamples compared to the general sample are shown in Figure 5.7 through Figure 5.11 (page 18). The charts appear to corroborate our initial findings, with the National, West, Midwest, and South trend lines following very closely and reporting similar linear equations. The Northeast does appear to diverge more substantially, but given the extremely small size of the subsample, its results should be viewed critically. Overall, the analogous subsample trends substantiate our analysis and water rate findings, and indicate that fluctuations in the sample generally did not appear to skew results. We did not develop subsamples for wastewater.

One inconsistent trend in the subsample is the apparent dip in water prices between 2012 and 2014 in the West. The subsample for these years is relatively small, with about 20 utilities in each year. Closer examination indicated that on a utility-by-utility basis, water rates generally increased between 2012 and 2014. A couple of select cities, however, did demonstrate nominal water rate declines between 2012 and 2014. There are multiple explanations for this rate decrease in the subsample:

1. Several utilities with notably higher rates and large populations (*e.g.,* Oakland), participated in the 2012 survey, but not in 2014.

2. After years of rate increases, the reported rates between 2012 and 2014 remained the same nominally, but the adjustment to 2014 dollars created the appearance of a decrease.

3. Some utilities (*e.g.,* Sacramento) implemented conservation pricing, decreasing rates for lower water consumption and raising rates for higher consumption. In this case, such a pricing scheme was likely undertaken to combat the severe California drought; rewarding conscientious water users and disincentivizing excess water use (see section 5.2).
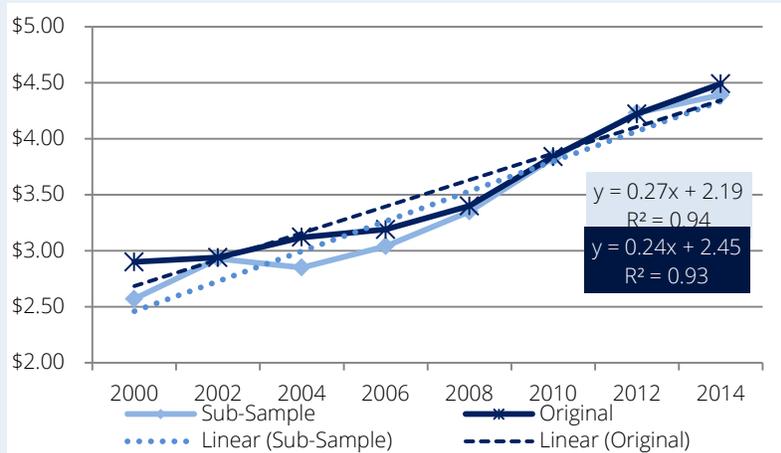
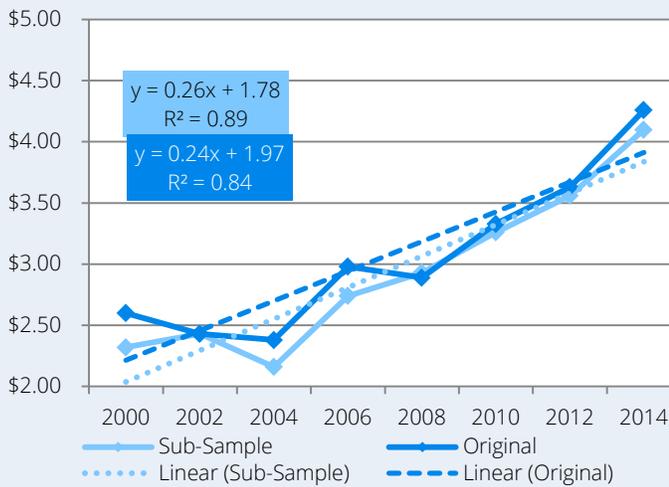Figure 5.6 National Water Rate Trends, 2000-2014

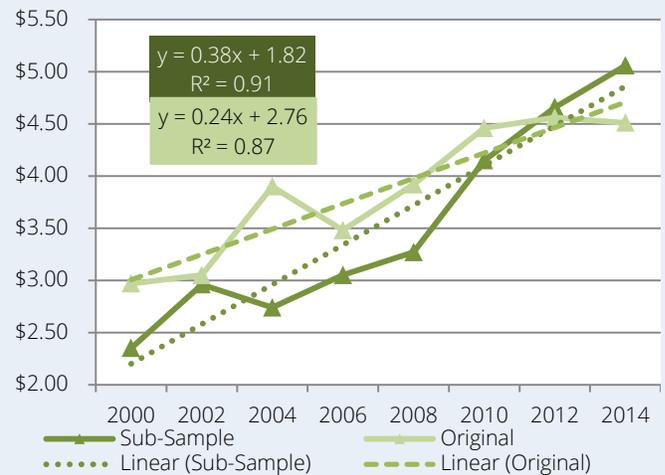Figure 5.7 Midwest Water Rate Trends, 2000-2014

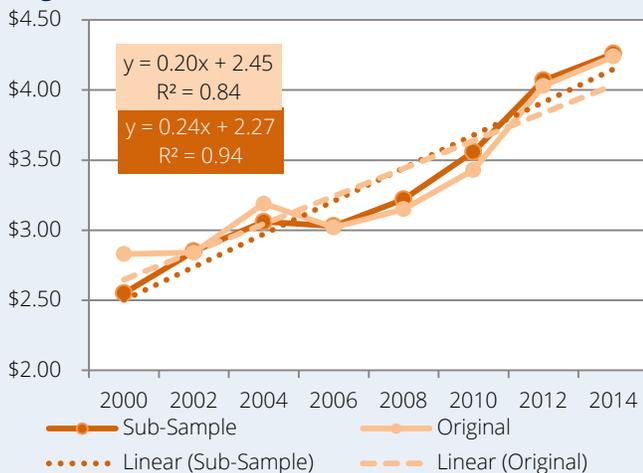Figure 5.9 Northeast Water Rate Trends, 2000-2014

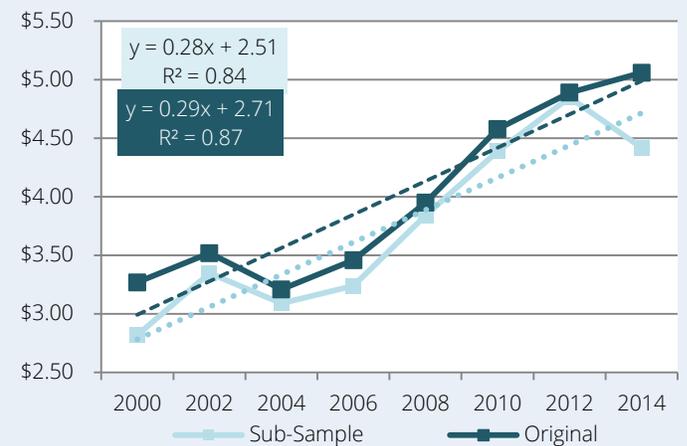
Figure 5.8 South Water Rate Trends, 2000-2014

Figure 5.10 West Water Rate Trends, 2000-2014

5.4 WASTEWATER TRENDS DISCUSSION

Figure 5.12 presents historical wastewater rates per the AWWA/RFC surveys. Throughout the survey years, wastewater rates in the Northeast and South are consistently above the national average, while the West hovers just below and prices in the Midwest are typically lower. In later survey years, the Northeast displays substantially higher wastewater rates than any other region. Between 2000 and 2008 the Midwest consistently reported the lowest wastewater rates, which from 2010 onward, however, rose above those in the West.

Figure 5.13 and Table 5.3 illustrate national and regional rate trends for the study period, as well as the observed change (%) in wastewater rates between each study. These rates have consistently risen between each survey and have never undergone a period of decline. Additionally, national wastewater rates have demonstrated steeper, (often) double-digit increases in recent years (2006–2012). The Midwest in particular exhibits some drastic wastewater rate increases: 21 percent between 2004 and 2006 and 17 percent between 2010 and 2012. In 2000, the Midwest wastewater rates were significantly below the national average, but now are on par with national rates and most other regions.

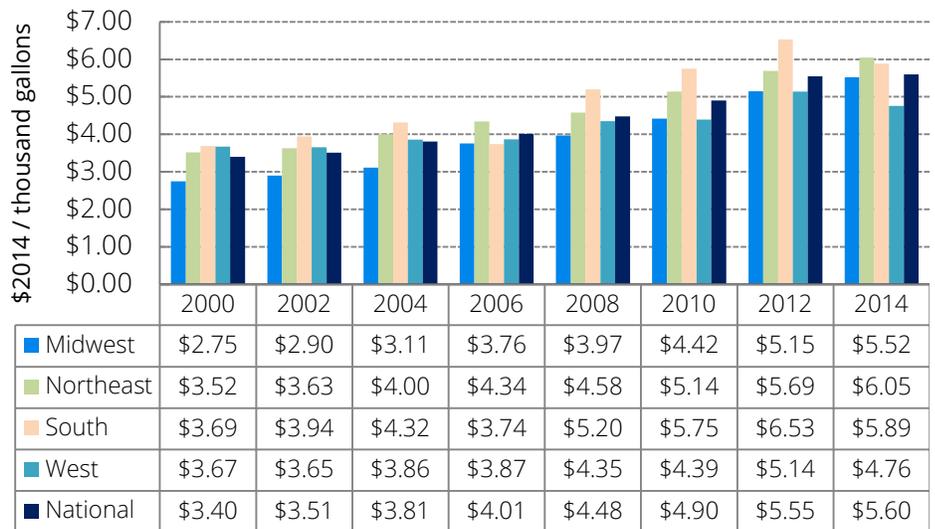| $2014 / thousand gallons	2000	2002	2004	2006	2008	2010	2012	2014
Midwest	$2.75	$2.90	$3.11	$3.76	$3.97	$4.42	$5.15	$5.52
Northeast	$3.52	$3.63	$4.00	$4.34	$4.58	$5.14	$5.69	$6.05
South	$3.69	$3.94	$4.32	$3.74	$5.20	$5.75	$6.53	$5.89
West	$3.67	$3.65	$3.86	$3.87	$4.35	$4.39	$5.14	$4.76
National	$3.40	$3.51	$3.81	$4.01	$4.48	$4.90	$5.55	$5.60

Figure 5.11 Historical Residential Wastewater Costs, 2000-2014
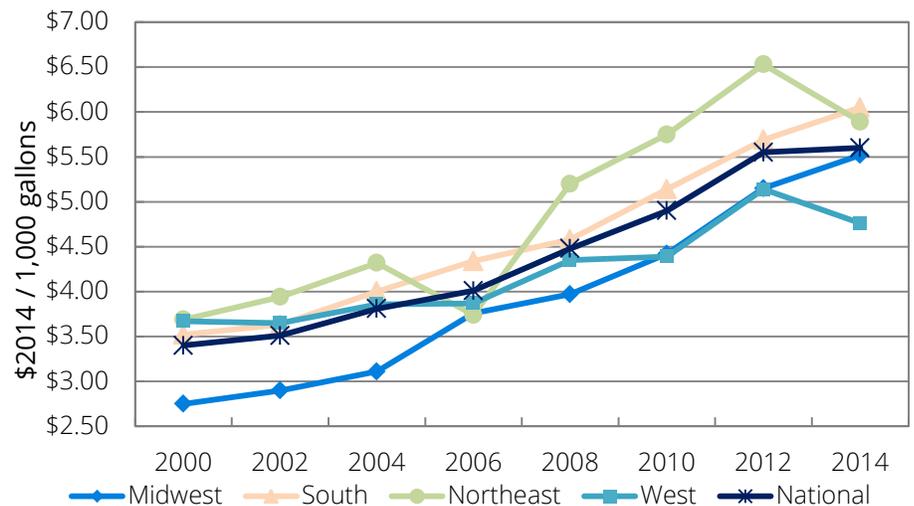
Figure 5.12 Historical Residential Wastewater Price Trends, 2000-2014

Table 5.3 Change (%) in Wastewater Rates by Region, 2000-2014

Survey Year	REGION				
	MW	S	NE	W	Nat'l
2000–2002	-7%	0%	3%	8%	1%
2002–2004	-2%	12%	28%	-9%	6%
2004–2006	25%	-5%	-11%	8%	2%
2006–2008	-3%	4%	13%	14%	7%
2008–2010	15%	9%	14%	16%	13%
2010–2012	9%	17%	2%	7%	10%
2012–2014	17%	5%	-1%	3%	6%

Figure 5.14 below presents the annual average wastewater rate increases over the entire study period (2000–2014) and the recent period (2006–2014). The average annual change does not vary significantly for the two different periods, indicating that rate increases have been fairly consistent since 2000. However, the average annual change in wastewater prices is variable by region. The Midwest, in the most extreme instance, has sustained more than *twice* the wastewater rate increase that the West has for both time periods.
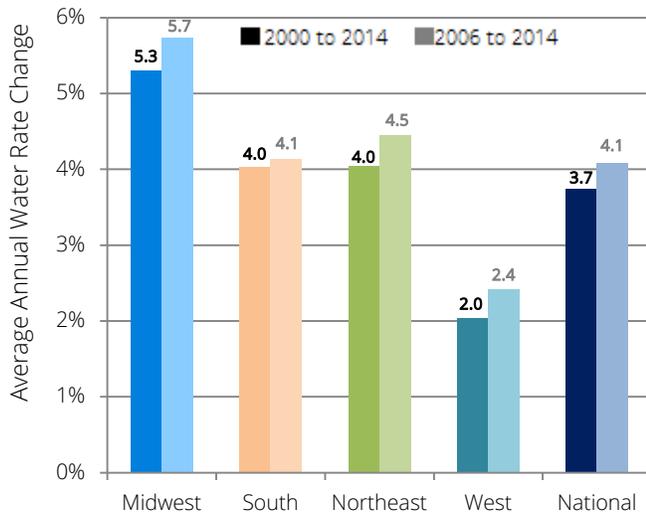

Figure 5.13 Average Annual Regional Wastewater Rate Increases (%)

5.4.1 Investigation of Wastewater Rate Declines

The rate decline of 13 percent in the Northeast between 2004 and 2006 appears to be driven by the same data characteristics as the decline in water rates during the same time period. Like for water rates, the sample of utilities changed significantly between these two survey years, with the sample size decreasing significantly. See section 5.3.2 for further explanation on how these differences in sample size impacted rates in the Northeast between 2004 and 2006. The sample size in the Northeast is very small between 2012 and 2014, with only 11 and 12 utilities participating in each

year, respectively. All but a few of the utilities participated in both surveys. While more utilities increased their rates than decreased them, several populous utilities decreased their rates.

Our analysis indicates that the West also witnessed a decline in wastewater rates between 2012 and 2014. These years had a relatively large sample size of about 60 utilities in each year. While the samples between the years varied slightly, further examination of wastewater rates for utilities that participated in both years indicated that this decline in wastewater rates is warranted: wastewater rates in more than half of the participating utilities declined between the two survey years.

5.5 DISCUSSION OF WATER AND WASTEWATER RATES

Figure 5.15 shows the increase (as a percent) in inflation-adjusted water and wastewater rates between the 2000 and 2014 surveys. Nationally, between 2000 and 2014 the typical residential water bill has increased about 55 percent. Cumulative water rate rises during the 14-year period ranged from a low of 50 percent in the South to a high of 64 percent in the Midwest.

Nationally, between 2000 and 2014 the typical residential wastewater bill has increased by about 65 percent. Total wastewater rate growth exhibited more variation by region. In the West, rates increased 30 percent during the 14-year period and the Midwest, 101 percent. While the pace of rate increases in the Midwest outstrip those of any other region, as of 2014, these rates remain some of the lowest in the country (only the West had lower average wastewater rates).
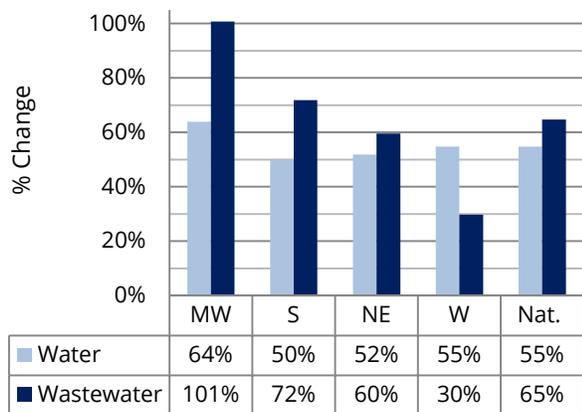
Figure 5.14 Total Percentage Change in Water and Wastewater Rates, 2000-2014

	MW	S	NE	W	Nat.
Water	64%	50%	52%	55%	55%
Wastewater	101%	72%	60%	30%	65%

The analysis presented earlier in this section characterizes the evident variation in rates as well as the pace and direction of rate trends by region for both water and wastewater between the survey years. A more holistic view of water rates, however, implies that these trends have more or less resulted in the same cumulative rate increase from 2000 to 2014. For wastewater, total rate changes have proved to be highly variable by region.

6. CONCLUDING REMARKS

Our findings corroborate those from the existing water and wastewater rate literature, and strengthen the observation that water and wastewater rate increases over the past 15 years have outstripped CPI by a wide margin. Investigation into some of the key underlying factors signifies that water and wastewater rate increases will continue. Impending expensive infrastructure needs, shifts and growth in population, and intensifying drought in certain regions of the country—paired with resultant issues of water supply shortages and conservation pricing—are all likely to

become more pronounced over the coming years. However, despite the acute rate hikes water and wastewater utilities have implemented to mitigate the financial impacts of these stresses, few such utilities are on solid financial footing.

Our estimates of the rise in water and wastewater prices are somewhat more conservative than estimates from the literature. Our calculated average water and wastewater rate increases between 2000 and 2014 using AWWA/RFC survey data are 3.9 percent and 4.6 percent respectively, in contrast to estimates from Black and Veatch of 5.6 percent and 6.1 percent between 2001 and 2013. The Circle of Blue Survey estimated a cumulative rate increase of 41 percent between 2010 and 2015, while our analysis indicates growth of 17 percent between 2010 and 2014. Our research also indicates a trend of more accelerated rate increases for wastewater than for water, a pattern existing studies also demonstrate. On balance, the literature is clear that against the backdrop of higher rates across the country, nominal rates are markedly variable by region. Throughout the analysis period, average water and wastewater rates at times have varied by more than 30% between regions.

While it was outside the scope of this paper to quantify various factors suspected to impel water price increases, such as drought, water source, infrastructure needs, population patterns, and conservation effects, measuring the impacts of these drivers on tariffs would improve our understanding of the institutional rationale behind these higher rates. Additionally, larger and consistent samples of utilities represented over time, with a more varied geographical distribution, would contribute to better insight into water and wastewater rate trends.

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