Water Resources Research Institute
of The University of North Carolina

Report No. 389

# MULTI-LEVEL FINANCIAL ANALYSIS OF RESIDENTIAL WATER AND WASTEWATER RATES AND RATE-SETTING PRACTICES IN NORTH CAROLINA

By
Jeffrey Hughes[1], Shadi Eskaf[1], Rich Thorsten[1], Glenn Barnes[1], Lee M. Mandel[2], and Owen Franklin[2]

[1]Environmental Finance Center
University of North Carolina
Chapel Hill, North Carolina

[2]North Carolina League of Municipalities
Raleigh, North Carolina

November 2006

UNC-WRRI-389

# MULTI-LEVEL FINANCIAL ANALYSIS OF RESIDENTIAL WATER AND WASTEWATER RATES AND RATE-SETTING PRACTICES IN NORTH CAROLINA

Jeffrey Hughes[1], Shadi Eskaf[1], Rich Thorsten[1], Glenn Barnes[1], Lee M. Mandel[2], and Owen Franklin[2]

[1]Environmental Finance Center
University of North Carolina
Chapel Hill, North Carolina

[2]North Carolina League of Municipalities
Raleigh, North Carolina

The research on which this report is based was supported by funds provided by the Urban Water Consortium through the Water Resources Research Institute of The University of North Carolina (WRRI). Contents of the publication do not necessarily reflect the views and policies of the WRRI, nor does mention of trade names of commercial products constitute their endorsement by the WRRI or the State of North Carolina.

This report fulfills the requirements for a project completion report of the Water Resources Research Institute of The University of North Carolina. The authors are solely responsible for the content and completeness of the report.

WRRI Project 50364

November 2006

**ACKNOWLEDGEMENTS**

The Environmental Finance Center is a program located at the School of Government at the University of North Carolina in Chapel Hill.

The authors would like to thank the numerous individuals who provided information, insight, and guidance for this project. We worked extensively with Lee Mandel and Owen Franklin of the North Carolina League of Municipalities on this project and thank them for their hard work. Particular appreciation is due to all the individuals representing their water and sewer utilities who responded to the surveys and those who sent us their rate sheets. Additional data were provided by several external sources. The staff at the North Carolina Rural Economic Development Center and their contractors (AMEC Earth and Environmental, Inc., McGill Associates, P.A., and Hobbs Upchurch & Associates, P.A.) were exceptionally helpful in sharing data from the recent Water 2030 study as well as rate sheets collected for FY2004-05. The North Carolina Local Government Commission shared financial data and reports on the water and sewer utilities in the state. The North Carolina Center for Geographic Information and Analysis provided G.I.S. shape files of the locations of utilities in North Carolina.

The authors would also like to acknowledge Andrew Westbrook and Garrett Davis of the Environmental Finance Center for their work on the project.

This project was partially funded by Water Resources Research Institute, the North Carolina Urban Water Consortium, and the United States Environmental Protection Agency.

**ABSTRACT**

The purpose of this report is to help North Carolina water and sewer utilities meet their policy objectives and assure that they have the revenues they need to protect public health. The report provides up-to-date information on current rate-setting practices and trends that can inform and influence (but not dictate) local decisions. The analyses uniquely determine and compare water and sewer bills for multiple levels of consumption and relies on data from multiple sources, including 1) a rates and financial practices survey completed by 277 utilities, 2) a rates inventory and database that includes information from 333 utilities, 3) a financial information database compiled and maintained by the NC State Treasurer, and 4) data from the United States Census Bureau.

Results demonstrate that utilities' rates and practices vary widely by community. Utility characteristics, such as size, water source and wastewater discharge, impact the prices utilities charge for service, yet other factors – such as demand conditions and the rates of nearby utilities – also affect rate-setting. Many utilities set rates to cover operating expenditures, yet most are reluctant to charge enough to adequately address their capital needs. Respondents stating that affordability concerns significantly impact their rate setting practices were more likely to have lower actual rates and lower rates as a percentage of median household income than utilities less concerned about affordability. Yet affordability appears to have a reduced role in determining other rate-setting practices, such as offering longer grace periods before penalties. With respect to conservation, utilities where managers claimed that conservation objectives significantly impacted rate-setting practices were more likely to have increasing block rate structures. However, these utilities did not send noticeably different price signals to residential customers than other utilities. Moreover, managers whose utilities were close to reaching capacity did not rate conservation as a significant factor more frequently than their counterparts.

**TABLE OF CONTENTS**

## LIST OF FIGURES

## LIST OF TABLES

## SUMMARY

The purpose of this report is to help water and sewer utilities meet their policy objectives and assure that they have the revenues they need to protect public health. The report provides up-to-date information on current rate-setting practices and trends that can inform and influence (but not dictate) local decisions. The North Carolina League of Municipalities (NCLM) and the Environmental Finance Center at the University of North Carolina at Chapel Hill School of Government (EFC) collaborated on this joint research project conducted from May 2005 to July 2006. This research was funded by the Water Resources Research Institute, the North Carolina Urban Water Consortium, and the U.S. Environmental Protection Agency.

Assuring the provision of safe drinking water and environmentally sound wastewater treatment requires a lot of money. The majority of these funds comes directly from water and sewer customers throughout the state and is collected by utilities through their rates, fees, and charges. Water and sewer rates ultimately determine how much revenue a community will have to maintain vital public health facilities.

A variety of entities provide water and sewer service in North Carolina, including government-owned utilities (counties, municipalities, special purpose units); for-profit utilities (small independent companies, statewide companies, and national or international firms); and not-for-profit entities (not-for-profit water corporations). This report focuses on the rates and rate-setting practices used by utilities that are not regulated by the North Carolina Utilities Commission, including government-owned utilities and not-for-profit water corporations. These utilities are responsible for providing service to the vast majority of residents served by centralized water and sewer systems (89 percent of customers served by water systems and over 80 percent served by wastewater systems)

This report draws its conclusions from a thorough analysis of data from several inter-related surveys and information sources including a rates and financial practices survey completed by 277 utilities, a rates inventory and database that includes information from 333 utilities, a financial information database compiled and maintained by the North Carolina State Treasurer and the United States Census Bureau.

In the past, rates and rate-setting practices primarily impacted utilities' bottom lines – low rates meant not enough revenue to operate. In today's complicated water policy arena, rates are much more than a tool for generating revenue. Rates have become tied to the major water policy issues and challenges facing utilities, including conservation, growth management, affordability, asset management, regionalization, and economic development.

The analyses in this report demonstrate the degree to which utilities across the state have taken advantage of the flexibility they have in setting rates and related policies. Rates and rate-setting practices vary from community to community in much the same way that the character and the profile of different communities vary. This variability makes it very difficult to find quick answers to the commonly asked question "How do our prices and policies compare to our neighbors'?" It is quite possible that two neighbors have fundamentally different views about

issues such as affordability, growth, and conservation - and copying each other's rates could compromise their policy goals.

The analysis clearly demonstrates the relationship between utility size and the rates they charge. This size-price relationship exists for both water and sewer utilities but is more pronounced for water utilities. Size measured by number of accounts has much less of an impact on rates than measuring size according to water production and wastewater treatment quantities. Size, however, is only one of several important factors that appear to influence rates. Indeed, conclusions only based on comparing the rates of two similarly sized utilities or the rates of one utility with the median of other utilities in its size class can be misleading. Communities that treat groundwater, for example, generally have lower rates than communities that treat surface water. Communities that treat their own water tend to have lower rates than communities that must purchase treated water from others. A sewer utility that discharges its wastewater into a more environmentally sensitive, and thus more regulated, river basin tend to have higher rates than utilities discharging into less regulated river basins. A thorough rate comparison should take into account as many of these factors as possible.

A comparison of rates should also consider the fact that utilities are not required to fully cover all of their costs in their rates. While many utilities set rates that are sufficient to meet their operating expenditures, most utilities are reluctant to charge enough to adequately address their capital needs. The abundance of utilities with negative operating margins demonstrates this problem. A utility that manages its capital assets well and takes steps to collect sufficient revenue to replace aging systems may look as if its rates are high when compared to a utility that is only concerned with meeting its current operating needs.

Rates are often compared for a specific amount of service – for example, 6,000 gallons a month. This single point of comparison, though, can mask important differences between utilities. A significant portion of any utility's customer base uses much less than, or much more than, 6,000 gallons, and using a single point of comparison only tells part of the story. Because pricing strategies and structures are so diverse across the state, two utilities may charge the same amount for 6,000 gallons but charge entirely different amounts for 3,000 gallons or 15,000 gallons. Why is this important? Some policy decisions depend more on what occurs at very low consumption amounts or very high consumption amounts than on the middle ground. For example, utilities concerned about affordability may be most interested in how their charges for basic consumption amounts (3,000 gallons a month) compare with other utilities. On the other hand, utilities concerned with conservation may be more concerned with how their rates for large-volume residential users compare. Looking at bills for 6,000 gallons will not necessarily provide any insight related to these other policy goals.

Some policy goals seem to be better reflected in rates and rate-setting practices across the state than other goals that conflict with practice. For example, utilities stating that affordability concerns had a significant impact in their rate setting practices were more likely to have both lower actual rates and lower rates as a percentage of median household income than utilities less concerned about affordability. In some ways, this is counter-intuitive – one might suppose that utilities with high rates would be more determined to consider affordability in rate setting, but the analysis suggests that a concern for affordability likely drives rates down. Concern for

affordability, though, appears to have much less of a role in determining other rate-setting practices, such as offering longer grace periods before penalties. In another example, utilities indicating that financial considerations drive rate setting do not appear to have either higher rates or rates that do a better job of covering costs as measured by operating margins than utilities less concerned with financial considerations. Utilities that are more concerned with conservation do not send noticeably different price signals to their residential customers to encourage conservation than any other utility. Another revelation is that managers of water systems that are close to capacity are not more likely to state that conservation is a significant factor in their rate-setting practices than their counterparts. Competing policies may force managers to make a decision that favors one policy over the other, such as the decision to use increasing block structures where fostering business-friendly policies and residential affordability are both significant factors in rate setting.

The role of rates and rate setting in promoting conservation has received increased attention since the drought of 2002. Increasing block rate structures in general promote conservation better than other rate structures; however, the analysis demonstrated the complexity of rate structures by showing that many utilities with uniform and even a few with declining block structure sent stronger price signals to customers than some types of increasing block structures. Clearly, many other aspects of rate structures besides the block structure play an important role in price signals, including the relative size of fixed charges versus commodity charges. Despite these nuances, increasing block structures continue to be the rate structure of choice for utilities that claim to have their rate setting influenced by conservation policy goals – far more utilities with conservation concerns were shown to have increasing block structures than utilities without similar concerns.

In conclusion, more does appear to be better – at least in terms of accurately understanding the pressures and driving factors behind rate setting. Rate comparisons that consider more factors than just distance and number of accounts are likely to provide a utility with a much broader and comprehensive view of their own rates. From a policy perspective, rates and rate structures appear to be impacting practices for many utilities in some basic areas, but the analyses suggests that more can be done to assure that rates and rate practices better reflect individual utility concerns and situations. As the regulatory and socio-economic environment in which utilities operate continues to evolve and become more complicated, the need for resisting simplified comparisons and the need for carefully considering the impacts of rates and rate structures will only increase.

## RECOMMENDATIONS

- Develop coordinated and common guidance materials to assist local governments and infrastructure-funding agencies in adjusting rates to meet cost recovery and capital facilities objectives.
- Develop guidance for state funding programs in determining the ability to pay of local utilities which are applying for grants and loans to expand services and meet regulations.
- Investigate how customer assistance programs may be tailored to match affordability concerns among both smaller and larger utilities.
- Focus conservation efforts in rate-setting by encouraging local utilities to examine the price signals their customers actually face for service, given the fixed and variable charges of existing rate structures.
- Develop models to encourage utilities to consider the relationship between existing rates, changes to rate structures, and future capital needs.
- Encourage rate-setting institutions to examine their own financial health, socio-economic and resource conditions, and long-term needs; as opposed to framing rate-setting debates squarely in terms of the practices in adjacent communities.

## INTRODUCTION

Assuring the provision of safe drinking water and environmentally sound wastewater treatment requires a lot of money. The majority of these funds comes directly from water and sewer customers throughout the state and is collected by utilities through their rates, fees, and charges. In 2005, government-owned utilities collected approximately $1.6 billion in revenue from their customers.

Setting water and sewer rates is one of the most important environmental and public health responsibilities of a local government or a utility. Water and sewer rates ultimately determine how much revenue a community will have to maintain vital public health facilities.

In the past, rates and rate-setting practices primarily impacted utilities' bottom lines – low rates meant not enough revenue to operate. In today's complicated water policy arena, rates are much more than a tool for generating revenue. Rates have become tied to the major water policy issues and challenges facing utilities, including conservation, growth management, affordability, asset management, regionalization and economic development.

The purpose of this report is to help utilities meet their policy objectives and assure that they have the revenues they need to protect public health. The report provides up-to-date information on current rate-setting practices and trends that can inform and influence (but not dictate) local decisions. The North Carolina League of Municipalities (NCLM) and the Environmental Finance Center at the University of North Carolina at Chapel Hill School of Government (EFC) collaborated to produce this report through a joint research project conducted from May 2005 to September 2006.[1]

A variety of entities provide water and sewer service in North Carolina, including government-owned utilities (counties, municipalities, special purpose units); for-profit utilities (small independent companies, statewide companies, and national or international firms); and not-for-profit entities (not-for-profit water corporations). This report focuses on the rates and rate-setting practices used by utilities that are not regulated by the North Carolina Utilities Commission, including government-owned utilities and not-for-profit water corporations. These utilities are responsible for providing service to the vast majority of residents served by centralized water and sewer systems (89 percent of customers served by water systems[2] and over 80 percent served by wastewater systems).

The report synthesizes information from several inter-related surveys and data sources:

**Rate Practices Survey:** The NCLM and the EFC implemented a detailed survey in the fall of 2005 that was completed by 277 utilities (217 municipal utilities and 60 other governmental and not-for-profit utilities – see Table 1). These utilities provided data on rate-setting practices and priorities, billing practices, system characteristics, and the policies they maintain on a range of subjects.

---

[1] Funding for this research was provided by the NC Water Resources Research Institute, the Urban Water Consortium, and the US Environmental Protection Agency.

[2] Calculated from the Environmental Protection Agency's 2005 SDWIS database of all drinking water systems.

**Rates Inventory and Analysis:** In addition, analysts collected and studied the rate schedules from 333 utilities, 247 of which had also participated in the practices survey. Table 2 shows the composition of utilities whose rate structures were analyzed. Collectively, the utilities included in this study serve approximately 90 percent of public water and sewer customers in the state.

**Upfront Charges Survey:** In order to compile a comprehensive view of the revenue tools used by utilities, the authors also carried out a survey of one-time charges. These charges take a variety of names and are used for a range of purposes – tap fees, connection charges, impact fees, capacity charges, etc. Information on the upfront charges for 325 utilities were collected and compiled into a separate database.

Additional sources of information used to analyze the rates in the context of various topics include public databases from such agencies as the North Carolina Department of State Treasurer (Local Government Commission), the North Carolina Rural Center, the United States Environmental Protection Agency, and the United States Census Bureau.

***Table 1: Rate Practices Survey Respondents FY 2005-2006***

| Institutional Arrangement | Provides Water and Sewer | Provides Water Only | Provides Sewer Only | Total |
|---|---|---|---|---|
| Municipality | 185 | 23 | 9 | **217** |
| County/District | 13 | 21 | 0 | **34** |
| Authority/Metropolitan District | 2 | 1 | 1 | **4** |
| Sanitary District | 1 | 5 | 2 | **8** |
| Not-for-Profit | 0 | 14 | 0 | **14** |
| **Total** | **201** | **64** | **12** | **277** |

***Table 2: Utility Rate Schedules Included in the Analysis FY 2005-2006***

| Institutional Arrangement | Provides Water and Sewer | Provides Water Only | Provides Sewer Only | Total |
|---|---|---|---|---|
| Municipality | 248 | 20 | 7 | **275** |
| County/District | 10 | 21 | 1 | **32** |
| Authority/Metropolitan District | 2 | 1 | 1 | **4** |
| Sanitary District | 1 | 4 | 3 | **8** |
| Not-for-Profit | 0 | 14 | 0 | **14** |
| **Total** | **261** | **60** | **12** | **333** |

This report is divided into four sections:

1. Description of utility assets and practice information
2. Rate structures
3. Comparative rate information
4. Relationships between rates and major water policy issues

## SYSTEM ASSETS AND PRACTICES

The rates survey first identified the characteristics of water and sewer systems in North Carolina. In addition, utilities provided information on a number of policies, from the type of equipment they use for meter reads to billing frequencies and late fees. The utilities vary greatly in size and system capacity, as well as in their standard practices. However, the vast majority of utilities review their rates annually.

### *Water System Attributes*[3]

North Carolina water and sewer utilities come in all shapes and sizes. The smallest water systems rely on a single well and a few thousand feet of water line to serve a few dozen families. The largest regional utilities have thousands of miles of water lines and multiple treatment plants that can serve thousands of customers. Table 3 shows the water system attributes for the practices survey respondents. This group consists of 265 municipal and non-municipal systems.

***Table 3: Characteristics of Respondents' Water Systems***

| Total Water Accounts | Number of Utilities | Average Number of Water Accounts | Average Annual Water Sales (MG) | Average Miles of Pipe | Average Number of Valves | Average Number of Hydrants | Average Number of Booster Stations |
|---|---|---|---|---|---|---|---|
| Up to 999 | 71 | 480 | 52 | 18 | 110 | 67 | 1 |
| 1,000 - 2,499 | 61 | 1,669 | 265 | 62 | 310 | 244 | 1 |
| 2,500 - 4,999 | 58 | 3,717 | 527 | 137 | 1,374 | 440 | 2 |
| 5,000 - 9,999 | 29 | 6,868 | 1,047 | 240 | 1,790 | 870 | 2 |
| 10,000 - 25,000 | 26 | 16,098 | 2,234 | 503 | 4,166 | 2,034 | 5 |
| More than 25,000 | 16 | 60,817 | 11,315 | 1,243 | 15,715 | 7,068 | 9 |

Seventy-two percent of the water utilities responding to the survey operate their own water treatment plant; the rest rely on purchased water from another entity. Fifty-one percent of water utilities with a water treatment plant treat surface water, compared to 46 percent that treat groundwater and 3 percent that treat a mix of surface water and groundwater.

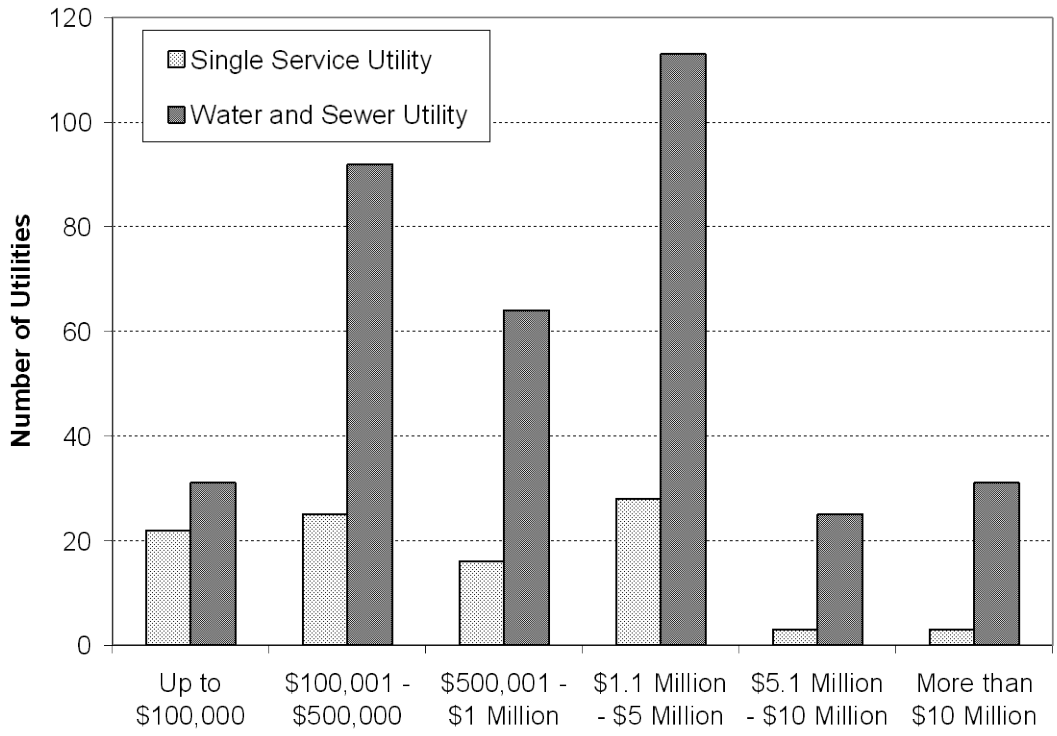
Most respondents have maps of more than half of their water system in an electronic format (GIS or CAD). The average amount mapped is 53 percent, while the median[4] amount is 75 percent.

Total revenues from water systems also vary greatly, as seen in Figure 1 below.

[3] Since not all 277 survey utilities responded to each individual question, and since certain questions were only asked of municipalities, the following results in this study derived from the survey are representative of the utilities that answered the relevant questions. For most questions, response rates exceeded 80 percent. Results are reported for all utilities, unless specifically reported for municipalities, county systems or other subgroups of utilities.

[4] Most of the statistics reported in this paper refer to *medians*. Exactly half of all the utilities in the sample have a value that is equal to or greater than (or equal to or lower than) the median value. The median is preferred over the average because averages are influenced by outlier or anomalous values whereas medians are not.

***Figure 1: Total Operating Revenues for Local Government Owned Water and Sewer Utilities in FY2004-05 (n=453)***




*Source: LGC audited special report on water and sewer finances of local governments for FY2004-05.*

Individual accounts within water utilities large and small also come in a variety of sizes. Small, residential users make up most of a water utility's total customer base. However, a few large users can account for a significant proportion of a utility's revenue.

### *Sewer System Attributes*

Seventy-seven percent of the practices survey respondents provide sewer service. This group consists of 213 municipal and non-municipal utilities. Table 4 below summarizes key characteristics of these respondents:

***Table 4: Characteristics of Respondents' Sewer Systems***

| Total Sewer Accounts | Number of Utilities | Average Number of Sewer Accounts | Average Annual Sewerage Sales (MG) | Average Miles of Pipe | Average Number of Lift Pump Stations | Average Age of Oldest Part of Collection System (Years) |
|---|---|---|---|---|---|---|
| Up to 999 | 73 | 439 | 61 | 17 | 5 | 36 |
| 1,000 - 2,499 | 53 | 1,602 | 269 | 37 | 11 | 57 |
| 2,500 - 4,999 | 37 | 3,726 | 565 | 109 | 14 | 61 |
| 5,000 – 9,999 | 17 | 7,391 | 1,560 | 166 | 19 | 77 |
| 10,000 - 25,000 | 17 | 17,469 | 2,738 | 319 | 30 | 84 |
| More than 25,000 | 9 | 72,323 | 8,722 | 1,244 | 47 | 83 |

Similar to water utility respondents, the sewer utility respondents represent the full spectrum of system sizes for government-owned and not-for-profit systems in the state. Eighty-three percent of the sewer utilities responding to the survey operate their own wastewater treatment plant:

- 49 percent of utilities that operate plants remove nutrients from wastewater at their plant(s) compared to 43 percent that do not (8 percent of respondents did not know);
- 71 percent of utilities that remove nutrients remove both nitrogen and phosphorus, compared to 14 percent that remove only nitrogen and 4 percent that remove only phosphorus (11 percent did not know);
- 58 percent of sewer utility respondents have pre-treatment ordinances, while another 9 percent of respondents did not know if they have this ordinance.

Forty percent of sewer respondents have surcharges for industrial waste that has a higher concentration of pollutants, compared to 26 percent that have these types of surcharges for commercial accounts. Most sewer respondents have or are developing a fats/oils/grease reduction program. Fifty-eight percent of respondents have such a program, 25 percent are developing a program, and 13 percent do not have a program (4 percent did not know). Fifty-one percent of existing programs have a discharge numerical limit. Ninety-five percent of existing programs include grease traps or interceptor requirements, and 78 percent include public education.

Total annual revenues from sewer systems vary greatly, as seen in Figure 1. Sewer utilities also find that, while most of their individual customers are residential, a significant proportion of their total revenues come from large industrial producers.

***Mandatory Connections***

Many utilities (municipalities, towns, some authorities) are given the authority to require that customers in their service area connect to (and therefore contribute revenue to) their systems. According to the survey, 68 percent of utilities have an ordinance requiring residents to connect to their water and/or sewer system.

***Meter Reading and Billing Frequency***

Meter reads can be conducted with hand-held devices, meter books or AMR/radio reads. For the most part, utilities use only one of these methods to read water meters, though approximately one-quarter of the municipalities use more than one method. Hand-held meter reading devices (i.e. Touchread) are used by 53 percent of municipalities, meter books by 38 percent, and AMR/radio read by 22 percent. Five municipalities, representing only 2 percent of the reporting sample, contract out their meter reading operations.

*The decision about how often to read meters is no longer purely a decision about minimizing costs*

Eighty-seven percent of utilities read water meters and send out residential water and sewer bills on a monthly basis, while 10 percent send out bimonthly bills. The decision about how often to read meters is no longer purely a decision about minimizing costs. For many utilities, the higher cost of reading water meters monthly (as opposed to bi-monthly or

quarterly) is offset by more flexibility in the design of the rate structure, a more stable monthly revenue stream to the utility, and a more affordable payment schedule for low-income customers who find bi-monthly bills too large to pay all at once.

### *Collection Enhancement Measures*

Instituting late payments and cutting off service are two common tools used to ensure customer payments. Figure 2 and Figure 3 show that practices in this area vary across the state, with 10 percent of the utilities imposing penalties within the first two weeks past the due date, 59 percent providing 2 to 3 weeks of leeway and 31 percent providing 3 weeks or more. The median number of grace period days provided by the surveyed utilities is 20. The amount of late time that utilities provide before disconnecting service is considerably longer, with a median period of 30 days. Approximately one-third of the utilities that responded to this question reported disconnecting non-paying customers in 14 days or less beyond the due date. Thirty-six percent of utilities provided at least a month before disconnection action occurred.

***Figure 2: Days from Billing Date that Customers Have to Pay Without Penalty? (n=211)***

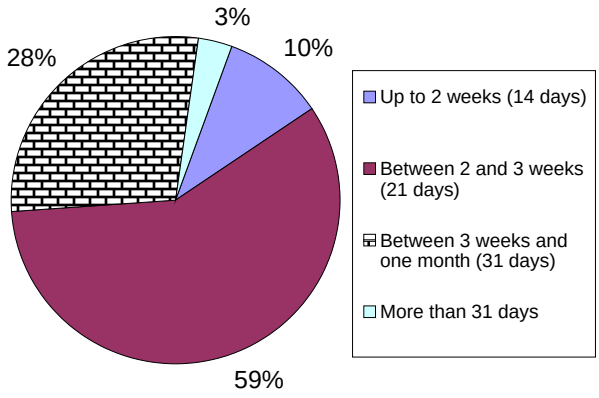
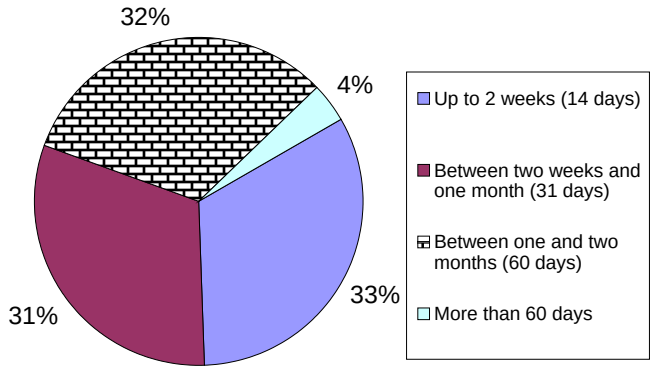



***Figure 3: Days a Bill Can Be Past Due Before Disconnecting Service? (n=207)***



### *Services Included in the Bill*

The "water bill" has become a multi-service billing instrument for many municipalities across the state. Including multiple charges on one bill increases billing efficiency but may make it more difficult for customers to understand what individual services cost. Of the municipalities that charge for other services on the bill, garbage collection was charged in 82 percent of the municipalities, electricity in 25 percent, recycling services in 22 percent, landfill disposal fees in 15 percent, and stormwater removal fees in 12 percent. Only 37 percent of municipalities that bill for multiple services have an ordinance specifying the order in which partial payments are to be applied among the various enterprise services. If water and sewer services are paid last, partial payments may increase the likelihood of customers being disconnected.

### *Reviewing and Adjusting Rates*

The majority of utilities, approximately 82 percent, annually review their water and sewer rates. Two-thirds of the utilities conducted their own internal staff analysis of their costs and rates during their last rate study, while 25 percent hired a consultant to perform the analysis. Two percent of utilities adjusted their rates using an inflation indicator, and 6 percent of utilities last adjusted their rates based on comparison with "peer" utility rates.

*The majority of utilities annually review their water and sewer rates*

According to the survey, 51 percent of utilities raised their residential water rates, and 55 percent raised their residential sewer rates for FY05-06. Rate increases enhanced revenue by an average of 7.2 percent for water service and 8.2 percent for sewer service. Prior to FY05-06, 46 percent of utilities had last raised their water rates in FY04-05, 41 percent had last raised their water rates within 5 years, and 12 percent had not raised their water rates in the last five years. The trend is similar for sewer rates.

### *Rate changes over time*

An historical review of the water rates of 155 municipalities in the study shows that the price charged for 3,000 gallons of water has increased an average of 160 percent for inside customers since 1986, compared to an inflation rate of 86 percent. The price charged for 10,000 gallons increased 151 percent over the same period (see Table 5 and Table 6 below.

***Table 5: Changes in Water Rates (1986 to 2006) for 3,000 Gallons/Month to Inside Customers (n=155)***

| | Not Controlling for Inflation | | | After Controlling for Inflation | | |
|---|---|---|---|---|---|---|
| | **Nominal Dollar Change** | **Percent Change from 1986** | **Average Percent Change Per Year Since 1986** | **Real Dollar Change** | **Percent Change from 1986** | **Average Percent Change Per Year Since 1986** |
| Average | $7.92 | 160% | 8.0% | $1.59 | 40% | 2.0% |
| Median | $7.29 | 120% | 6.0% | $1.00 | 18% | 0.9% |
| Minimum | $0.20 | 3% | 0.2% | -$3.16 | -44% | -2.2% |
| Maximum | $24.22 | 681% | 34.1% | $9.35 | 321% | 16.0% |

***Table 6: Changes in Water Rates (1986 to 2006) for 10,000 Gallons/Month to Inside Customers (n=161)***

| | Not Controlling for Inflation | | | After Controlling for Inflation | | |
|---|---|---|---|---|---|---|
| | **Nominal Dollar Change** | **Percent Change from 1986** | **Average Percent Change Per Year Since 1986** | **Real Dollar Change** | **Percent Change from 1986** | **Average Percent Change Per Year Since 1986** |
| Average | $19.13 | 151% | 7.6% | $3.75 | 35% | 1.8% |
| Median | $18.30 | 130% | 6.5% | $3.36 | 24% | 1.2% |
| Minimum | $0.95 | 5% | 0.3% | -$7.96 | -43% | -2.2% |
| Maximum | $52.35 | 471% | 23.5% | $22.59 | 207% | 10.4% |

In other words, rate increases averaged 2 percent a year greater than the consumer price index over this period. Interestingly, real prices (after adjusting for inflation) actually fell for 25 percent of the municipalities—their rate increases were below the rate of inflation. On the other end of the scale, however, rates for 16 percent of the municipalities increased more than 5 percent per year after inflation for the 20 year period.

## STRUCTURING RATES

Utilities employ a range of rate structures to determine what their customers pay each month. Almost all utilities use a combination of fixed ("minimum") charges and variable charges in their rate structures. However, there is considerable variation in how the fixed charges and variable charges are calculated and in how different classes of customers are charged.

### *Classes of Customers*

Forty-six percent of water utilities charge different rates for different classes of customers. For utilities with different customer classes:

*Forty-six percent of water utilities charge different rates for different classes of customers*

- 70 percent have a commercial/industrial class
- 50 percent have a bulk/wholesale class
- 18 percent have a special class for individual large customers (such as a manufacturing plant)
- 14 percent have a customer class for multi-family customers (such as condominiums)

Thirty-eight percent of sewer utilities charge different rates for different classes of customers. Of these sewer utilities:

*Thirty-eight percent of sewer utilities charge different rates for different classes of customers*

- 73 percent have a commercial/industrial class
- 29 percent have a bulk/wholesale class
- 17 percent have a special class for individual large customers
- 9 percent have a customer class for multi-family customers

In addition, 16 percent of sewer utilities serve households that are not also customers of the water system (16 percent).

***Base Charges and Consumption Allowances***

Nearly all utilities include base charges on their residential water and sewer bills which customers must pay regardless of the amount of water consumed. Utilities use different names for these base charges, including "minimum charges," "fixed fees," "customer service charges," and "administrative fees."

Many utilities provide an allowance for a specific amount of water consumption (or wastewater disposal) with their base charge. For these utilities, the variable portion of the rate structure only takes effect when a customer uses more than the allowance included in the base charge; otherwise, a customer using less than the allowance amount pays only the base charge. Other utilities charge a fixed monthly fee that does not include any consumption allowance.

The monthly-equivalent amount of these charges ranges considerably, regardless of whether the base charge includes consumption. Larger utilities tend to charge lower base charges than smaller utilities, as shown in Table 7 and Table 8. Smaller utilities more commonly include consumption allowances than do larger utilities. Larger utilities commonly use base charges without consumption allowances. Overall, 71 percent of water utilities and 62 percent of sewer utilities include consumption allowances with their base charges.

***Table 7: Fixed Monthly Water Base Charges***

| | | Base Charge Does Not Include any Consumption | | Base Charge Includes Some Consumption | |
|---|---|---|---|---|---|
| **Total Water Accounts** | **Number of Utilities** | **Median Base Charge** | **Percent of Utilities** | **Median Base Charge** | **Percent of Utilities** |
| Up to 999 | 62 | $12.00 | 24% | $12.50 | 74% |
| 1,000 - 2,499 | 55 | $9.00 | 16% | $12.25 | 84% |
| 2,500 - 4,999 | 49 | $7.75 | 21% | $10.70 | 76% |
| 5,000 - 9,999 | 28 | $6.28 | 32% | $10.10 | 68% |
| 10,000 - 24,999 | 25 | $5.83 | 76% | $10.36 | 24% |
| More than 25,000 | 16 | $3.80 | 75% | $10.00 | 25% |

***Table 8: Fixed Monthly Sewer Base Charges***

| | | Base Charge Does Not Include any Consumption | | Base Charge Includes Some Consumption | |
|---|---|---|---|---|---|
| **Total Sewer Accounts** | **Number of Utilities** | **Median Base Charge** | **Percent of Utilities** | **Median Base Charge** | **Percent of Utilities** |
| Up to 999 | 62 | $13.16 | 26% | $13.90 | 73% |
| 1,000 - 2,499 | 47 | $5.19 | 28% | $13.50 | 66% |
| 2,500 - 4,999 | 32 | $8.00 | 41% | $13.90 | 50% |
| 5,000 - 9,999 | 17 | $5.72 | 65% | $10.97 | 35% |
| 10,000 - 24,999 | 16 | $6.52 | 75% | $13.29 | 13% |
| More than 25,000 | 9 | $2.73 | 89% | $4.40 | 11% |

The majority of consumption allowances range from 1,000 gallons of water or sewer per month to 4,000 gallons per month. The median consumption allowance is 2,000 gallons per month for each service (water and sewer). This standard does not change based on the size of utilities; the median allowance remains 2,000 gallons per month for all six size categories used in this analysis for water and sewer.

***Commodity Rate Block Structures***

The three most common rate structures are uniform, increasing block, and decreasing block. A uniform rate structure exists when the rate at which water is charged (beyond the consumption allowance) does not change as the customer uses more water. An increasing block structure increases water rates as consumption rises. These rates are tied to blocks of consumption; for example, one rate block could be zero to 5,000 gallons or 2,500 gallons to 10,000 gallons. This structure often underpins a water conservation strategy. A decreasing block structure reduces water rates as consumption rises and often supports an economic development strategy.
Other rate structures used in North Carolina include a hybrid of increasing and decreasing blocks where rates increase or decrease for specific targeted blocks of consumption amounts, seasonal uniform water rate structures where different water rates apply at different times of the year, uniform rate structures with a cap on sewer consumption, flat monthly fees, and tiered flat fees based on consumption amounts. Seasonal uniform rate structures support conservation, especially for those utilities that experience great seasonal consumption changes (e.g. tourist locations). Flat fees are rarely used for single family residential customers but often are applied to multi-user or mobile home consumers.

Uniform rate structures are by far the most prevalent in North Carolina, especially for sewer utilities (see Figure 4 and Figure 5).

***Figure 4: Water Rate Structures (n=321)***

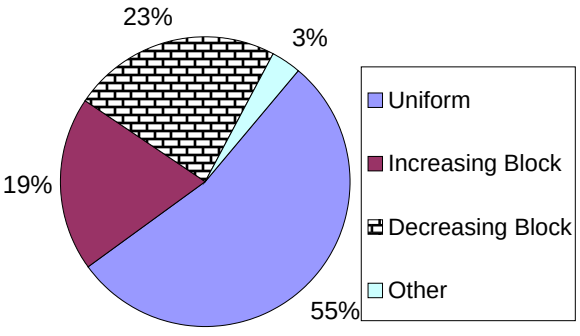



***Figure 5: Sewer Rate Structures (n=273)***

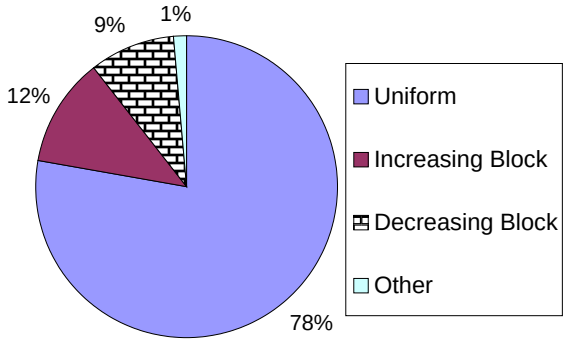



Figure 6 shows an interesting nuance with rate structures. Many utilities that use increasing or decreasing block structures set the starting points of the block outside of the range that would impact the average residential user (0 to 15,000 gallons per month). Thus, these customers have a *de facto* uniform rate structure for residential customers, and the percentage of customers statewide affected by increasing and decreasing blocks at this lower gallon-per-month range is significantly less than for the full range of consumption.

***Figure 6: Rate Structures in NC, Applicable Up to 15,000 GPM (n=321)***

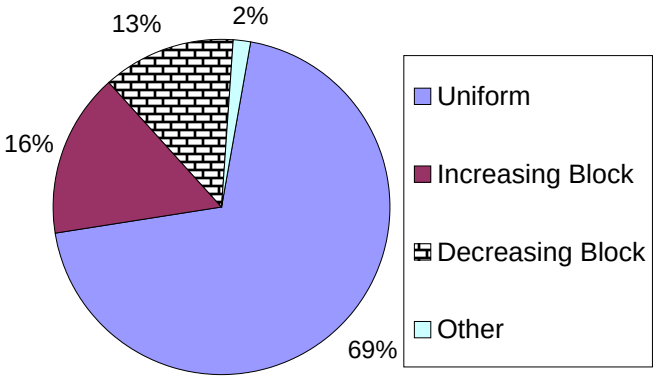
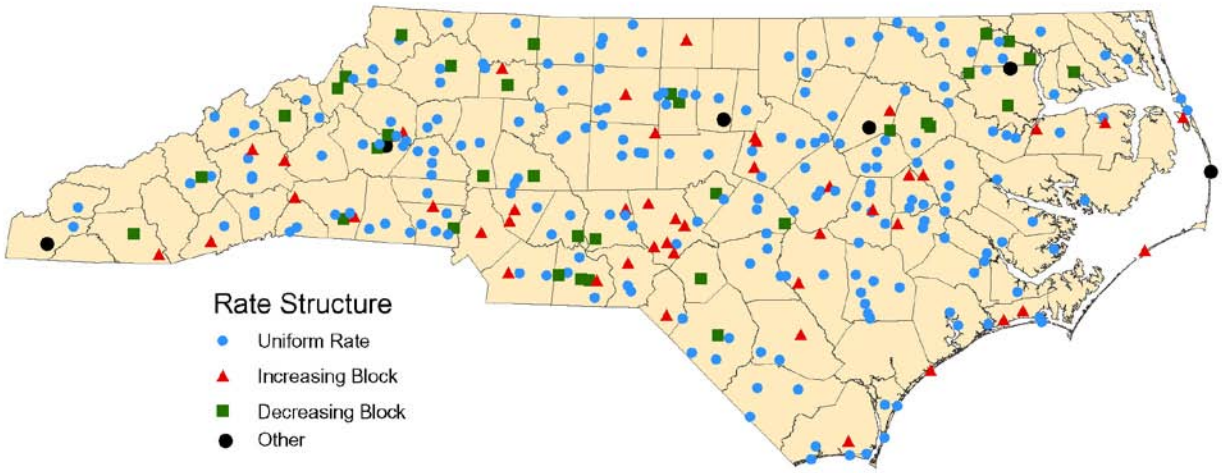



Figure 7 maps the different types of rate structures across North Carolina. The rate structures vary across the state in no discernible pattern, but there appears to be fewer decreasing block water rate structures in the Eastern counties of the state.

***Figure 7: Water Utility Rate Structures in North Carolina as of February 2006***



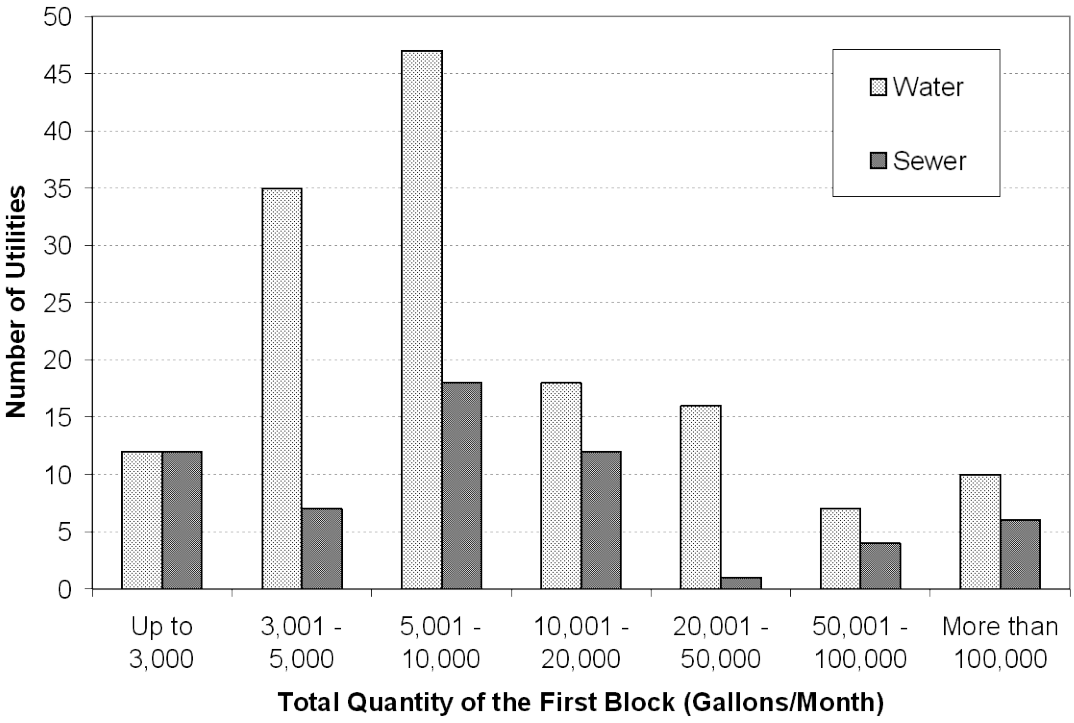

***Size of the First Block in Block Rate Structures***

As mentioned above, some utilities design separate rates and rate structures for commercial users. Other utilities use only one rate structure for residential and commercial users but design the blocks in their rate structures effectively to charge different rates for residential and commercial customers. Under this one-rate structure, the first block is set to include all possible

consumption levels for residential customers, thereby applying a uniform rate for these customers, while commercial account consumption typically exceeds the first block allotment.

The size of the first block for all block rate structures is shown Figure 8. It is important to note that 30 percent of water and sewer block rate structures set their first block at 20,000 gallons of consumption per month or more. Residential customers in North Carolina, on average, use between 5,000 and 6,000 gallons per month over the course of one year. Residential consumption in summer months often increases by 150 to 200 percent but still rarely exceeds 20,000 gallons of water and sewer per month. In effect, the 30 percent of utilities that use this block rate structure apply a uniform rate to their residential customers and a different rate to their commercial and industrial customers. The majority of these utilities (about 75 percent) use decreasing block rates, providing water and sewer service at a lower rate for businesses than for residential customers to promote economic development in the area.

***Figure 8: Total Quantity of the First Block in All Block Rate Structures (n=157)***




***Marginal Prices***

One of the most important elements of a rate structure is the price customers pay for the last 1,000 gallons purchased each month. For example, if a household uses 6,000 gallons, the first 3,000 gallons may have only cost $3.00 per thousand, but if the price per thousand increased to $4.00 after 3,000 gallons, then the household may consider the price of their water to be $4.00 per thousand. The median marginal price rate for water (not including base charges) at 5,000 gallons is about $2.80 per 1,000 gallons. The median sewer price at this amount is about $3.44 per 1,000 gallons.

### *Inside/Outside Billing*

Municipal utilities often serve customers that live outside of city limits. Approximately 80 percent of municipal utilities that serve non-municipal customers charge "outside" customers higher rates than "inside" customers. A combined bill for 6,000 gallons of water and sewer is, on average, 157 percent higher for outside customers than for inside customers of municipalities that have different inside/outside rates. The median combined bill for outside customers is $71.74; compared to $47.90 for inside customers (see Figure 9 and Table Table 9).

*The combined monthly bill for 6,000 gallons of water and sewer is, on average, 157 percent higher for outside customers than for inside customers of municipalities that have different inside/outside rates*

***Figure 9: Median Combined Residential Water and Sewer Billings for Municipal Rate Structures with Different Inside/Outside Rates (n=223)***

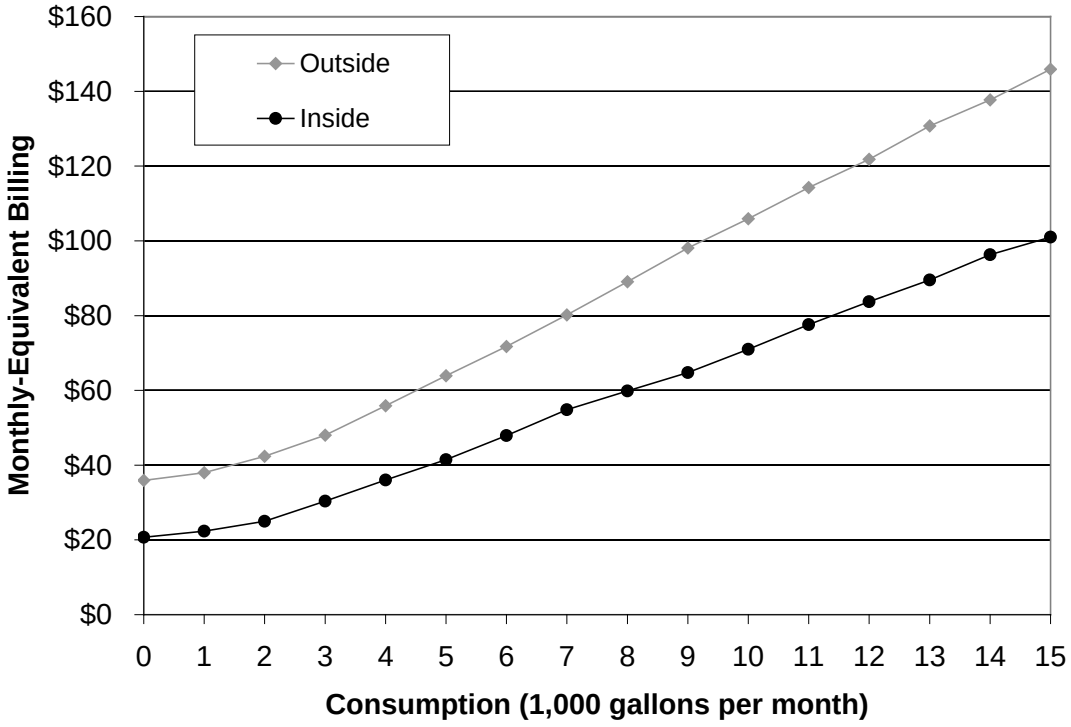
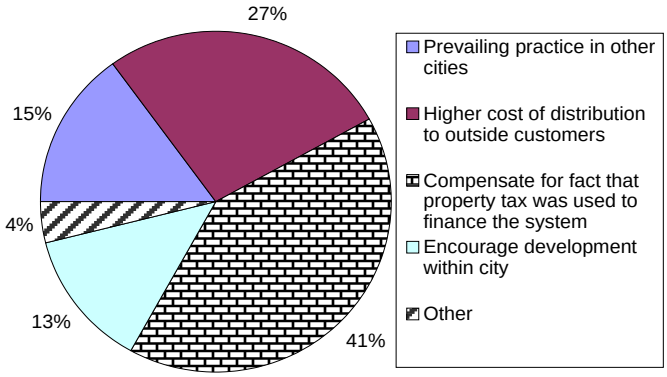



***Table 9: Median Combined Water and Sewer Bill for Inside and Outside Residential Customers of Municipal Utilities with Different Inside/Outside Rates***

| Size of Utility by Number of Water/Sewer Accounts | Number of Municipal Utilities | Median Combined Bill for 3,000 Gallons | | Median Combined Bill for 6,000 Gallons | | Median Combined Bill for 10,000 Gallons | |
|---|---|---|---|---|---|---|---|
| | | Inside | Outside | Inside | Outside | Inside | Outside |
| Up to 999 | 39 | $32.00 | $48.00 | $51.00 | $71.61 | $76.57 | $99.35 |
| 1,000 - 2,499 | 40 | $31.64 | $49.29 | $51.87 | $77.92 | $74.91 | $119.16 |
| 2,500 - 4,999 | 28 | $27.23 | $49.89 | $43.12 | $71.31 | $64.96 | $103.15 |
| 5,000 - 9,999 | 19 | $27.70 | $49.21 | $41.35 | $74.41 | $61.59 | $105.10 |
| 10,000 - 24,999 | 17 | $30.69 | $47.69 | $46.21 | $77.30 | $70.82 | $117.17 |
| More than 25,000 | 9 | $26.03 | $39.71 | $43.28 | $63.15 | $64.83 | $98.11 |

Most municipalities that charge different outside and inside rates simply double inside water rates for outside customers. Many municipal utilities also double sewer rates. Other strategies include doubling only the variable commodity rates or the base charges, tripling the inside rates or increasing them by a different percentage. The primary reasons for charging different outside rates among municipal utilities is shown in Figure 10.

***Figure 10: Primary Reason for the Difference between Inside and Outside Municipal Rates (n=166)***




## COMPARING WHAT UTILITIES CHARGE

Rate surveys often focus on what individual utilities charge their customers. While this report enables rate comparisons, comparing rates without care can lead to misperceptions. Arguments such as "our neighboring community charges their average customers $30 for water, so we should charge our customers $30 or less" can lead to dangerous public health consequences. Furthermore, this type of analysis does not look at the subtleties of rates – what does each utility charge their low-use customers, their high-use customers, and their commercial customers? Most importantly, simple comparisons normally exclude consideration of the key local conditions that influence the cost of providing services, such as the size of the utility, its past

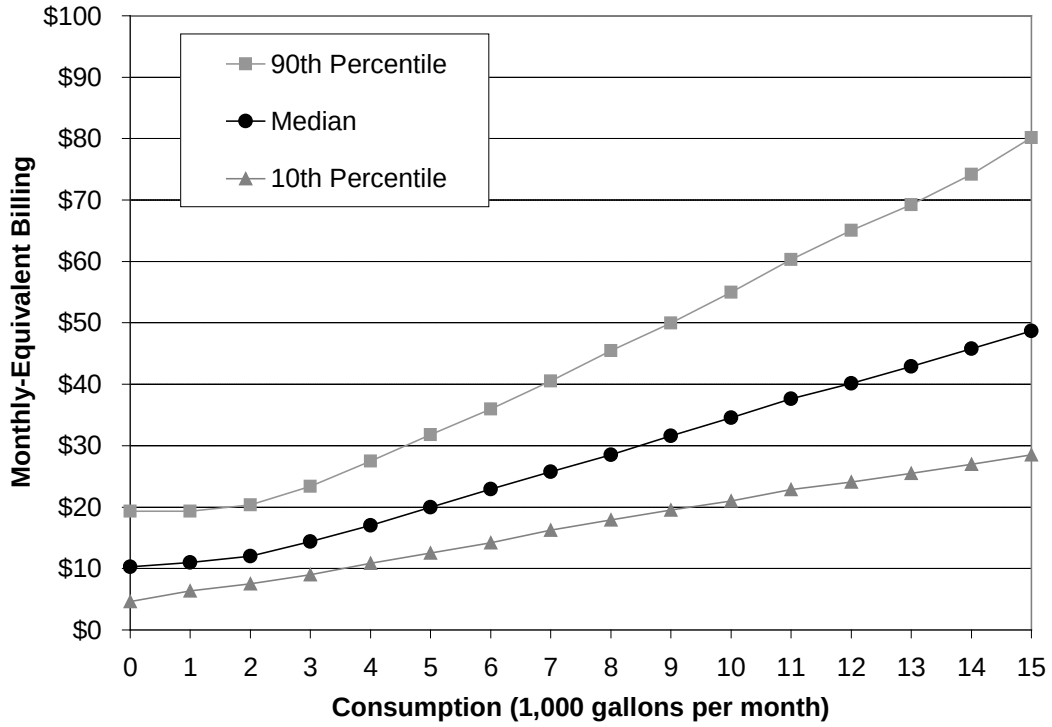
capital decisions, its treatment techniques, its sources of raw water, or the quality of receiving waters. High rates do not necessarily reflect poor or inefficient management, and low rates often have more to do with a fear over rate shock or an interest in charging lower rates than one's peers than with superior management. In fact, some utilities with low rates have done so at the expense of their assets by making short-term sacrifices that are likely to adversely impact cost and service in the long term.

*High rates do not necessarily reflect poor or inefficient management, and low rates often have more to do with fear than with superior management*

### *Median Charges for Residential Water and Sewer Service*

Figure 11 shows the median amount utilities bill their residential water customers for different consumption amounts on a monthly basis5. Medians are shown instead of averages to avoid the information skewing that can occur due to exceptionally large or small outliers; medians mark the halfway value among all utilities in the sample. The chart also shows what utilities in the 10th (lower) and 90th (upper) percentiles charge for water and sewer service. These amounts include all fixed and consumption-based minimum base charges. The median monthly amount charged for zero gallons of water is $10.30, $22.96 for 6,000 gallons, and $34.58 for 10,000 gallons.

***Figure 11: Monthly Residential Water Bills by Consumption (n=332)***

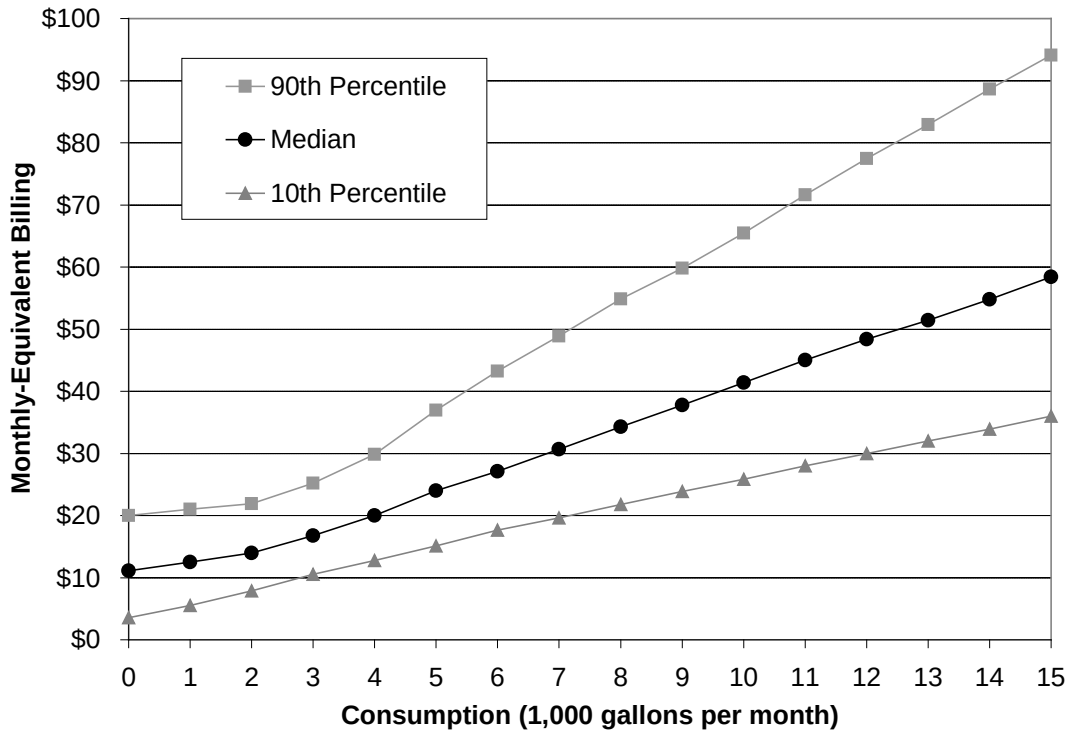



*Note: Includes multiple rate structures for utilities with unique rate structures for different districts*

[5] For utilities that bill on a non-monthly basis (bi-monthly or quarterly), charges have been calculated and presented on a monthly basis to allow for comparison.

Figure 12 presents information on median monthly sewer bills across typical residential consumption levels. The median monthly sewer bill for customers consuming zero gallons of water is $11.24. At 6,000 gallons, median bills rise to $27.83. Median bills for 10,000 gallons total $41.42.

***Figure 12: Monthly Residential Sewer Bills by Consumption (n=275)***




*Note: Includes multiple rate structures for utilities with unique rate structures for different districts*

***Median Charges for Service Provided to Commercial Customers***

Figure 13 and Figure 14 show the range of what utilities charge commercial customers across the state for water and sewer service. The median monthly water bill for "inside" commercial customers consuming zero gallons is $12.00. Median bills total $78.20 for 25,000 gallons and $285.44 for those consuming 100,000 gallons. The charges for sewer are significantly higher than for water, especially for large users ($12.50 for zero consumption, $98.37 at 25,000 gallons and $365.62 at 100,000 gallons).

***Figure 13: Monthly Commercial Water Bills by Consumption (n=67)***

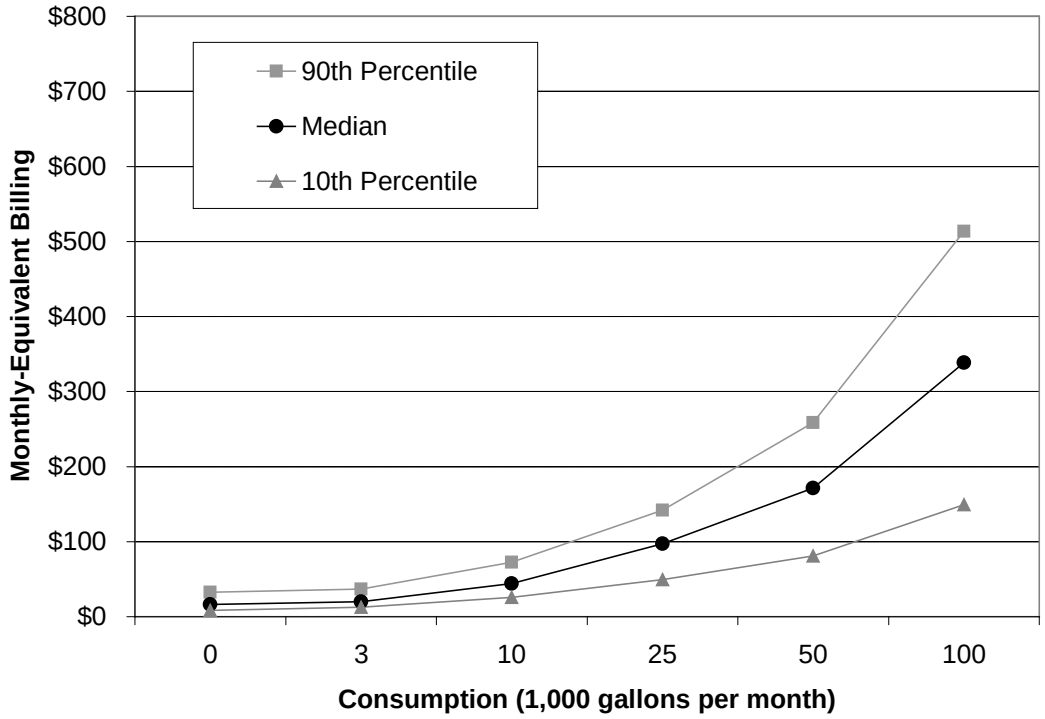
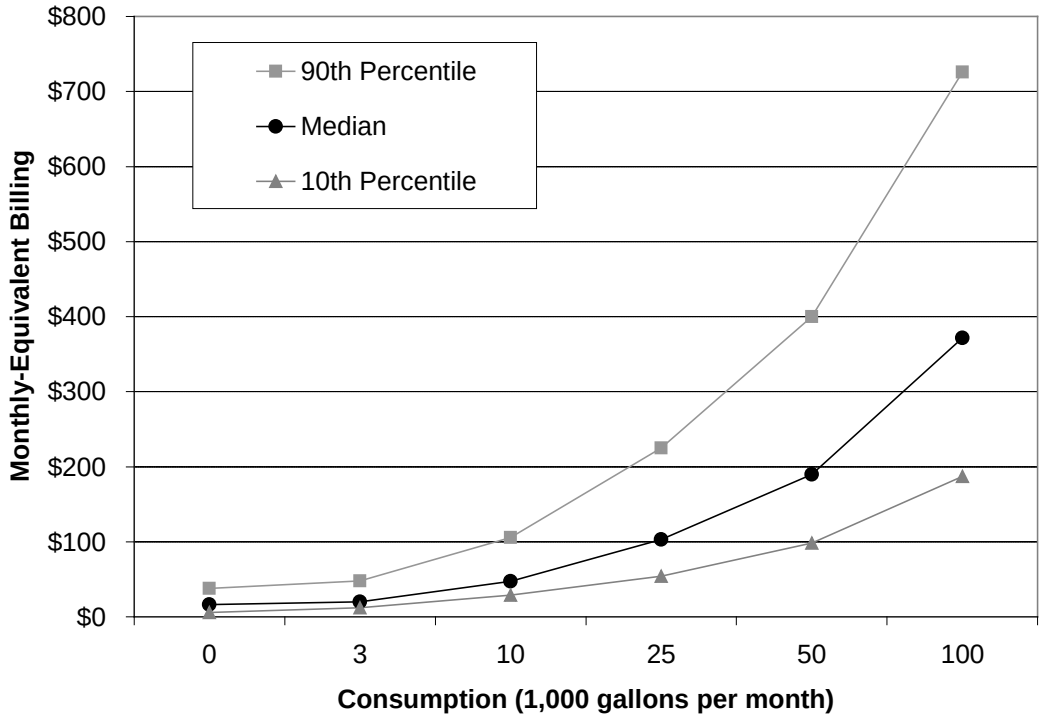



***Figure 14: Monthly Commercial Sewer Bills by Consumption (n=45)***



### *Water and Sewer Charges by Size of Utility*

Table 10 illustrates the "economy of scale" inherent to the provision of water. With the exception of one group, larger utilities tend to charge lower water and/or sewer bills for an average residential consumption level (6,000 gallons per month) than do smaller utilities. Information on operating ratios[6] for different-sized utilities suggests that smaller utilities, both in terms of accounts and production, are less likely to fully recover their operating and capital costs through their rates. In other words, smaller utilities should probably raise their rates even higher, thereby increasing the rate gap between small and large systems.

***Table 10: Median Water and Sewer Bills for 6,000 Gallons Based on Number of Accounts***

| Size of Utility by Number of Water/Sewer Accounts | Median Water and/or Sewer Operating Ratio | Median Water Bill for 6,000 Gallons (Number of Utilities) | Median Sewer Bill for 6,000 Gallons (Number of Utilities) |
|---|---|---|---|
| Up to 999 | 0.90 | $23.69 (62) | $27.78 (62) |
| 1,000 - 2,499 | 1.01 | $24.64 (55) | $27.40 (47) |
| 2,500 - 4,999 | 1.16 | $22.00 (49) | $27.42 (32) |
| 5,000 - 9,999 | 1.11 | $20.23 (28) | $26.21 (17) |
| 10,000 - 24,999 | 1.18 | $23.95 (25) | $29.04 (16) |
| More than 25,000 | 1.18 | $18.27 (16) | $27.68 ( 9) |

However, the number of accounts is not always an indicator of the capacity of a water utility because some utilities that serve relatively few accounts have large customers that use enormous quantities of water. Table 11 shows the even greater impact that water sales have on what utilities charge. The largest utilities in the state are able to charge a residential customer approximately 4 dollars (20 percent) less than the median for all utilities across the state. Small utilities in close proximity to these larger utilities may feel pressure to keep their rates low. In many cases, water production costs more than what these smaller utilities charge their customers (see Section Five below).

***Table 11: Median Water Bill for 6,000 Gallons Based on Quantity of Water Sold/Year***

| Size of Utility by Quantity of Water Sold per Year (MGY) | Number of Utilities | Median Water Bill for 6,000 Gallons | Median Water and/or Sewer Operating Ratio |
|---|---|---|---|
| Up to 30 | 34 | $22.54 | 0.86 |
| 31 - 60 | 43 | $26.00 | 0.88 |
| 61 - 180 | 78 | $24.23 | 1.01 |
| 181 - 600 | 77 | $23.63 | 1.08 |
| 601 - 2,300 | 45 | $19.57 | 1.08 |
| More than 2,300 | 32 | $18.46 | 1.14 |

The volume-to-cost relationship is even more pronounced for sewage. Table 10 shows relatively little correlation between the number of accounts and what customers are charged for sewer service; however, Table 12 shows that utilities that treat large amounts of wastewater charge

[6] Operating ratios in this report are calculated as the total operating revenues divided by total operating costs, including depreciation. The ratios do not include capital costs. Data for operating ratios were provided by the LGC in their audited special report on water and sewer finances of local governments for FY2004-05.

considerably less than utilities that treat smaller amounts. The largest utilities treating over 2,000 MGY (or 5.5 MGD) charge $5 (17 percent) less than the smallest utilities.

***Table 12: Median Sewer Bill for 6,000 Gallons/Month Based on Quantity of Wastewater Treated per Year***

| Size of Utility by Quantity of Wastewater Treated per Year (MGY) | Number of Utilities | Median Sewer Bill for 6,000 Gallons | Median Water and/or Sewer Operating Ratio |
|---|---|---|---|
| Up to 15 | 25 | $30.00 | 1.02 |
| 16 – 50 | 36 | $30.00 | 0.88 |
| 51 – 150 | 72 | $26.45 | 0.93 |
| 151 - 600 | 60 | $28.25 | 1.06 |
| 601 - 2,000 | 37 | $26.05 | 1.11 |
| More than 2,000 | 26 | $24.96 | 1.14 |

Running a combined water and sewer utility enables utilities to offer their customers lower prices than utilities that provide just water or just sewer service. Combined utilities are able to spread some costs, such as management and customer service costs (billing etc.), among both water and sewer. The median charge for 6,000 gallons of water among combined utilities is approximately 8 dollars (27 percent) less than the median charge among water-only utilities (see Table 13).

***Table 13: Median Water and Sewer Bills for 6,000 Gallons/Month Based on Services Provided by the Utility***

| Type(s) of Service Provided | Median Water Bill for 6,000 Gallons (Number of Utilities) | Median Sewer Bill for 6,000 Gallons (Number of Utilities) | Median Water and/or Sewer Operating Ratio |
|---|---|---|---|
| Water-Only or Sewer-Only Utility | $29.56 ( 58) | $33.55 ( 12) | 1.08 |
| Water and Sewer Utility | $21.50 (263) | $27.12 (261) | 1.02 |

***Impact of Water Source and Treatment on Rates***

Both the processes of treating and distributing water and collecting and treating wastewater have a major impact on the prices utilities charge their customers. In most cases, the more complicated processes required to treat surface water makes providing surface water significantly more expensive than providing ground water – something that is reflected in data on what these different types of utilities charge (Table 14)..

***Table 14: Median Water Bill for 6,000 Gallons Based on Source of Water***

| Source of Water | Number of Utilities | Median Water Bill for 6,000 Gallons |
|---|---|---|
| Surface Water | 194 | $23.52 |
| Groundwater | 127 | $21.50 |

Similarly, utilities that purchase water from other utilities rather than treating it themselves have higher costs, and therefore higher prices, than utilities that have their own treatment facilities. In addition, when a utility imports water, some of the water is lost due to leaks in the pipe system. As a result, these utilities are purchasing water that they cannot sell, further driving up the cost.

Table 15 shows that utilities that depend on other utilities for water or wastewater treatment charge their customers substantially more than do utilities with their own treatment capacity. The trend is similar for sewer utilities.

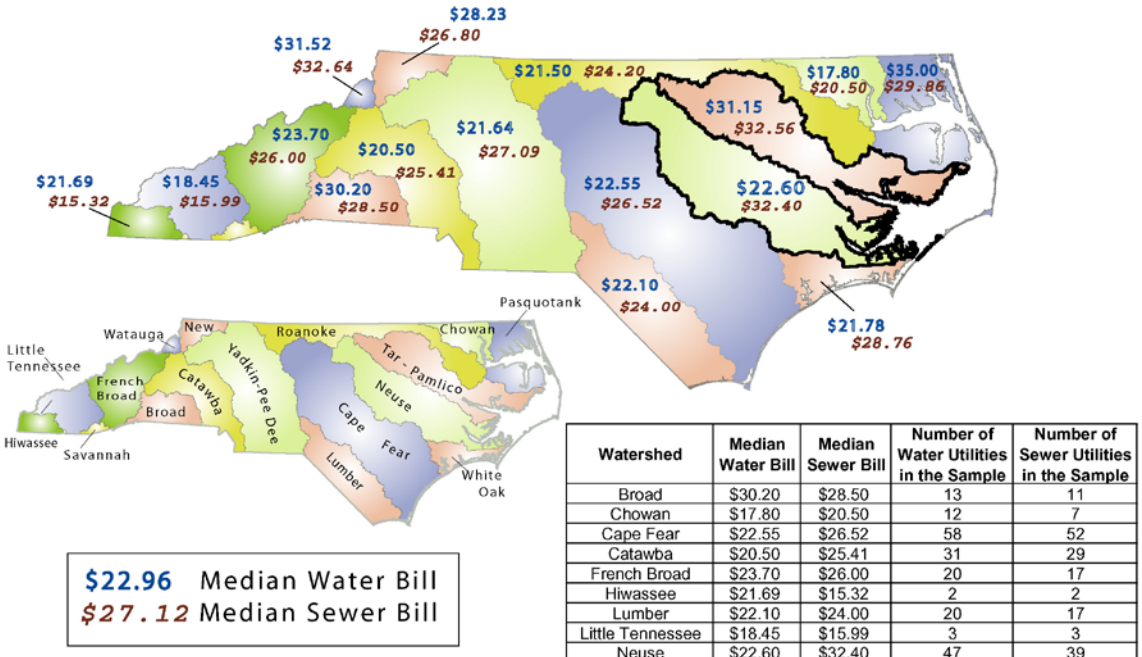
***Table 15: Median Water Bill for 6,000 Gallons Based on Whether Utility Purchases Water***

| Purchase or Non-Purchase System | Number of Utilities | Median Water Bill for 6,000 Gallons |
|---|---|---|
| Full or partial purchase | 96 | $26.17 |
| Non-purchase | 225 | $21.25 |

### *Sewer Rates and the Local Environment*

On the wastewater side, the quality of the body of water that receives treated wastewater can be an important cost driver. For example, the Neuse River Basin and the Tar-Pamlico Rules, outlined in Figure 15, have an abundance of impaired streams and stringent regulations. These conditions necessitate higher treatment costs for utilities that discharge into these basins. This higher cost is reflected in the sewer bills charged by the utilities. As Figure 15 indicates, utilities in these basins charge some of the highest sewer bills in the state.

***Figure 15: Median Water and Sewer Bills for 6,000 Gallons/Month Among North Carolina's Watersheds***

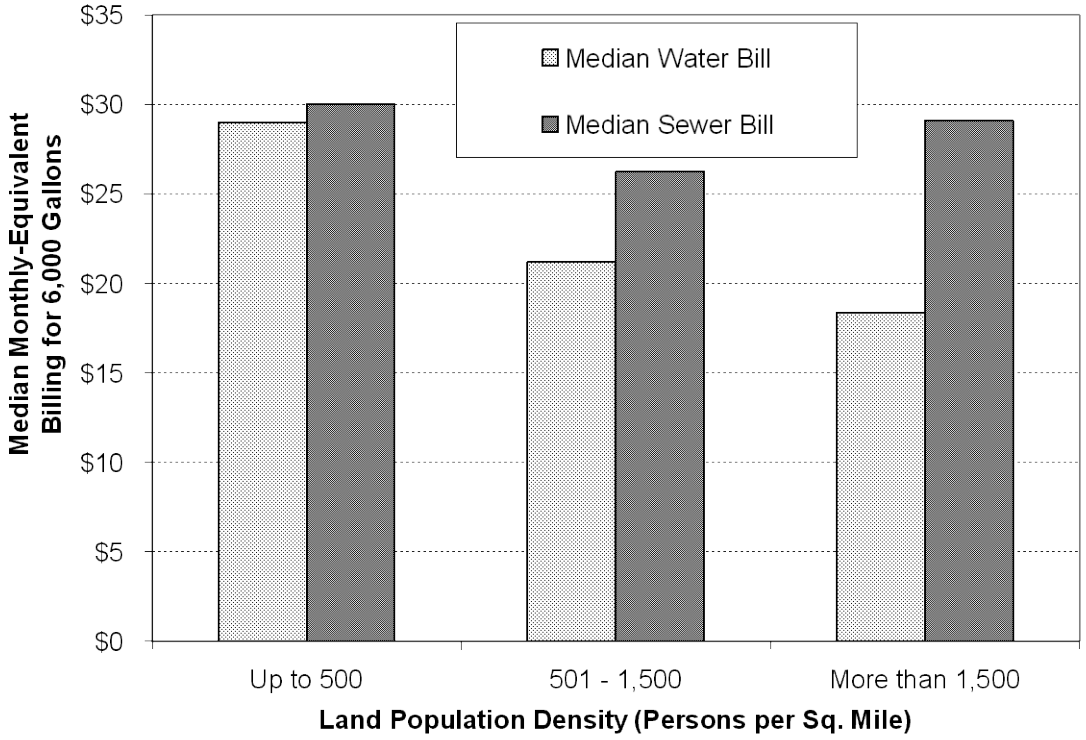



| Watershed | Median Water Bill | Median Sewer Bill | Number of Water Utilities in the Sample | Number of Sewer Utilities in the Sample |
|---|---|---|---|---|
| Broad | $30.20 | $28.50 | 13 | 11 |
| Chowan | $17.80 | $20.50 | 12 | 7 |
| Cape Fear | $22.55 | $26.52 | 58 | 52 |
| Catawba | $20.50 | $25.41 | 31 | 29 |
| French Broad | $23.70 | $26.00 | 20 | 17 |
| Hiwassee | $21.69 | $15.32 | 2 | 2 |
| Lumber | $22.10 | $24.00 | 20 | 17 |
| Little Tennessee | $18.45 | $15.99 | 3 | 3 |
| Neuse | $22.60 | $32.40 | 47 | 39 |
| New | $28.23 | $26.80 | 5 | 5 |
| Pasquotank | $35.00 | $29.86 | 11 | 5 |
| Roanoke | $21.50 | $24.20 | 19 | 14 |
| Tar-Pamlico | $31.15 | $32.56 | 23 | 20 |
| Watauga | $31.52 | $32.64 | 3 | 2 |
| White Oak | $21.78 | $28.76 | 8 | 6 |
| Yadkin-Pee Dee | $21.64 | $27.09 | 46 | 44 |

### *Customer Density Impacts on Rates*

Figure 16 shows the relationship between population density and median water and sewer bills. Population density is an important cost factor for infrastructure – serving higher density areas often requires less resources to distribute the same amount of water and collect the same amount of wastewater than lower density areas require. Indeed, utilities serving more densely populated areas charge less for an equal amount of water service than utilities serving less densely populated areas. This relationship, however, does not hold true for sewer service. One reason may be that the high cost of maintaining sewer lines in urban areas where the most basic repair task can require significant excavation and paving repair costs.

***Figure 16: Median Water and Sewer Billings for Municipalities and County Utilities by Land Population Density (n=298)***




### *System Age and Growth Rates*

The relationship between system age and rates is not clear cut. Older systems tend to have higher maintenance costs than newer systems but may have less capital costs if the assets were installed with grant financing or are fully amortized.

Newer systems and fast-growing systems that have been obligated to expand their systems substantially in the last few years may have higher capital costs than slower-growth areas due to the rising cost of construction and diminishing pool of grant funds. In fact, as Table 16 shows,

utilities serving high growth communities charge their customers considerably more than slower growth communities.

***Table 16: Median Water and Sewer Bills for 6,000 Gallons Based on the Expected 5-Year Growth of the Service Population***

| Expected 5-Year Growth of Service Population | Number of Utilities (Water, Sewer) | Median Water Bill for 6,000 Gallons | Median Sewer Bill for 6,000 Gallons |
|---|---|---|---|
| Up to 10% | 193, 152 | $22.44 | $25.76 |
| 11 - 50% | 97, 83 | $23.40 | $28.43 |
| More than 50% | 12, 11 | $29.16 | $31.12 |

Utilities with well-established systems also often carry less debt than do newer utilities. Older systems, however, will eventually have to be upgraded. Figure 17 shows that medium-aged communities (median home age 21 to 40 years) carry the lowest debt loads – less than both newer communities (median home age up to 20 years) with recent expansions and older communities (median home age greater than 40 years old) that may now be in the process of replacing assets that have reached the end of their useful life.

***Figure 17: Median Water and Sewer Billing and Long-Term Debt for Municipalities by Age of Homes in the Town (n=248)***

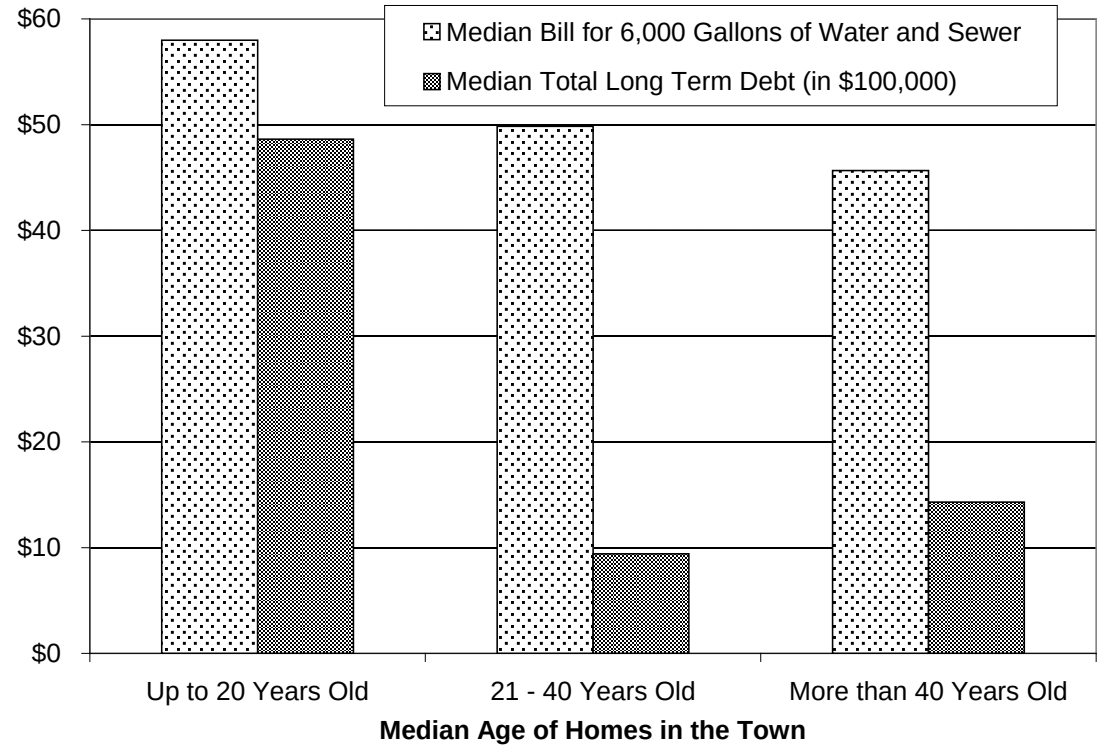



Table 17 shows what utilities charged based on the median age of the homes of the customers in their service area.

***Table 17: Median Water and Sewer Bills for 6,000 Gallons/Month Based on the Median Age of Homes***

| Age of Town by Median Age of Homes (Municipal Utilities Only) | Number of Utilities (Water, Sewer) | Median Water Bill for 6,000 Gallons | Median Sewer Bill for 6,000 Gallons |
|---|---|---|---|
| Up to 20 years | 14, 11 | $28.25 | $30.08 |
| 21 – 40 years | 129, 127 | $21.58 | $27.84 |
| More than 40 years | 124, 116 | $20.73 | $25.71 |

***Rates and Connection Charges***

The recurring user charges (rates) make up the majority of utility revenue across the state. However, for some fast growing areas, revenue from connection charges and impact fees can be significant. The magnitude of the connection charges varies significantly across the state. Do utilities with higher upfront charges charge lower monthly rates? Not according to the data from surveys. Table 18 shows that the median recurring rates for utilities increase as the connection charges increase. In other words, utilities do not seem use high connection charges as a way of keeping their rates low.

***Table 18: Median Water and Sewer Bills for 6,000 Gallons/Month Based on the Connection Charge***

| Connection Charge | Number of Utilities | Median Water Bill for 6,000 Gallons | Median Sewer Bill for 6,000 Gallons | Median Combined Water and Sewer Bill for 6,000 Gallons |
|---|---|---|---|---|
| $240 - $950 | 59 | $20.13 | $22.72 | $44.77 |
| $1,000 - $1,900 | 62 | $19.76 | $26.30 | $45.59 |
| $2,000 - $3,980 | 46 | $22.03 | $28.59 | $53.00 |
| $4,000 - $10,039 | 29 | $24.06 | $30.75 | $56.78 |

***Governance Structure and Rates***

Water and sewer utilities are owned and operated by either public, private, or non-profit organizations. Public organizations include different arrangements of local governments such as municipalities, counties, districts, water and sewer authorities, metropolitan water or sewer districts and sanitary districts. The board members of water and sewer authorities, metropolitan districts and non-profit institutions are appointed, whereas board members are elected in the other institutional arrangements.

Table 19 and Table 20 show the median water and sewer charges for different management structures. Most of the systems are operated by municipalities, and those systems also boast the lowest median bills. Authorities, sanitary districts, and county system service areas are often more spread out than municipal systems, which may explain the higher rates for these organizations; however, the governance structure itself may also have an impact. Elected officials may face greater pressure to keep rates low to maintain support among the utility's customer base, which is made up of the voting public. For example, the higher operating ratios

for authorities (1.3) compared to municipalities (1.02) may be a sign that authorities are able to actively raise rates to generate funds for capital more easily than municipalities. Municipal systems can also use non-rate revenue, such as property taxes, to cover revenue shortfalls.

***Table 19: Median Water Bills by Management Structure***

| Management Structure | Number of Utilities | Median Water Bill for 6,000 Gallons | Median Operating Ratio |
|---|---|---|---|
| Authority/Metropolitan District | 4 | $ 28.87 | 1.30 |
| County/District | 31 | $ 30.69 | 1.20 |
| Municipality | 267 | $ 21.30 | 1.02 |
| Not-for-Profit | 14 | $ 26.67 | N/A |
| Sanitary District | 5 | $ 24.77 | 1.13 |

***Table 20: Median Sewer Bills by Management Structure***

| Management Structure | Number of Utilities | Median Sewer Bill for 6,000 Gallons | Median Operating Ratio |
|---|---|---|---|
| Authority/Metropolitan District | 3 | $31.50 | 1.30 |
| County/District | 11 | $32.60 | 1.15 |
| Municipality | 255 | $26.95 | 1.02 |
| Sanitary District | 4 | $41.00 | 0.83 |

## RATES AND POLICIES

The pricing strategy a utility employs is one of its most important policy tools. Rates and pricing strategies can be designed to support a variety of pressing water policy agendas, and, conversely, rate strategies that are not well designed can conflict with the stated policy objectives of the utility. For this reason, the rates survey included a series of questions designed to reveal the policy drivers behind rates. The relationship between rates and specific policy initiatives are explored below.

### *Revenue Stability and Full Cost Pricing*

Financial sustainability—or "the bottom line"—remains the most important policy goal for most utilities, with 78 percent of water utilities and sewer utilities indicating that cost recovery or financial stability was the most important factor in designing rates and rate structures.

Utilities with rates driven primarily by financial objectives did, on average, charge their residential customers more for water and sewer services (6,000 gallons/month) than other utilities: a median of $49.90, versus a median of $41.94. However, as Table 21 shows, utilities with rates driven primarily by financial objectives were no more or less likely to employ a particular type of rate structure than utilities that identified another primary objective to rate setting practices.

***Table 21: Percentage of Water Rate Structures in Use by the Most Important Policy Objective in Rate-Setting***

| Most Important Policy Objective in Rate-Setting | Number of Utilities in the Sample | Uniform Rate Structure | Decreasing Block Structure | Increasing Block Structure | Other Rate Structure |
|---|---|---|---|---|---|
| Covering costs & sustainable finance | 171 | 48% | 28% | 22% | 2% |
| Other objective | 45 | 53% | 20% | 20% | 7% |

Seventy-one percent of water utilities believed their charges covered the full cost of water; 23 percent believed full costs exceeded their charges, and 6 percent were not sure. For sewer services, a higher percentage (36 percent) responded that their charges were insufficient to cover full costs – 57 percent believed charges covered full costs, and 7 percent were not sure.

Indeed, "full cost pricing" is one of the professed policy goals of many utilities, professional organizations (AWWA[7]), and the Environmental Protection Agency.[8] But full cost pricing is difficult to define. If a utility receives grant funds for their infrastructure, can it claim to practice full cost pricing? If a utility is able to meet their budget each year, but has fallen behind on their capital replacement plan, does it practice full cost pricing?

Our survey found inconsistencies between utility managers' perceptions of full cost pricing and actual accounting data. Using financial data, operating ratios were constructed for 157 of the survey respondents to compare managers' perceptions of cost recovery to the North Carolina Local Government Commission data on operating ratios. Twenty-eight percent of utilities that claimed their rates covered all costs actually maintained operating ratios of less than 1.0 (i.e. "in the red"). These full cost pricing utilities were in fact charging some of the lowest rates for water and sewer service. In contrast, 22 percent of utilities that did not think their rates covered the costs of their water and/or sewer systems reported combined operating ratios of at least 1.0 (i.e. "in the black").

*Our survey found inconsistencies between utility managers' perceptions of full cost pricing and actual accounting data*

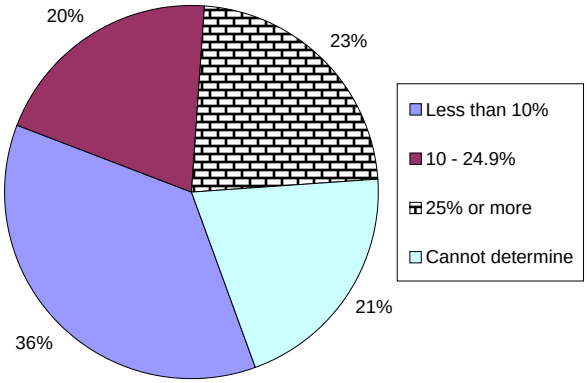
Utilities' revenues are also often vulnerable to changes in their customer profile. For example, if a large water-consuming plant shuts down or relocates, the water utility will unexpectedly lose the revenue collected from this customer.

Figure 18 provides the breakdown of the percentage of system revenue that originates from the utilities' five largest customers. Twenty-three percent of utilities, mostly municipalities, estimate that more than a quarter of their revenues are collected from five individual customers. It is somewhat important that 21 percent of utilities were not able to estimate the proportion of their revenue that is tied to their largest customers.

[7] See AWWA's policy statement on Water Use Efficiency, first adopted Jan. 27, 1991. http://www.awwa.org/About/OandC/officialdocs/AWWASTAT.cfm

[8] Full cost pricing is one of four "pillars" that the USEPA now promotes as being at the heart of sound utility water resources management. See http://www.epa.gov/water/infrastructure/

***Figure 18: Percentage of Revenue Originating from the Utility's Five Largest Customers (n=247)***




***Rates and Regionalization***

The rising cost of maintaining small systems has led many water utilities to consider regionalization and utility partnerships as a possible alternative to the "one community, one utility" model that currently prevails in North Carolina. 'Watershed planning', a related concept that promotes regionalism on a watershed basis, is another one of the U.S. EPA's four founding sustainable infrastructure pillars.[9]

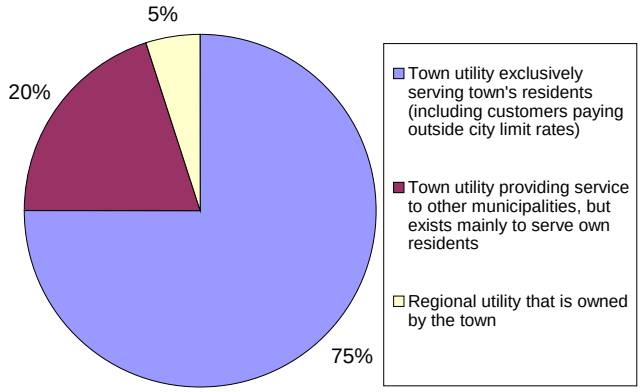
Utility rate and financial policies and practices are a window into the different regionalization perspectives and opinions that exist across utilities. Only 5 percent of the municipalities surveyed consider themselves a regional water utility. Another 20 percent noted that they provide water to non-municipal customers but still don't consider themselves as a regional utility (see Figure 19). The responses were similar for sewer utilities. Most municipal respondents defined their sewer system as one that exclusively serves its residents. Seventy-five percent exclusively serve customers within or directly adjacent to municipal boundaries; 20 percent provide sewer service to other municipalities but mainly exist to serve their own residents; 5 percent consider themselves a regional sewer utility owned by a single town.

Municipal utilities that defined themselves as regional have lower median rates than those that do not ($44.53 for combined water and sewer, versus $49.25). The use of inside/outside differentials has been an impediment to regional partnerships in some areas. Municipal utilities that define themselves as regional, however, are almost as apt to use differentials (81 percent) as less regionally-oriented systems (87 percent with differentials).

County systems tend to serve customers that are spread out over a larger geographic area and customers that live within different towns. Some county systems, however, are much less "regional" in their scope. Only 42 percent of county-managed water utility respondents (14) serve the entire county, with the remainder serving only particular areas of their county. Countywide water systems charge lower median rates than localized county systems ($26.80 median water bill versus $34.00 median water bill).

[9] See http://www.epa.gov/water/infrastructure/

***Figure 19: Municipal Water and Sewer Perceptions Regarding Regional Identity (n=203)***

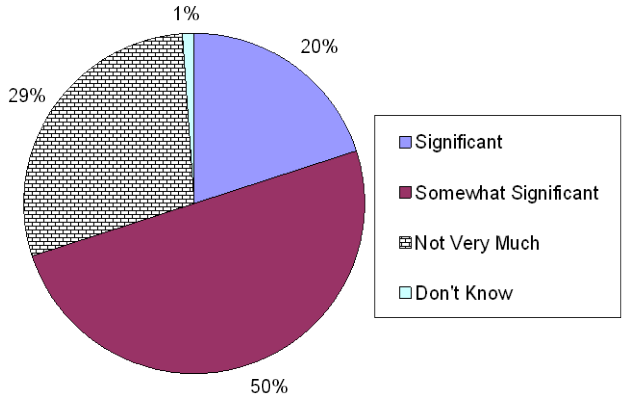



Utilities employ a variety of practices to facilitate regional partnerships that do not involve rates. For example, many utilities (64 percent) have developed service boundary agreements to help avoid confusion and conflict as their systems grow. Establishing system interconnections with neighboring utilities is an essential step in building regional partnerships. According to the survey, 87 percent of water systems reported having interconnections with other utilities, and an additional 7 percent are planning interconnections. While cost is often heralded as one of the driving factors of partnerships, relatively few utilities indicated cost as one of the reasons behind their connection (approximately 13 percent). Many utilities (59 percent) listed emergency supply as one reason.

***Rates and Conservation***

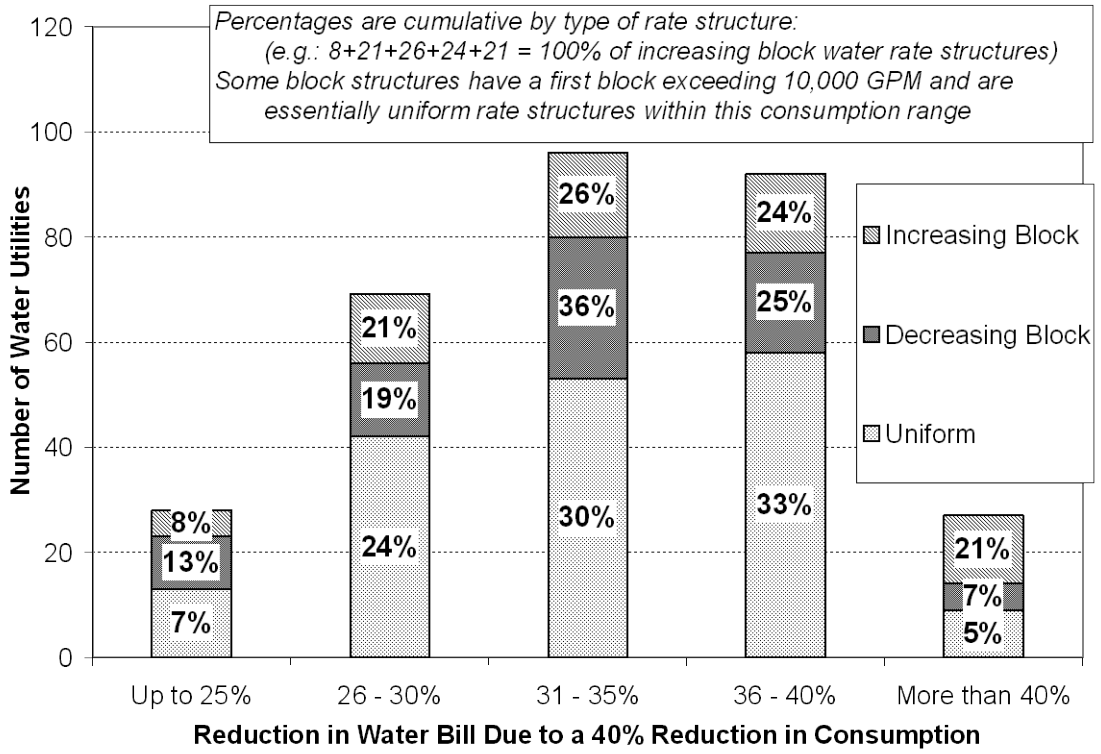
The drought of 2002 led to numerous local and state conservation initiatives. Sixty-two percent of utilities have a water shortage ordinance, and 70 percent indicated conservation was "significant" or "somewhat significant" factor in their rate-setting practices (see Figure 20). Only 1 percent of the utilities, however, indicated that conservation was the most important factor governing rates compared to other factors (finance, affordability etc.).

***Figure 20: How Utilities Rate Conservation as a Factor in Influencing Overall Rate Structures (n=242)***



One of the most widely accepted conservation "rules of thumb" is that an increasing rate block pricing structure supports conservation, while a decreasing rate block structure hinders conservation. This maxim, however, does not always hold true. Many systems with increasing blocks do not start the blocks in a range that would impact the residential customers most likely to change their behavior. Also, a system with a relatively low base charge and a relatively high uniform block volume charge may send a much stronger conservation message than a utility with a high base charge and relatively lower set of increasing block volume charges. Figure 21 shows the percent bill reductions a customer experiences in utilities with different types of rate structures. Indeed, many utilities with uniform blocks and even some with decreasing blocks have rate structures that lower customer bills at a higher percentage than utilities with increasing blocks. Forty-six percent of utilities that rated conservation as "significant" use an increasing rate block structure, compared to 16 percent of utilities that did not rate conservation as "significant."

***Figure 21: Reductions in Monthly Water Bills for a 40-Percent Reduction in Residential Consumption, from 10,000 Gallons to 6,000 Gallons (n=312)***




Furthermore, the rates being charged for high levels of residential water consumption by conservation-conscious utilities do not differ significantly from the rates being charged by all other water utilities. More importantly, utilities concerned with conservation do not provide a noticeably higher price incentive than other utilities to encourage their residential customers to curb high consumption use: conservation-conscious utilities decrease the water bill by a median of 53 percent for customers who cut their consumption from 15,000 gallons to 6,000 gallons, whereas the other utilities decrease the bill by a median of 52 percent.

There is additional evidence of conflicts between policy and practice. Seventeen percent of utilities that rated conservation as a "significant" factor in rate-setting continue to use decreasing block rate structures and charge much lower rates than the other utilities. The median water bill for these utilities for 15,000 gallons is $41.74, compared to the statewide median bill of $48.00. Table 22 also shows that respondents who believe their water systems are close to capacity are not much more likely to be concerned with conservation than other utility managers.

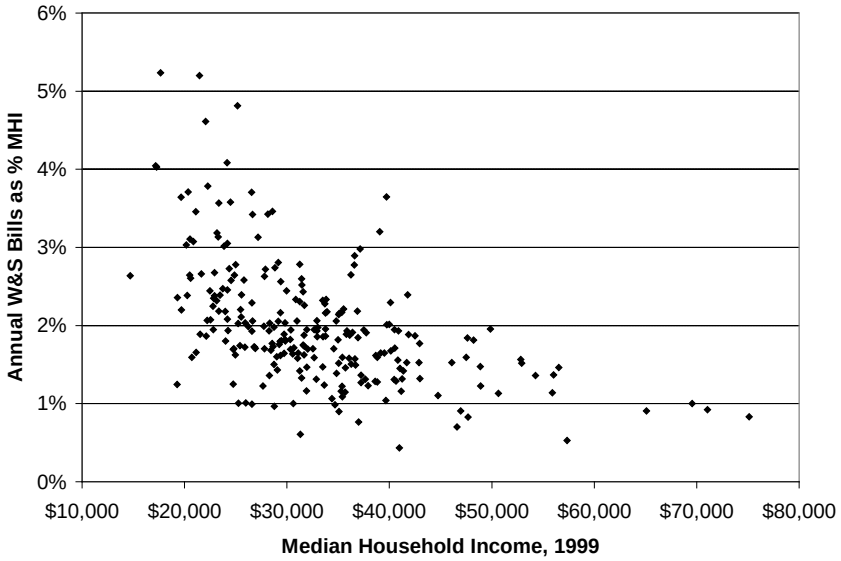
***Table 22: Significance of Conservation in Rate Setting Practices, Based on Whether the Water System is Close to Capacity***

| | Conservation is Not "Significant" | Conservation is "Significant" |
|---|---|---|
| Water System is Not Close to Capacity (n=174) | 81% | 19% |
| Water System is Close to Capacity (n=42) | 79% | 21% |

***Rates and Affordability***

One of the biggest challenges to addressing affordability effectively is identifying the degree to which an affordability problem exists. Figure 22 shows one of the commonly used affordability indicators—water and sewer expenditures as a percentage of community median household income ("MHI") versus community income. The chart demonstrates the wide variation in the percent of income households must spend for water and sewer services. There is no universal standard measure of what constitutes "affordable" service; however, several state funding programs use 0.75 percent of MHI for water and 0.75 percent MHI (1.5 percent combined) as the minimum criteria to receive grant funds. Seventy-five percent of the municipal and county utilities included in the inventory charge greater than 1.5 percent of the community median household income for water and sewer service. The median percentage of MHI spent to obtain 6,000 gallons per month of water and sewer service was 1.88 percent among 258 municipalities and counties.

***Figure 22: Comparison of Median Household Income with Combined Water and Sewer Bills as a Percentage of Median Household Income for Inside Customers (n=252)***



Sixty percent of the survey respondents indicated that affordability was a significant factor in determining rates. Almost 20 percent of respondents indicated it was the single most important factor influencing rates. As expected, communities with very low median household incomes were more likely to be concerned about affordability – 67 percent of the communities with the lowest MHI (lowest 15th percentile) stated that affordability was a significant concern. Concern for affordability, though, is not limited to low income communities. Forty-seven percent of the wealthiest communities (top 15th percentile) indicated that affordability was a significant concern, as shown on Table 23. Further, utilities charging high water rates and utilities charging low water rates were equally likely to indicate that affordability was a significant concern.

*Sixty percent of the survey respondents indicated that affordability was a significant factor in determining rates*

***Table 23: Significance of Affordability in Rate Setting Practices among the Wealthiest and Least Wealthy Communities in North Carolina, Based on Median Household Income***

| | Affordability is Not "Significant" | Affordability is "Significant" |
|---|---|---|
| Utilities Serving the Least Wealthy Municipalities & Counties – in the Lowest 15th Percentile of MHI (n=33) | 39% | 61% |
| Utilities Serving the Wealthiest Municipalities & Counties – in the Highest 15th Percentile of MHI (n=34) | 53% | 47% |

Considering the importance placed on percent of MHI spent on services, one could logically expect that this indicator would be linked to a concern for affordability at the local level. Somewhat surprisingly, the communities with consumers paying a lower percent of MHI on services were much more likely to be concerned about affordability (see Table 24).

***Table 24: Significance of Affordability in Rate Setting Practices among Communities with the Highest and Lowest Rates Relative to Median Household Income***

| | Affordability is Not "Significant" | Affordability is "Significant" |
|---|---|---|
| Combined Water and Sewer Bill for 6,000 Gallons is Less Than or Equal to 1% of Municipality's or County's MHI (n=11) | 18% | 82% |
| Combined Water and Sewer Bill for 6,000 Gallons is Greater Than or Equal To 3% of Municipality's or County's MHI (n=16) | 50% | 50% |

It is likely that having affordability as a significant factor in rate setting is what drives rates in many communities to be very low. This would explain another important finding – utilities that stated that affordability was a significant concern in rate development were less likely to set rates at levels that recovered their costs. Utilities that identified affordability as a significant rate concern had a median operating ratio of 1.02 compared to 1.11 for utilities that did not identify affordability as a significant concern. Furthermore, Table 25 shows that utilities with significant affordability concerns are 37 percent more likely to not recover operating costs through their revenues. This may indicate that the major impact of affordability concerns is that utilities are pressured to keep rates below cost more than other utilities.

***Table 25: Operating Ratios of Utilities, Based on Affordability as a Significant Factor in Rate Setting Practices***

| | Operating Ratio is Less than 1.0 ("in the red") | Operating Ratio is More than 1.0 ("in the black") |
|---|---|---|
| Affordability is Not a Significant Factor in Rate-Setting (n=91) | 30% | 70% |
| Affordability is a Significant Factor in Rate Setting (n=133) | 41% | 59% |

The significance a utility placed on affordability in rate setting did not have an impact on the type of rate structure employed by the utility (see Table 26).

***Table 26: Water Rate Structures, Based on Whether Affordability is a Significant Factor in Rate Setting Practices***

| | Decreasing Block | Increasing Block | Uniform |
|---|---|---|---|
| Affordability is Not a Significant Factor in Rate-Setting (n=96) | 27% | 18% | 55% |
| Affordability is a Significant Factor in Rate Setting (n=129) | 24% | 26% | 50% |

Utilities were also asked about other ways in which they addressed financial hardship or payment problems. Two-thirds of the surveyed utilities indicated that they have policies and services to assist customers with financial hardships. The use of emergency assistance programs, while relatively rare, has surfaced as an alternative to keeping rates artificially low. Two percent of the surveyed utilities reported that their customers have access to some type of emergency fund that was managed by the local government or utility, and 8 percent reported access to a fund managed by an external charity or other organization. Other utilities set up individual payment plans, made adjustments on the sewer bill for water leakages or filling swimming pools, or provided a credit for late payment fees.

Common practices among the utilities reporting on their policies and services assisting customers with financial hardships include, in order of prevalence:

- 81 percent offer extensions to due dates
- 16 percent provide emergency or hardship funds to help customers pay bills
- 6 percent cancel the customers' bills and absorb the costs
- 4 percent lower bills for customers who meet specific documented socioeconomic criteria.

Were utilities that claimed to take affordability into consideration for rate setting more likely to have lenient non-payment policies? Not really. According to the survey results, the median grace period for utilities that indicated that affordability significantly impacted rate setting was the exact same (20 days) as it was for utilities that indicated that affordability was not a significant concern. The median number of days before cut offs for utilities with significant concern for affordability was slightly higher (30 days) than it was for utilities that indicated that affordability was not significant (26 days), as shown in Table 27.

***Table 27: Grace Periods and Number of Days Before Disconnection, Based on Whether Affordability is a Significant Factor in Rate Setting Practices***

| | Median Number of Days Since Billing Date to Pay Bill Without Penalty | Median Number of Days Bill Can Be Past Due Before Disconnection |
|---|---|---|
| Affordability is Not a "Significant" Factor in Rate Setting (n=80) | 20 | 26 |
| Affordability is a "Significant" Factor in Rate Setting (n=122) | 20 | 30 |

### *Economic Development*

Water and sewer infrastructure are an essential contributor to a community's capacity for economic growth, and, for some utilities, concern over the impact of rates on business is a critical factor. While 10 percent of water and 12 percent of sewer utilities responded that fostering a business-friendly environment was a significant concern in setting rates, no utility identified it as the single most important factor. The use of decreasing block rate structures for commercial customers is one of the most common ways a concern for business is reflected in utility management. Table 28 shows that 29 percent of utilities indicating that fostering business-friendly policies is a significant factor in rate-setting use decreasing block water rate structures, compared to 25 percent of other water utilities. A similar trend exists for sewer service. However, 33 percent of business-conscious utilities use increasing block rate structures compared to 22 percent of other utilities. While this practice appears counterintuitive, it may be the result of competing policies, since all of the water utilities (except one) that rated fostering business-friendly policies as a significant factor in their rate setting also rated affordability as a significant factor.

***Table 28: Water Rate Structures, Based on Whether Fostering Business-Friendly Policies is a Significant Factor in Rate Setting Practices***

| | Decreasing Block | Increasing Block | Uniform |
|---|---|---|---|
| Fostering Business-Friendly Policies is Not a Significant Factor in Rate-Setting (n=204) | 25% | 22% | 53% |
| Fostering Business-Friendly Policies is a Significant Factor in Rate-Setting (n=21) | 29% | 33% | 38% |

### *Impact Fees and Growth Management*

Communities across the state have very different views toward development. Some communities see growth and development as essential to their well being, while others are concerned about the negative impacts of growth.

Some communities have instituted significant water and sewer connection charges and impact fees under the philosophy that "growth should pay for itself." Almost all water and sewer utilities charge at least one of three types of fees in North Carolina: tap fees, impact fees and special assessments. Tap fees are designed to recover all or a portion of the cost (materials and labor) of

water or sewer service line installation. Impact fees are associated with system capacity development. Utilities have great flexibility in setting tap and impact fees, and, as a result, the basis for determining fees and fee amounts varies widely. Table 29 shows the prevalence of fees across the state. While almost all utilities charge tap fees, larger utilities are much more likely to charge impact fees than smaller utilities.

***Table 29: Tap and Impact Fees for Selected Service Providers in North Carolina***

| | Water | | | | Sewer | | | |
|---|---|---|---|---|---|---|---|---|
| | Tap Fee | | Impact Fee | | Tap Fee | | Impact Fee | |
| **Residential Connections** | **No. of Utilities** | **Median Tap Fee** | **No. of Utilities** | **Median Impact Fee** | **No. of Utilities** | **Median Tap Fee** | **No. of Utilities** | **Median Impact Fee** |
| Up to 1,000 | 100 | $453 | 27 | $500 | 77 | $450 | 22 | $575 |
| 1,001-4,000 | 100 | $598 | 39 | $750 | 79 | $550 | 31 | $900 |
| More than 4,000 | 87 | $650 | 46 | $750 | 63 | $750 | 39 | $975 |
| **All Utilities** | **287** | **$550** | **112** | **$700** | **219** | **$550** | **92** | **$900** |

Table 30 shows the relationship between the projected system growth rate and the median value of utility impact fees. Clearly, utilities with higher service population growth predictions are both more likely to use impact charges and more likely to charge higher fees. The trend is similar for sewer utilities and sewer impact fees.

***Table 30: Water Impact Fees Based on 5-Year Expected Service Population Growth***

| 5-Yr Expected Service Population Growth | Number of Utilities | Percent of Utilities with Water Impact Fees | Median Water Impact Fee |
|---|---|---|---|
| -8.0% - 0.0% | 20 | 20% | $450 |
| 0.3% - 5.0% | 99 | 24% | $650 |
| 5.1% - 10% | 76 | 37% | $635 |
| 10.1% - 20.0% | 61 | 36% | $600 |
| 20.1% - 628.8% | 46 | 63% | $975 |

**LIST OF PUBLICATIONS**

Hughes, J. and S. Eskaf (2005). "Multi-level Financial Analysis of Residential Water and Wastewater Rates and Rate Setting Practices in North Carolina." Presented at the NC AWWA/WEA Annual Conference, November 2005, Greensboro NC.

Hughes, J., S. Eskaf and R. Thorsten (2005). "Financial Analysis of Residential Water and Sewer Rates and Rate Setting Practices." Presented at the national AWWA/WEF Joint Management Conference, February 2006, Salt Lake City UT.

Hughes, J., R. Thorsten, S. Eskaf and G. Davis (2006). "Financial and Spatial Analysis of Residential Water and Wastewater Rates and Rate Setting Practices." Poster presented at the NC WRRI Annual Conference, April 2006, Raleigh NC.

Hughes, J., S. Eskaf and R. Thorsten (2006). "Multi-level Financial Analysis of Residential Water and Wastewater Rates and Rate Setting Practices." Presented at the international IWA World Water Congress, September 2006, Beijing China.

North Carolina League of Municipalities and the Environmental Finance Center at UNC (2005). "North Carolina Water and Sewer Rates and Rate Structures." Raleigh NC: NCLM.

North Carolina League of Municipalities and the Environmental Finance Center at UNC (2006). "An Overview of Water and Sewer Rates, Rate Structures and Rate Setting Practices in North Carolina." Raleigh NC: NCLM.

North Carolina League of Municipalities and the Environmental Finance Center at UNC (2006). *How Much Does Clean Water Cost? 2006 – The Story Behind the Revenue: An Analysis of the Rates and Rate-Setting Practices that Fund Water and Sewer Service in North Carolina*. NCLM Report No. 329. Raleigh NC: NCLM.

**LIST OF REFERENCES**


Beecher, J.A., et al. (1994). Revenue Effects of Water Conservation and Conservation Pricing: Issues and Practices. The National Regulatory Research Institute, Ohio State University, Columbus, Ohio.

Beecher, Janice A. and Peter E. Shanaghan (1998). "Water Affordability and the DWSRF." American Water Works Association Journal 90 (5): 68-75. May 1998. Denver, Colorado.

Beecher, Janice A. Phone conversation on September 3, 2004.

Chesnutt, Thomas W., Casey McSpadden and John Christianson (1996). "Revenue Instability Induced by Conservation Rates." Journal of the American Water Works Association 88 (1): 52-63. Jan 1996. Denver, Colorado.

Gasteyer, Stephen. "The Price of Good Water – Some Thoughts about Water and Sanitation Affordability." Presented at the Affordability Workshop for the Environmental Financial Advisory Board, EPA, in San Francisco, California. August 18, 2004.

Hewitt, Julie A. "An Investigation into the Reasons Why Water Utilities Choose Particular Residential Rate Structures." Article in: The Political Economy of Water Pricing Reforms. Ed. Ariel Dinar (2000). The International Bank for Reconstruction and Development/The World Bank, Washington D.C.

Hughes, Jeff (2003). The Financial Health of NC Water and Sewer Utilities: Results of Statewide Financial Capacity Analysis. Conference paper and presentation titled "Assessing the Financial Capacity of NC Water and Sewer Utilities" presented at the NC AWWA/WEA 83rd Annual Conference in Greensboro, North Carolina. November 16-19, 2003.

Jordan, Jeffrey L. (1996). 1994/95 Survey of Private Water Rates in Georgia. Department of Agriculture and Applied Economics, University of Georgia, Griffin, Georgia.

Jordan, Jeffrey L. (1998). 1998 Georgia Survey of Wastewater Rates & Facilities. Department of Agriculture and Applied Economics, University of Georgia, Griffin, Georgia.

Jordan, Jeffrey L. (1998). "Issue 3: Evaluating Water System Financial Performance and Financing Options." Written for the Georgia Water Series. Department of Agriculture and Applied Economics, University of Georgia, Griffin, Georgia.

Manning, Paige (2004). "Drinking Water Rate Survey for Public Water Systems", part of the on-going Improving Financial and Managerial Capacity of Small Public Water Systems project. Mississippi State University Extension Service. In correspondence with Paige Manning, we will receive the data in Fall 2004.

North Carolina League of Municipalities (2002). How Much Does Clean Water Cost – 2002. Raleigh, North Carolina.

North Carolina Rural Economic Development Center (1998). Clean Water - Our Livelihood, Our Life: A Report on the North Carolina Water & Sewer Initiative. Raleigh, North Carolina.

Ohio EPA. (2004). 2002 Sewer and Water Rate Survey. Office of Fiscal Administration, Economic Analysis Unit, Columbus, Ohio. Available online at http://www.epa.state.oh.us/ofa/ofamain.html.

Raftelis Financial Consulting, PA (2002). 2002 Water and Wastewater Rate Survey. Charlotte, North Carolina.

Raucher, Robert. "Affordability of Water Service: What Does it Mean? How is it Measured? Why Does it Matter?" Presented at the Affordability Workshop for the Environmental Financial Advisory Board, EPA, in San Francisco, California. August 18, 2004.

Rubin, Scott J. (2001). Affordability of Water Service. National Rural Water Association, Duncan, Oklahoma.

Rubin, Scott J. (2003). The Cost of Water and Wastewater Service in the United States. National Rural Water Association, Duncan, Oklahoma.

State of North Carolina Department of State Treasurer (2004). Memorandum #1017 to Officials of Municipalities with Water and Sewer Systems, dated April 28, 2004.

Supalla, Raymond J. and Saeed Ahmad (1997). Defining the Financial Capacity of Rural Communities to Meet Sewer and Water Needs. Department of Agricultural Economics, University of Nebraska, Lincoln, Nebraska.