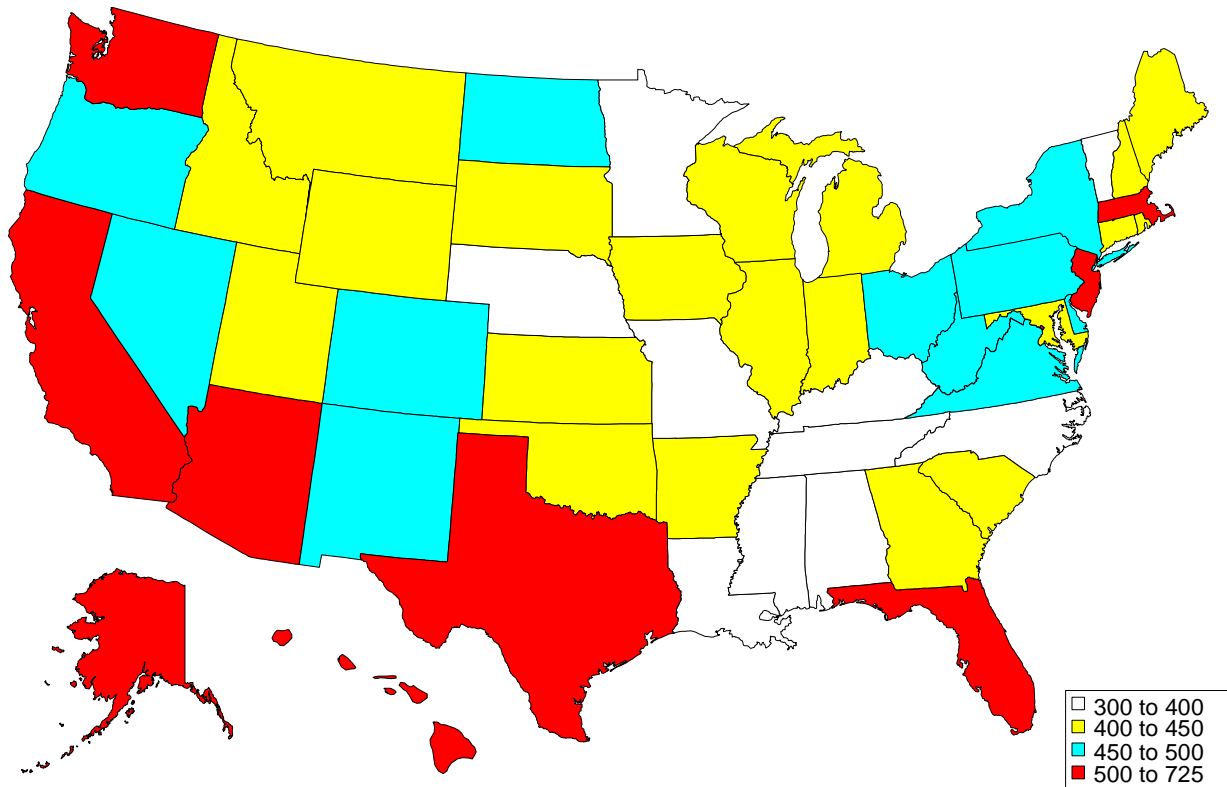


# The Cost of Water and Wastewater Service in the United States



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## Executive Summary

The cost of water and wastewater service (“W/WW”) in the United States has drawn increased attention in recent years. One concern in public discussions about the cost of W/WW, however, is the lack of comprehensive data about the amount that households actually spend for W/WW.

The Census Bureau has collected data that provides an unprecedented “snapshot” of the actual cost of W/WW to households. The “long form” survey for the 2000 census collected detailed information about household incomes and expenditures during 1999 from a stratified sample of approximately one percent of the households in the country, or about 1.2 million households.

The purpose of this paper is to analyze the data from the census survey to begin to provide a more detailed picture of the cost of W/WW to households with various characteristics. A few of the major findings in this study include the following:

- Nationally, 62% of households pay directly for W/WW. The other households either have the cost included in a rental payment or maintenance fee (18%) or do not pay for service (20%, most of whom are not served by a central W/WW provider).
- The average annual cost of W/WW for a household that pays directly for service is \$476 per year, ranging from \$334 in Nebraska to \$721 in Hawaii.
- Nationally, higher-income households represent a much larger share of households that pay directly for water than do lower-income households. This results in the median household income of those who pay directly for W/WW being \$7,700 per year (17%) higher than the national median income.
- The average household spends 1.6% of its income for W/WW, but the median household spends only 0.8% of its income for W/WW. In fact, only 25% of households spend more than the average percentage of income on W/WW.
- Some groups that often are thought to have little direct responsibility for paying for W/WW service in fact do pay W/WW bills directly. These include people who live in mobile homes (47% pay directly for service), households with incomes less than \$20,000 per year (47% pay directly), and one-person households (49% pay directly).

This paper also highlights some of the important differences in these factors throughout the country. For example, while few (29%) renters pay directly for W/WW, in non-metropolitan areas the percentage climbs to 43%. Similarly, nationally 47% of mobile home residents pay directly for W/WW, but in some states the figure is more than 70%. As a consequence of these types of regional, statewide, and even intrastate variations in all of these factors, including differences in the cost of W/WW itself, care must be exercised in using the national-level analyses and trends to draw conclusions about circumstances in any particular part of the country.

## **Introduction**

The cost of water and wastewater service (abbreviated here as “W/WW”) in the United States has drawn increased attention in recent years. Various stakeholders believe that the cost of W/WW is too high, placing an undue burden on low-income households. (Saunders) Others, however, believe that W/WW is a bargain compared to the value of the service and the relative cost of other utility services, such as energy and telecommunications services. (US EPA 1998)

Similarly, some stakeholders discuss the affordability of water and wastewater as if they were separate issues. (US EPA 1998) In fact, though, in communities where both services are provided centrally, it is common for water and wastewater utilities to have agreements that provide for the disconnection of water service if the wastewater bill is not paid. That is, in order to keep water service in the household, it is necessary to pay both the water and wastewater bills. Obviously, disconnection of water service also effectively removes wastewater service from the home, as well. The two services, therefore, are inextricably linked – both must be present in order for either service to be available to the household.

Periodically, the US EPA and various other parties conduct surveys in an attempt to estimate the cost of W/WW in the United States and in particular locations. (Raftelis; US EPA 2002) Those surveys, however, tend to be limited in scope geographically and tend to under-represent small communities or others served by small utilities. In addition, the surveys collect information from utilities, not households. As a consequence, the surveys cannot determine the actual burden placed on households by paying the bills for W/WW (“burden” can be represented by the percentage of income that the household pays for W/WW). In addition, in many communities, the water and wastewater providers are different entities. Utility surveys in these communities, therefore, may not fully capture the total household burden for W/WW.

The federal government’s Consumer Expenditure Survey provides information at the household level for expenditures on W/WW. (US Bureau of Labor Statistics) One problem with the W/WW data from that survey, however, is that it does not segregate households that do not pay directly for W/WW. Thus, the averages and aggregate data reported in that survey include a large percentage of households that report having no expenditure for W/WW.

Many of these problems are solved by using data collected by the U.S. Bureau of the Census as part of the decennial census. (Rubin 1998) In particular, the “long form” survey for the 2000 census collected detailed information about household incomes and expenditures from a stratified sample of approximately one percent of the households in the country, or about 1.2 million households. In developing this survey, the Census Bureau divides the country into 532 areas, known as Public Use Microdata Areas, or PUMAs. A PUMA never crosses state boundaries and generally contains about 400,000 people. For those states that have relatively low population, however, the entire state constitutes one PUMA. The Census Bureau has made available the data from this survey, known as the Public Use Microdata Sample, or PUMS. (US Census Bureau 2003)

The PUMS contains data on each household's annual income, as well as its expenditures for W/WW (combined into a single entry) and other types of expenditures. The PUMS also includes demographic information about the household, such as race or ethnicity, age of the household members, the number of people in the household, and whether the PUMA is in a metropolitan or non-metropolitan area. The PUMS also collects information about the home (termed the "housing unit") itself, including whether it is owned or rented (called "tenure"), the number of rooms in the home, and the characteristics of the building in which it is located (for example, whether it is a one-unit detached house, part of a multi-unit building, a mobile home, etc.). (US Census Bureau 2003)

All economic data in the PUMS is for calendar year 1999, as reported by respondents when the census data were collected in April 2000.

The purpose of this study is to analyze the entire PUMS dataset to estimate the cost of W/WW for households with various characteristics. The database was compiled and summarized at the national, state, and PUMA levels using computer programs developed for this project using the dBASE<sup>®</sup> platform. Statistical analysis was performed using SPSS<sup>®</sup>. Microsoft Excel<sup>®</sup> with a mapping software add-in from Mapland<sup>®</sup> was used for preparing tables, graphs, and maps.

All results described in this study are based on the weighted results of the survey responses collected by the Census Bureau. The weightings were developed by the Census Bureau, and are included in each PUMS record, to "allow users to produce estimates that closely approximate published data in other products." (US Census Bureau 2003) In other words, the weighted results produce estimates within a reasonably small margin of error for any relevant geographic area. As an example, the Census Bureau reports that there were 1,737,080 households in Alabama in 2000. Performing a weighted calculation on the PUMS data derives an estimate of 1,736,817 households in Alabama in 2000, a difference of 263 households, or 0.015%.

In interpreting and using these data, it should be emphasized that, unless otherwise noted, all results are reported only for households that pay directly for W/WW and that have an annual household income of at least \$1,000.<sup>1</sup> That is, income, age, and other characteristics are tabulated only for households that pay directly for service. While this should provide useful information for policy makers and other stakeholders, it should be noted that many households that do not pay directly for W/WW pay those costs indirectly through rents or maintenance fees. Thus, the reader should be careful when using these results to draw conclusions about the impact of increases in the cost of W/WW. Increases in W/WW costs can be expected to be passed on to those who pay directly for the service, but they also can

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<sup>1</sup> The analysis is restricted to households that report incomes of at least \$1,000 to eliminate anomalous results that would be obtained by including the approximately 0.5 million households (0.5% of all households) that report little or no income, but still have substantial expenditures for W/WW and other services. It cannot be determined from the PUMS documentation whether households that report very low incomes in fact have such low incomes (and pay for services by increasing debt or reducing savings) or if they are excluding certain types of income from their responses.

be expected to be passed on through increased rents and maintenance fees for many of those who do not pay directly for service.

### **Results for the United States as a Whole**

In 2000, there were approximately 103.4 million households in the United States that had income of at least \$1,000 during 1999. Of these, approximately 64.1 million (62%) paid directly for W/WW in 1999. (“Pay directly” for service means that a separate bill is received for the service and that the cost is not included in a rental or maintenance fee.) Among the households that did not pay directly for W/WW, 18.4 million (18%) report that the cost of W/WW is included in their rent, maintenance fee, or similar charge. The remaining 20.9 million households (20%) do not pay for service. Presumably most of these households supply their own W/WW.

Among the households that paid a W/WW bill in 1999, the average bill was \$476 per year. That average bill represents 1.1% of the national median household income (MHI) of \$41,994. That figure, however, understates the W/WW burden to the average household that pays directly for W/WW. The average household, among those paying for W/WW, spent 1.6% of its income for W/WW. Fifty percent of households, however, spent less than 0.8% of their income for W/WW, while 25% spent more than the average of 1.6%.

As will be seen below, these figures do not represent the impact of W/WW costs on households with characteristics that differ from the average or median household. A more detailed breakdown of these figures by the following six household characteristics is provided below: size of household, age of people, income, tenure, type of housing unit, and the size of housing unit.

#### *Size of Household*

Table 1 shows that about half (49%) of the one-person households in the United States paid directly for W/WW. One-person households that pay directly for W/WW spent nearly 2.4% of their income for W/WW, a higher percentage of income for the service than almost any other group or subgroup in the study.

As the number of people in the household increases, the average W/WW also increases, roughly in the range of \$35 to \$75 per year for each additional person. After a household contains two people, though, there is very little change in the prevalence of households that pay directly for W/WW. As Table 1 shows, going from one person to two people increases the prevalence of paying directly for W/WW from 49% to 64%. Larger households, though, see a relatively minor change in this percentage, peaking at 70% of four-person households that pay directly for W/WW.

A combination of increases in household income, the size of the bill for W/WW, and changes in the likelihood that a household will pay directly for W/WW is reflected in the calculation of the average W/WW bill as a percentage of income. For households that pay directly for service, the average bill declines as household size increases until the household has four people (1.2% of income). Then, the W/WW burden increases, such that households with six or more people pay 1.6% of their income for W/WW.

### *Age of People*

As shown in Table 2, it does not appear that the age of people in the household has a significant effect on the cost of W/WW. For example, households with at least one person age 65 or older pay only \$31 per year less, but 0.6% of their income more, for W/WW than do households without an elderly person.

Households with at least one child age 17 or younger pay more for W/WW (about \$93 per year) than do households without children. This is to be expected, however, since households with minor children are likely to have more people in them, on average, than households without minor children. Importantly, though, as a percentage of income, there is not a major difference in the cost of W/WW. Households with minor children pay approximately 1.4% of their income for W/WW, while those without minor children pay 1.6% of their income for W/WW.

Indeed, further analysis shows that there is not a meaningful difference between the results for households with an elderly or young person and those for all households of the same size. For example, households with one person age 65 or older had an average W/WW bill of \$385 per year, compared to all one-person households that had an average bill of \$378 per year. Similarly four-person households with at least one minor child had an average W/WW bill of \$535 per year, compared to all four-person households that had an average bill of \$539 per year.

It also does not appear that the age of residents affects whether the household pays directly for W/WW. In each instance, between 60% and 66% of households pay directly for W/WW.

Overall, the age of household residents does not appear to be meaningful in determining the household's W/WW bill or the percentage of the household's income that is spent for W/WW.

### *Annual Household Income*

Table 3 shows that as the level of household income increases, the household is more likely to pay directly for W/WW and the amount that is paid for service increases. Specifically, only 42% of households with incomes below \$10,000 per year pay directly for W/WW. This figure increases steadily as income increases, so that more than 77% of households with annual incomes of \$100,000 or more pay directly for W/WW.

The data also show that the annual cost for W/WW increases as income increases, by approximately \$15 per year for each \$10,000 increase in income. Because the cost of W/WW increases at a much slower rate than the change in incomes (for example, a 100% increase in income is associated with an increase in W/WW costs of about 5%), the percentage of household income spent for W/WW declines precipitously as income increases.

As a result of higher-income households being more likely to pay directly for W/WW than are lower-income households, the median income of households that pay directly for W/WW is 17% higher than the MHI of the country as a whole. The national MHI among households

with incomes of \$1,000 or more in 1999 was \$42,700.<sup>2</sup> In contrast, the MHI in 1999 for households that paid directly for W/WW was \$49,900.

From this fact, it is apparent that households that do not pay directly for W/WW have a much lower MHI than households that pay directly for service. Specifically, households that report the cost of W/WW is included in their rent or other fee have a MHI of only \$30,000. Those who report that W/WW has no cost (predominantly households that supply their own W/WW) have a MHI of \$36,300.

It should be noted, though, that even though households that pay directly for water have a higher MHI, there are still millions of low-income households that pay directly for W/WW. That is, of 21.4 million households with annual incomes between \$1,000 and \$20,000, 10 million households paid directly for W/WW. This represents one-sixth of all households that pay directly for W/WW.

### *Housing Tenure*

More than twice as many homeowners pay directly for W/WW as do those who rent (78% vs. 29%). Table 4 shows that, among those who pay directly for W/WW, the average W/WW bill for homeowners is only about 15% higher than it is for renters (\$486 vs. \$422).

As a percentage of income, however, there is a larger difference between owners and renters. The W/WW burden for renters is 60% higher than it is for homeowners (2.2% of income vs. 1.4% of income).

### *Type of Housing Unit*

Table 5 shows that the type of housing unit has a significant effect on whether the household pays directly for W/WW. More than 81% of detached, one-unit (single family) homes pay directly for W/WW. This figure declines steadily as the type of housing becomes more clustered, culminating in buildings with ten or more units having fewer than 10% of households paying directly for W/WW.

Among those households that pay directly for W/WW, the percentage of income spent for service increases for single- and two-family buildings as the housing becomes more clustered – going from 1.4% of income for one-unit detached homes to 2.2% of income in two-unit buildings. Larger buildings, however, then see a decline in the W/WW burden.

### *Size of Housing Unit*

The effect of the size of the housing unit (the number of rooms in the home) is shown in Table 6. Interestingly, the average W/WW bill is not significantly different between homes with 1-3 rooms and those with 4-6 rooms. In fact, the larger homes have a slightly lower W/WW bill than the smaller ones (\$442 vs. \$448).

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<sup>2</sup> This is slightly higher than the national MHI for all households of \$41,994, because households with incomes less than \$1,000 are excluded from this analysis.

The bill as a percentage of income, however, declines steadily as the size of the home increases. This is not surprising, since the size of the home is expected to be highly correlated with the household's income.

### *Statistical Analysis of Correlation Among Various Factors and W/WW Bill*

Charges for W/WW are determined, in large part, by local factors. These typically include the location and quality of source and receiving water, the distance over which water or wastewater must be transported, energy and labor costs, the age of the facilities, the availability of grants or low-interest loans, the degree of cross-subsidization to or from other municipal services, taxes imposed on utilities, among others. It is not expected, therefore, that a statistical analysis of national data would be able to explain differences in W/WW costs with a high degree of certainty. Such an analysis, however, should be able to highlight several factors that affect the magnitude and direction of W/WW costs at the household level.

A multi-linear regression analysis, using stepwise regression, was performed to determine if, in fact, certain factors are highly correlated with the level of household W/WW costs. The results of the analysis are instructive, not because they can be used to predict W/WW costs for a particular household, but because they show that certain factors are highly correlated with the level of W/WW costs.

In particular, the results of the analysis show that five factors are highly correlated with the level of household W/WW costs. As expected, these factors do not "explain" why a household's W/WW bill is a particular amount. The overall model explains only 7.5% of the variation in W/WW costs nationwide (that is, the R-squared of the regression model is 0.075).

The results, however, are statistically significant, meaning that it is unlikely that the variations observed are the result of random chance. In fact, for the model as a whole and for each of the variables in the model, there is a less than 1 in 1,000 chance ( $p < 0.001$ ) that the observed trends are the result of random occurrences.

As shown in Table 7, the following factors are shown to be highly correlated with a household's W/WW cost:

- Number of people in the household
- Value of the home
- Whether the home is located in a metropolitan area
- Annual household income
- Type of housing unit (mobile home, etc.)

Interpreting the results of the regression analysis begins with the constant, which is \$295. This can be viewed as the hypothetical "base" bill for W/WW; that is, the annual cost if none of the other factors were present (which, of course, is not actually possible). The other factors then act to increase or decrease this base amount.



In particular, the factors have the following effect on the hypothetical base charge:

- Each additional person in the household increases the W/WW bill by \$39 per year.
- If the home has a value between \$100,000 and \$250,000, the W/WW bill increases by \$30 per year; homes with a value between \$250,000 and \$500,000 show an increased W/WW bill of \$114 per year; and homes with a value of \$500,000 or more have an increased W/WW bill of \$300 per year.
- If the home is located in a metropolitan area, the W/WW bill increases by \$49 per year.
- The W/WW bill increases by about \$3 per year for each \$10,000 increase in the household's annual income.
- If the housing unit is part of a two-unit building, the cost increases by \$53 per year.<sup>3</sup> If, however, the unit is a mobile home or part of a larger (10 units or more) building, then the cost decreases by \$55 or \$110 per year, respectively.

The results of the regression analysis provide an interesting look at several factors that appear to be important in determining the differences in W/WW costs throughout the country.

## State-by-State Results<sup>4</sup>

### *All Households*

While they are interesting, the national trends do not capture important differences among the states. Table 8 shows the wide range of variability among the states. For example, nationally 62% of households pay directly for W/WW. On a state-by-state basis, however, this figure ranges from 35% of households in Vermont to 80% of households in Alabama.

The average bill for W/WW also varies significantly – from a low of \$334 per year in Nebraska to a high of \$721 per year in Hawaii (within the contiguous 48 states, the highest state is California with an annual average W/WW cost of \$591). Figure 1 illustrates the range of differences among the states.

### *Differences Between the Hypothetical Median Household and Actual Households*

The household burden for W/WW bills is even more divergent among the states. Obviously, the calculation of the average percentage of income spent for W/WW captures not only the variability in the cost of W/WW, but also the divergence in the distribution of incomes among the states. Importantly, it also is affected by the types of households in each state that pay directly for W/WW. In some states, such as Maryland, Minnesota, New Hampshire, and Vermont, it appears that the typical household that pays directly for W/WW is similar to the median income household in the state. Thus, in those states, the average W/WW bill as a

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<sup>3</sup> This increase may be the result of two units being served through a single W/WW connection; thus, one unit reports a higher cost while the other reports that the cost is included in its rent or maintenance fee.

<sup>4</sup> The state-by-state analyses include the 50 states and the District of Columbia.

percentage of MHI is less than 0.2 percentage points different from the actual average percentage of income paid for W/WW.

In other states, however, there is a much larger variance between the W/WW burden for the hypothetical median income household and the burden for actual households. In several states (Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, South Carolina, Texas, and West Virginia), the difference between the hypothetical median household's W/WW burden and the actual average W/WW burden exceeds 0.5 percentage points. For example, in West Virginia, the average W/WW bill is 1.6% of MHI, but the actual percentage of income paid by the average West Virginia household is 2.2%.

The difference between the actual impact of W/WW bills and the impact for the household with median income appears to be related to the percentage of low-income households that pay directly for W/WW, as compared to the percent of high-income households that do so.

Nationally, 21% of households have annual incomes less than \$20,000, while roughly the same percentage (23%) have incomes of \$75,000 or more. Among households that pay directly for W/WW, however, only 16% have incomes less than \$20,000, while 28% have incomes of \$75,000 or more. This can be expressed as a ratio of low-income to high-income households; in this case, the ratio would be 0.6, meaning that there are only 60% as many low-income households as there are high-income households that pay directly for W/WW. That is, on a national level, households that pay directly for W/WW are skewed toward those with higher incomes. This was reflected in the discussion, above, when it was shown that the MHI of households that pay directly for W/WW was \$49,900, or roughly 17% higher than the MHI of all households in the United States.

This trend, however, does not hold true in each state. Table 9 shows a state-by-state analysis of the income distribution of households that pay directly for W/WW. The results in several states differ significantly from the national average.

As just discussed, nationally there are only 0.6 times as many low-income households that pay directly for W/WW as there are high-income households. In contrast, West Virginia has 2.2 times as many low-income households that pay directly for service as it has high-income households. Thus, of the 506,000 households that pay directly for W/WW in West Virginia, 28% have incomes less than \$20,000 per year, but only 12% have incomes of \$75,000 or more.

In total, there are 14 states with ratios of 1.0 or above; that is, states where there is a higher percentage of low-income (less than \$20,000) households paying directly for W/WW than there is of high-income (\$75,000 or above) households. The most extreme cases are in Arkansas, Mississippi, and West Virginia – all with ratios of 1.8 or above, meaning that their ratio of low-income to high-income households paying directly for service is more than three times the national average (ratio of 0.6).

In those states, and others with high ratios, increased W/WW costs will affect low-income households at a significantly higher level than they do on a national basis. Similarly, states with very low ratios of low-income households that pay directly for W/WW (such as Alaska,

Connecticut, Hawaii, Maryland, Massachusetts, and New Jersey – all of which have ratios of 0.2, meaning that high-income households paying directly for service outnumber low-income households by about 5-to-1) are likely to see a much lesser impact on low-income households than would be expected from a national-level analysis.

### *Differences in Responsibility for W/WW in Different Housing Types*

Differences in the direct payment for W/WW in certain types of housing also vary substantially from one state to another. Table 10 shows some of that variability for states that have at least 5% of their households in a particular type of housing.

For example, nationally 47% of mobile homes pay directly for W/WW. In several Southern states, however, that percentage exceeds 65% (Alabama, Arkansas, Louisiana, Mississippi, and Texas). In some of the New England states, though, the percentage of mobile homes that pay directly for W/WW is less than 25% (Maine, New Hampshire, and Vermont).

The same type of variability is seen in the direct billing of residents in apartment buildings (or similar multi-unit buildings, such as condominiums and cooperatives) with at least ten units. Nationally, fewer than 10% of such housing units pay directly for W/WW. Several Southern states, though, have a percentage that is at least twice the national average (Alabama, Georgia, North Carolina, Tennessee, and Texas), with Georgia's percentage more than three times the national average (32% vs. 10%).

In contrast, some states with large urban populations have fewer than 2% of these types of housing units paying directly for W/WW (District of Columbia, New York, and Rhode Island).

### *State Results Generally*

If similar comparisons were repeated for any other factor, the same type of variability would be present among the states. For example, the percentage of one-person households that pay directly for W/WW varies from 23% in the District of Columbia to 72% in Mississippi (compared to the national average of 49%). Similarly, the amount that one-person households pay for W/WW varies from less than 1.7% of their income in Maryland, Minnesota, and New Hampshire to more than 3.0% of income in Hawaii and West Virginia.

In summary, national averages can provide the general relationships among factors – for instance, that the bill for W/WW increases with income and household size, or that it is little affected by the age of household members. An analysis conducted at the national level, however, does not capture the substantial differences among the states. For every factor analyzed in this study, the range in variation among the states is substantial, forming extremely wide ranges above and below the national average.

### **Differences Between Metropolitan and Non-Metropolitan Areas**

Out of the 104 million households in the United States, approximately 83 million households are located in metropolitan areas (MAs), while only 21 million are located in non-metropolitan areas (non-MAs). Except in New England, MAs are determined at the county

level; that is, an entire county is either in a MA or it is classified as being non-MA. In a previous paper, it has been shown that the economic and demographic characteristics of MAs are significantly different than non-MAs. (Rubin 2003c) In particular, the levels of income are substantially lower in non-MAs than they are in MAs.

The PUMS data shows that there also are substantial differences in the cost of water between MAs and non-MAs. In interpreting the PUMS data, however, it should be noted that the data set includes 61.2 million households in MAs, but only 4.0 million households that are in non-MAs. The remaining households are in PUMAs that contain a mixture of MAs and non-MAs. In other words, the PUMS data set contains data classifiable by MA for 74% of MA households, but only 19% of non-MA households. Thus, any conclusions drawn about differences between MAs and non-MAs should recognize that the PUMS data do not make it possible to identify most non-MA households.

With that caveat, Table 11 shows that the average cost of W/WW in MAs is 32% higher than it is in non-MAs (\$512 vs. \$386). However, because incomes in MAs tend to be at least 40% higher than they are in non-MAs (Rubin 2003c), the average W/WW burden is higher in non-MAs than it is in MAs (1.8% of income vs. 1.4% of income).

Tables 12 through 15 compare selected characteristics between MAs and non-MAs; specifically, one-person households, households with incomes between \$10,000 and \$19,999, homeowners, and renters. Each of these tables shows that there are major differences between MAs and non-MAs.

For example, Table 12 shows that one-person households in non-MAs are more likely to pay directly for W/WW than one-person households in MAs (58% vs. 45%). The table also shows that water bills take a higher percentage of income for these households in non-MAs than they do in MAs (2.7% vs. 2.2%).

Table 13 is interesting because it controls for differences in income between MAs and non-MAs. Initially, it should be noted that this subset of low-income households represents a much larger percentage of the population in non-MAs than it does in MAs (18% of non-MA households vs. 11% of MA households).

Households with the same income, however, pay a smaller percentage of their income for W/WW in non-MAs than they do in MAs (2.6% vs. 3.1%). In non-MAs, however, they are more likely to have to pay directly for W/WW (59% vs. 45%).

Tables 14 and 15 reflect some of the differences in the makeup of the housing stock and the use of centralized water systems between MAs and non-MAs. Table 14 shows that homeowners in MAs are more likely to pay directly for W/WW than homeowners in non-MAs (84% vs. 69%). In contrast, renters in MAs are much less likely to have to pay directly for W/WW than renters in non-MAs (24% vs. 43%). In both instances, though, residents of MAs pay a lower percentage of their household's income for W/WW (1.3% vs. 1.6% for owners; 2.0% vs. 2.7% for renters).

Interestingly, despite the differences in W/WW responsibility for owners and renters between MAs and non-MAs, there is no difference in the overall percentage of households that pay

directly for W/WW. Simply, because the incidence of home ownership is much higher in non-MAs (74% vs. 63%), the same percentage of households (62%) in MAs and non-MAs pay directly for W/WW.

In summary, the cost of W/WW in MAs tends to be significantly higher than it is in non-MAs, for any relevant characteristic (household size, income, tenure, etc.). That cost difference, however, is more than offset by the higher income levels in MAs, such that households in non-MAs pay a higher percentage of income for W/WW than comparable households in MAs (except, of course, when comparing households with the same level of income).

### **Important Intrastate Differences**

Moving from the national averages and trends to state-level analysis shows some of the tremendous variation in the direct payment for W/WW, the cost of that service, and the percentage of household income used to pay for service. Even the state-level analysis, though, does not capture the full range of differences among communities.

To illustrate some of that variation, additional analysis was performed at the PUMA level. Rather than attempting to conduct a detailed analysis for each of the 532 PUMAs, a few states will be highlighted to illustrate some of the differences between urban, suburban, and rural areas.

In terms of responsibility for the W/WW bill, New York is the most diverse state in the country. On average, 42% of New York households pay directly for water. In New York City, however, that percentage is less than 2%, while on Long Island (Nassau and Suffolk Counties) 78% of households pay directly for W/WW.

Similarly, the amount paid for W/WW in New York averages \$450 per year, but that figure varies by a multiple of more than three times from one part of the state to another, as shown in Figure 2. In Brooklyn (Kings County), where 23% of the households pay directly for W/WW, the average annual bill for service is \$854 (nearly twice the statewide average). In central New York (Syracuse and surrounding counties), however, the average bill for W/WW is only \$255 per year, which is slightly more than one-half the statewide average.

Analyses in some other states show similar differences within a state.<sup>5</sup> For example, Figure 3 shows the differences in the percentage of income paid for W/WW within Texas. Overall, the average Texas household spends 1.9% of its income for W/WW. That percentage varies, though, from 1.1% of income in suburban Dallas to 3.0% of income in several counties in Southwest Texas. These differences are not the result of differences in the cost of W/WW or the prevalence of service, but in the levels of income in those areas. Thus, the PUMA with the lowest W/WW cost as a percentage of income (1.1% in PUMA 48080, Collin County in suburban Dallas) has 87% of its households paying directly for service at an average cost of \$658 per year. The PUMA with the highest cost as a percentage of income (3.0% in PUMA

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<sup>5</sup> The Appendix to this report provides a summary of data, by PUMA, in each state.

48130, encompassing more than 30 counties in Southwest Texas) has 71% of its households paying directly for service at an average cost of \$650 per year.

## **Conclusion**

The major findings in this study include the following:

- Nationally, about six of every ten households pays directly for W/WW. The other households either have the cost included in a rental payment or maintenance fee (18%) or do not pay for service (20%, most of whom are not served by a central W/WW provider).
- The average annual cost of W/WW for a household is \$476 per year, ranging from \$334 in Nebraska to \$721 in Hawaii.
- The median household income of those who pay directly for W/WW is about \$7,700 per year (17%) higher than the national median income.
- Generally, higher-income households represent a much larger share of households that pay directly for water than do lower-income households. Nationally, 28% of W/WW customers have incomes of \$75,000 per year or higher, while only 16% have incomes below \$20,000 per year. The variation among the states, however, is enormous – with some states having nearly twice as many low-income households as high-income ones that pay directly for service.
- The average household spends 1.5% of its income for W/WW, ranging from a low of 1.0% of income in New Hampshire to a high of 2.2% of income in West Virginia.
- The number of people in a household has a relatively small impact on the annual cost of W/WW, increasing the bill by less than \$40 per year for each additional person.
- Increased income has a very small impact on the cost of W/WW for the household. Each \$10,000 increase in income can be expected to increase the bill by between \$5 and \$15 per year. In fact, a 100% increase in income is likely to increase the W/WW bill by less than 5%.
- Homeowners are almost three times as likely as renters to pay directly for W/WW, but there is little difference in the average bill for W/WW service between those groups.
- If other factors are held constant, the number of rooms in the home shows no relationship to the cost of W/WW service.
- The value of the home, however, is highly correlated with the W/WW bill, at least among higher-priced homes (those with a value of \$100,000 or more).
- Some groups that often are thought to have little direct responsibility for paying for W/WW service in fact do pay W/WW bills directly. These include people who live in mobile homes (47% pay directly for service), households with incomes less than \$10,000 per year (42% pay directly), households with incomes between \$10,000 and \$20,000 per year (50% pay directly), and one-person households (49% pay directly).

This paper also highlights some of the important differences in these factors throughout the country. State-by-state and regional variations in all of these factors, and in the cost of W/WW itself, will lead to national-level analyses or conclusions having very different impacts around the country. For example, while few (29%) renters pay directly for W/WW, in non-metropolitan areas the percentage of renters who pay directly for service is 43%. Similarly, nationally 47% of mobile home residents pay directly for W/WW, but in some states the figure climbs to more than 70%, while in others it is lower than 20%.

Even within a single state, the amount of variation can be extremely large. For example, in New York the average W/WW bill ranges from about \$250 per year to more than \$850 per year. Similarly, in Texas, where the average household spends 1.9% of its income for W/WW, there are counties where the average is as low as 1.1% of income and others where it is as high as 3.0% of income.

In conclusion, the Census Bureau's Public Use Microdata from the 2000 census provides an important source of information into the costs and burdens of water and wastewater service at the household level. This paper represents an initial effort to summarize those data, to characterize the costs of water and wastewater service throughout the country, and to begin highlighting and explaining some of the tremendous variation in costs in various parts of the United States. Other researchers are encouraged to use this rich dataset to further refine this analysis and to continue to "mine" the data for additional insights into the costs and burdens associated with the provision of water and wastewater service.

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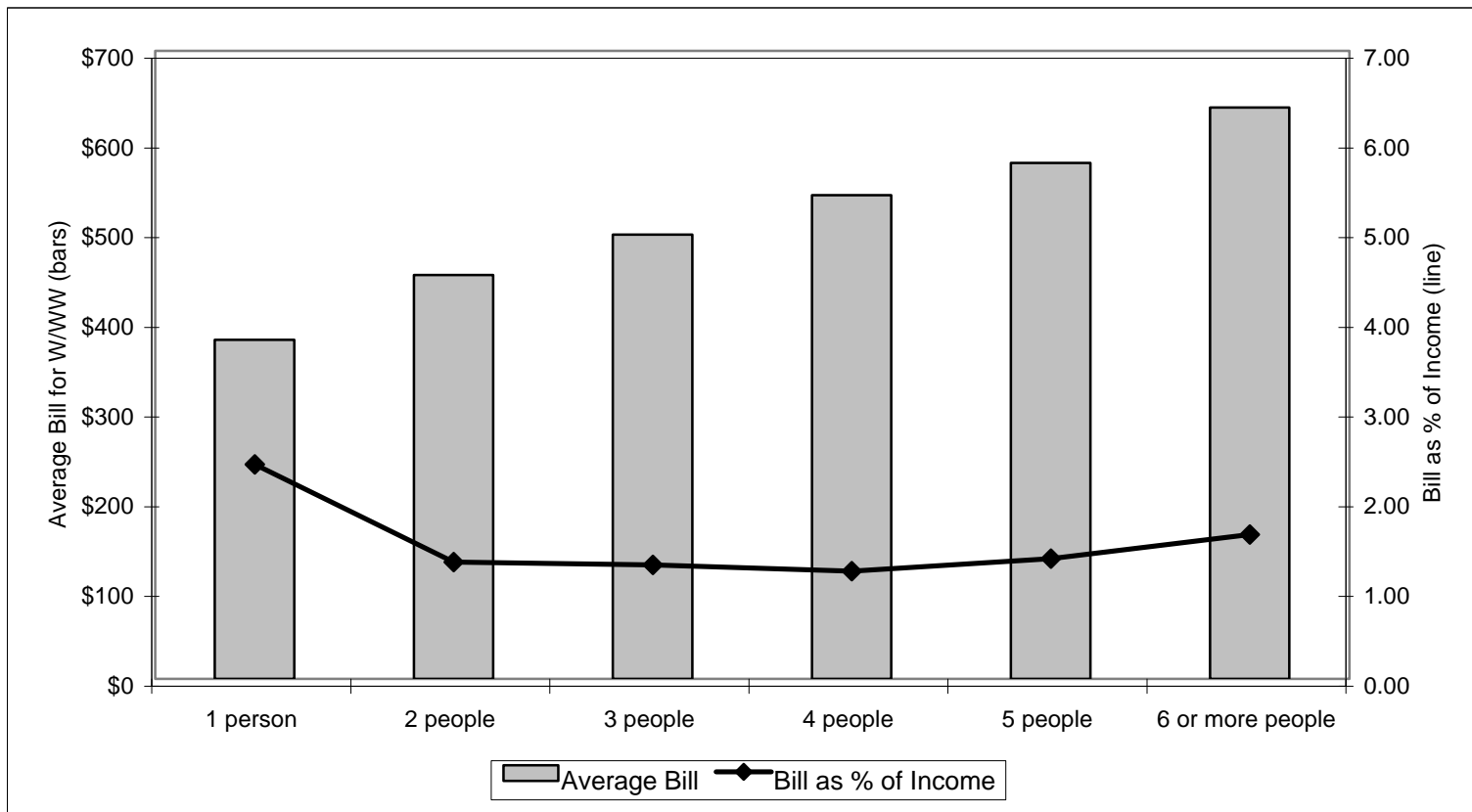
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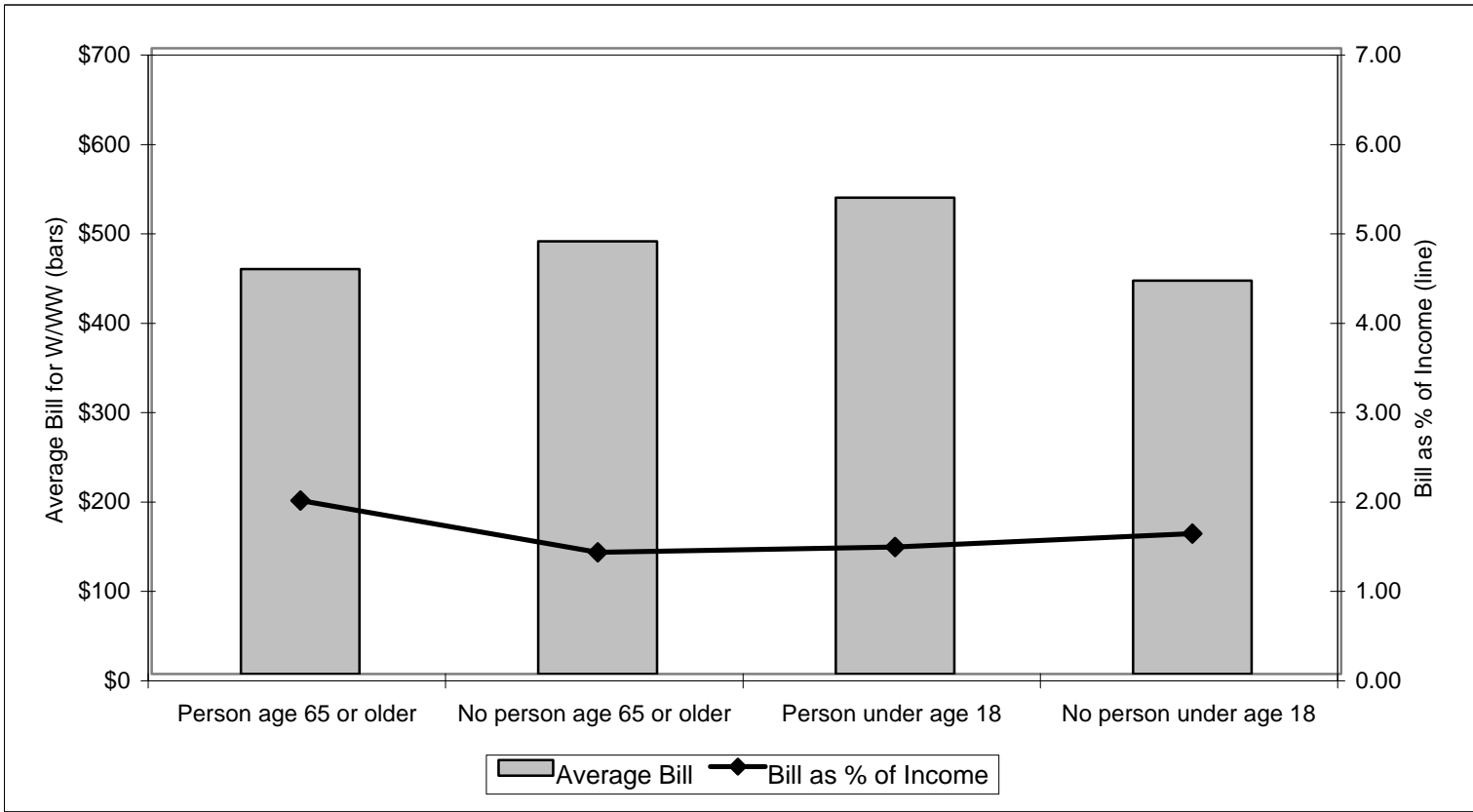
**Table 1**  
**Relationship Between Household Size and W/WW Bill**

<b>Type of Household</b>	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
1 person	26,149,268	49.01	378	2.39
2 people	33,948,697	64.36	450	1.30
3 people	17,164,204	65.86	495	1.27
4 people	14,869,096	69.62	539	1.20
5 people	6,969,684	69.40	575	1.34
6 or more people	4,334,157	67.81	637	1.61



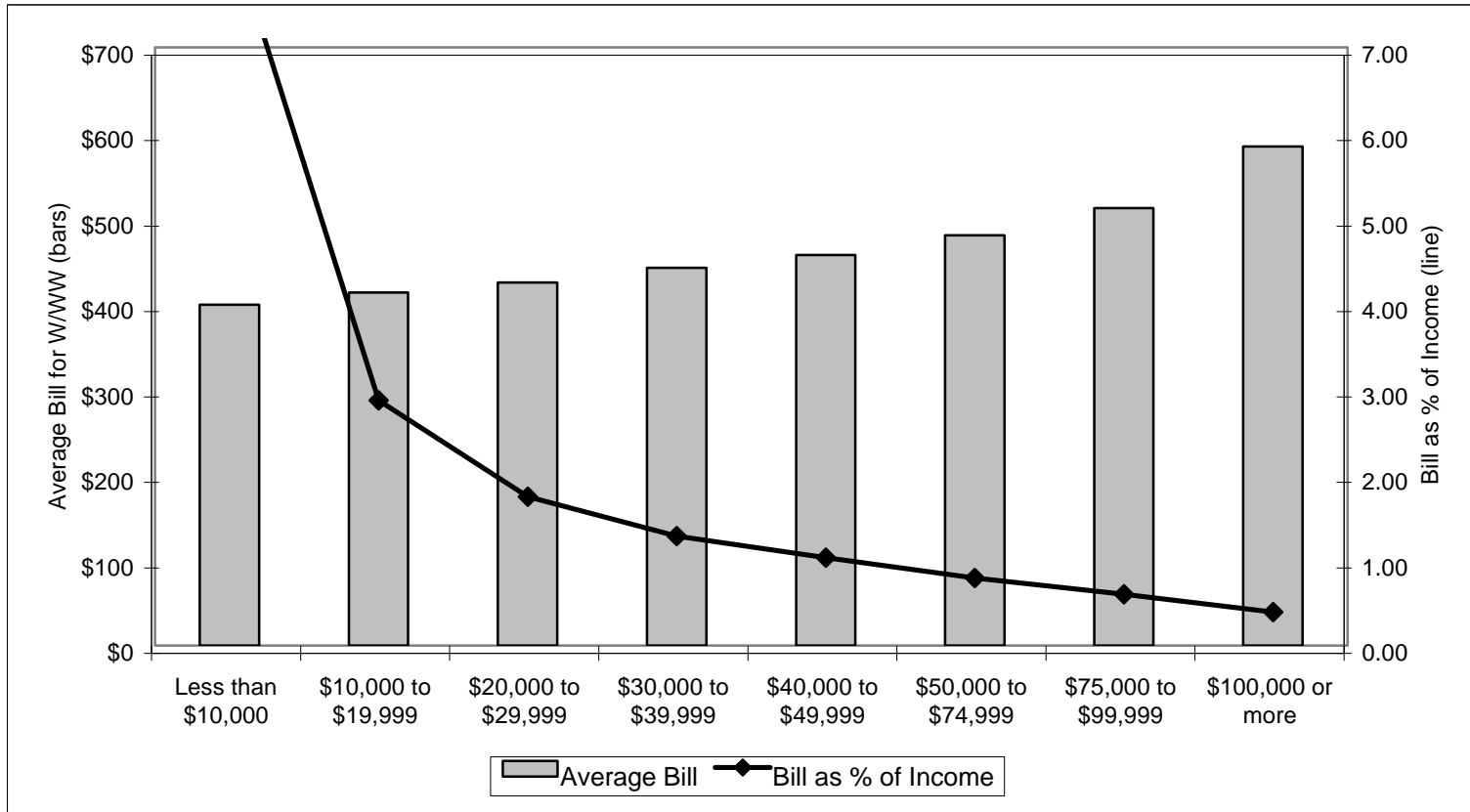
**Table 2**  
**Relationship Between Age and W/WW Bill**

<b>Type of Household</b>	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
Person age 65 or older	24,720,579	66.35	453	1.94
No person age 65 or older	78,714,527	60.59	484	1.36
Person under age 18	37,603,344	66.09	533	1.42
No person under age 18	65,831,762	59.62	440	1.57



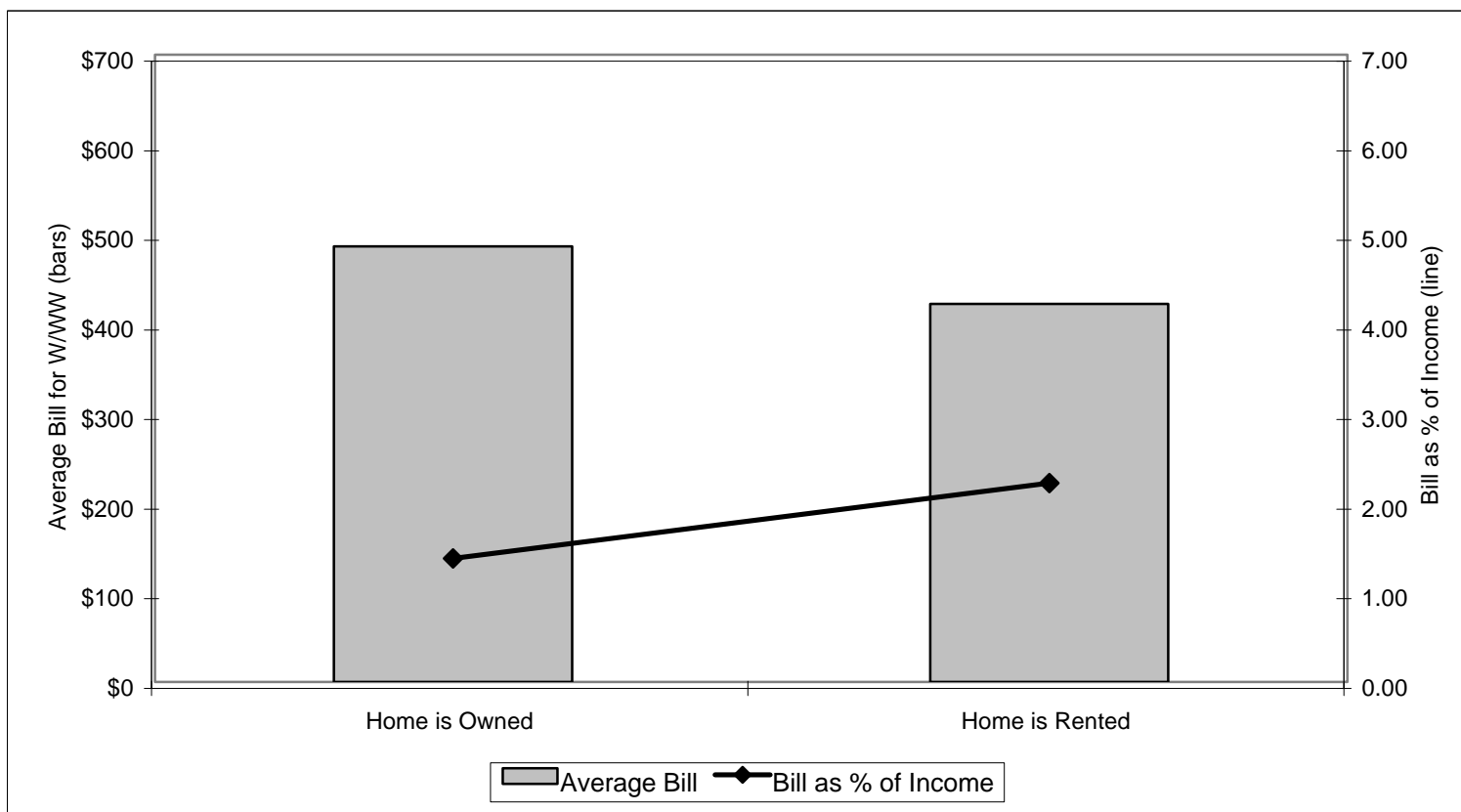
**Table 3**  
**Relationship Between Annual Household Income and W/W Bill**

<b>Type of Household</b>	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
Less than \$10,000	8,085,340	41.61	399	8.40
\$10,000 to \$19,999	13,285,453	49.90	413	2.87
\$20,000 to \$29,999	13,645,244	54.26	425	1.74
\$30,000 to \$39,999	13,006,945	58.48	442	1.28
\$40,000 to \$49,999	11,228,285	62.86	457	1.03
\$50,000 to \$74,999	20,285,059	68.44	480	0.79
\$75,000 to \$99,999	10,498,576	74.28	512	0.60
\$100,000 or more	13,400,204	77.28	584	0.39



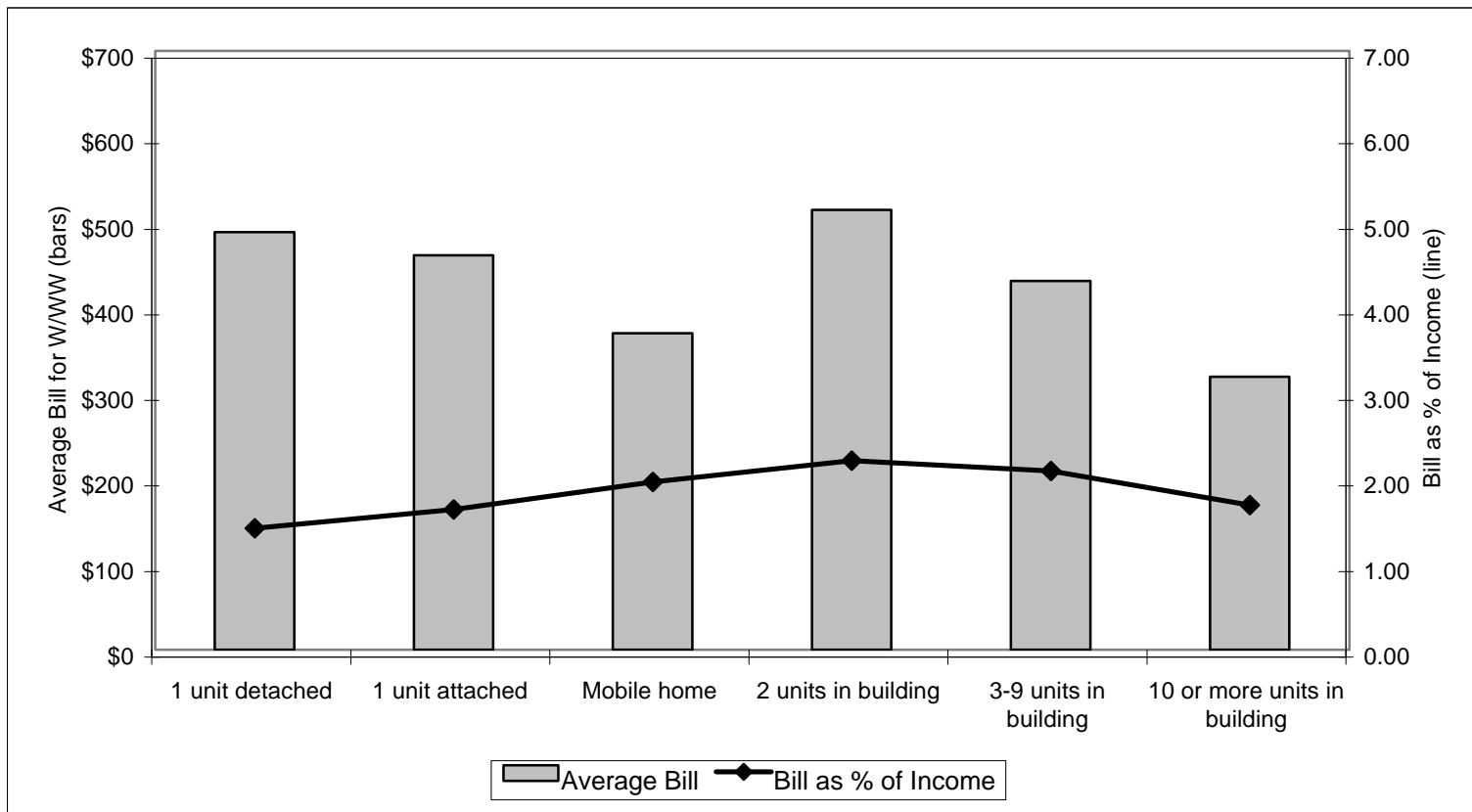
**Table 4**  
**Relationship Between Housing Ownership (Tenure) and W/WW Bill**

<b>Type of Household</b>	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
Home is Owned	69,041,712	78.32	486	1.38
Home is Rented	34,393,394	29.15	422	2.22



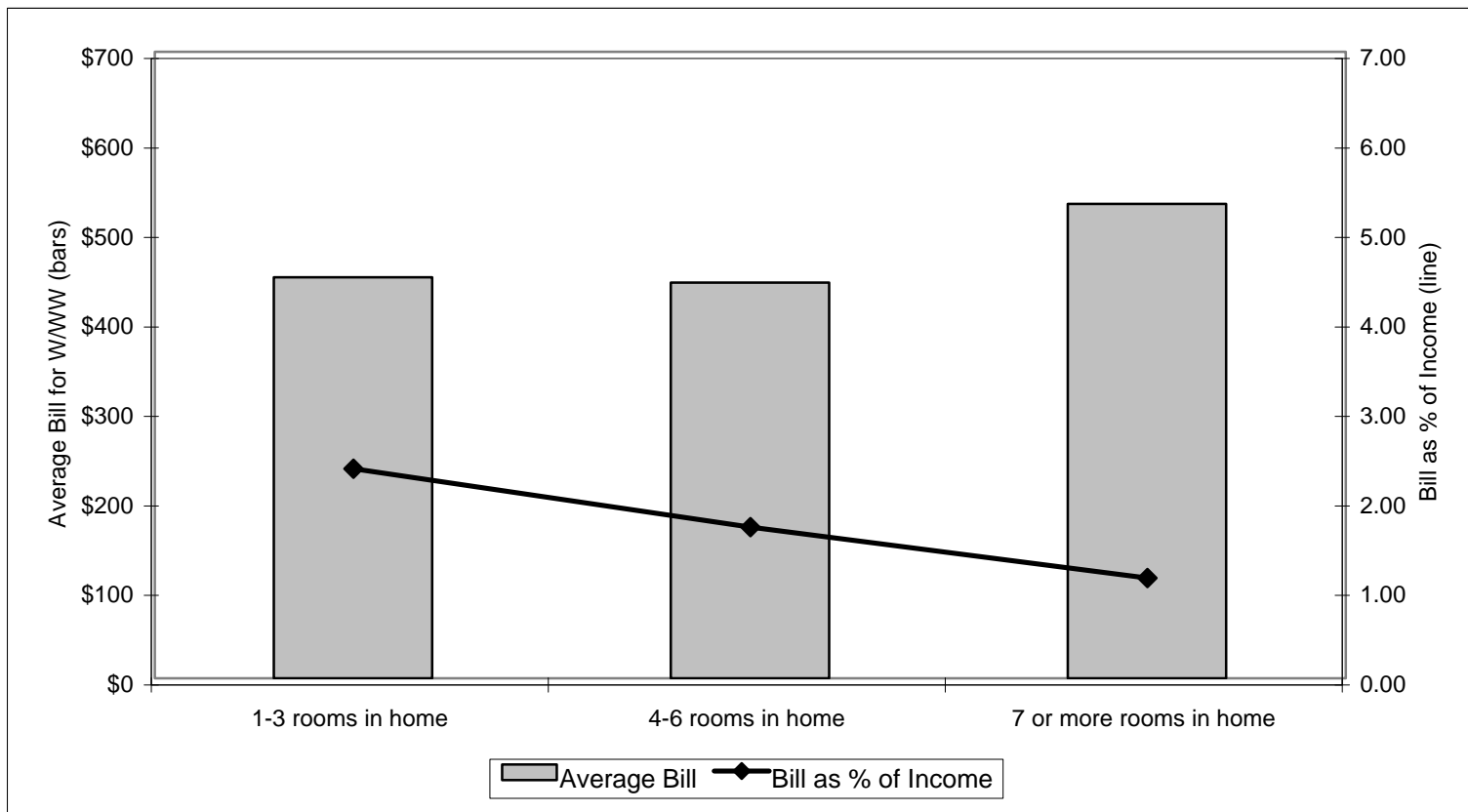
**Table 5**  
**Relationship Between Type of Housing Unit and W/WW Bill**

<b>Type of Household</b>	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
1 unit detached	64,022,653	81.05	488	1.42
1 unit attached	5,757,810	67.49	461	1.64
Mobile home	7,227,628	47.38	370	1.96
2 units in building	4,315,621	43.45	514	2.21
3-9 units in building	9,425,711	19.02	431	2.09
10 or more units in building	12,577,743	9.56	319	1.69



**Table 6**  
**Relationship Between Number of Rooms and W/WW Bill**

<b>Type of Household</b>	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
1-3 rooms in home	16,460,543	25.59	448	2.34
4-6 rooms in home	56,437,067	62.40	442	1.69
7 or more rooms in home	30,537,496	80.79	530	1.12



**Table 7**  
**Results of Multivariate Regression Analysis**

Variable	Coefficient	t-statistic	Significance (p)
constant	295.29 ± 0.12	2516.06	< 0.001
Number of people in household	39.26 ± 0.03	1264.41	< 0.001
Value of home:			
\$100,000 to \$249,999	29.52 ± 0.11	277.06	< 0.001
\$250,000 to \$499,999	113.51 ± 0.18	630.96	< 0.001
\$500,000 or more	299.58 ± 0.32	926.58	< 0.001
Located in metropolitan area	48.76 ± 0.10	496.49	< 0.001
Annual household income	0.0003 ± 0.0000	343.68	< 0.001
Type of building:			
Two-unit building	52.89 ± 0.27	193.01	< 0.001
Mobile home	-54.61 ± 0.21	-259.26	< 0.001
Building with 10 units or more	-110.16 ± 0.34	-320.37	< 0.001

R-squared: 0.075

Standard error of estimate: 368.07

F-statistic: 574,122 (p<0.001)

**Table 8**  
**Summary of State Results for All Households**

	Number of Households	% Households Pay for W/WW	Avg. W/WW Bill of Paying HHs	Avg. W/WW Bill as % of Income	Avg. W/WW Bill as % of MHI
Alabama	1,684,863	79.96	371	1.64	1.09
Alaska	220,658	42.33	603	1.63	1.17
Arizona	1,865,750	69.66	552	1.65	1.36
Arkansas	1,018,569	77.26	418	1.85	1.30
California	11,285,634	60.56	591	1.52	1.24
Colorado	1,636,462	64.23	465	1.23	0.99
Connecticut	1,281,080	48.50	442	1.10	0.82
Delaware	295,250	58.65	456	1.31	0.96
District of Columbia	238,823	38.46	505	1.49	1.26
Florida	6,202,839	62.25	573	1.91	1.48
Georgia	2,941,022	68.91	426	1.43	1.00
Hawaii	394,954	53.87	721	1.62	1.45
Idaho	462,706	59.07	413	1.54	1.10
Illinois	4,508,577	62.86	426	1.22	0.91
Indiana	2,301,392	61.06	424	1.42	1.02
Iowa	1,135,366	70.17	421	1.37	1.07
Kansas	1,022,384	76.08	419	1.40	1.03
Kentucky	1,552,439	74.51	387	1.56	1.15
Louisiana	1,597,412	75.95	385	1.90	1.18
Maine	513,407	35.57	429	1.40	1.15
Maryland	1,949,916	58.19	432	1.01	0.82
Massachusetts	2,394,256	53.43	519	1.26	1.03
Michigan	3,721,234	55.58	420	1.34	0.94
Minnesota	1,876,421	56.41	390	1.01	0.83
Mississippi	1,010,191	77.55	372	1.89	1.19
Missouri	2,156,308	68.22	390	1.39	1.03
Montana	352,074	49.63	417	1.72	1.26
Nebraska	656,455	63.08	334	1.13	0.85
Nevada	736,094	60.42	472	1.22	1.06
New Hampshire	470,019	35.55	410	1.00	0.83
New Jersey	3,011,314	61.00	559	1.31	1.01
New Mexico	663,373	66.47	470	1.85	1.38
New York	6,869,263	41.60	450	1.25	1.04
North Carolina	3,071,642	57.33	378	1.37	0.96
North Dakota	253,107	60.63	451	1.54	1.30
Ohio	4,372,020	64.40	459	1.47	1.12
Oklahoma	1,312,418	73.56	443	1.87	1.33
Oregon	1,313,819	58.88	489	1.45	1.20
Pennsylvania	4,687,381	63.03	492	1.70	1.23
Rhode Island	400,788	53.11	420	1.29	1.00
South Carolina	1,496,062	65.82	419	1.65	1.13
South Dakota	285,788	67.32	418	1.50	1.18
Tennessee	2,185,992	74.60	380	1.45	1.05
Texas	7,222,150	72.53	555	1.92	1.39
Utah	694,329	72.48	439	1.20	0.96
Vermont	238,251	34.51	357	1.05	0.87
Virginia	2,663,683	58.75	465	1.32	1.00
Washington	2,239,923	60.50	569	1.58	1.24
West Virginia	717,626	70.47	465	2.22	1.57
Wisconsin	2,063,117	54.11	400	1.14	0.91
Wyoming	190,505	61.25	442	1.52	1.17
All U.S.	103,435,106	61.97	476	1.51	1.13
High	11,285,634	79.96	721	2.22	1.57
	California	Alabama	Hawaii	West Virginia	West Virginia
Low	190,505	34.51	334	1.00	0.82
	Wyoming	Vermont	Nebraska	New Hampshire	Maryland



**Table 9**  
**Incomes of Households Paying Directly for W/WW**

	All Households that Pay Directly for W/WW	Percent with Incomes Less than \$20,000 Per Year	Percent with Incomes Greater than \$75,000 Per Year	Low Income vs. High Income
Alabama	1,347,156	24.50	17.73	1.4
Alaska	93,408	8.16	40.94	0.2
Arizona	1,299,592	13.91	27.07	0.5
Arkansas	786,945	25.86	14.64	1.8
California	6,834,788	11.46	38.79	0.3
Colorado	1,051,159	10.96	33.10	0.3
Connecticut	621,355	8.97	40.71	0.2
Delaware	173,171	10.95	33.70	0.3
District of Columbia	91,853	11.88	44.27	0.3
Florida	3,861,267	16.78	24.35	0.7
Georgia	2,026,723	16.07	28.47	0.6
Hawaii	212,754	9.13	42.85	0.2
Idaho	273,341	16.39	19.95	0.8
Illinois	2,834,001	12.98	31.63	0.4
Indiana	1,405,117	15.79	21.86	0.7
Iowa	796,666	15.92	18.29	0.9
Kansas	777,787	16.98	22.47	0.8
Kentucky	1,156,694	22.94	19.16	1.2
Louisiana	1,213,237	26.37	18.05	1.5
Maine	182,637	15.87	22.05	0.7
Maryland	1,134,610	9.83	40.19	0.2
Massachusetts	1,279,369	10.00	41.70	0.2
Michigan	2,068,206	14.42	29.45	0.5
Minnesota	1,058,421	10.58	32.11	0.3
Mississippi	783,440	29.32	14.98	2.0
Missouri	1,471,012	17.90	22.04	0.8
Montana	174,745	21.46	15.18	1.4
Nebraska	414,087	15.13	21.44	0.7
Nevada	444,729	9.89	30.97	0.3
New Hampshire	167,101	9.49	33.10	0.3
New Jersey	1,836,784	9.22	44.64	0.2
New Mexico	440,923	22.36	18.51	1.2
New York	2,857,857	11.35	38.00	0.3
North Carolina	1,760,982	18.40	23.26	0.8
North Dakota	153,447	18.48	18.77	1.0
Ohio	2,815,702	15.92	24.70	0.6
Oklahoma	965,423	23.63	16.58	1.4
Oregon	773,564	12.64	26.12	0.5
Pennsylvania	2,954,611	17.75	24.44	0.7
Rhode Island	212,859	12.77	29.85	0.4
South Carolina	984,749	20.14	20.62	1.0
South Dakota	192,389	17.34	16.47	1.1
Tennessee	1,630,855	20.67	19.49	1.1
Texas	5,238,329	18.01	25.91	0.7
Utah	503,246	9.91	28.41	0.3
Vermont	82,210	12.94	23.20	0.6
Virginia	1,564,935	12.38	35.01	0.4
Washington	1,355,248	10.92	32.39	0.3
West Virginia	505,717	27.74	12.44	2.2
Wisconsin	1,116,360	12.31	25.98	0.5
Wyoming	116,683	18.64	18.56	1.0
All U.S.	64,098,244	15.59	28.32	0.6
High	6,834,788 California	29.32 Mississippi	44.64 New Jersey	2.2 West Virginia
Low	82,210 Vermont	8.16 Alaska	12.44 West Virginia	0.2 Alaska

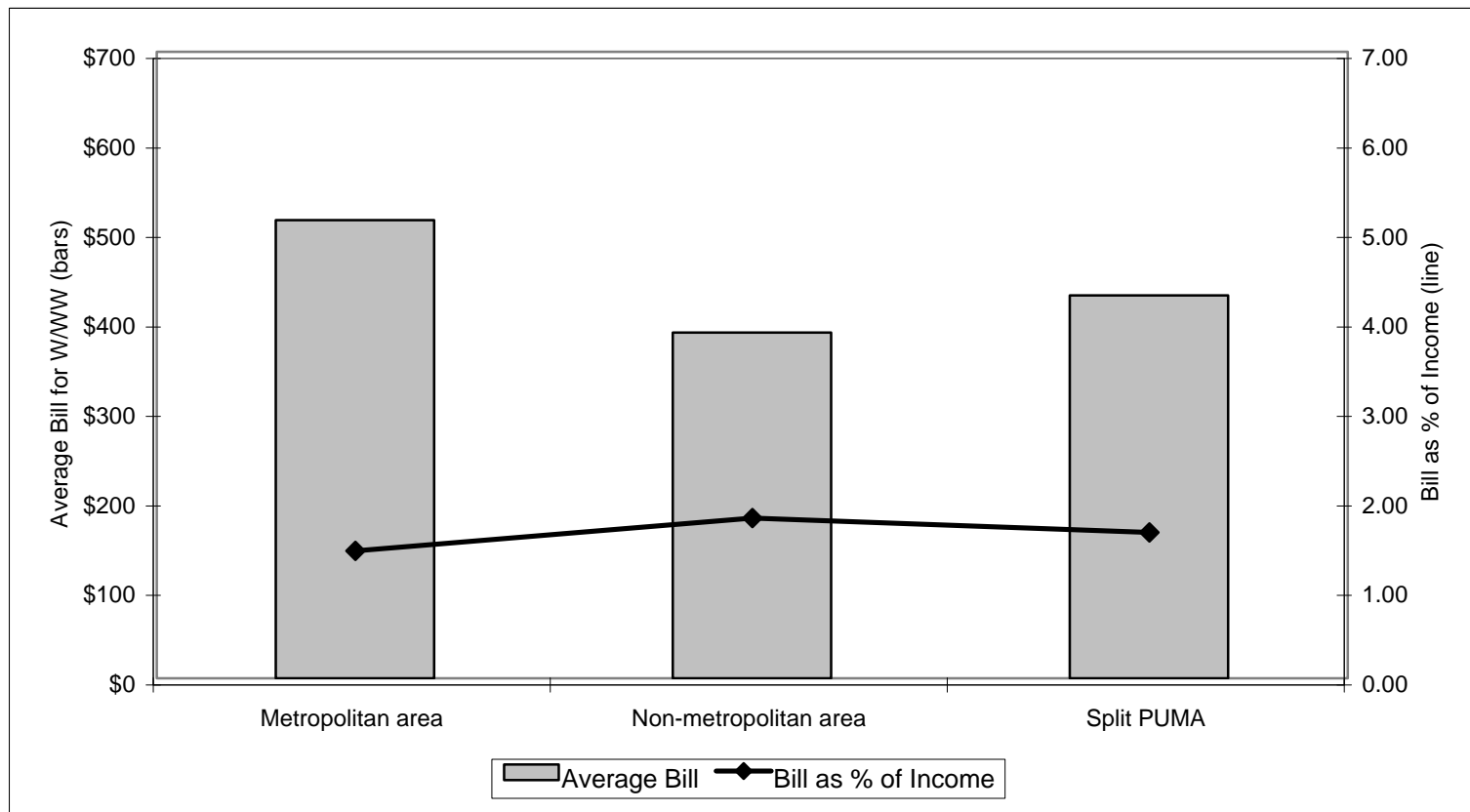
**Table 10**  
**Percentage of Households Paying Directly for W/WW, by Type of Housing**

	Percent of All Households Paying Directly for W/WW	Percent of Mobile Homes Paying Directly for W/WW	Percent of Units in Dense Buildings (10 Units or More) Paying Directly for W/WW
Alabama	79.96	74.22	27.00
Alaska	42.33	27.55	2.89
Arizona	69.66	60.71	11.56
Arkansas	77.26	66.74	
California	60.56		9.18
Colorado	64.23	44.39	12.83
Connecticut	48.50		6.33
Delaware	58.65	31.43	5.60
District of Columbia	38.46		1.64
Florida	62.25	40.51	17.74
Georgia	68.91	44.31	32.56
Hawaii	53.87		2.07
Idaho	59.07	33.70	
Illinois	62.86		5.53
Indiana	61.06	45.29	7.81
Iowa	70.17		8.12
Kansas	76.08	59.19	11.44
Kentucky	74.51	64.62	10.15
Louisiana	75.95	68.32	9.24
Maine	35.57	13.87	
Maryland	58.19		7.00
Massachusetts	53.43		2.59
Michigan	55.58	32.07	3.25
Minnesota	56.41		2.74
Mississippi	77.55	72.18	
Missouri	68.22	45.36	7.72
Montana	49.63	33.22	2.23
Nebraska	63.08		4.18
Nevada	60.42	45.10	7.97
New Hampshire	35.55	19.12	3.01
New Jersey	61.00		7.77
New Mexico	66.47	57.64	11.60
New York	41.60		1.29
North Carolina	57.33	35.80	19.79
North Dakota	60.63	39.12	2.05
Ohio	64.40		7.50
Oklahoma	73.56	54.75	13.64
Oregon	58.88	33.36	7.58
Pennsylvania	63.03		5.56
Rhode Island	53.11		1.58
South Carolina	65.82	47.06	
South Dakota	67.32	47.43	3.57
Tennessee	74.60	62.51	22.88
Texas	72.53	65.61	20.58
Utah	72.48		12.26
Vermont	34.51	24.35	
Virginia	58.75	28.92	10.12
Washington	60.50	36.18	12.09
West Virginia	70.47	56.07	
Wisconsin	54.11		5.91
Wyoming	61.25	38.60	
All U.S.	61.97	47.38	9.56
High	79.96	74.22	32.56
	Alabama	Alabama	Georgia
Low	34.51	13.87	1.29
	Vermont	Maine	New York

Note: Results limited to states where at least 5% of housing units are of the given type

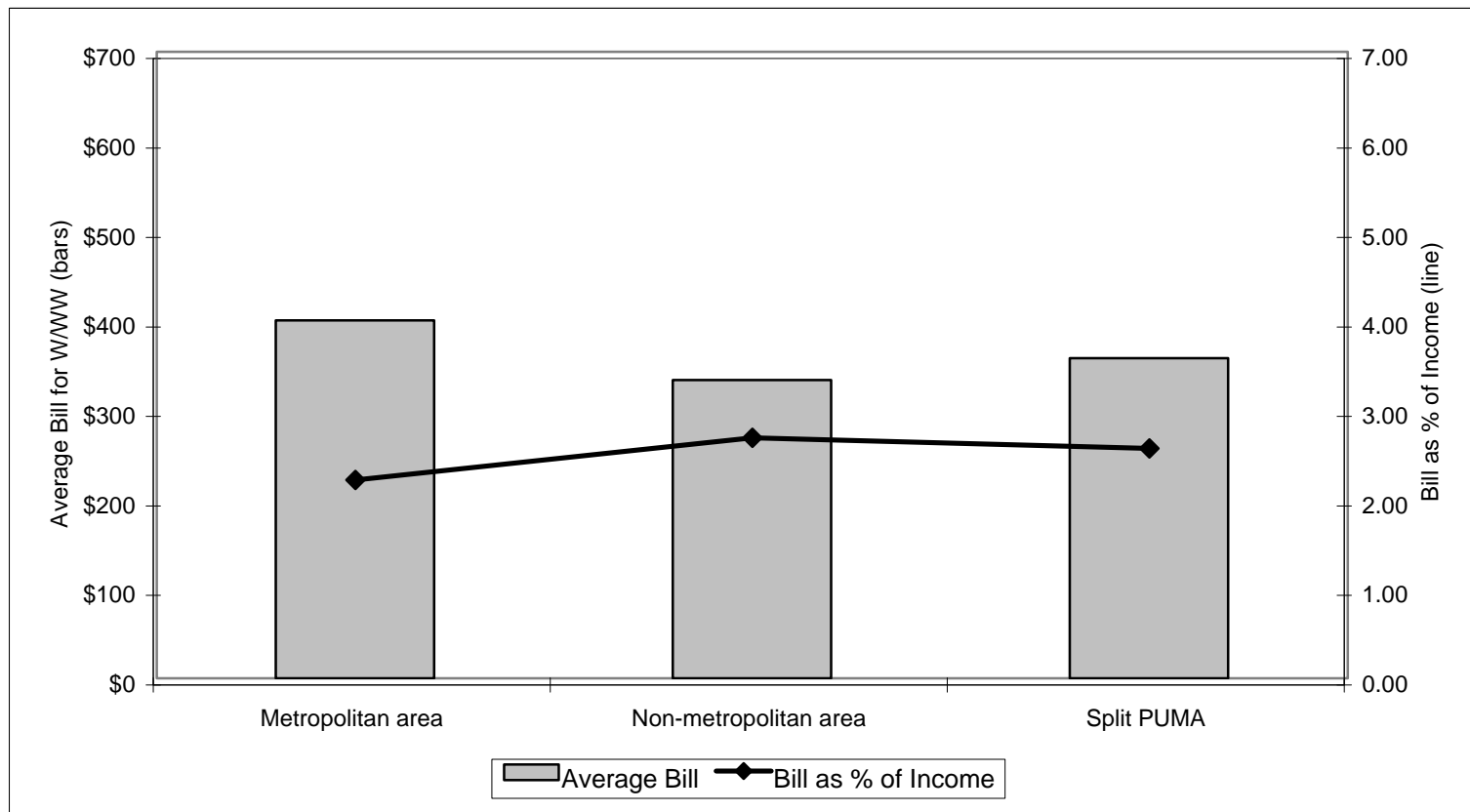
**Table 11**  
**Metropolitan vs. Non-Metropolitan Areas - All Households**

	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
Metropolitan area	61,228,975	62.07	512	1.42
Non-metropolitan area	4,011,314	61.89	386	1.79
Split PUMA	38,194,817	61.81	428	1.63



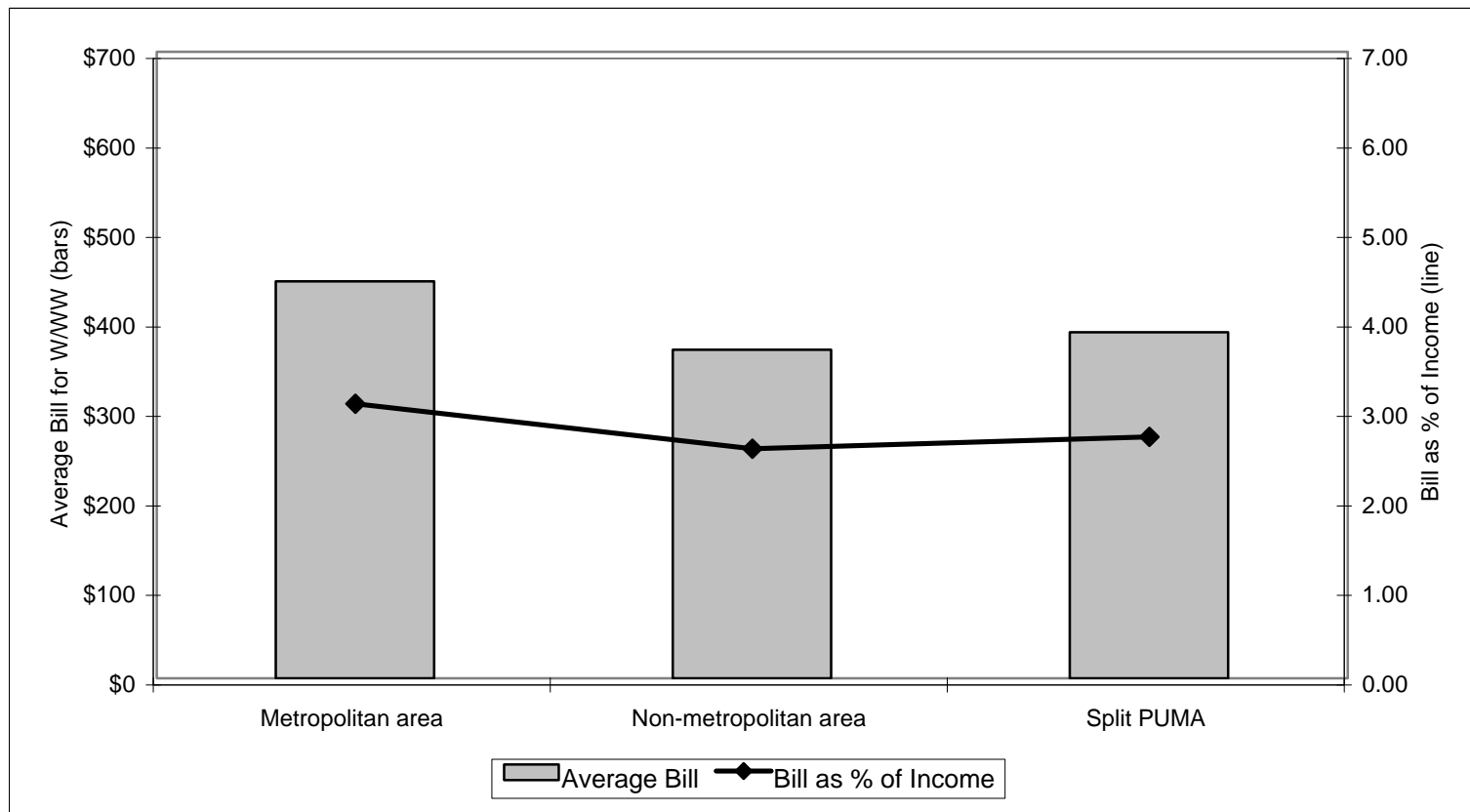
**Table 12**  
**Metropolitan vs. Non-Metropolitan Areas - One-Person Households**

	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
Metropolitan area	15,807,617	45.46	400	2.22
Non-metropolitan area	1,013,937	58.28	333	2.69
Split PUMA	9,327,714	54.01	358	2.57



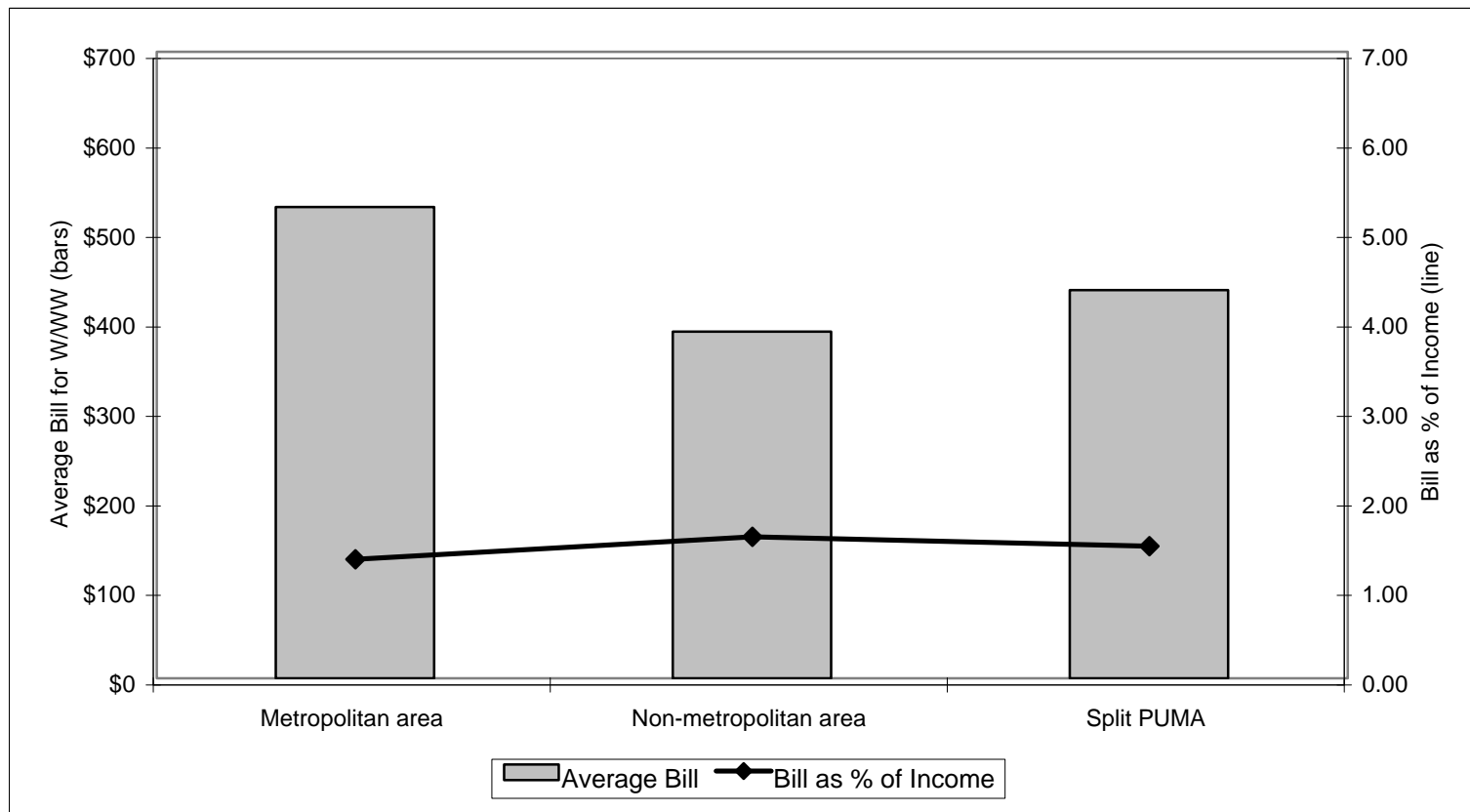
**Table 13**  
**Metropolitan vs. Non-Metropolitan Areas - Households with Income from \$10,000-\$19,999**

	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
Metropolitan area	6,983,914	45.03	443	3.07
Non-metropolitan area	712,929	58.82	367	2.56
Split PUMA	5,588,610	54.86	387	2.70



**Table 14**  
**Metropolitan vs. Non-Metropolitan Areas - Households that Own Home**

	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
Metropolitan area	38,597,046	84.22	527	1.33
Non-metropolitan area	2,956,908	68.59	387	1.58
Split PUMA	27,487,758	71.07	434	1.48



**Table 15**  
**Metropolitan vs. Non-Metropolitan Areas - Households that Rent Home**

	<b>Number of Households</b>	<b>% Households Pay for W/WW</b>	<b>Avg. W/WW Bill of Paying HHs</b>	<b>Avg. W/WW Bill as % of Income</b>
Metropolitan area	22,631,929	24.29	443	2.02
Non-metropolitan area	1,054,406	43.10	381	2.70
Split PUMA	10,707,059	38.06	401	2.34

