Twin Cities Regional Water Billing Analysis

PREPARED FOR THE METROPOLITAN COUNCIL

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Section 1
Executive Summary

The Metropolitan Council (Council) commissioned CDM Smith to determine if the rates and rate structures that the water utilities in the Twin Cities Metropolitan (Metro) area use to bill their customers have any effect on water consumption. Socioeconomic and land use factors were also considered in this analysis. The study was funded by the Council using funds received from the Clean Water Fund.

1.1 Data Collection

Data was collected from the three sources listed below. More information on the data collection process can be found in Section 2.

- **Individual Municipal Utilities**: Billing rates, rate structures, other fees associated with water utility bills, and water conservation efforts were collected for the individual municipal utilities. Information was gathered on 126 municipal utilities in the Metro area.
- **Metropolitan Council**: Socioeconomic and zoning data was collected from the Council webpage. Note that this is for the municipality and not the municipal utility. Data were collected for 126 municipalities.
- **Department of Natural Resources (DNR)**: Monthly and yearly water consumption, number of utility connections based on customer class, and water consumption by customer class for the various municipal utilities in the Metro area were collected from the State Water Use Database System (SWUDS). Data were collected for 94 municipal utilities.

1.2 Description of Database

The data were compiled into four different sub-databases which are described below. More information can be found in Section 3.

- **Sub-database 1. Rates and Rate Structures**: This database lists each of the rate structures that each municipal utility in the Metro area uses to bill their water customers.
- **Sub-database 2. Socioeconomic Data**: This database contains information regarding the social and economic profile of each municipality in the Metro area utilizing a municipal water supply. It also contains data regarding the area, in acres, of each land use classification within the municipality.
- **Sub-database 3. Number of Connections and Volumes**: This database contains information on the number of water utility connections and volume of water used per customer class for individual municipal utilities.
- **Sub-database 4. Monthly Use**: This database contains information regarding the total volume of water that each municipal utility used per month for each year that they reported the data to the SWUDS data base.

1.3 Data Analysis

Data is grouped and analyzed according to nine categories: (1) rate structures, (2) total Metro area water use, (3) individual municipal utility water use, (4) municipal characteristics, (5) equivalent water bills, (6) factors affecting per capita water use, (7) impact of separate irrigation meters, (8) peak month to winter average ratio (a.k.a. peak month ratio), and (9) impact of water conservation practices. The results of these analyses are summarized below, and can be found in more detail in Section 4.

Note that throughout this report the terms "municipality," "community," "utility" and water "system" might be used interchangeably at times. The focus of this study is to compare and contrast water rates across utilities and to identify possible associated similarities and differences in municipal socioeconomic characteristics. The term "municipal utility" should not be construed as a description of ownership. No information was collected or evaluated to differentiate municipally-owned, publicly-owned, or privately-owned utilities.

1.3.1 Rate Structures

Data on rate structures was collected for 126 municipal utilities. Fewer than half (47 percent) of the municipal utilities examined have only one rate structure for all their customers. The remaining municipal utilities classify their customers into between two and eight customer classes with a separate rate structure for each class (e.g., residential, industrial, commercial, etc.).

Usually the first tier is a low volume with average winter use and often a discounted rate, often referred to as the "lifeline" rate. The second tier is usually set to include average volume use (including summer use) with a rate that covers the full cost of service. The third tier, or higher tiers, usually contains higher rates to discourage excessive water use. As discussed in Section 4.5.5, an increasing tiered rate structure may not be deemed a "conservation" rate structure if the step up in rates from tier to tier does not convey the conservation incentive to the customer and change customer behavior.

About three-quarters (76 percent) of the rate structures used in the Metro area are tiered rate structures with between one and ten tiers. The remaining 26 percent are comprised of uniform rate structures.

1.3.2 Total Metro Area Water Use

The total amount of water used across the Metro area has been increasing since the 1990's.

In general, household water use varies with the seasons. Area-wide, the average daily peak demand typically occurs in July and is over twice the average daily winter use rate. Specifically, average winter use from 2000 to 2012 for the entire Metro area was 265 million gallons per day (MGD) while average water use in July was 568 MGD.

1.3.3 Individual Municipality Utility Water Use

Total water use by individual municipal utility ranges widely across the Metro area from a low of 0.035 MGD in Dayton to over 60 MGD in both Minneapolis and St. Paul. Almost half (48 percent) of the municipal water utilities use less than 1 MGD, 34 percent use 1 to 5 MGD, and 16 percent use 6 to 10 MGD. The only two utilities greater than 10 MGD are Minneapolis and St. Paul, which supply an average of more than 60 MGD to their customers, including wholesale supply to nearby municipalities.

Average per capita water use for total municipal water use ranges from a low of 64 gallons per capita day (GPCD) in Lakeland to a high of 207 GPCD in Wayzata. When examining residential water use only, the average per capita water use ranges from a low of 41 GPCD in Bayport to a high of 148 GPCD in Wayzata

1.3.4 Municipal Characteristics

Socioeconomic data was obtained for 126 municipalities in the Metro area. The 2010 population ranges from 112 in New Trier to 382,578 in Minneapolis, with a median population of 9,052. The median household income (averaged across years 2008 to 2012 for each municipality) ranges from $23,400 up to $151,900, with a median across municipal utilities of $72,400.

Data was obtained on the zoning areas of each municipality. The percent of area within the municipality that is residential (excluding all open water areas from the total) was calculated. The percent of land area that is residential ranges from four percent up to 90 percent with an average of 43 percent.

1.3.5 Equivalent Water Bills

Equivalent monthly water bills were calculated for each of the municipal utilities. To do this, each municipal utility was represented by a single rate structure. When more than one structure existed, the single-family, residential, or smallest meter size was used.

The hypothetical water bills for 8,000 gallons per month ranged from $8.60 in White Bear Lake to $123.91 in East Bethel. The average was approximately $30 and half the hypothetical bills were between $19 and $36 per month. 8,000 gallons was chosen as the hypothetical water use since it was close to the calculated average monthly residential household water use of 8,200 gallons. The municipalities were then grouped by which tier the 8,000 gallons per month fell within. Of the rate structures analyzed, 33 were a uniform structure and thus had no tiers. Of those with tiered rate structures, most (54 percent) of the rate structures are designed such that 8,000 gallons per month is in the second tier. Since this 8,000 gallon volume represents the average water use, as described in the Rate Structure section above, it is usual that this volume would fall in the second tier of a tiered rate structure. However, for 32 percent of the tiered rate structures the hypothetical volume was in the first tier, and for 14 percent it was the third tier.

1.4 Summary of Results

The most significant results and conclusions from the Utility Billing Study are summarized below.

1.4.1 Factors Affecting per Capita Water Use

Factors including population, number of rate structures, number of tiers, percent of the area zoned residential, median household income, number of people per household, monthly bill for 8,000 gallons, tier the 8,000 gallons falls in, and percent of income spent on water were analyzed to determine if they have any effect on the average total or average residential per capita water consumption among the individual municipal utilities.

Of all the factors listed above, median household income, average number of people per household, equivalent monthly water bill, and percent of income spent on water were found to have an influence on the amount of water people were using. Specifically:

- As the median household income increases, the residential water use per capita increases as well.

- As the average number of people per household increases, the residential per capita water use tends to also increase.
- As the equivalent monthly water bill of 8,000 gallons increases, the amount of residential water used per capita tends to decrease.
- As the percent of a household's income spent on water increases, the residential per capita water use tends to decrease.

1.4.2 Impact of Separate Irrigation Meters

In total, 37 municipal utilities in the Metro area offer one or more separate rate structure(s) for different types of irrigation customers (e.g., residential irrigation or industrial irrigation customers). Analysis of the total per capita water use and residential per capita water use between municipalities with and without separate irrigation meters was inconclusive. Rather than evaluate differences across utilities, it is recommended that an analysis be conducted within utilities that offer separate irrigation metering, such as a comparison of residential water use among customers with and without separate residential irrigation meters.

1.4.3 Peak Month to Winter Average Use

The peak month to winter average use ratio was analyzed in comparison to the corresponding total per capita water use, residential per capita water use, percent of municipality zoned residential, median household income, and the equivalent monthly bill of 8,000 gallons to determine if any of the aforementioned factors influenced the peak month to winter average ratio. The following results were found:

- As residential per capita water use increases, the peak month ratio tends to increase. As high peak month summer use is usually driven by lawn irrigation, it makes sense that communities with a higher peak ratio would have higher per capita water use due to increased irrigation use.
- As the median household income increases, the peak month ratio increases. This indicates that there is an increase in outdoor water use as income rises.
- As the equivalent monthly water bill increases, the peak month ratio decreases. This indicates that as the monthly water bill increases, people are less inclined to use water for non-personal use reasons (i.e., outdoor water use is curtailed).

1.4.4 Impact of Conservation Ordinances and Programs

Only a limited number of municipalities in the Metro area were found to have water conservation programs for customers. It should be noted that these programs were found using a basic internet search without direct contact with each municipality. The conservation programs found ranged from providing educational materials to rebates and financing for fixture replacement, and landscape audits.

It is difficult to compare the effects of these programs across municipalities. Differences in water use across these municipalities, and those without specific conservation programs, may be due to differences in municipal characteristics rather than whether or not there is a conservation program.

Section 2
Data Collection

Data collected for this study includes water utility rates and rate structures for the various municipal utilities in the Twin Cities metropolitan (Metro) area of Minnesota. Additional information collected includes socioeconomic data, number of utility connections per customer class, and monthly and yearly volume of water used. More information on the data collection process is provided in this section.

2.1 Data Sources

The data used in these analyses were collected from the following three sources:

- **Individual Municipal Utilities**: The billing rates, rate structures, other fees associated with water utility bills, and water conservation efforts for each of the municipal utilities in the Metro area were obtained from municipal web sites and/or direct contact with the utility. The use of a city ordinance or fee schedule was the preferred source of information. When this was not available, the information was gathered from either the municipality's utility webpage, or direct conversations with a utility representative. There are a total of 186 municipalities in the Metro area, 58 of which have no municipal water system. These were not used in any analyses. Information could not be obtained for 4 municipalities: Fort Snelling, Greenwood, Landfall, and Oak Grove. Of the remaining 124 municipalities, 122 are serviced mostly from a single source municipal utility and two were serviced by two separate municipal utilities. In total there were 126 municipal utilities[1]. Note the use of the terms municipality and municipal utility. For the purpose of this study, a municipality is a city, town, or township. A municipal utility is a governmental organization that provides public utilities to its residences and charges the customers for use of these utilities. Oftentimes this is a one-to-one ratio and the terms can almost be used interchangeably. That is, the municipality is also the municipal utility. However, this is not always the case. In some instances a municipality is serviced by one or more than one outside utility. In this case the municipality and municipal utility are not the same. For example, Columbia Heights purchases its water from Minneapolis. As can be seen here, the municipality and municipal utility are not the same.

- **Metropolitan Council**: Socioeconomic and zoning data including population, number of households, number of people per household, median household income, per capita personal income, and land use for each of the municipalities were obtained from the individual city profile data found on the Metropolitan Council website. Note that this information is for the municipality and not the municipal utility.

  Population and number of households were provided for the years 1970, 1980, 1990, 2000, and 2010. The Metropolitan Council estimated the population and number of households for 2013 and projected them for 2020, 2030, and 2040. In order to use data for the most recent available year,

[1] The 126 municipal utilities were determined in the following manner:
- 186 total municipalities – 58 municipalities with no municipal water system – 4 municipalities without information = *124 municipalities* on a public water supply
- There are 122 municipalities which receive water mostly from one source and two which receive water from two sources. 122 + 4 = *126 municipal utilities*

the 2010 data was selected. To be consistent, the 2010 data for average household size was also used. For median household income and per capita personal income, the American Community Survey (ACS) 2008-2012 data from the Council webpage was selected because it contained data for 2010. This data set was inflation-adjusted to the 2012 dollar, which was closest to the current year 2014, making it relatable to current conditions and comparable to the other socioeconomic data.

- **Department of Natural Resources (DNR)**: Data regarding monthly/yearly water consumption, number of connections based on customer class, and water consumption by customer class for the various municipal utilities were collected from the State Water Use Database System (SWUDS), which is maintained by the DNR but was provided by the Metropolitan Council. SWUDS is a database that stores data regarding, among other things, the amount of water that a permittee, in this case a municipal utility, withdraws from rivers or aquifers. It also tracks the amount of water each municipal utility delivers to each customer class. All data is classified by permit number, which relates to a specific municipality. There are 94 municipal utilities with sufficient data to analyze total Metro area water use, 93 with sufficient data to analyze per capita water use for total municipal consumption, and 91 with sufficient data to analyze per capita water use for residential consumption only.

2.2 Data Caveats and Discrepancies

In total, there are 186 municipalities in the Metro area. Data from municipalities that did not have a municipal water supply were not used in this study. This accounted for 58 municipalities, all of which are listed in Table 2-1 below:

Table 2-1. Municipalities in the Metro Area

Metro Area Municipalities	Metro Area Municipalities	Metro Area Municipalities
Afton	Greenvale Township	Nowthen
Baytown Township	Grey Cloud Island Twp	Pine Springs
Belle Plaine Township	Ham lake	Randolph Township
Benton Township	Hampton Township	Ravenna Township
Bethel	Hancock Township	Rockford
Blakeley Township	Hanover	San Francisco Township
Camden Township	Helena Township	Sand Creek Township
Castle Rock Township	Hollywood Township	Scandia
Cedar Lake Township	Independence	Sciota Township
Coates	Jackson Township	Spring Lake Township
Corcoran	Laketown Township	St. Lawrence Township
Credit River Township	Linwood Township	St. Mary's Point
Dahlgren Township	Louisville Township	Stillwater Township
Dellwood	Marshan Township	Vermillion Township
Denmark Township	May Township	Waconia Township
Douglas Township	Medicine lake	Waterford Township
Eureka Township	Miesville	Watertown Township

Metro Area Municipalities	Metro Area Municipalities	Metro Area Municipalities
Gem Lake	New Market Township	West Lakeland Twp
Grant	Niniger Township	Young America Twp
Greenvale Township	Northfield	

Of the remaining municipalities with a public water supply, some data caveats and discrepancies did exist. These are discussed further in the following section.

2.2.1 Billing Rates and Rate Structures

Utility billing rates and rate structures could not be obtained for four municipalities with a municipal water supply. Data was not available for Fort Snelling, Greenwood, Landfall, and Oak Grove. Billing rates and rate structures were not provided on their websites nor was successful contact made with anyone working for those municipalities.

Both Deephaven and Maplewood purchase their water from two different suppliers. Deephaven receives water from both Minnetonka and Shorewood and Maplewood receives water from St. Paul and North St. Paul. For the purposes of this study, both purchasing municipalities were considered to consist of two municipal utilities. This brings the total number of municipal utilities to 126.

2.2.2 Socioeconomic Data and Zoning Data

Population, land use, and economic data could not be found for Fort Snelling or New Prague. These cities were therefore left out of the socioeconomic portion of the data analysis. It should be noted that New Prague, while located in the Metro area, is not governed by the Metropolitan Council.

2.2.3 Water Consumption and Number of Connections

A detailed analysis of the data contained in the SWUDS database found missing data, errors, and/or discrepancies. Errors that were obvious and easy to fix, such as a decimal point errors associated with volume of water used, were corrected before the analysis was completed. Other data that were clearly in error, but not fixable, were removed from analysis. In other instances, data were missing for entire municipalities.

The following municipal utilities were not included in any water use analysis due to lack of data in the SWUDS database.

- **East Bethel**: No SWUDS data was available for this municipality.
- **Greenfield:** No SWUDS data was available for this municipality.
- **Long Lake**: No SWUDS data was available for this municipality.
- **Marine on St Croix**: No SWUDS data was available for this municipality.
- **New Trier**: No SWUDS data was available for this municipality.
- **Oak Grove**: No SWUDS data was available for this municipality.
- **Randolph**: No SWUDS data was available for this municipality.

The following municipal utilities were included in the analysis but with limited data from the SWUDS database:

Monthly Use

- **Bayport**: Only a few reporting years had data on the number of residential connections; therefore, the averages are based upon limited data.

Number of Connections and Volumes

- **Columbus**: The data table did not contain residential water use data, only the population served and volume of water appropriated. No residential gallons per capita day (GPCD) was calculated.
- **Dayton**: The data table did not contain residential water use data, only the population served and volume of water appropriated. No residential gallons per capita day (GPCD) was calculated.
- **Hamburg**: The data table did not contain residential water use data, only the population served and volume of water appropriated. No residential gallons per capita day (GPCD) was calculated.
- **Minnetrista**: There were data issues associated with 2008 and 2010. These years were not used.
- **New Prague**: There were no obvious errors in the Monthly Water Use Data; however, the City of New Prague did not provide Population and Land Use Data to the DNR SWUDS database. Per capita water consumption could be calculated. It should be noted that New Prague is not in the area governed by the Metropolitan Council.
- **Orono**: The population data was missing for most of the years meaning only a limited number of years was used.

Some municipalities purchase their water from other municipal utilities. In these situations there was no information available for the purchaser in the SWUDS database because when one municipality purchases their water from another municipality, the amount of water used and number of connections for the purchasing municipality is contained within the seller's permit number and cannot be separated out. Those municipalities that purchase water are listed below:

- **Arden Hills**: Purchases water from St. Paul.
- **Birchwood Village**: Purchases water from White Bear Lake.
- **Columbia Heights**: Purchases water from Minneapolis.
- **Crystal**: Purchases water from Minneapolis.
- **Deephaven**: Purchases water from Minnetonka and Shorewood.
- **Falcon Heights**: Purchases water from St. Paul.
- **Fort Snelling**: Purchases water from Minneapolis.
- **Golden Valley**: Purchases water from Minneapolis.
- **Greenwood**: Purchases water from Excelsior.
- **Hilltop**: Purchases water from Minneapolis.
- **Lake St. Croix Beach**: Purchases water from Lakeland.
- **Lakeland Shores**: Purchases water from Lakeland.

- **Landfall**: Purchases water from Oakdale.
- **Lauderdale**: Purchases water from St. Paul.
- **Lilydale**: Purchases water from St. Paul.
- **Little Canada**: Purchases water from St. Paul.
- **Maplewood**: Purchases water from North St. Paul and St. Paul.
- **Mendota**: Purchases water from St. Paul.
- **Mendota Heights**: Purchases water from St. Paul.
- **New Hope**: Purchases water from Minneapolis.
- **North Oaks**: Purchases water from White Bear Township.
- **Osseo**: Purchases water from Maple Grove.
- **Roseville**: Purchases water from St. Paul.
- **Sunfish Lake**: Purchases water from St. Paul.
- **West St. Paul**: Purchases water from St. Paul.
- **Willernie**: Purchases water from Mahtomedi.
- **Woodland**: Purchases water from Minnetonka.

2.3 Summary

Data from a total of 186 municipalities were reviewed in this analysis. In summary, this analysis is based on the following number of Metro area municipalities, as detailed in Table 2-2.

Table 2-2. Total Number of Municipal Water Utilities in the Metro Area

Type of Municipality	Count
Stand-alone municipal water utilities	90
Municipal water utilities that sell water to other utilities	11
Municipal water utilities that purchase water from others [a]	27
Municipalities with no municipal water system	58
Total number of municipalities	186

[a] Deephaven and Maplewood each purchase water from two separate municipal utilities. For this reason, each of these municipalities is evaluated as two municipalities in the analysis of rate structures.

Section 3
Description of Database

A database used for this study was created and edited in Microsoft Excel 2010 (Excel) and then transferred into Microsoft Access 2010 (Access). Access was chosen as the final program because the Metropolitan Council stated it was their preferred database structure. The complete database is being provided to the Metropolitan Council in a separate electronic file.

3.1 Organization of the Database

The database is organized into four different sub-databases. These sub-databases are listed below and are described in more detail in the following sections. Note that each database is from a single data source.

- **Sub-database 1**: Rates and Rate Structures.
- **Sub-database 2**: Socioeconomic Data.
- **Sub-database 3**: Number of Connections and Volumes.
- **Sub-database 4**: Monthly Use.

3.1.1 Rates and Rate Structures

The rates and rate structures sub-database includes information about the current (2014) water utility rates and rate structures for each of the municipal utilities. As stated previously, this data came from either the municipality's website or through direct contact with the utility itself. The specific information covered in this sub-database is described in Table 3-1 . An example for the fictitious town of Water City, MN can be found in Table B-1 of Appendix B.

Table 3-1. Data Contained in Rate Structure Database

Rate Structure Data Label	Description
CTU ID	The ID given to each municipality by the Minnesota Geospatial Information Office. This ID is the best common field between the different sub-databases and is the field that allows the data in each sub-database to be linked together. The ID also allows the data to be mapped onto a GIS map.
Utility	The name of the municipality.
Month and Year	The month and year the current water utility rates were adopted in each of the municipal utilities.
Customer Class	Identifies how the customer classes are defined for billing purposes. A blank, or "—"means that the municipality has no municipal water system. "All" means that the utility does not charge different rates for customer classes such as building type or land use, meter size, or any other method (i.e., everyone is charged using the same billing rate structure). "Building Type" means that different customer classes are charged based on either building type or land use (e.g., residential and industrial). "Meter Size" means that the applicable billing rate structure is determined by the size of water meter installed at the property.

Rate Structure Data Label	Description
Customer Sub-class	Further identifies the specific category of customer class. Land use typically includes, but is not limited to, residential, commercial, industrial, and institutional. Meter size typically includes ¾-inch, 1-inch, and larger. A full listing of all types of customer subsectors can be found in Appendix C.
Frequency	The billing cycle. Billing usually occurred either monthly or quarterly; however, there were a few instances of a bi-monthly billing cycle.
Rate Structure	How the billing rate structure was constructed. The structures are either flat, increasing, or seasonal. "Flat" indicates a flat rate meaning that the customer is charged the same amount no matter the volume used or the time of year. "Increasing" indicates an increasing tiered rate structure, also known as an increasing block rate structure. With this rate structure, the unit price of the water increases as the volume of water used increases, with the prices being set per tier. The first tier is charged one rate, the second tier is charged a higher rate, the third at an even higher rate, and so on. "Seasonal" indicates that the rates are based on the season. The user is charged one rate during the winter months, and another, usually higher rate, in the summer months. Municipal utilities sometimes use different billing rate structures when billing different customer classes. For example, a residential customer may be charged using one billing rate structure while a commercial customer may be charged using another.
Tiers	The number of "blocks" within each rate structure for a given customer sector.
Units	The billing units, typically 1,000 gallons or 100 cubic feet.
Description of "Units"	Description of units when the municipality simply identified the billed volume as units.
Base Charge Amount	The amount a customer was charged just for having a connection.
Basis	Additional information about the base charge.
Amount ($) for a ¾" Meter	The base charge for a ¾" meter. This was used when the base charged varied with meter size as a way to have an equal base rate comparison.
Monthly Minimum	The minimum charge per month. In most situations a municipality charged either a base charge or a monthly minimum, but not both; however, this was not always the case.
Description	A description of what was contained within the monthly minimum charge.
Testing Fee	Fees related to the Minnesota Department of Health testing of public water supplies.
1st Tier ($/unit) through 9th Tier ($/unit)	The cost of water per unit (rate) in each of the tiers, up to 9 tiers.
Units in 1st Tier through Units in 9th Tier	The volume range of water in each of the tiers, up to 9 tiers.
Surcharge $/Unit	Price of the surcharge, if any, that the municipality charged.
Surcharge Description	A description of the surcharge.
Comments	Any additional information that did not fit under any of the previous column headings.

3.1.2 Socioeconomic Data

The Socioeconomic Data sub-database contains information on the social and economic profile of the municipalities. Note again that this is data regarding the municipality and not the utility. It also contains information about the area, in acres, of each land use classification within the municipality. As stated previously, this data comes from the Metropolitan Council's website. The specific information contained in the sub-database is described in Table 3-2 below. An example for the fictitious town of Water City, MN can be found in Table B-2 in Appendix B.

Table 3-2. Data Contained in Socioeconomic Database

Socioeconomic Data Label	Description
CTU ID	The ID given to each municipality by the Minnesota Geospatial Information Office. This ID is the best common field between the different sub-databases and is the field that allows the data in each sub-database to be linked together. The ID also allows the data to be mapped onto a GIS map.
City	The name of the municipality.
2010 Population	Population of each municipality in 2010 based on US Census data.
2010 Households	The number of households in each municipality in 2010 based on US Census data.
Number of People Per Household in 2010	The number of people per household in each municipality in 2010 based on US Census data.
Median Household Income 2008-2012 (in $000s)	The median household income (in $000s) in each municipality. The median income was averaged from 2008 to 2012 and was inflation-adjusted to reflect the 2012 dollar.
Per Capita Personal Income (in $000s)	The average per capita personal income (in $000s) per household in each municipality. The average per capita personal income was averaged from 2008 to 2012 and was inflation-adjusted to reflect the 2012 dollar.
Single Family (acres) through Railway (acres)	The number of acres zoned for each land use type listed in the column headings for each municipality.

3.1.3 Number of Connections and Volumes

The Number of Connections and Volumes sub-database contains information on the number of water utility connections per customer class, as well as the volume of water used. As stated previously, this data comes from the DNR SWUDS database. The specific data provided in this sub-database is described in more detail in Table 3-3. An example for the fictitious town of Water City, MN can be found in Table B-3 in Appendix B.

Table 3-3. Data Contained in Connections and Volumes Database

Connections and Volumes Data Label	Description
CTU ID	The ID given to each municipal utility by the Minnesota Geospatial Information Office. This ID is the best common field between the different sub-databases and

Connections and Volumes Data Label	Description
	is the field that allows the data in each sub-database to be linked together. The ID also allows the data to be mapped onto a GIS map.
Permittee Name	The name of the municipal utility.
Year	The reporting year, from 1988 to 2012.
Pop	The population of the municipality for the reporting year as reported in SWUDS database.
Res., Comm., Ind., Ag., Other	The volume of water used by the residential, commercial, industrial, agricultural, and other connections, respectively, of the municipal utility for that reporting year.
Res. Conn, Comm. Conn, Ind. Conn, Ag., Conn., Other Conn	The number of residential, commercial, industrial, agricultural, and other connections, respectively, for each customer class.
Res. Met., Comm. Met., Ind. Met., Ag. Met., Other Met.	The number of residential, commercial, industrial, agricultural, and other meters, respectively, for each customer class.
Tot. Sold	The total volume, in gallons, of water sold by the municipal utility for that reporting year.
Tot. Appr	The total volume of water appropriated by the municipal utility for that reporting year. The difference between the total appropriated and total sold is often due to leaks in the system and situations where water was used but the volume used was not tracked.
Notes	Additional notes.
Max Day Vol	The maximum daily volume that the municipality used during the reporting year.
Max Vol. Date	The date the maximum daily volume was used.

3.1.4 Monthly Use

The Monthly Use sub-database contains information about the total volume of water that the permittee used per month for each year that they reported the data to the DNR in the SWUDS database. The specific information contained in the Monthly Use sub-database is described in more detail below. An example for the fictitious town of Water City, MN can be found in Table B-4 in Appendix B.

Table 3-4. Data Contained in Monthly Use Database

Monthly Use Data Label	Description
CTU ID	The ID given to each municipality by the Minnesota Geospatial Information Office. This ID is the best common field between the different sub-databases and is the field that allows the data in each sub-database to be linked together. The ID also allows the data to be mapped onto a GIS map.
Permittee	The name of the municipal utility.
Resource	The drinking water source. A 1 represents ground water; 2 is a lake; 3 is a stream or river; 4 is a ditch; 5 is a dug pit; 6 is a quarry or gravel pit; and, 7 is a wetland.
Year	The reporting year, from 1988 to 2012.
January – December	The volume of water used, in gallons, per month.
Installation Total	The volume of water used, in gallons, per year.
Use ID	The DNR water appropriation use codes. There are 66 different codes; however, the only one that pertains to this study is 211, which represents Municipal Waterworks.

3.2 Future Updates

Data, as described in Section 1, for all municipalities/municipal utilities have been entered into the Access database, even those that do not currently have a municipal water supply. This was done so that information could be added in the future if those municipalities ever do develop municipal water supply. This will allow the Metropolitan Council to update the database when new information becomes available.

Section 4
Data Analysis

4.1 Description of Terms

Water utilities must charge their customers in order to build, maintain, and improve their water infrastructures. Customers are billed using a specific rate structure which has a specific associated rate, or rates if multiple tiers were used. Within this section the following terms apply:

Customer Class—The way in which a municipal utility classifies its customers. Some utilities do not have any type of distinction between their customers so all customers are billed using the same rate structure. Other utilities may break up their customers into different classes and will use a different rate structure to charge each class. Land use/ building type and meter size are the two ways in which municipal utilities in the Metro area classify their customers.

Rate Structure—The method used by the utility to charge the different customer classes. Rate structures in the Metro area are either flat, increasing, or seasonal.

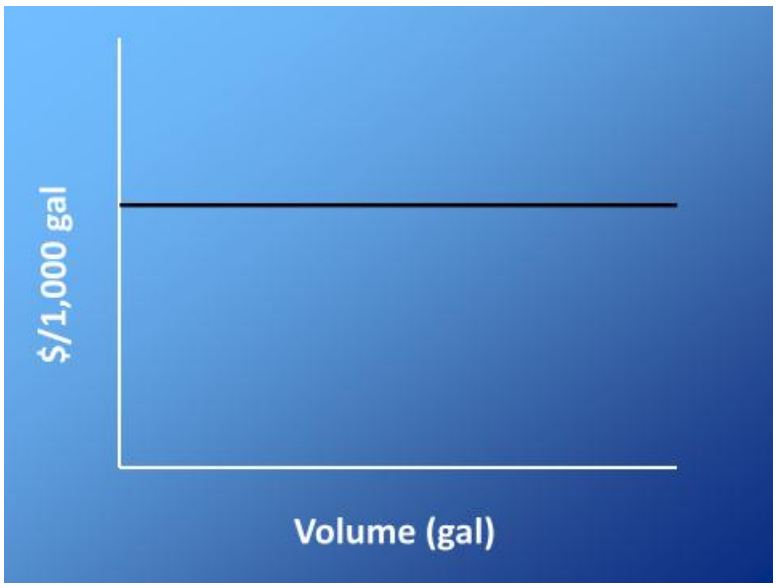
Tiers or Blocks—The volume of water at which a customer is charged a specific rate

Rate—The charge for a unit of water, usually defined as dollars per hundred cubic feet (ccf) or dollars per 1,000 gallons.

4.1.1 Flat Rate Structure

When the structure is a flat rate, the municipal utility has only one volumetric charge per unit of water, meaning they charge their customer class a constant price per unit of water, no matter the volume of water consumed as shown in Figure 4-1.

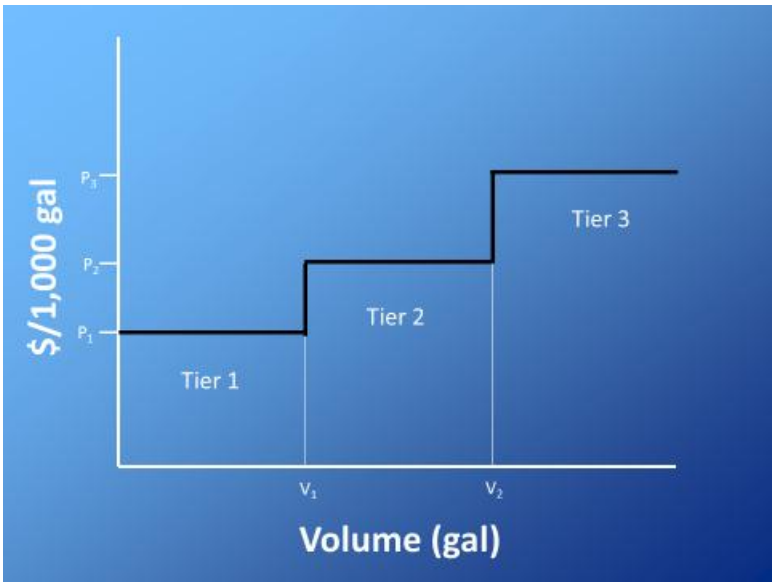
Figure 4-1: Flat (Uniform) Rate Structure



4.1.2 Tiered Rate Structure

Other utilities use multiple volumetric charges within a given rate structure. These multiple volumetric charges are often referred to as tiers or blocks and the resulting structure is referred to as a tiered rate structure. The Metro area uses two types of tiered structure designs. The first is an increasing, or conservation, rate structure. With this type of structure, the rate increases as the volume of water increases. Figure 4-2 provides a schematic of an increasing rate structure. This structure is used to encourage water conservation by charging a customer more when they use more water. In this figure there are three volumetric tiers, each with a different billing rate for the customer class. Usually the first tier is a low volume with average winter use and often a discounted rate, often referred to as the "lifeline" rate. The second tier is usually set to include average volume use (including summer use) with a rate that covers the full cost of service. The third tier, or higher tiers, usually contains higher rates to discourage excessive water use. As discussed below in Section 4.5.5, an increasing tiered rate structure may not be deemed a "conservation" rate structure if the step up in rates from tier to tier does not convey the conservation incentive to the customer and change customer behavior.

Figure 4-2: Increasing Tiered Rate Structure



The second type of tiered rate structure design is a seasonal rate structure (Figure 4-3). With this structure, customers are usually charged one rate in the winter and a second, higher rate during the summer for the same volume of use. This rate structure is used to recover revenues associated with the cost of additional water use during the summer months, and to discourage excessive irrigation practices.

Figure 4-3: Seasonal Tiered Rate Structure

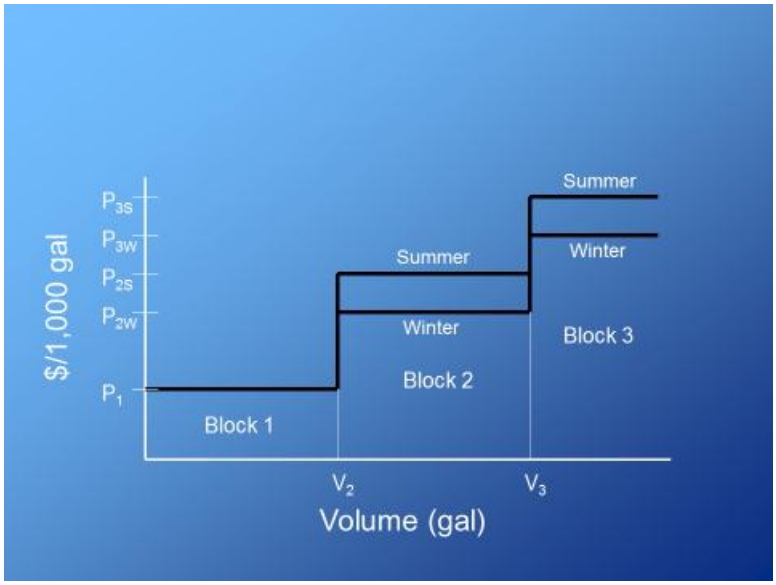
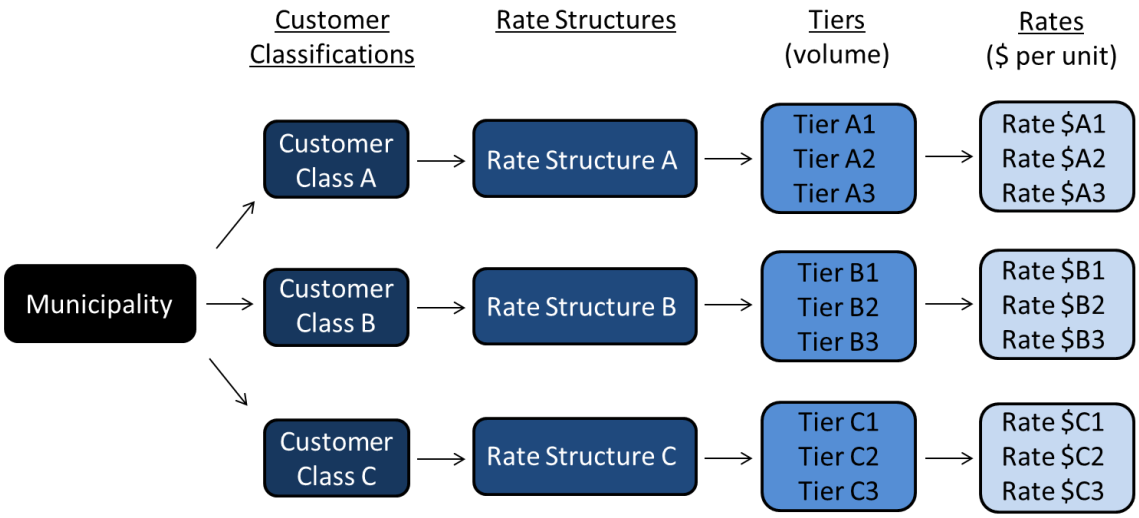


Figure 4-4 shows how these terms relate to each other in regards to how a municipal utility bills its customer.

Figure 4-4: The Relationship between Customer Classifications, Rate Structures, Tiers, and Rates



The above relationship is shown in a slightly different manner in Figure 4-5a, Figure 4-5b, and Figure 4-5c. Each figure shows the water utility billing mechanisms for each of three fictitious municipal utilities, Municipal Utility I, Municipal Utility II, and Municipal Utility III. First, Municipal Utility I is a utility that does not break its customers up into different classes and, therefore, has only a single rate structure for all customers. However, contained within that single rate structure are multiple tiers and, consequently, multiple rates.

Second, Municipal Utility II provides an example of a utility that charges its customers based on meter size (i.e., meter size is the customer class). In this example, Municipal Utility II has four different rate structures, one for customers with a ¾-inch meter, another for customers with a 1-inch meter, yet another for

customers with a 1-½-inch meter, and finally, one rate structure for customers with a 2-inch meter and above. Within each rate structure there are three different tiers which correspond to increasing water use. Therefore, Municipal Utility II has four different rate structures, each with three different tiers. Note that the water volumes that define the breadth of each tier differ across the four rate structures.

Municipal Utility III provides an example of a utility charging their customers based on type of property or building (i.e., type of property or building is the customer class). Municipal Utility III has broken their customers into residential, industrial, and irrigation accounts. Within the residential and industrial accounts, there are two different tiers associated with the volume of water used, as well as different rates charged for these different tiers. The irrigation accounts are charged a flat rate. This means that Municipal Utility III uses three different rate structures, two of which contain two tiers, and one of which uses one tier.

Municipal Utility I

Increasing Rate Structure Description

Municipal Utility I has a single rate structure for all customers consisting of 5 tiers.

Base Charge

$1.50 Administrative charge applied each billing cycle

Table 4-1: Municipal Utility I Volumetric Charge Table

Rate per 1,000 gal	Volume Tier
$1.50	0 to 5,000 gallons
$2.00	5,001 to 10,000 gallons
$2.50	10,001to 15,000 gallons
$3.00	15,001 to 20,000 gallons
$3.50	20,001 and higher gallons

Municipal Utility II

Increasing Rate Structure Description

Municipal Utility II has four different rate structures based on meter size, each with 3 tiers.

Base Charge

$1.50 Administrative charge applied each billing cycle.

Table 4-2: Municipal Utility II Volumetric Charge Table

Meter Size	Volume Tier	Rate per 1,000 gallons
¾-inch	0 to 5,000 gallons	$3.00
¾-inch	5,001 to 15,000 gallons	$3.05
¾-inch	15,001 and higher gallons	$3.20
1-inch	0 to 10,000 gallons	$3.00

Meter Size	Volume Tier	Rate per 1,000 gallons
1-inch	10,001 to 30,000 gallons	$3.05
1-inch	30,000 and higher gallons	$3.20
1½-inch	0 to 22,000 gallons	$3.00
1½-inch	22,001 to 70,000 gallons	$3.05
1½-inch	70,000 and higher gallons	$3.20
2-inch and larger	0 to 50,000 gallons	$3.00
2-inch and larger	50,001 to 100,000 gallons	$3.05
2-inch and larger	100,001 and higher gallons	$3.20

Municipal Utility III

Increasing Rate Structure plus Flat Fee for Irrigation Description

Municipal Utility III has three rate structures based on land use. Two increasing rate structures with two tiers and one flat rate structure.

Base Charge

$1.50 Administrative charge applied each billing cycle.

Table 4-3: Municipal Utility III Volumetric Charge Table

Land Use Category	Volume Tier	Rate per 1,000 gallons
Residential	0 to 15,000 gallons	$1.50
Residential	15,001 and higher gallons	$2.50
Industrial	0 to 30,000 gallons	$2.00
Industrial	30,001 and higher gallons	$3.00
Irrigation	All irrigation systems	$2.30

4.2 Metro Area Rate Structures

4.2.1 Rate Structures

Rate structure data was collected for 126 municipal utilities. Of the 126 municipal utilities, approximately 47 percent (59) have a single rate structure for all customers, and 53 percent (67) separate customers into different billing categories with a separate rate structure for each category. When using different customer classifications, some utilities classify customers according to meter size while others by land use, and apply different rates for each classification. Across the 126 municipal utilities there are a total of 275 rate structures.

Table 4-4: Number of Municipal Utilities by Number of Rate Structures

Number of Rate Structures	Number of Municipal Utilities	Total # of Rate Structures	% of Municipal Utilities
1	59	59	46.8%
2	24	48	19.0%
3	21	63	16.7%
4	14	56	11.1%
5	3	15	2.4%
6	2	12	1.6%
7	2	14	1.6%
8	1	8	0.8%
Total	126	275	100%

A different method of comparison is to compare rate structures and categorize them according to the number of tiers. Table 4-5 shows that 26.2 percent of these rate structures in the Metro area are uniform rates with only one tier. Of those with multiple tiers, most (64.7 percent) have between 2 and 4 tiers. Only 9.2 percent of the rate structures have more than 4 tiers.

Table 4-5: Number of Rate Structures with Multiple Tiers

Tiers	Total # of Rate Structures	%
1	72	26.2%
2	61	22.2%
3	84	30.5%
4	33	12.0%
5	20	7.3%
6	2	0.7%
7	1	0.4%
8	1	0.4%
10	1	0.4%
Total	275	100%

As demonstrated in Figures 4-4 and 4-5, each tier represents a unique billing rate that is charged to a customer. The rate is defined in dollars per unit. In the Metro area, rates range anywhere from $0.89 per 1,000 gallons up to $18.23 per 1,000 gallons (East Bethel 4th block). Rates vary between municipal utilities based upon a number of factors. Treatment of surface water is typically more costly than treatment of groundwater. New infrastructure capital costs are larger than capital costs for older infrastructure. And finally, some rate structures place greater emphasis on the service charge and lesser emphasis on the volumetric charge(s), while some others place lesser emphasis on the service charge and greater emphasis on the volumetric charge(s).

4.2.2 Billing Units and Frequency

Other considerations regarding rate structures include the billing units and the frequency of billing. While most municipal utilities use 1,000 gallons as the unit of volume in their rates, some use 100 cubic feet (100 cubic feet = one CCF = 748 gallons), and some simply identify the billed volume as "units" (Table 4-6).

The frequency of billing indicates how often the customer receives a bill, and varies from monthly to semi-annually (Table 4-7). In the Metro area, most municipal utilities bill customers on a quarterly basis. Some municipal utilities bill different customer classes at different frequencies (i.e., different rate structures are billed at different frequencies). For example, the residential customers may be billed quarterly while the commercial customers are billed monthly. One utility allows the customers to choose between monthly and quarterly billing.

Table 4-6: The Number of Rate Structures Associated with the Billing Units

Billing Frequencies	Rate Structures
1,000 gal	233
100 gal	1
100 cu ft	24
"Units"	17
Total	275

Table 4-7: The Number of Rate Structures Associated with the Frequencies

Billing Frequencies	Rate Structures
Semi-annual	1
Quarterly	146
Bi-monthly	9
Monthly	101
Quart(res)/Month(com)	11
Undetermined	7
Total	275

4.3 Water Use

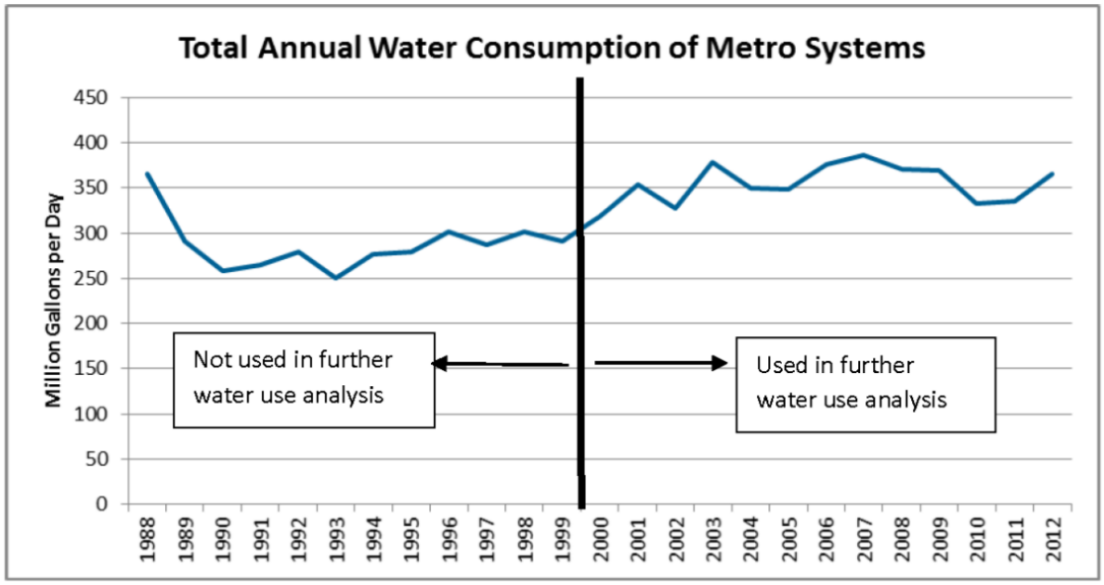
While there are a total of 126 municipal water systems in the Metro area for which data were collected, there are only 94 for which there was sufficient data with regards to total water use data (See Appendix A). There are only 93 municipal utilities for which there is sufficient data to calculate total per capita water use and 91 with sufficient data for residential per capita water use. For most utilities this data is monthly for years 1988 through 2012, as described in Section 3.1.4.

4.3.1 Total Metro Area Water Use

Figure 4-6 shows the change in the total amount of water consumed in the Metro area (i.e., the sum of all municipal utilities) from 1988 to 2012. Overall, water use has increased since the early 1990's but is about

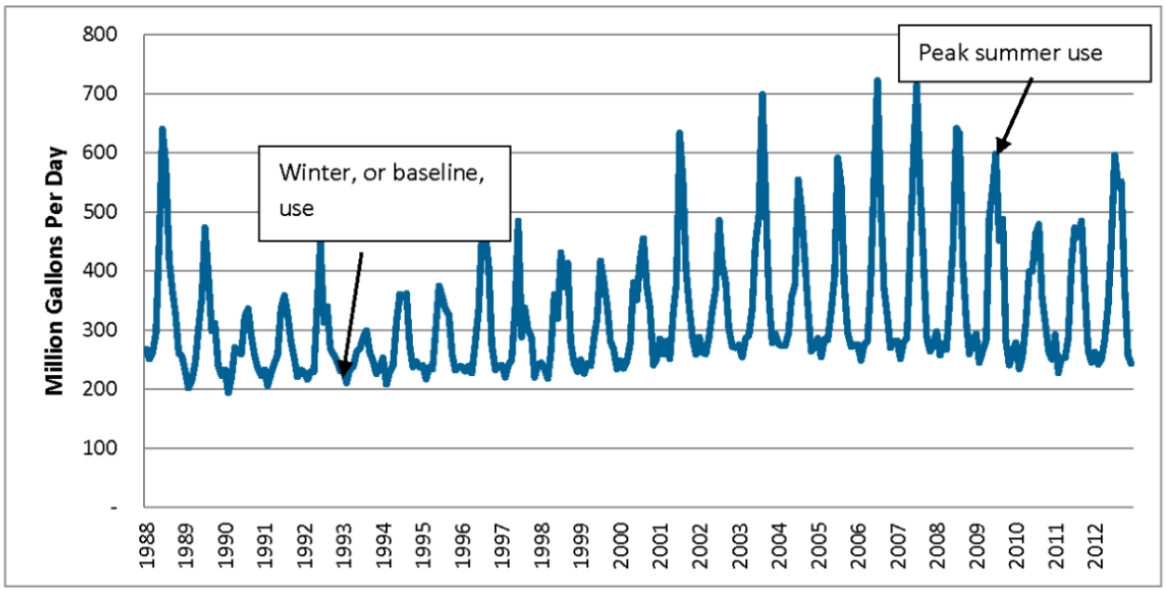
the same level as 1988, which was a drought year (Figure 4-4). Year-to-year changes reflect growth, economic conditions, and the effects of drought.

Figure 4-6: Total Annual Water Consumption in the Metro Area from 1988 to 2012



In general, household water use tends to vary with the seasons, with the lows occurring in the winter months and the highs, or peaks, occurring during the summer months. Winter months use generally contains the baseline (non-seasonal) water use. This includes water used for showering, flushing the toilet, laundry, washing dishes, etc. It does not include water used for irrigation. The peaks in summer water use on the other hand are likely correlated with weather due to irrigation and cooling water demands. Years with less summer peaking are likely correlated with cooler/wetter summers. As Figure 4-7 shows, the monthly water patterns for the entire Metro area follow this distinct seasonality of water use. The increase in the winter/baseline water use from about 2003 to 2008 is likely due to increased growth in number of customers and increasing affluence, while the subsequent drop in the winter/base water use post-2008 is likely due to the recession. The variation in the summer peak use is due to summer weather conditions; however, the taller summer spikes (in the presumably hot/dry summers) starting about 2001 may be due to increasing lot sizes in newer housing and the prevalence of automatic irrigation systems. The water use patterns prior to about 2000 probably reflect smaller lot sizes, less irrigation systems, and older water use fixtures and thus are deemed to not be representative of current water use patterns. The data from 2000 forward are more representative of current household characteristics, fixtures, and water use patterns.

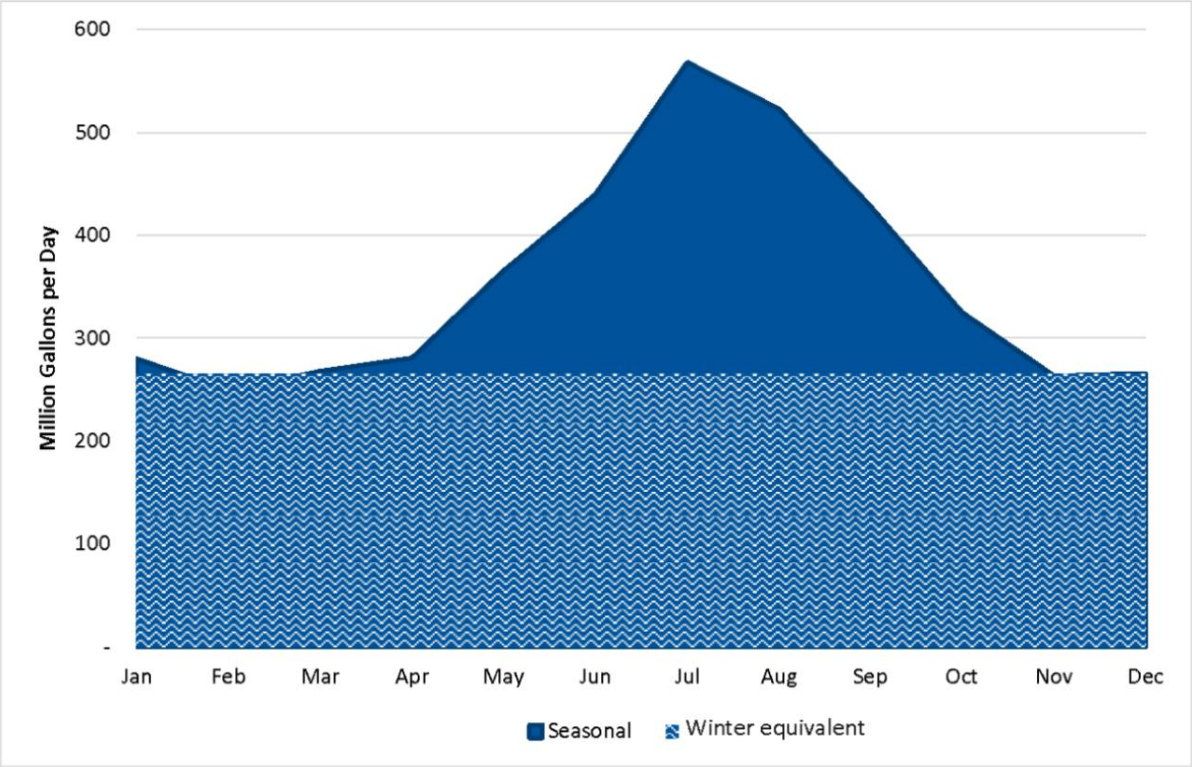
Figure 4-7: Total Monthly Water Consumption of the Metro Area from 1988 to 2012



From this point on, water use data from 2000 to 2012 is used in the analysis. This is because the data from 2000 to 2012 is deemed the most reflective of current conditions.

Looking more closely at the variations between summer and winter use, the average peak demand occurs in July and is approximately twice the winter use (Figure 4-8). Specifically, the average winter use from 2000 to 2012 was 265 MGD while the average use in July was 568 MGD. Again, the most likely cause of this increase is irrigation and other outdoor water use.

Figure 4-8: Average Monthly Water Consumption from 2000-2012



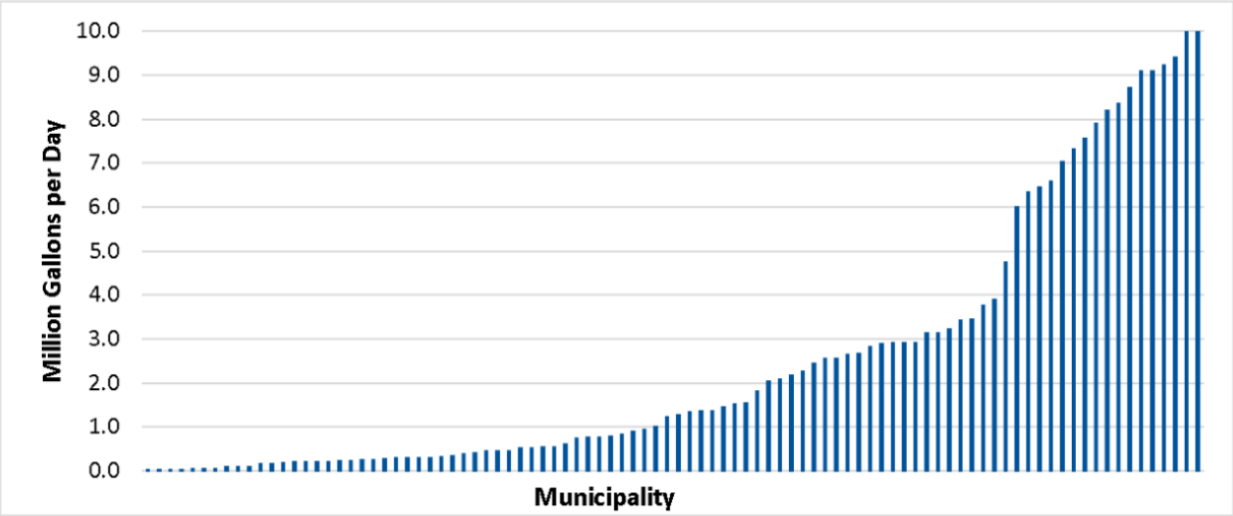
4.3.2 Individual Municipal Water Use

Until this point the water use for all the municipalities has been considered together. While this gives a good understanding of the overall water use in the Metro area, it does not consider how water use may differ **between** the municipalities. In this section, water use is broken up by utility and the results are compared to each other.

Individual Municipal Water Use Analysis

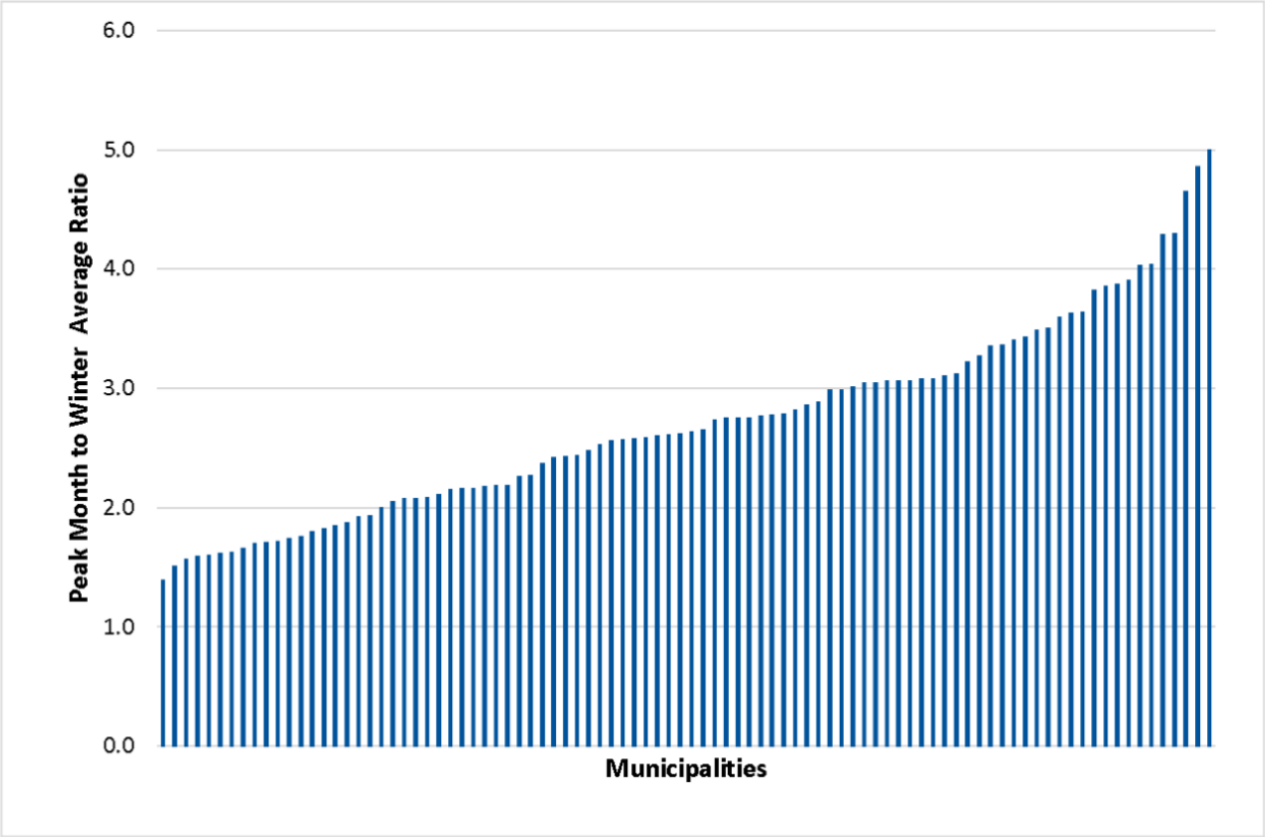
Figure 4-9 breaks out the average annual water use by individual municipality to show the variations between the different communities. Of the 94 municipal water systems in the Metro area for which sufficient data are available, two cities (Minneapolis and St. Paul) averaged more than 60 MGD. These two systems are not shown in Figure 4-9 as they would distort the vertical scale. These two cities have large water use in part because they are larger cities, but also because their water volumes include the water sold to their wholesale customers. Almost half of the municipal water systems (48 percent) used less than 1 MGD, 34 percent used between 1 and 5 MGD, and 16 percent used between 5 and 10 MGD. The remaining 2 percent use more than 60 MGD.

Figure 4-9: Annual Average Daily Volume (2000-2012) by Municipality



The monthly use database described in Section 3.1.4 was used to determine the peak month water consumption for each utility for each year of data available. That volume of water was then compared to the winter average month consumption for that same municipality/year and a ratio between the two for each year was found. Finally, the peak month to winter average ratio was averaged across multiple years (2000 to 2012) for each utility. The resulting average peak month to winter average ratio for each municipality is illustrated in Figure 4-10. In this analysis, the higher the ratio, the greater the difference between summer and average winter water use. For example, a ratio of two means that the summer water use was twice the amount as the winter water use. The peak month to winter average ratios range from 1.40 (New Brighton) up to 5.00 (Andover) with a Metro area average of 2.71.

Figure 4-10: Average Peak Month to Winter Average (2000-2012) by Municipality



Per Capita Individual Municipal Water Use Analysis

While average annual water use calculations indicate how much water a municipality is using, it does not take into account the population of the municipality. Municipalities might have higher use because of the individual water use practices of their customers, or they may have higher water use simply because they have a greater population. It is, therefore, important to consider the per capita use.

Data for total annual water use, residential annual water use, population, and number of residential connections from the DNR Number of Connections and Volumes database were used to derive the total per capita water use (Total GPCD), residential per capita water use (Res GPCD) and residential per connection (i.e., household) water use (Residential gallons per day [Res GPD]) for each municipal water supplier. The data from 2000 to 2012 were used to calculate these water use metrics. Total GPCD water use is the average amount of water used per day between all the different types of customer classes. As stated previously in Section 3.1.1, the types of customers in the SWUDS database consist of residential, commercial, industrial, agricultural, and other users. Total GPCD was calculated for 93 municipalities. Residential GPCD is the average amount of water that each individual resident used each day. It is based on the population value given for each municipality and reported residential metered consumption. Residential GPD is the average amount of water a residential household used each day. The value is based on residential metered consumption and the number of residential connections, and does not take into account the number of people in the household. Both Residential GPCD and Residential GPD were calculated for 91 municipalities. The ranges and average values are shown in Table 4-8. Values for "Total GPCD" are derived from reported "total appropriated" volume, which is the total water pumped volume,

not the total volume sold. The “Res GPCD” and “Res GPD” values are derived from metered residential volume (i.e., residential volume sold).

For comparison, similar data from a CDM Smith database of total municipal water use with data from eight states is included in Table 4-8. This data ranges from a small Midwestern rural water district in Oklahoma where some residents have private wells up to an affluent resort town (Aspen, CO) where most water users are visitors. However 80 percent of the systems represented in this database are between 70 and 311 GPCD. These values are derived from total volume pumped.

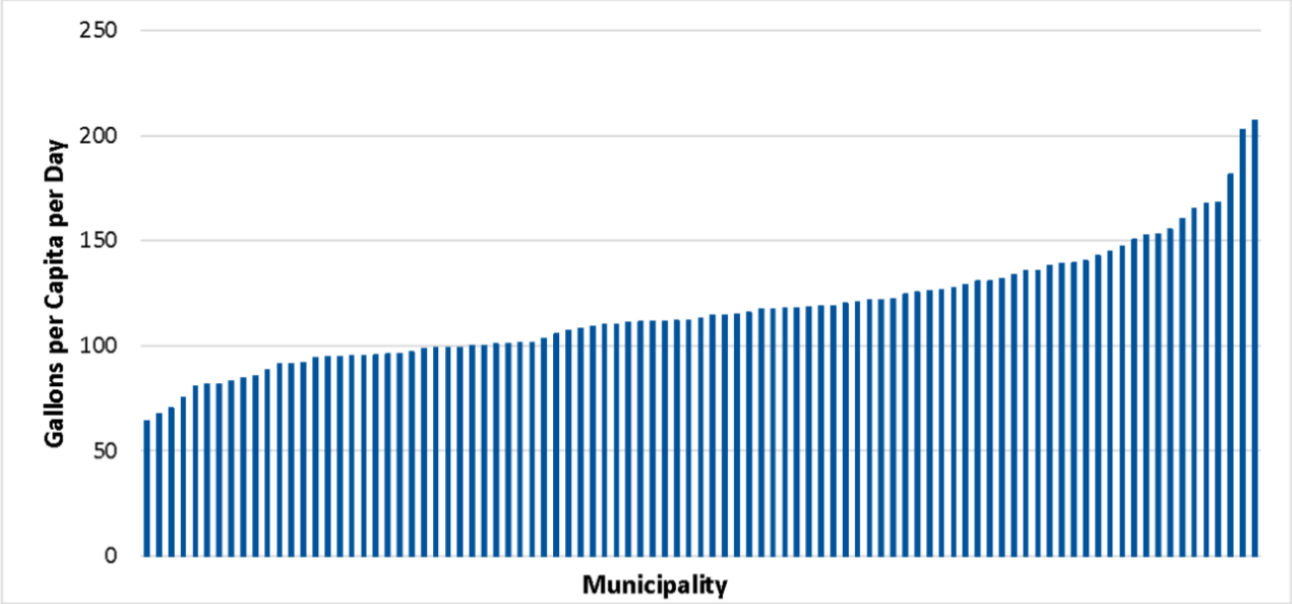
Table 4-8: Range of Water Use Metrics for 2000-2012

Statistical Value	Total GPCD	CDM Smith Sample Total GPCD	Residential GPCD	Residential GPD
Number	93	704	91	91
Max	207.1	1,851	148.4	493.8
Average	116.5	177.3	80.4	270.6
Median	113.2	145.4	78.5	271.9
Min	64.2	62.6	41.0	158.0

As shown in the table above, the per capita water use for total municipal water use (i.e., all the customer classes) ranges from a low of 64 GPCD in Lakeland up to a high of 207 GPCD in Wayzata. Water use per capita varies from city to city due to the mix of residential, commercial, and industrial customers; lot size, affluence, and social norms; conservation efforts; and, water rates. In some instances, the geography of the water system service area may not align with the geography of the municipal census boundaries resulting in a mismatch of data and a distortion of the per capita calculations.

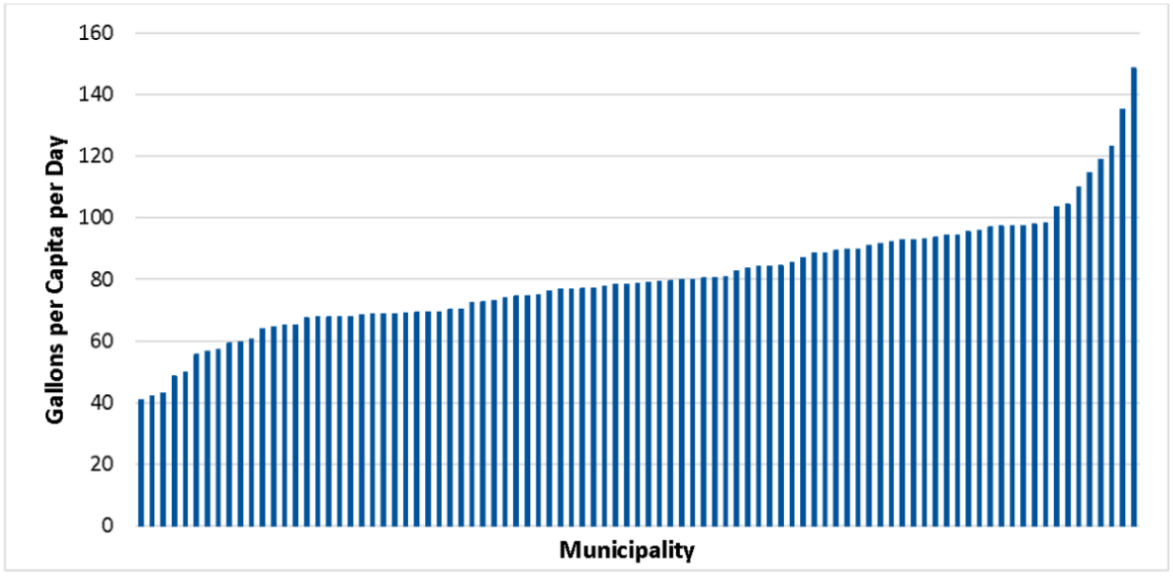
The distribution of the municipal total per capita values for the 93 municipalities is shown in Figure 4-11. Most of the municipalities are between 100 and 150 GPCD, with 10 above 150 GPCD and 29 below 100 GPCD.

Figure 4-11: Average Daily Water Use per Capita per Municipality



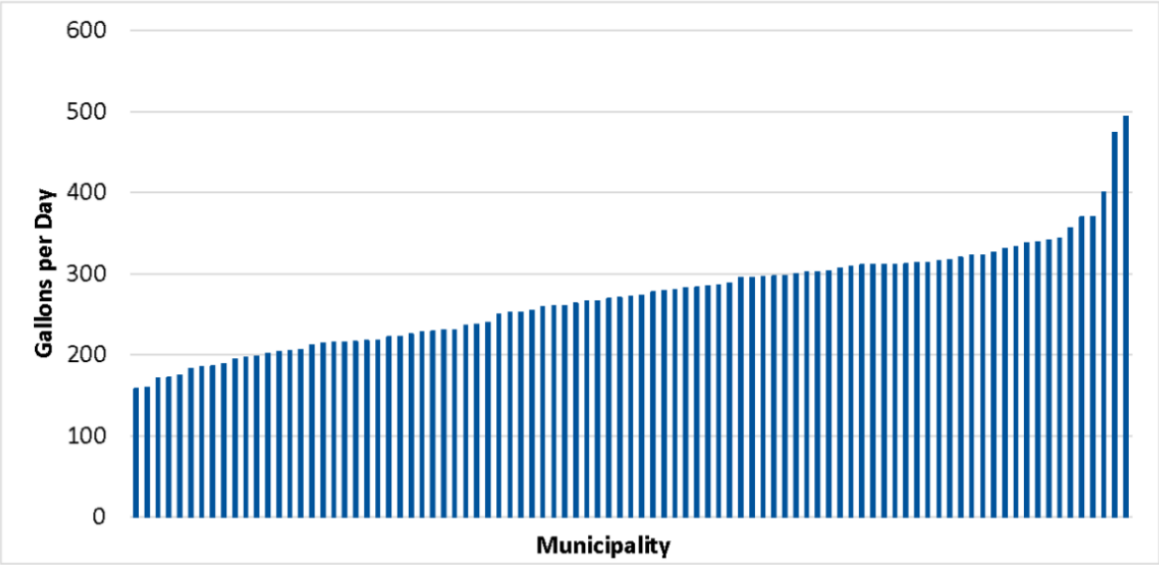
The same analysis was completed for the residential water use, only. The per capita water use for **residential** water use ranges from a low of 41 GPCD in Bayport up to a high of 148 GPCD in Wayzata. Most of the municipalities (80.2 percent) have average residential per capita values between 60 GPCD and 100 GPCD. The average daily residential per capita use for each of the municipalities is shown in Figure 4-12.

Figure 4-12: Average Daily Residential Water Use per Capita



A third analysis was completed to determine the residential water use per connection. The residential water use **per connection** (i.e., per household) in gallons per day (GPD) ranges from a low of 158 GPD in New Germany up to a high of 494 GPD in Wayzata. Most of the water use per residential connection is between 200 GPD and 350 GPD (Figure 4-13).

Figure 4-13: Average Daily Residential Water Use per Connection (Household)



4.4 Municipal Characteristics

Socioeconomic data was obtained for 126 municipalities in the Metro area. The 2010 population of the cities ranges from 112 (New Trier) up to 382,578 (Minneapolis), with a median population of 9,052. The low median population is a reflection of the large number of smaller communities represented in the data. This corresponds with the large number of municipal systems reported in the prior section that have low volumes of water use. The 2010 US Census number of persons per household ranges from 1.7 up to 3.3 with an average of 2.6 persons per household. The median household income (averaged across years 2008 to 2012 for each municipality) ranges from $23,400 up to $151,900, with a median across municipal utilities of $72,400.

Data was obtained on the zoning areas of each municipality. The percent of area within the municipality that is residential (excluding all open water areas from the total) was calculated. The percent of land area that is zoned residential ranges from 4 percent up to 90 percent with an average of 43 percent.

4.5 Relationships of Rates, Water Use and Municipal Characteristics

4.5.1 Equivalent Water Bills

A separate analysis of the municipal water use and rate data was conducted in order to compare rates across municipal utilities. This was achieved by comparing a hypothetical water bill from each municipal utility for customers assuming they were using the same volume of water in each community. In order to make this comparison between the municipal utilities, each utility had to be represented by only one rate structure. This allows for an equal comparison across rate structures. Among municipal utilities with more than one rate structure, the rates for single-family, residential, or smallest meter size (i.e., ¾" or 5/8") were selected for use in this analysis.

Among the 126 municipal utility rate structures used in the comparison, 105 (83 percent) bill in gallons ($ per 1,000 gallons) and 21 (17 percent) bill in cubic feet ($ per 100 cf, ccf, or "unit"). Similarly, 66 percent bill quarterly, 30 percent bill monthly, and 5 percent bill bi-monthly. Furthermore, 33 (26 percent) of these

municipal utilities have a single (uniform) rate while 93 (74 percent) have tiered rates. The distribution of rates by these characteristics is summarized in Table 4-9.

Table 4-9: Billing Characteristics for Rate Comparison

Units	Tiers	Monthly	Bi-monthly	Quarterly	Total
Gallons	Uniform	10	0	8	18
Gallons	Tiers	25	6	56	87
CCF	Uniform	2	0	13	15
CCF	Tiers	1	0	5	6
Units	Total	38	6	82	126

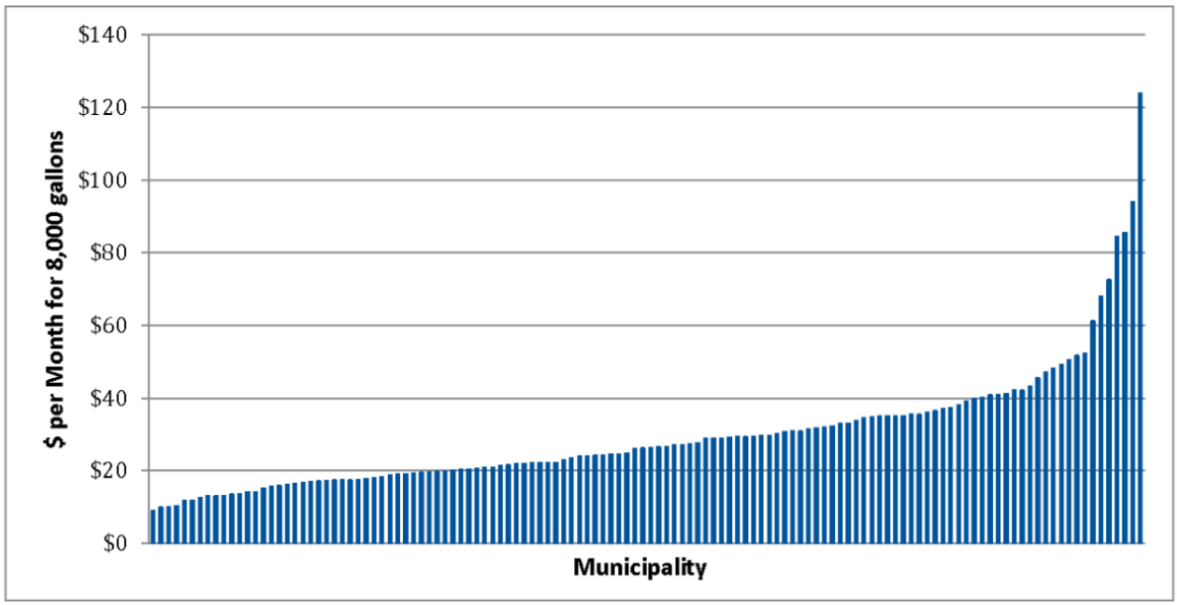
For each of these municipal utilities, a hypothetical water bill was calculated assuming a monthly water use of 8,000 gallons per month (or 1,070 cubic feet). As noted above in Table 4-8, the average Metro area residential household uses about 270 gallons per day, or about 8,200 gallons per month. Thus 8,000 gallons per month is assumed to represent average residential water use in the Metro area. Quarterly and bi-monthly bills were converted to equivalent monthly bills for purposes of comparison. If rates are differentiated between inside and outside the city limits, the inside city limits rate was selected. If rates are differentiated between winter and summer, the summer rate was selected.

The hypothetical converted monthly water bills ranged from $8.60 (White Bear Lake) up to $123.91 (East Bethel) with an average of almost $30 and a median value of almost $25. Half of the hypothetical bills were between $19 and $36 per month. The range of equivalent monthly bills is summarized in Table 4-10 and illustrated in Figure 4-14.

Table 4-10: Equivalent Monthly Bills based on 8,000 Gallons per Month

Statistical Value	Equivalent Monthly Bill
Maximum	$123.91
75th %	$35.13
Average	$29.10
Median	$24.69
25th %	$19.08
Minimum	$8.60

Figure 4-14: Equivalent Monthly Bills based on 8,000 Gallons per Month



One important question is which tier the average volume of water consumed per month (8,000 gallons) falls within for each rate structure. As noted above, some of these structures are uniform rate structures with a single rate regardless of the volume used. Thus, the monthly bill calculated for those rate structures is based upon the uniform rate multiplied by 8,000 gallons of water assumed to be used in one month. Of the 93 municipal utilities with tiered rate structures, the hypothetical volume of 8,000 gallons per month fell into the second tier for most (55 percent) of these rates. Since the 8,000 gallon per month volume is representative of average water use, one would expect this volume to fall into the second tier of a tiered rate structure. However, for 31 percent of the tiered rates the hypothetical average volume was in the first tier, and for 14 percent of the tiered rates the hypothetical average volume fell in the third tier (Table 4-11).

Note that a standard rate structure for tiered rates, such as that described by AWWA (M1 – Principles of Water Rates, Fees, and Charges, Chapter 4) should reflect the increasing cost of service as one moves from base capacity (e.g., winter demand) up to peak demand. Thus, the first block is often based upon average winter demand, the second block might reflect average summer demand, and higher blocks reflecting excessive use. If the first block were designed based upon the winter demand, then the 8,000 gallon per month usage assumed to represent average annual (i.e., including both winter and summer use) would likely fall in the second block.

Table 4-11: Tier in which 8,000 gallons per Month is Charged

Location of 8,000 gallons in Rate Structure	Number with tiered rate structures	% with tiered rate structures
Uniform	33	NA
First tier	29	31%
Second tier	51	55%
Third tier	13	14%

Location of 8,000 gallons in Rate Structure	Number with tiered rate structures	% with tiered rate structures
Total	126	100%

Of the 33 uniform rates, the billing rates ranged from $1.00 to $8.45 per 1,000 gallons, with an average rate of $3.69 per 1,000 gallons. Water bills ranged from $11.90 to $85.60 per month and averaged $32.95.

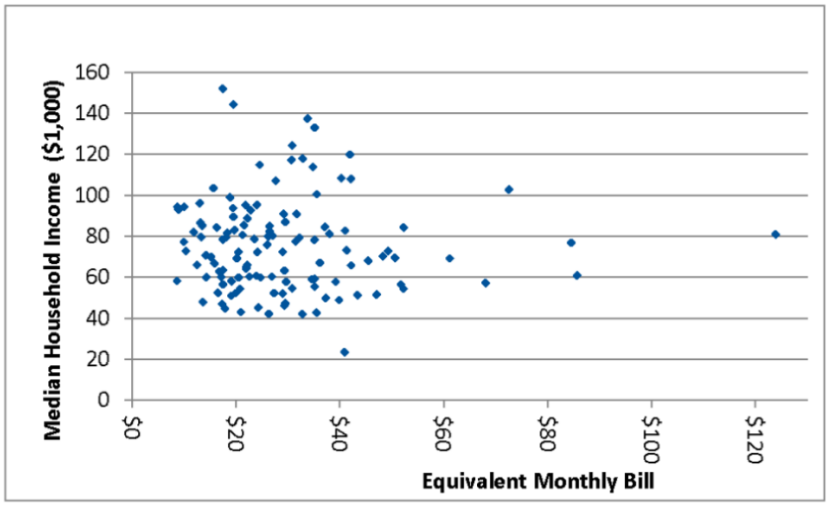
Of those rates in which 8,000 gallons per month remained in the first of multiple tiers, the billing rates ranged from $0.89 to $4.97 per 1,000 gallons, with an average of $2.50 per 1,000 gallons. Water bills for this group ranged from $8.90 to $48.28 per month and averaged $25.16.

Of those rates in which 8,000 gallons per month is in the second tier, the billing rates ranged from $0.88 to $7.00 per 1,000 gallons, with an average of $2.73 per 1,000 gallons. Water bills for this group ranged from $8.69 to $84.53 per month and averaged $25.83.

Of those rates in which 8,000 gallons per month is in the third tier, the billing rates ranged from $1.02 to $15.26 per 1,000 gallons, with an average of $4.84 per 1,000 gallons. Water bills for this group ranged from $8.60 to $123.91 per month and averaged $37.76.

The equivalent monthly water bill calculated for each municipality based upon 8,000 gallons per month was compared to the median household income for each municipality as shown in Figure 4-15. This was done to determine if there was a correlation between the income of the municipality and the monthly water bill. The general pattern suggests no correlation between the monthly water bill and income, although the data on the far right of Figure 4-15 represent higher water bills in moderate income communities. This is could be a function of infrastructure costs and upgrades in these communities.

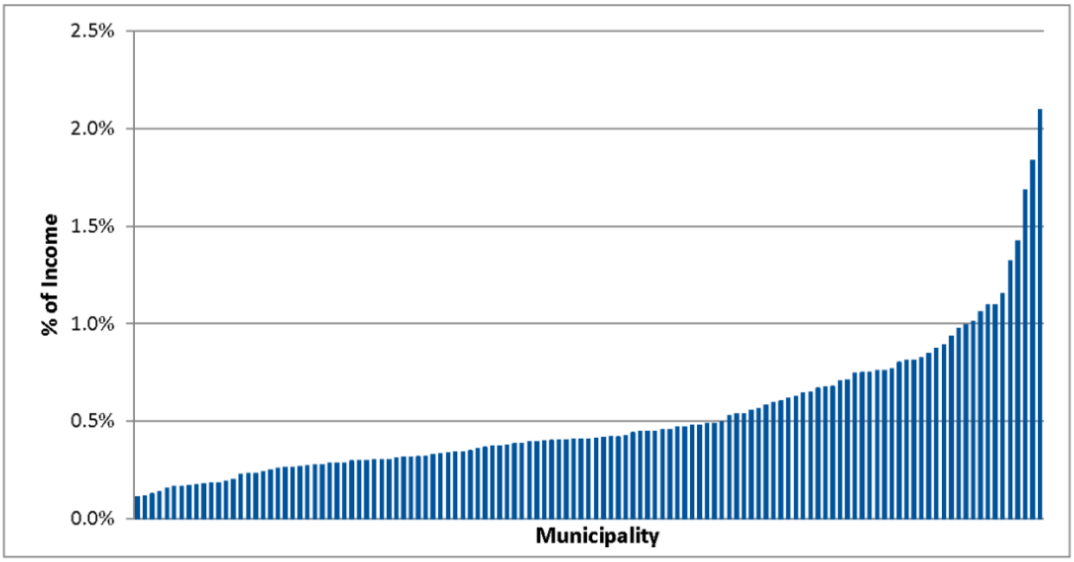
Figure 4-15: Equivalent Monthly Bills Compared to Median Household Income



The equivalent monthly water bill calculated for each municipality based upon the hypothetical average of 8,000 gallons per month use was multiplied by 12 to approximate an annual expenditure. This annual water bill was compared to the median household income for each municipality. The annual water bill as a

percent of median household income was calculated for each municipality as a representation of the affordability of water in each community. The annual water bill as a percent of income ranged from 0.11 percent (Woodbury) up to 2.1 percent (Hilltop) as shown in Figure 4-16, with an average of 0.52 percent. Most of the communities with higher percentages are smaller communities with high infrastructure costs, while those with lower percentages are higher income communities.

Figure 4-16: Annual Water Bill as Percent of Income

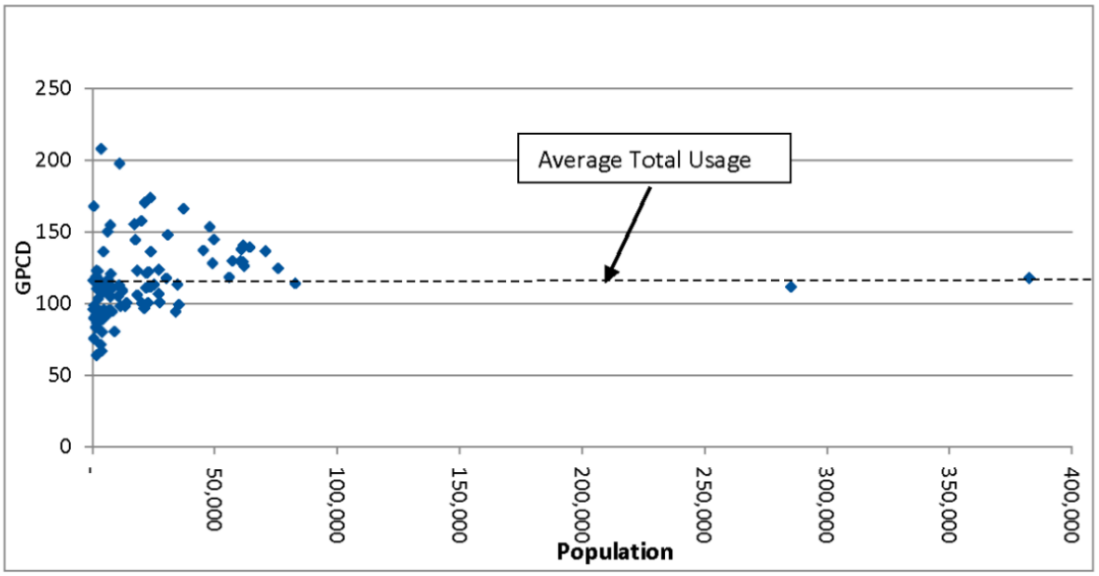


4.5.2 Factors Affecting Per Capita Water Use

As discussed in Section 4.2.2, the monthly water use, population and number of connections from 2000 to 2012 was used to derive the average total water use per capita, average residential water use per capita, and average residential water use per connection (assumed to be equivalent to water use per household).

The **total** water use per capita, which includes water use by all sectors shows a common relationship with population (Figure 4-17). Note that in Figure 4-17, the per capita water use value is the 2000 to 2012 average for each municipality, which is compared with the municipality's 2010 population. As shown in the figure, there is a wide range of per capita use in the towns with smaller populations. This is common in smaller towns because the influence of one or two large water users (such as an industrial customer) can skew the per capita water metric. As municipal utilities increase in population size, the influence of a few large users diminishes and the per capita metric converges close to the Metro average.

Figure 4-17: Per Capita Water Use versus Population for the Utilities



The total water use per capita was compared with the number of rate structures (as discussed in Section 4.1) to determine if the number of rate structures that a municipality implemented had any influence on the amount of water that people were using. No significant pattern was found between the municipal per capita water use and the number of rate structures offered by the municipality (Figure 4-18). Similarly, no significant pattern was found between the municipal per capita water use and the number of tiers within the rate structure (Figure 4-19).

Figure 4-18: Per Capita Water Use versus the Number of Rate Structures

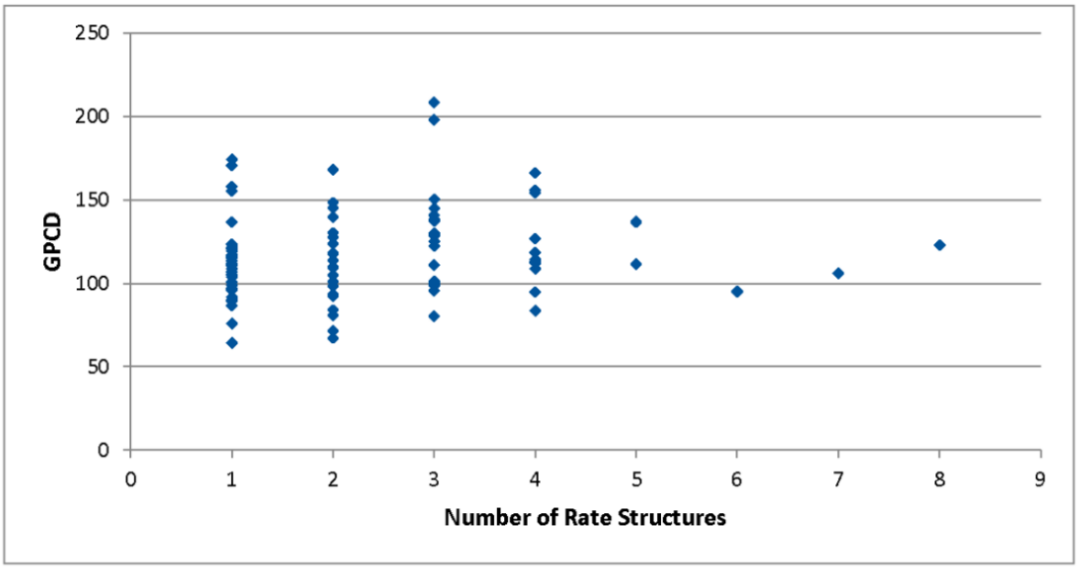
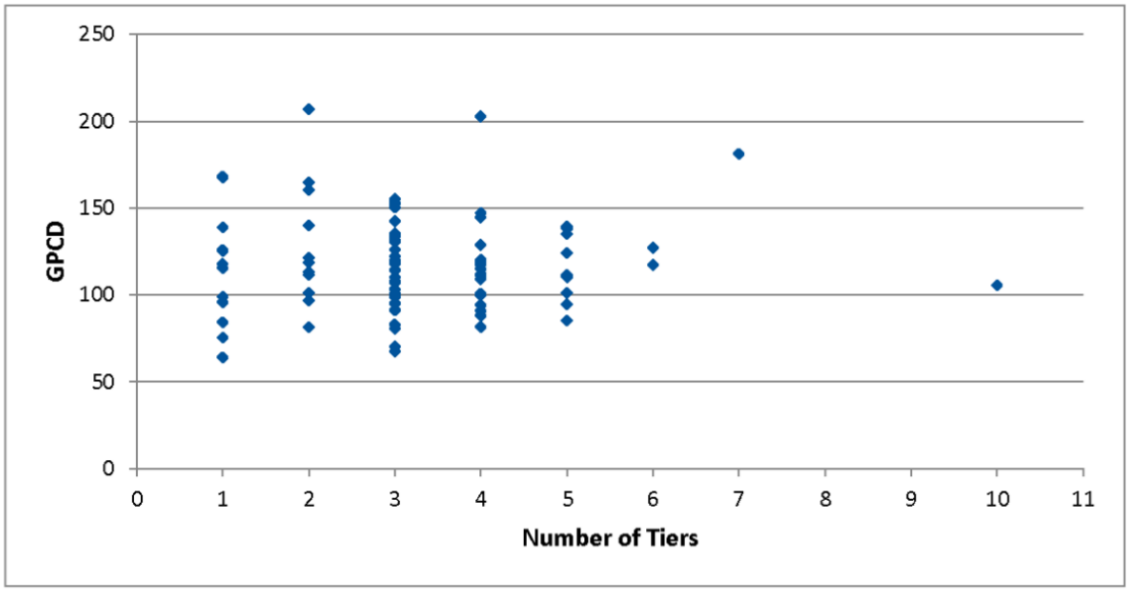
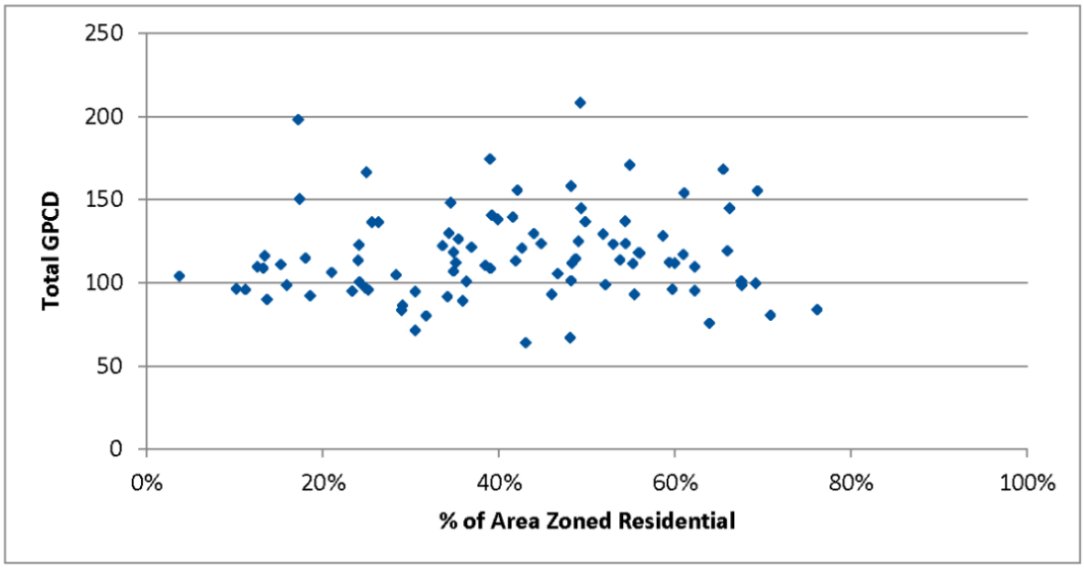


Figure 4-19: Per Capita Water Use versus the Number of Tiers



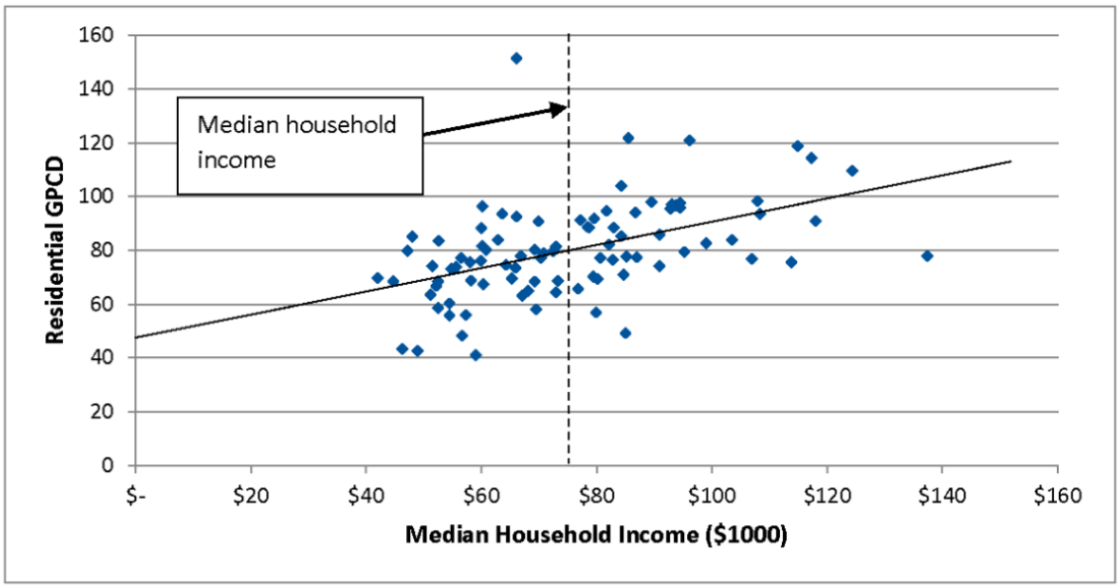
The total water use per capita was compared with the percent of municipal land area that is zoned residential (Figure 4-20). Again, no significant pattern was found between the municipal per capita water use and the percent residential area. Comparison of the percent of land residential with the municipal average for residential only water use per capita produced similar results (not shown).

Figure 4-20: Per Capita Water Use versus the Percent of a Municipality Zoned for Residential Housing



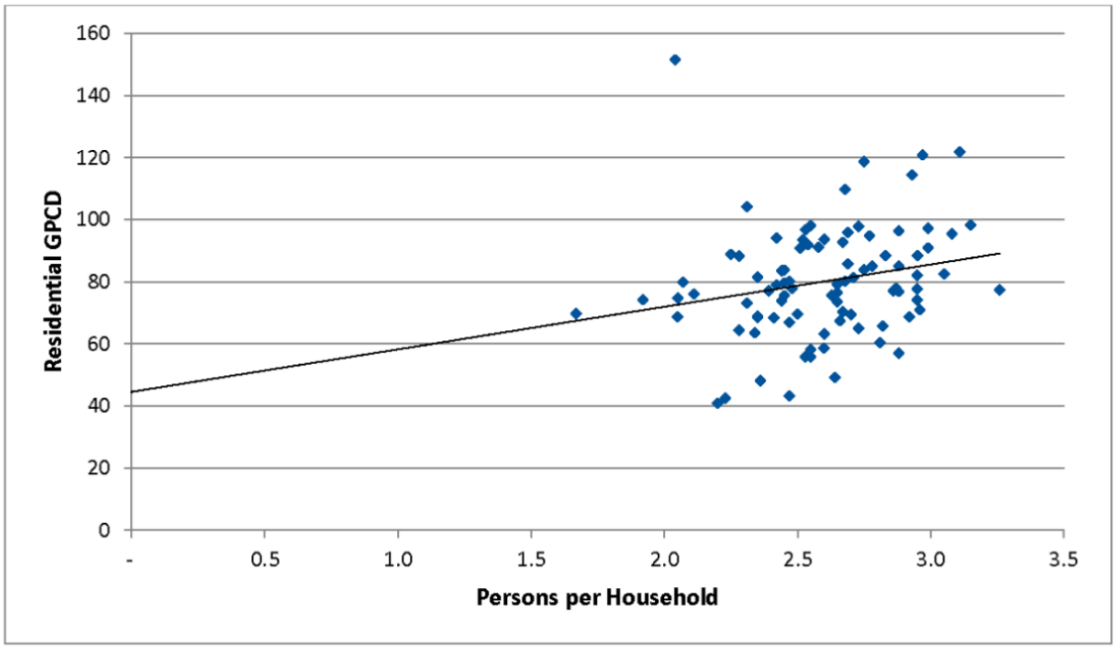
The **residential** water use per capita was compared with median household income to determine if income had an influence on water use. This analysis found a positive (increasing) correlation (Figure 4-21). In general, one can say that the higher the median household income of a community, the higher the residential per capita water use.

Figure 4-21: Per Capita Residential Water Use versus Median Household Income



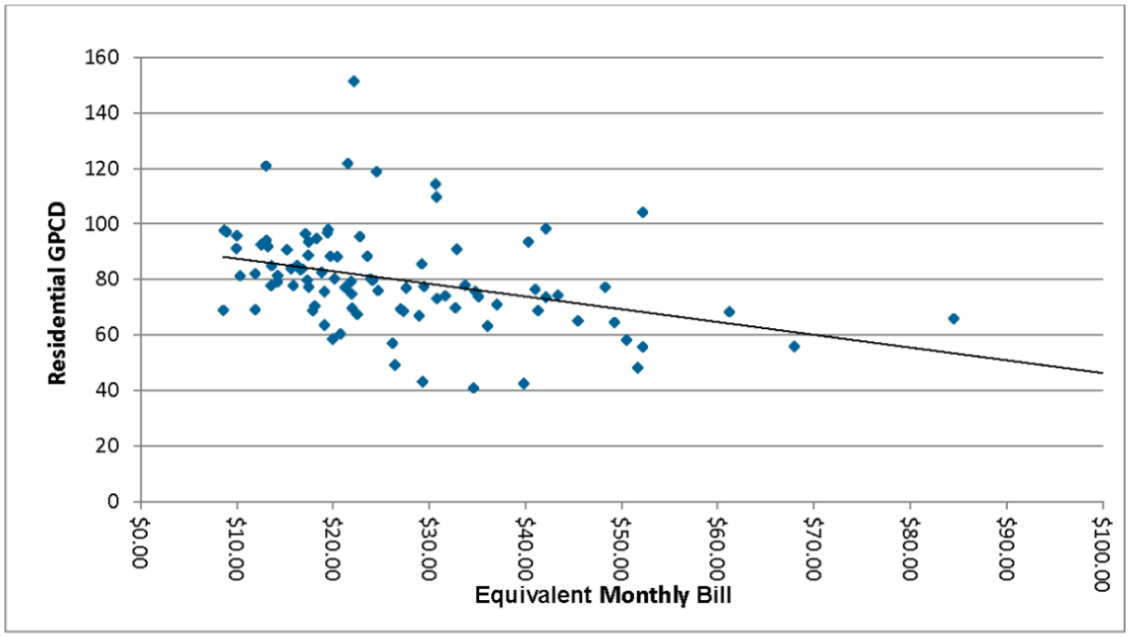
Similarly, there is a pattern that as the municipal average of persons per household increases there is a tendency for the residential water use per capita to increase, although this is not always the case (Figure 4-22).

Figure 4-22: Per Capita Residential Water Use versus the Average Number of People per Household



The average residential water use per capita was compared with the hypothetical water bill based upon 8,000 gallons per month water use. Overall, there is a pattern that suggests that as the equivalent monthly water use bill increases, the average residential water use per capita decreases, although this pattern is not as evident among the municipal utilities with lower water bills (Figure 4-23).

Figure 4-23: Residential Per Capita Water Use versus the Equivalent Monthly Water Bill



The residential per capita water use was also compared with the tier of the rate structure in which the hypothetical 8,000 gallons per month was located, as shown in Table 4-12. When 8,000 gallons per month is located in the first or second tier of the rate structure, average residential water use per capita is actually slightly higher than that found with uniform rates. However, if 8,000 gallons per month is in the third tier of the rate structure water use per capita is significantly lower (Figure 4-24). Note that municipal utilities with rate structures in which 8,000 gallons per month is in the third tier also tend to have higher water bills, as discussed in Section 4.5.1.

This suggests that rates in which 8,000 gallons per month is in the first or second tier are not sufficient to influence customers to conserve water. The volume of 8,000 gallons per month was selected for the analysis, because this volume is close to the overall average residential household water use per month. One would not expect the average use to fall in the first tier of a multi-tier rate structure if the rate structure were intended to influence customer water use and promote water conservation. This suggests that about one quarter of the municipal utilities (24 of 91, i.e., those in which 8,000 gallons per month is in the first tier) could improve the water efficiency messaging sent to customers by redesigning their rate structure. It is important to note here that the tiered rate structure must have a high enough cost to promote conservation as well. Simply placing the average amount of water used per billing cycle in the second tier is not enough.

Figure 4-24: Residential Per Capita Water Use versus Tier for 8,000 Gallons

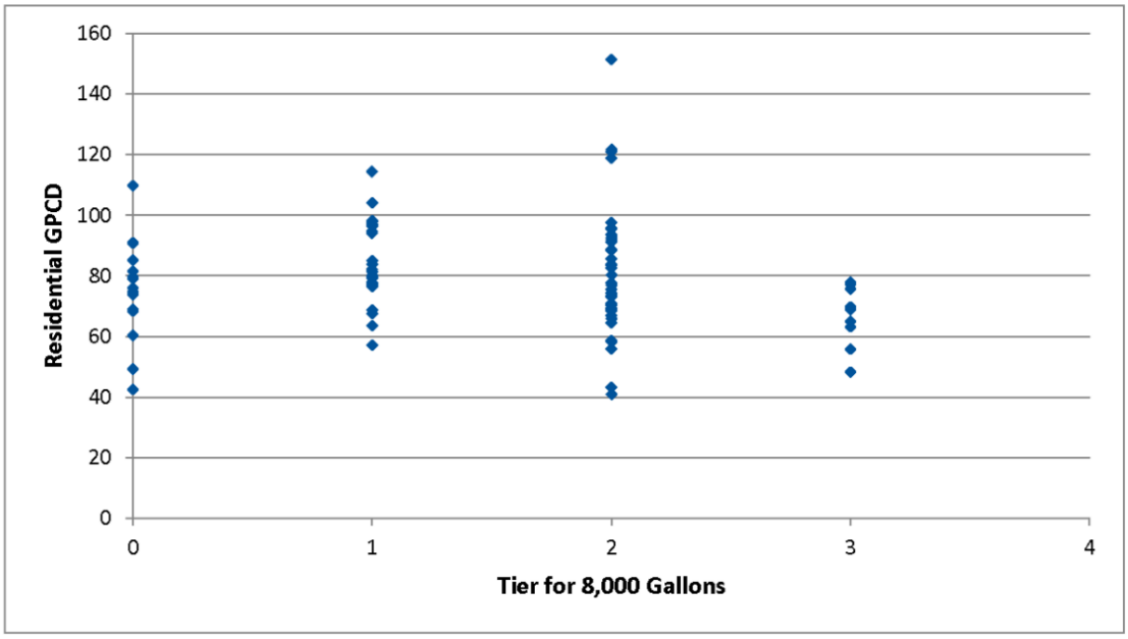
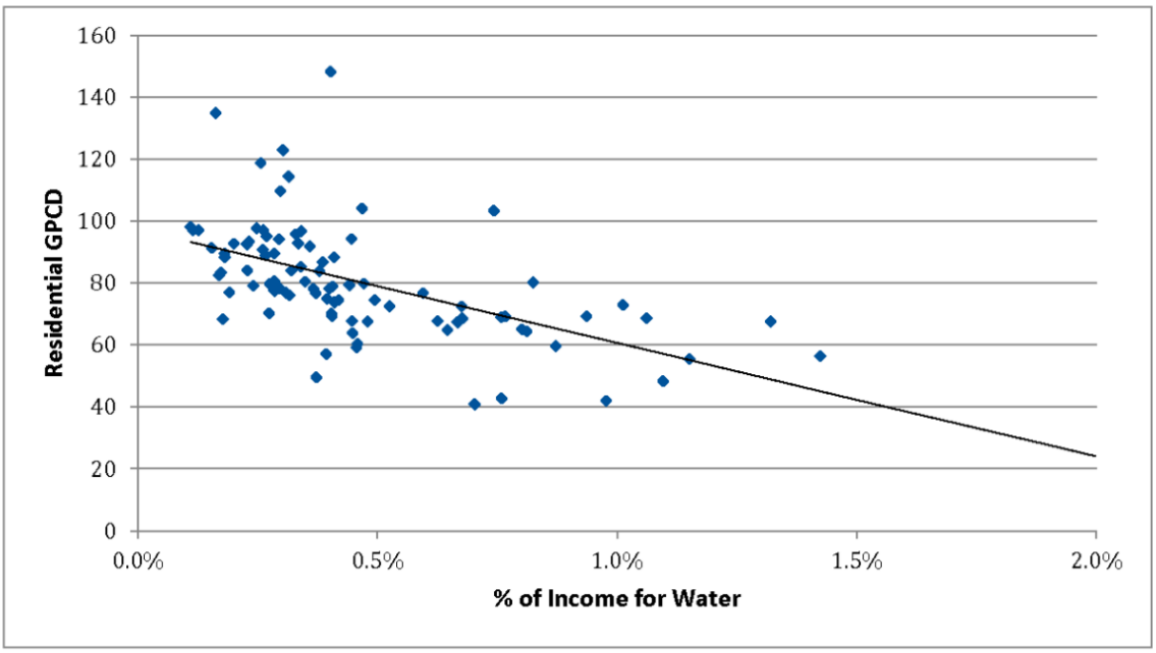


Table 4-12: Range of Residential Water Use per Capita by Location of 8,000 Gallons per Month

Tier	Number of Municipal Utilities	Minimum Residential GPCD	Average Residential GPCD	Maximum Residential GPCD
3rd Tier	11	48.2	68.1	77.9
2nd Tier	41	41.0	82.1	151.5
1st tier	24	57.1	84.7	114.4
Uniform rate	15	42.6	75.5	109.7
Total	91	41.0	80.0	151.5

Residential water use per capita was compared with the percent of income spent on water, as discussed in Section 4.5.1. Note that water use data were not available for the two small communities with the highest ratios of annual water bill to income and thus are not part of this analysis. The pattern illustrated in Figure 4-25 suggests that municipal utilities tend to have lower per capita residential water use when the percent of income spent on water is above average (i.e., above 0.5 percent of income).

Figure 4-25: Residential Per Capita Water Use versus Percent of Household Income Spent on Water



4.5.3 Impact of Separate Irrigation Meters

Some municipalities provide separate metering and billing (i.e., a separate rate structure) for irrigation meters. One advantage to separate irrigation metering is that these accounts are not charged for corresponding sewer services. In the Metro area, there are 37 municipal utilities that offer one or more separate rate structures for irrigation accounts. Some of these municipal utilities have separate rate structures for different types of irrigation customers, such as residential or commercial irrigation. Some municipal utilities have separate rates for commercial and/or industrial irrigation but not separate residential irrigation meters. The City of Excelsior has different irrigation rate structures for customers within and outside of the municipal utility boundaries. In addition, the city has different commercial water rate structures for accounts with or without irrigation meters in combination with whether or not the account is located inside the municipal utility boundaries.

In theory, one would expect that households that also have separate irrigation meters would display lower water use on the primary water service account. Of the municipal utilities used in the per capita water use comparison discussed in this section, 32 have separate irrigation rate structures that could be available to residential customers. An analysis of total municipal per capita water use, and residential per capita water use among municipalities with and without these irrigation rate structures was inconclusive. As noted, there are a variety of classifications for irrigation meters. Water use in systems that had “residential irrigation” or simply “irrigation” meters were evaluated in comparison with water use among all other systems. Results showed that both total and residential per capita water use was higher in systems that had irrigation meter rate structures that could be applicable to residential customers. This suggests that other factors (e.g., affluence, age of housing, cost of water, etc.) is influencing the data more than the availability of separate irrigation meters.

A more detailed analysis of the effects of irrigation meters on residential water use patterns could be developed based upon the comparative water use of customers in locations that offer separate residential

irrigation meters. This would include the municipalities of Elko New Market, North Oaks, Plymouth, and White Bear Township. A comparative analysis of non-residential, commercial, and/or industrial water use among customers with and without irrigation meters could be developed for Excelsior, Lino Lakes, Minnetonka (and the portion of Deephaven served by Minnetonka), Plymouth, White Bear Township, Woodbury, and Woodland.

4.5.4 Assessment of Peak Water Use

The calculation of a ratio of peak month to winter average water use for each municipality with monthly data is described in Section 4.3.2. The peak month to winter average ratios range from 1.4 (New Brighton) up to 5.0 (Andover) with a Metro area average ratio of 2.71. The peak month to winter average ratio of each municipality was compared with per capita water use, and then with socioeconomic and rate information to identify any patterns with respect to peak water use.

The peak month to winter average ratio relative to corresponding total system per capita use is shown in Figure 4-26. There is only the slightest pattern between these two variables that would suggest a positive relationship. Figure 4-27 shows the relationship between the peak month ratio and corresponding residential per capita water use. This analysis shows a distinct positive relationship suggesting that as residential per capita water use increases the system-wide peak month ratio increases. High summer peak month water use is usually driven by lawn irrigation. For communities with a large proportion of residential customers it makes sense that the high peak month ratio of the system would correspond with the higher per capita water use due to more irrigation use.

Figure 4-26: Total Per Capita Water Use versus Peak Month to Winter Average Ratio

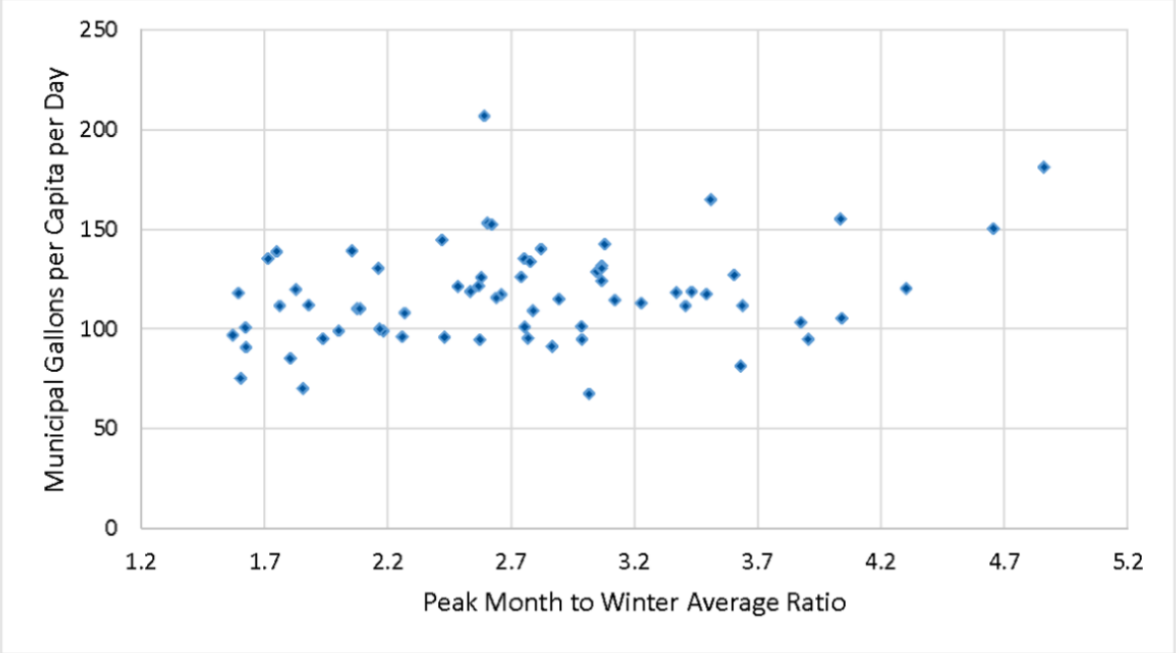
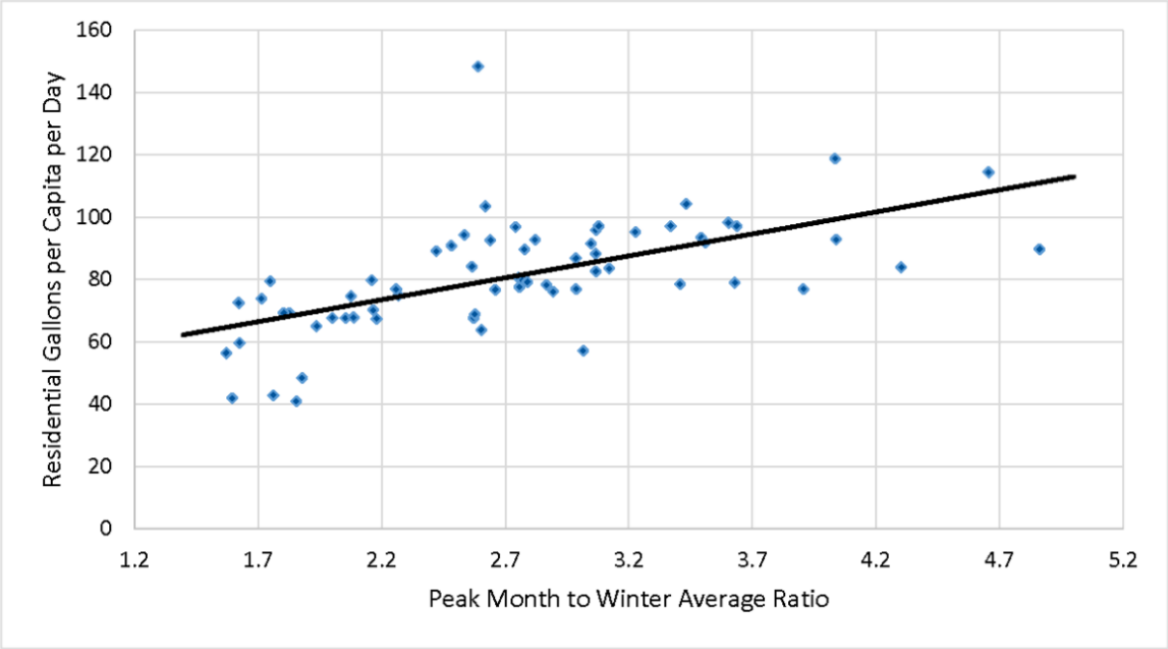


Figure 4-27: Residential Per Capita Water Use versus Peak Month to Winter Average Ratio



As with the residential per capita water use, the median household income shows a positive relationship with the peak month ratio. This relationship is illustrated in Figure 4-28. Municipalities with peak month to winter average ratios less than 2.0 have median household incomes less than $80,000 per year; although, not all municipalities with median incomes less than $80,000 have low ratios. Nearly all municipalities with ratios greater than 3.1 (except Fridley) have median household incomes greater than $80,000.

As was demonstrated in Section 4.5.2, there is a positive relationship between residential per capita water use and median household income. Therefore, it would make sense that if there is a positive relationship between the peak month ratio and residential per capita water use, there would also be a positive relationship between the peak month ratio and median household income. As with the residential per capita discussion, the median household income of a municipality may be an indicator of potentially more irrigation, which contributes to higher peak month ratios.

The peak month to winter average use ratio was compared to the percent of the municipal area that is zoned residential. No significant correlation was found as can be seen in Figure 4-29. The fact that a municipality has a higher percent of its area zoned for residential use does not necessarily imply that there is more irrigation water use or a corresponding higher peak month ratio. Peak month water use in the non-residential sectors is typically driven by an increase in water use for cooling purposes (e.g., cooling towers).

Figure 4-28: Median Household Income versus Peak Month to Winter Average Ratio

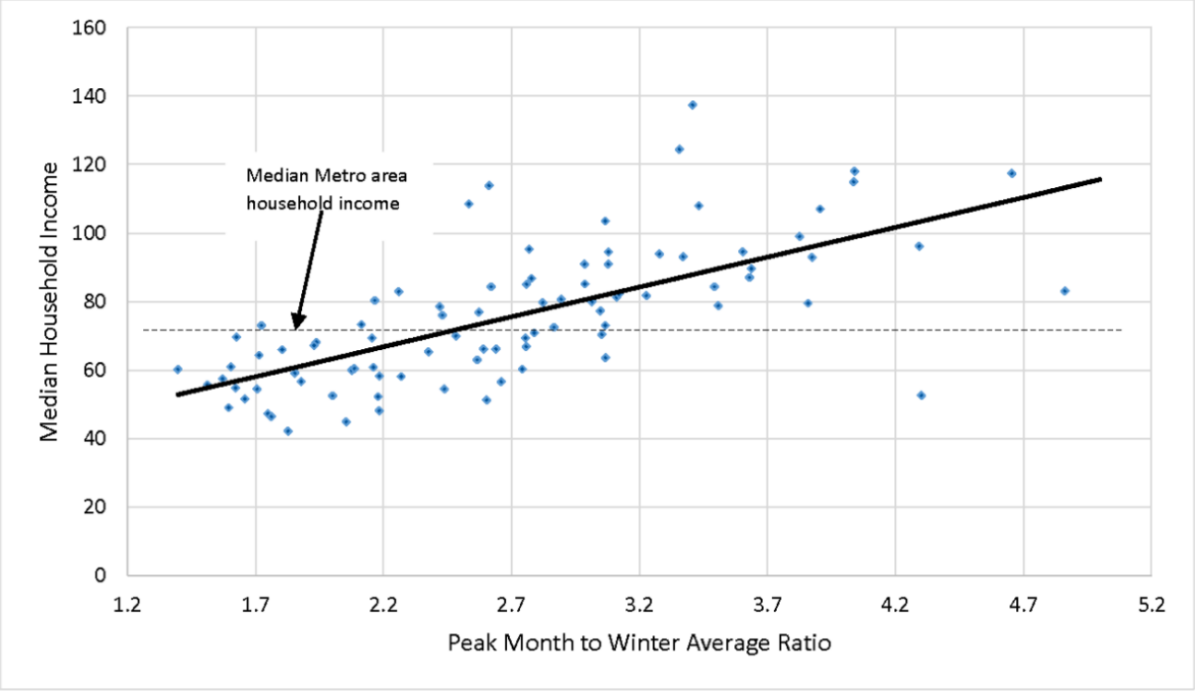
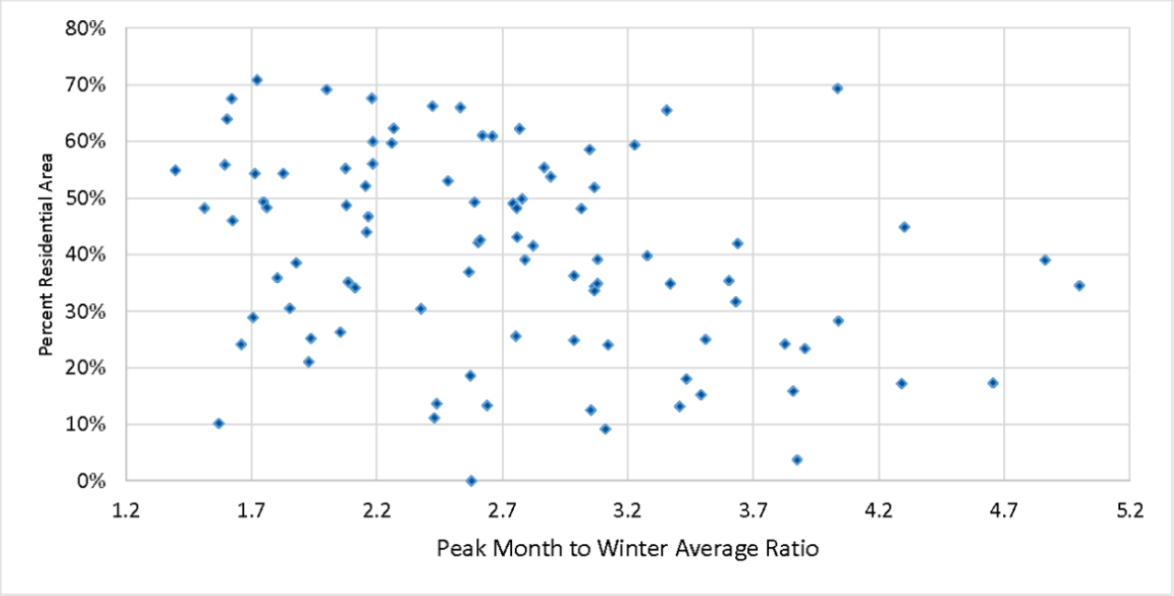


Figure 4-29: Percent Residential Area versus Peak Month to Winter Average Ratio

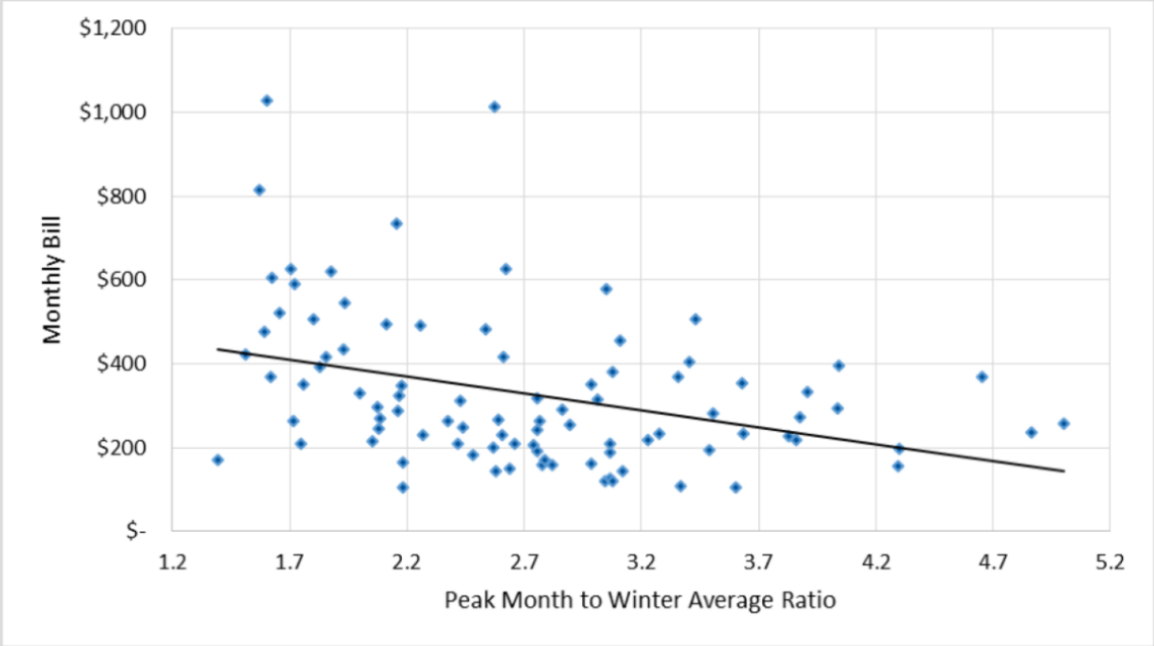


The hypothetical monthly water bill described in Section 4.5.2, based on 8,000 gallon consumption per month was compared with the peak month to winter average ratio. As seen in Figure 4-30, there is a slight downward (negative) pattern. Those municipalities with ratios greater than about 2.7 tend to have lower equivalent monthly water bills and again for those with ratios greater than about 3.5, although not all municipalities with lower bills have high ratios. Conversely, those municipalities with high water bills have relatively lower ratios. This is similar to the negative relationship between the equivalent monthly bill and

residential per capita use discussed in Section 4.5.2 (Figure 4-23). This suggests that residential water customers in municipalities with higher rates may be inclined to irrigate less and thus those municipalities experience lower peak month ratios.

No discernible patterns were identified between the peak month ratio and either the frequency of billing or the tier of the rate structure in which 8,000 gallons per month was located.

Figure 4-30: Equivalent Monthly Bill versus Peak Month to Winter Average Ratio



4.5.5 Impact of Conservation Ordinances and Programs

Information on conservation ordinances and programs by municipalities was obtained during the collection of water rates data. It was collected by a basic internet search only and no contact was made with the individual municipalities. The intent of a water conservation program is to extend the life of the water supply, or current infrastructure capacity, by promoting the efficient use of water. Water conservation has been defined as “the beneficial reduction of water use or water loss” while water efficiency is defined as using the minimum amount of water to achieve a particular function, or “using water wisely.” There are different levels of conservation beginning with water rates.

There is a common misunderstanding that an increasing tiered water rate structure, or seasonal rates, automatically constitutes a conservation rate structure. This is not always the case. The rate structure must send the message (i.e., price signal) to the consumer to conserve or use water efficiently in order to be considered a conservation rate structure. “If the difference between block rates is insubstantial, the customer will likely not notice any changes to their monthly bills as they move in and out of later blocks of usage. For a block rate structure to be effective in communicating the higher (or lower) price of water at different consumption levels, the difference in the block rates should be significant.” (Designing Water Rate Structures for Conservation & Revenue Stability, M. Tiger et al., UNC Environmental Finance Center, 2014). Thus, a tiered rate structure is not a conservation rate if the customer is not getting the message.

Another misconception about conservation pertains to odd/even day watering ordinances and restrictions. Odd/even watering reduces peak day (and peak hour) demand by spreading the peak day demand throughout a given week. This is beneficial to system operators who are managing system pressure and storage tank levels on a daily and hourly basis, but has no impact on overall water consumption. It is only when the volume of irrigation water is reduced (such as dialing down the number of minutes per irrigation cycle) that water conservation occurs.

Similarly, a distinction must be made between short-term water conservation measures such as temporary watering restrictions during a drought or emergency and long-term conservation measures intent on permanent reductions in water use. Many municipalities have ordinances for emergency water use restrictions that can be invoked during a drought or emergency. These typically prohibit non-essential uses such as irrigation and car washing. However, once the emergency conditions are resolved, these water use behaviors return to normal. Such ordinances are important but will not affect overall water use in the long-run.

In general, water conservation, or a change in water use, is achieved through either a change in technology (e.g., changing out a showerhead or an irrigation sprinkler head) or a change in behavior (e.g., taking a shorter shower, or resetting the irrigation controller). As with the adoption of any new technology (or behavior), the change requires three prerequisites: 1) the technology must be available in the marketplace; 2) there must be an incentive (positive or negative) to change; and, 3) there must be information available to explain the need for change and how to achieve the change. The technological marketplace for water conservation has changed significantly over the last few decades as witnessed by the competition among manufacturers of toilets, showerheads, irrigation systems, leak detection equipment, etc. For the customer, water efficiency measures can include toilet replacements, high efficiency clothes washers, smart and efficient irrigation systems, and recirculating cooling towers in commercial and industrial locations. Note that for some of these water efficiency measures there are associated energy savings. For the utility, water efficiency may include 100 percent metering of customers, appropriately designed rates, meter and distribution line replacement programs, and leak detection.

A review of conservation programs offered by Metro area municipalities for their customers is summarized in Table 4-13. Programs range from providing educational materials to rebates and financing for fixture replacement, and landscape audits.

Table 4-13: Active Conservation Programs

Municipality	Program
Chanhassen	WaterWise Water conservation program, irrigation audit program
Eden Prairie	Rebates for toilets, clothes washers, faucets, showerheads, irrigation systems, landscaping, pervious pavement
Edina	Financing for installation of energy and water efficient products
Hugo	Irrigation inspections, landscape allowances, water audits of city property, rebate program for replacing old fixtures
Lexington	Provides educational materials, and replacement incentives
Maple Grove	Free conservation kits
Maple Plain	Provides educational materials
Minnetonka	Fall open house and eco fair events

Municipality	Program
Plymouth	Grant program for native lawns, rain gardens, moisture sensors
Victoria	Rebates for energy efficient appliances

It is difficult to compare the effects of these programs across municipalities. Differences in water use across these municipalities, and those without specific conservation programs, may be due to differences in municipal characteristics other than whether or not there is a conservation program. The proper approach to evaluating the effectiveness of a given conservation program for a given municipality is a statistical analysis of water use over time that controls for the influences of weather, the economy (i.e., the recession), rate changes, loss or addition of significant water users, etc.

Section 5
Results and Recommendations

The primary purpose of this analysis is to assess the relationship between water pricing and water consumption in the Metro area for those municipalities that operate a municipal water utility. This section summarizes the major findings of this analysis.

5.1 Summary

The following summarizes the data that was used in this analysis:

- **A total of 128 municipalities operate municipal water utilities**: Of these, 4 were missing data and two had two municipal utilities. In total there were 126 utilities for which data was analyzed to analyze rate structure characteristics.
- **The majority of the discrepancies were found in the SWUDS database**: Those that were obvious and easy to fix were corrected prior to the data analysis. Information on municipalities that purchased their water from outside sources (27) was not available. No data was available for 7 municipalities which provided municipal water to their customers. Of the remaining 94 municipalities, all had enough data to analyze total Metro area water use, 93 had complete enough data to analyze per capita water use for total municipal consumption, and 91 had complete enough data to analyze per capita water use for residential consumption, only.
- **Eighty-five percent (85%) of the utilities have rate structures that bill use per 1,000 gallons**: The remaining 15 percent bill either by 100 gallons, 100 cubic feet, or by "units." For most consumers, gallons are more understandable than cubic feet.
- **Fifty-five percent (53%) of the utilities have rate structures that bill quarterly**: Thirty-seven percent (37%) bill monthly and the remaining 10 percent bill either semi-annually, bi-monthly, or bill their residential customer's quarterly and commercial customers monthly. More frequent billing increases customer awareness of water use.
- **Fifty-three percent (53%) of the municipal water utilities break their customers into separate customer classes**: The remaining 47 percent have only one rate structure to bill all their customers. The number of rate structures range from 1 to 8.
- Twenty-six percent (26%) of the rate structures use a flat rate when billing the associated customer class: The remaining 74 percent use between 2 and 10 tiers.
- **A total of 37 municipalities offer separate irrigation metering and billing**: Some of these municipal utilities have separate rate structures for different types of irrigation customers, such as residential or commercial irrigation. Some municipal utilities have separate rates for commercial and/or industrial irrigation but not separate residential irrigation rates.
- A total of 10 municipal water utilities have water conservation programs that are in addition to tiered rate structures and emergency watering restrictions: These utilities offer irrigation audits, appliance rebates, education, and low flow adapters. For the purpose of this analysis, odd/even

watering restrictions are not considered conservation programs because water use is not reduced, although the peak load on the system is diminished.

5.2 Results

5.2.1 Water Use in the Metro Area

Water use was assessed for the overall Metro area and per municipality. The following is concluded for regional water consumption:

- **Monthly water patterns follow a distinct seasonality of water consumption**. Peak summer demand is almost twice the winter use rate for the Metro area.
- **Area-wide peak demand typically occurs in July of each year**. Specifically, the winter average use from 2000 to 2012 was 265 MGD while the average use in July was 586 MGD.

A comparison of the water use for individual communities found:

- **Nearly half (48%) of the municipal water systems supply less than one MGD to their customers**. Thirty-four percent (34%) supply 1 to 5 MGD, and 16 percent supply 6 to 10 MGD. The remaining 2 percent consist of Minneapolis and St. Paul, which supply an average more than 60 MGD to their customers, including wholesale supply to nearby municipalities.
- **The peak month to winter average ratios** range from 1.4 (New Brighton) up to 5.0 (Andover) with a Metro area average of 2.71.
- **The per capita water use for total municipal water use** (i.e., all the customer classes) ranges from a low of 64 GPCD in Lakeland up to a high of 207 GPCD in Wayzata.
- **The per capita water use for residential water use** ranges from a low of 41 GPCD in Bayport up to a high of 148 GPCD in Wayzata.
- **The residential water use per connection** (i.e., per household) in gallons per day (GPD) ranges from a low of 158 GPD in New Germany up to a high of 494 GPD in Wayzata.

5.2.2 Relationship between Rates, Water Use and Municipal Characteristics

A separate analysis of the municipal water use and rate data was conducted in order to compare rates across municipalities. The comparison is based upon a water bill from each municipality for a hypothetical residential customer using the same volume of water in each community. This allowed for an equal comparison across rate structures. The following relationships were found as a result of this analysis:

- When average water use per month falls into the first or second tier of a tiered rate structure, then the average residential water use per capita tends to be slightly higher than average residential use in a municipality without a tiered rate structure. When the average water use falls in the third tier of the rate structure, the average residential water use tends to be lower. This suggests that rate structures in which the average residential customer use is in the first or second tier are not sending customers the message to conserve water.
- **Of the municipal utilities with tiered rate structures, 31 percent had the hypothetical volume in the first tier**. A conservation driven rate structure should result in the average water user volume falling in the second tier of a tiered rate structure.

- **The general pattern suggests no correlation between the monthly water bill and income**. The hypothetical annual water bill as a percent of income ranged from 0.11 percent (Woodbury) up to 2.1 percent (Hilltop), with an average of 0.52 percent.
- No significant pattern was found between the municipal per capita water use and the number of rate structures offered by the municipality. Similarly, no significant pattern was found between the municipal per capita water use and the number of tiers within the rate structure.
- **No significant pattern was found between the municipal per capita water use and the percent residential area**. Comparison of the percent of land zoned residential with the average residential water use per capita produced similar results.
- **A positive (increasing) correlation was found between water use and median household income**. In general, the higher the median household income of a community, the higher the residential per capita water use.
- Municipalities tend to have lower per capita residential water use when the percent of income spent on water is above 0.5 percent of income.
- There is a pattern that suggests that as the equivalent monthly (8,000 gallons) water bill increases, the average residential water use per capita decreases, although this pattern is not as evident among the municipalities with lower water bills.
- An analysis of total municipal per capita water use, and residential per capita water use among municipalities with and without irrigation rate structures was inconclusive. Of the 125 municipalities used in the per capita water use comparison, 32 have separate irrigation rate structures that could be available to residential customers.
- **Analysis of the impact of conservation ordinances and programs was inconclusive**. Of the 124 municipalities for which billing rate structure information was available, only 10 had some sort of conservation program. These programs included, but were not limited to, rebates, financing for conservation projects, education, and landscape audits. There was not enough data to perform an analysis.

5.2.3 Effect of Water Conservation Rate Structures

From the data analyzed in this study, it did not appear that the conservation rate structures have any effect on water use. Increasing tiered rate structures and seasonal tiered rate structures do not automatically constitute a conservation rate structure. In order to promote conservation, the rate structure must have a significant enough cost increase between tiers as to have an impact on a monthly water bill.

Another important finding regarding the tiered rate structures is that:

Where the Metro area hypothetical average water use of 8,000 gallons per month is located in the first or second tier of the rate structure, average residential water use per capita tends to be **slightly higher** than that found with uniform rates. However, if this hypothetical average water use per month is in the third tier of the rate structure, water use per capita is significantly lower.

This suggests that rates in which this hypothetical average water use per month is in the first or second tier are not sending customers the message to conserve water. One would not expect this use to be in the first tier of a multi-tier rate structure if the rate structure were intended to “send the message” about water conservation. This suggests that about one quarter of the municipalities (24 of 91, i.e., those in which the

hypothetical average water use per month is in the first tier) could improve the water efficiency messaging sent to customers by redesigning their rate structure. Note, however, that the hypothetical average water use of 8,000 gallons per month is representative of the entire Metro area and was applied across all rate structures for comparative purposes. This finding is not based upon the actual average water use of each individual municipality.

5.3 Recommendations

Based on the findings of this analysis, the Metropolitan Council should consider the following next steps:

1. **Advocate for improved quality control of SWUDS data**. It is understood that the management of this data is the responsibility of the Minnesota Department of Natural Resources. However, the Metropolitan Council could advocate for improved quality review of the data.
2. Conduct a more detailed analysis of rate structures across municipalities based on an average customer consumption from each municipality. The winter average and peak month average consumption per residential connection for each municipal utility can be compared with applicable rate structures to identify those municipalities that: (a) bill the same for summer and winter use; or, (b) have significantly higher billing rates for summer use. Similarly, an analysis of the billing rates for excessive use, such as 1.5 times the average summer use, may identify those municipalities with true conservation rates. Tiered water rates in which the upper tiers are a lot more than average summer use are probably sending a true conservation signal to customers, and thus might exhibit lower water use. This analysis could be conducted with the existing database.
3. Conduct detailed analysis to assess the impacts conservation activities.
    a. Conduct a more detailed analysis of the effects of irrigation meters on residential water use patterns. This would include the municipalities of Elko New Market, North Oaks, Plymouth, and White Bear Township. A comparative analysis of non-residential, commercial, and/or industrial water use among customers with and without irrigation meters could be developed for Excelsior, Lino Lakes, Minnetonka (and the portion of Deephaven served by Minnetonka), Plymouth, White Bear Township, Woodbury, and Woodland. Additional data separating customers in the same category with and without irrigation meters would need to be obtained.
    b. Create a redesigned tiered rate structure that effectively encourages conservation to use as a case study. Metropolitan Council could partner with one of the municipalities whose average residential household falls within the first tier to develop a pilot project for a properly designed rate structure that encourages conservation while preserving revenue. Alternatively, a hypothetical analysis of a generic Metro area municipality could be created.
    c. Conduct an analysis of water conservation program effectiveness. Data on water use, rates, demographics, weather, and conservation programming could be evaluated and normalized in an effort to identify the effects of conservation programs on water use among those municipalities that offer water conservation programs.
4. Support an outreach program to educate utility managers.
    a. Conduct a rate structure workshop for utility managers and other municipal officials to educate them about how to create and implement effective conservation rate structures.

b. Conduct a water conservation program workshop for utility managers and other municipal officials to educate them about components of successful conservation programs.

Appendix A

Data Available from Each Source for Each Municipality

TWIN CITIES REGIONAL WATER BILLING ANALYSIS
APPENDIX A
JUNE 1, 2015

CTU ID	Municipal Utility	Billing Rates and Rates Structures Data	Socioeconomic and Zoning Data	SWUDS Data - Monthly Usage	SWUDS Data - Number of Connections and Volumes	Notes
Stand Alone						
2393954	Andover	C	C	C	C	
2393964	Anoka	C	C	C	C	
2393967	Apple Valley	C	C	C	C	
2394090	Bayport	C	C	C	C	Number of connections/volume analysis is based on limited data
2394113	Belle Plaine	C	C	C	C	
2394183	Blaine	C	C	C	C	
2394198	Bloomington	C	C	C	C	
2393428	Brooklyn Center	C	C	C	C	
2393429	Brooklyn Park	C	C	C	C	
2393472	Burnsville	C	C	C	C	
2393762	Carver	C	C	C	C	
2393784	Centerville	C	C	C	C	
2393797	Champlin	C	C	C	C	
2393799	Chanhassen	C	C	C	C	
2393809	Chaska	C	C	C	C	
2393526	Circle Pines	C	C	C	C	
2393601	Cologne	C	C	C	C	
2393610	Columbus	C	C	C	I	Not used in Total GPCD, residential GPCD, or residential GPD
2393628	Coon Rapids	C	C	C	C	
2393644	Cottage Grove	C	C	C	C	
2394471	Dayton (pt-hennepin)	C	C	C	P	Not used in residental GPCD or residential GPD
2394586	Eagan	C	C	C	C	
2394596	East Bethel	C	C	I	I	
2394614	Eden Prairie	C	C	C	C	
2394621	Edina	C	C	C	C	
2394658	Elko New Market	C	C	C	C	
664099	Empire Township	C	C	C	C	
2394747	Farmington	C	C	C	C	
2394789	Forest Lake	C	C	C	C	
2394826	Fridley	C	C	C	C	
2394988	Greenfield	C	C	I	I	
2394274	Hamburg	C	C	C	P	Not used in residential GPCD or residential GPD
2394282	Hampton	C	C	C	C	
2394320	Hastings	C	C	C	C	
2394417	Hopkins	C	C	C	C	
2394440	Hugo	C	C	C	C	
2395429	Inver Grove Heights	C	C	C	C	
2395483	Jordan	C	C	C	C	
2395589	Lake Elmo	C	C	C	C	
2395614	Lakeville	C	C	C	C	
2395696	Lexington	C	C	C	C	Monthly data: only has reported values in summer months
2395725	Lino Lakes	C	C	C	C	
2395756	Long Lake	C	C	I	I	
2395764	Loretto	C	C	C	C	
2395841	Maple Plain	C	C	C	C	
2395007	Marine on St. Croix	C	C	I	I	
2395049	Mayer	C	C	C	C	
2395084	Medina	C	C	C	C	
2395351	Minnetonka Beach	C	C	C	C	
2395352	Minnetrista	C	C	C	P	Data from 2008 and 2010 were not used
2395111	Mound	C	C	C	C	
2395118	Mounds View	C	C	C	C	

2395187	New Brighton	C	C	C	C	
2395195	New Germany	C	C	C	C	
2395211	New Prague	C	I	C	P	Missing 2010 pop data. Monthly water use data errors in 2003.
2395216	New Trier	C	C	I	I	
2395227	Newport	C	C	C	C	
2395278	Norwood Young America	C	C	C	C	
2395282	Oak Grove	I	C	I	I	
2395285	Oak Park Heights	C	C	C	C	
2396081	Orono	C	C	C	P	Only a limited number of years were used due to missing population data
2396242	Plymouth	C	C	C	C	
2396284	Prior Lake	C	C	C	C	
2396311	Ramsey	C	C	C	C	
2396316	Randolph	C	C	I	I	
2396362	Richfield	C	C	C	C	
2396388	Robbinsdale	C	C	C	C	
2396415	Rogers	C	C	C	C	
2396433	Rosemount	C	C	C	C	
2396543	Savage	C	C	C	C	
2395854	Shakopee	C	C	C	C	
2395876	Shoreview	C	C	C	C	
2395877	Shorewood	C	C	C	C	
2395918	South St. Paul	C	C	C	C	
2395934	Spring Lake Park	C	C	C	C	
2395935	Spring Park	C	C	C	C	
2396471	St. Anthony	C	C	C	C	
2396475	St. Bonifacius	C	C	C	C	
2396487	St. Francis	C	C	C	C	
2396500	St. Louis Park	C	C	C	C	
2396516	St. Paul Park	C	C	C	C	
2395969	Stillwater	C	C	C	C	
2397036	Tonka Bay	C	C	C	C	
2397106	Vadnais Heights	C	C	C	C	
2397127	Vermillion	C	C	C	C	
2397135	Victoria	C	C	C	C	
2397159	Waconia	C	C	C	C	
2397211	Watertown	C	C	C	C	
2397235	Wayzata	C	C	C	C	
2397369	Woodbury	C	C	C	C	

CTU ID	Municipal Utility	Billing Rates and Rates Structures Data	Socioeconomic and Zoning Data	SWUDS Data - Monthly Usage	SWUDS Data - Number of Connections and Volumes	Notes
Sells Water to Another Municipality						
2394717	Excelsior	C	C	C	C	
2395609	Lakeland	C	C	C	C	
2395818	Mahtomedi	C	C	C	C	
2395838	Maple Grove	C	C	C	C	
2395345	Minneapolis	C	C	C	C	
2395350	Minnetonka	C	C	C	C	
2395261	North St. Paul	C	C	C	C	
2395287	Oakdale	C	C	C	C	
2396511	St. Paul	C	C	C	C	
2397299	White Bear Lake	C	C	C	C	
665981	White Bear Township	C	C	C	C	

CTU ID	Municipal Utility	Billing Rates and Rates Structures Data	Socioeconomic and Zoning Data	SWUDS Data - Monthly Usage	SWUDS Data - Number of Connections and Volumes	Notes
Purchases Water from Another Municiaplity						
2393979	Arden Hills	C	C	I	I	
2394171	Birchwood Village	C	C	I	I	
2393607	Columbia Heights	C	C	I	I	
2393683	Crystal	C	C	I	I	
2394486	Deephaven (Minnetonka)	C	C	I	I	
2394486	Deephaven (Shorewood)	C	-	--	--	
2394738	Falcon Heights	C	C	I	I	
664202	Fort Snelling (unorg.)	I	I	I	I	

2394924	Golden Valley	C	C	I	I	
2394245	Greenwood	I	C	I	I	
2394389	Hilltop	C	C	I	I	
2395610	Lakeland Shores	C	C	I	I	
2395599	Lake St. Croix Beach	C	C	I	I	
2395626	Landfall	I	C	I	I	
2395642	Lauderdale	C	C	I	I	
2395708	Lilydale	C	C	I	I	
2395733	Little Canada	C	C	I	I	
2395846	Maplewood	C	C	I	I	
2395096	Mendota	C	C	I	I	
2395097	Mendota Heights	C	C	I	I	
2395201	New Hope	C	C	I	I	
2395259	North Oaks	C	C	I	I	
2396098	Osseo	C	C	I	I	
2396435	Roseville	C	C	I	I	
2396006	Sunfish Lake	C	C	I	I	
2397275	West St. Paul	C	C	I	I	
2397314	Willernie	C	C	I	I	
2397370	Woodland	C	C	I	I	

CTU ID	Municipal Utility	Billing Rates and Rates Structures Data	Socioeconomic and Zoning Data	SWUDS Data - Monthly Usage	SWUDS Data - Number of Connections and Volumes	Notes
No Municipal Water Supply						
2393887	Afton	NA	NA	NA	NA	
663529	Baytown Township	NA	NA	NA	NA	
663556	Belle Plaine Township	NA	NA	NA	NA	
663571	Benton Township	NA	NA	NA	NA	
2394156	Bethel	NA	NA	NA	NA	
663612	Blakeley Township	NA	NA	NA	NA	
663731	Camden Township	NA	NA	NA	NA	
663763	Castle Rock Township	NA	NA	NA	NA	
663767	Cedar Lake Township	NA	NA	NA	NA	
2393579	Coates	NA	NA	NA	NA	
2393634	Corcoran	NA	NA	NA	NA	
663886	Credit River Township	NA	NA	NA	NA	
663913	Dahlgren Township	NA	NA	NA	NA	
2394503	Dellwood	NA	NA	NA	NA	
663965	Denmark Township	NA	NA	NA	NA	
663994	Douglas Township	NA	NA	NA	NA	
664113	Eureka Township	NA	NA	NA	NA	
2394871	Gem Lake	NA	NA	NA	NA	
2394963	Grant	NA	NA	NA	NA	
664346	Greenvale Township	NA	NA	NA	NA	
664354	Grey Cloud Island Townsh	NA	NA	NA	NA	
2394273	Ham Lake	NA	NA	NA	NA	
664386	Hampton Township	NA	NA	NA	NA	
664388	Hancock Township	NA	NA	NA	NA	
2394288	Hanover (Hennepin Count	NA	NA	NA	NA	
664443	Helena Township	NA	NA	NA	NA	
664502	Hollywood Township	NA	NA	NA	NA	
2395420	Independence	NA	NA	NA	NA	
664569	Jackson Township	NA	NA	NA	NA	
664705	Laketown Township	NA	NA	NA	NA	
664793	Linwood Township	NA	NA	NA	NA	
664829	Louisville Township	NA	NA	NA	NA	
664919	Marshan Township	NA	NA	NA	NA	
664932	May Township	NA	NA	NA	NA	
2395082	Medicine Lake	NA	NA	NA	NA	
2395317	Miesville	NA	NA	NA	NA	
665104	New Market Township	NA	NA	NA	NA	
665126	Nininger Township	NA	NA	NA	NA	
2395265	Northfield	NA	NA	NA	NA	
2437910	Nowthen	NA	NA	NA	NA	

2396211	Pine Springs	NA	NA	NA	NA	
665377	Randolph Township	NA	NA	NA	NA	
665381	Ravenna Township	NA	NA	NA	NA	
2396406	Rockford (pt-hennepin)	NA	NA	NA	NA	
665551	San Francisco Township	NA	NA	NA	NA	
665541	Sand Creek Township	NA	NA	NA	NA	
2396548	Scandia	NA	NA	NA	NA	
665569	Sciota Township	NA	NA	NA	NA	
665676	Spring Lake Township	NA	NA	NA	NA	
665519	St. Lawrence Township	NA	NA	NA	NA	
2396508	St. Marys Point	NA	NA	NA	NA	
665712	Stillwater Township	NA	NA	NA	NA	
665860	Vermillion Township	NA	NA	NA	NA	
665887	Waconia Township	NA	NA	NA	NA	
665929	Waterford Township	NA	NA	NA	NA	
665931	Watertown Township	NA	NA	NA	NA	
665966	West Lakeland Township	NA	NA	NA	NA	
666069	Young America Township	NA	NA	NA	NA	

LEGEND
C = Complete Data
P = Partial Data
I = Insufficient Data
NA -= Not Applicable

Appendix B

Examples of the Four Databases

TWIN CITIES REGIONAL WATER BILLING ANALYSIS
APPENDIX B
1-Jun-15

Table B-1

CTU ID	Utility	Month	Year	Customer Sector	Customer Subsector	Frequency	Rate Structure	Blocks
123456	Water Town	Jan	2013	Building Type	Residential	Monthly	Increasing	4
123456	Water Town	Jan	2013	Building Type	Industrial	Monthly	Increasing	4
123456	Water Town	Jan	2013	Building Type	Commercial	Monthly	Seasonal	2
123456	Water Town	Jan	2013	Building Type	Irrigation	Monthly	Flat	1

Table B-2

CTU ID	City	2010 Population	2010 Households	Number of People Per Household in 2010	Median Household Income 2008-2012 (in $000s)	Per Capita Personal Income (in $000s)	Single Family (acres)	Multi- family (acres)
123456	Water Town	22,088	8,234	2.68	$79.70	$34.20	3015	269

Table B-3

CTU ID	PERMITTEE	YEAR	POP	RES	RES_CONN	RES_MET	COMM	COMM_CONN
123456	Water Town	1999	23,458	684,247,000	5,921	5,921	32,433,000	100
123456	Water Town	2000	21,548	763,908,000	6,214	6,214	37,187,000	158
123456	Water Town	2001	22,200	794,627,000	6,322	6,322	43,665,000	167
123456	Water Town	2002	22,517	803,538,000	6,489	6,489	61,753,000	167
123456	Water Town	2003	22,640	829,415,000	6,715	6,715	70,852,000	171
123456	Water Town	2004	23,367	833,693,000	6,915	6,915	74,226,000	187
123456	Water Town	2005	24,099	854,329,000	7,001	7,001	77,549,000	189
123456	Water Town	2006	24,251	851,029,000	7,052	7,052	83,218,000	204
123456	Water Town	2007	24,381	843,471,000	7,098	7,098	80,248,000	207
123456	Water Town	2008	24,622	836,826,000	7,121	7,121	78,527,000	192
123456	Water Town	2009	24,657	846,458,000	7,128	7,128	72,650,000	196
123456	Water Town	2010	24,891	766,815,000	7,175	7,175	72,428,000	196
123456	Water Town	2011	23,217	753,930,000	7,214	7,214	71,589,000	197
123456	Water Town	2012	24,458	849,495,000	7,239	7,239	73,518,000	196

Table B-4

CTU ID	PERMITTEE	RESOURCETYPE_ID	Year	JANUARY	FEBRUARY	MARCH	APRIL	MAY
123456	Water Town	1	1999	41,657,000	38,184,000	42,220,000	46,548,000	74,750,000
123456	Water Town	1	2000	47,633,000	43,887,000	47,882,000	59,731,000	122,495,000
123456	Water Town	1	2001	48,803,000	44,890,000	49,023,000	49,161,000	74,860,000
123456	Water Town	1	2002	54,123,000	47,990,000	53,700,000	52,010,000	80,415,000
123456	Water Town	1	2003	52,701,000	47,310,000	52,270,000	58,470,000	80,569,000
123456	Water Town	1	2004	49,980,000	46,440,000	49,828,000	58,570,000	81,855,000
123456	Water Town	1	2005	54,275,000	46,651,000	53,090,000	56,591,000	68,213,000
123456	Water Town	1	2006	101,646,000	46,880,000	52,188,000	64,381,000	92,431,000
123456	Water Town	1	2007	43,677,000	40,033,000	64,872,000	52,764,000	114,966,000
123456	Water Town	1	2008	34,628,000	51,930,000	53,667,000	53,995,000	92,352,000
123456	Water Town	1	2009	53,701,000	47,862,000	52,564,000	58,466,028	188,197,000
123456	Water Town	1	2010	50,421,000	43,098,000	46,481,000	69,878,000	109,418,000
123456	Water Town	1	2011	49,485,000	44,271,000	47,993,000	48,384,000	65,916,000
123456	Water Town	1	2012	45,936,000	41,988,000	42,253,000	55,698,000	84,649,000

Units	Description of "units"	Base Charge	Amount ($)	Basis	Amount ($) for 3/4" meter	Monthly Minimum	Description	Testing Fee
1,000 gal	NA	Varies		Meter size	$6.00	NA	NA	$0.53
1,000 gal	NA	Varies		Meter size	$6.00	NA	NA	$0.53
1,000 gal	NA	Varies		Meter size	$6.00	NA	NA	$0.53
1,000 gal	NA	Varies		Meter size	$6.00	NA	NA	$0.53

Retail and other (acres)	Office (acres)	Industrial/Util (acres)	Extractive (acres)	Instutional (acres)	Park, Rec, or Preserve (acres)	Golf Course (acres)	Mixed Use Residential (acres)
215	2	92	0	120	1099	0	0

COMM_MET	IND	IND_CONN	IND_MET	AG	AG_CONN	AG_MET	OTH
100	4,593,000	3	3	-	-	-	17,726,000
158	5,647,000	3	3	-	-	-	22,348,000
167	5,710,000	3	3	-	-	-	24,845,000
167	6,874,000	3	3	-	-	-	21,765,000
171	7,032,000	3	3	-	-	-	23,478,000
187	9,704,000	4	4	-	-	-	25,431,000
189	9,675,000	4	4	-	-	-	27,846,000
204	9,719,000	4	4	-	-	-	26,478,200
207	9,654,000	4	4	-	-	-	30,478,000
192	5,476,000	3	3	-	-	-	25,478,000
196	5,647,000	3	3	-	-	-	26,487,000
196	5,542,000	3	3	-	-	-	27,485,000
197	5,651,000	3	3	-	-	-	30,984,200
196	5,882,000	3	3	-	-	-	31,487,000

JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	INSTALLATION_TOTAL
70,270,000	103,838,200	91,878,000	77,469,000	59,722,000	49,692,000	52,498,000	748,726,200
93,664,000	127,234,000	161,030,000	96,188,000	89,495,000	45,903,000	48,497,000	983,639,000
90,030,000	170,098,000	134,600,000	86,148,000	60,255,000	53,350,000	51,686,000	912,904,000
88,720,000	124,629,000	98,030,000	84,790,000	55,240,000	51,160,000	52,064,000	842,871,000
109,895,000	138,776,000	186,409,000	122,618,000	77,239,000	47,180,000	49,700,000	1,023,137,000
95,662,000	157,086,000	132,740,000	92,980,000	66,020,000	50,310,000	51,440,000	932,911,000
89,908,000	178,166,000	105,159,000	109,893,000	73,017,000	49,128,000	63,637,000	947,728,000
177,331,000	181,283,000	138,328,000	96,185,000	51,371,000	51,541,000	54,006,000	1,107,571,000
164,687,000	192,519,000	128,276,000	99,178,000	48,341,000	73,665,000	47,758,000	1,070,736,000
114,060,000	174,737,000	174,148,000	97,911,000	61,892,000	50,959,000	52,542,000	1,012,821,000
112,417,000	151,311,000	115,166,000	114,401,000	58,255,000	45,344,000	48,875,000	1,046,559,028
99,444,000	126,210,000	125,830,000	76,595,000	67,605,000	44,211,000	47,450,000	906,641,000
106,878,000	117,703,000	118,716,000	111,454,000	84,072,000	45,440,000	46,371,000	886,683,000
123,459,000	142,682,000	145,037,000	143,499,000	79,233,000	44,836,000	47,109,000	996,379,000

1st Block $/unit	Units in 1st Block	2nd Block $/unit	Units in 2nd Block	3rd Block $/unit	Units in 3rd Block	4th Block $/unit	Units in 4th block
$1.50	0-5,000	$2.00	5,001-10,000	$2.50	10,001-15,000	$3.00	15,000+
$1.50	0-20,000	$2.00	20,001-40,000	$2.50	40,001-60,000	$3.00	60,000+
$2.00	Summer	$2.75	Winter	--	--	--	--
$2.90	All	--	--	--	--	--	--

Mixed Use Industrial (acres)	Mixed Use Commercial/Other (acres)	Major Roadways (acres)	Agricultural (acres)	Undeveloped (acres)	Open water (acres)	Airport (acres)	Railway (acres)
0	0	83	81	402	513	0	0

OTH_ CONN	OTH_ MET	TOT_ SOLD	TOT_ APPR	RATES	NOTES	MAX_DAY_VOL	MAX_VOL_DATE
14	14	738,999,000	739,169,000	1		12,487,000	6/29/1999
17	17	829,090,000	829,260,000	1		11,117,000	7/1/2000
23	23	868,847,000	869,017,000	4		11,488,000	7/16/2001
20	20	893,930,000	894,100,000	1		20,251,000	7/15/2002
17	17	930,777,000	930,947,000	6		7,843,000	7/3/2003
22	22	943,054,000	943,224,000	1		7,736,000	7/23/2004
25	25	969,399,000	969,569,000	1		7,300,000	8/7/2005
27	27	970,444,200	970,614,200	1		7,710,000	7/20/2006
32	32	963,851,000	964,021,000	6		7,514,000	7/28/2007
28	28	946,307,000	946,477,000	6		6,842,000	5/28/2008
30	30	951,242,000	951,412,000	4		6,241,600	7/21/2009
31	31	872,270,000	872,440,000	4		5,998,000	5/27/2010
34	34	862,154,200	862,324,200	4		5,687,000	6/29/2011
37	37	960,382,000	960,552,000	6		6,746,000	9/3/2012

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Appendix C

Detailed Description of Various Customer Classifications in the Metro Area

Table C-1. All Land Use Type of Sectors and Classifications in the Metro Area

Number and Type of Sectors	Type of Sector Classification - Land Use
1-Sector Type A	All
2-Sectors Type A	All
2-Sectors Type A	Hydrant Sales
2-Sectors Type B	All except separate metered irrigation
2-Sectors Type B	Irrigation
3-Sectors Type C	All except multi-family and bulk sales
3-Sectors Type C	Bulk sales
3-Sectors Type C	Multi-family
3-Sectors Type C	Single family residential
4-Sectors Type D	Multi-family residential
4-Sectors Type D	Commercial/Industrial
4-Sectors Type D	Irrigation
4-Sectors Type E	Residential
4-Sectors Type E	Commercial
4-Sectors Type E	Industrial (>3”)
4-Sectors Type E	Irrigation Meters
4-Sectors Type F	Residential
4-Sectors Type F	Commercial
4-Sectors Type F	Irrigation
4-Sectors Type F	Large-User irrigation
4-Sectors Type G	Residential
4-Sectors Type G	Residential irrigation
4-Sectors Type G	Commercial irrigation
4-Sectors Type G	Commercial non-irrigation
4-Sectors Type H	Residential
4-Sectors Type H	Non-residential (>1-in meter)
4-Sectors Type H	Senior
4-Sectors Type H	Irrigation meters
4-Sectors Type I	Single family dwelling
4-Sectors Type I	Multi-family/mobile homes
4-Sectors Type I	Commercial/industrial/intuitional
4-Sectors Type I	Special senior rates
4-Sectors Type J	Residential/manufactured homes/multi-family
4-Sectors Type J	Commercial/industrial/intuitional
4-Sectors Type J	Irrigation sprinkler accounts
4-Sectors Type J	Bulk water accounts
5-Sectors Type K	Residential

Number and Type of Sectors	Type of Sector Classification - Land Use
5-Sectors Type K	Commercial
5-Sectors Type K	Industrial
5-Sectors Type K	Institutional
5-Sectors Type K	Irrigation only meters
5-Sectors Type L	Residential
5-Sectors Type L	Residential irrigation
5-Sectors Type L	Commercial/industrial
5-Sectors Type L	Commercial/industrial irrigation
5-Sectors Type L	Oversized commercial meter
5-Sectors Type M	Residential
5-Sectors Type M	Multi-family residential
5-Sectors Type M	School-institutional
5-Sectors Type M	Irrigation
5-Sectors Type M	Bulk sales
6-Sectors Type N	Residential
6-Sectors Type N	Commercial
6-Sectors Type N	Hotel
6-Sectors Type N	Bulk water from hydrant
6-Sectors Type N	Sod installation (new construction)
6-Sectors Type N	Swimming pool fill
8-Sectors Type O	Residential – in city
8-Sectors Type O	Residential – out of city
8-Sectors Type O	Commercial w/irrigation meter – in city
8-Sectors Type O	Commercial w/irrigation meter – out of city
8-Sectors Type O	Commercial w/o irrigation meter – in city
8-Sectors Type O	Commercial w/o irrigation meter – out of city
8-Sectors Type O	Irrigation – in city
8-Sectors Type O	Irrigation – out of city

Table C-2. All Meter Size Type of Sectors and Classifications in the Metro Area

Number and Type of Sectors	Type of Sector Classification – Meter Size
2-Sectors Type P	5/8", 3/4" and irrigation meters
2-Sectors Type P	All other meter sizes
7-Sectors Type Q	1” meter
7-Sectors Type Q	1.5” meter
7-Sectors Type Q	2” meter
7-Sectors Type Q	3” meter

Number and Type of Sectors	Type of Sector Classification – Meter Size
7-Sectors Type Q	¾” meter
7-Sectors Type Q	4” meter
7-Sectors Type Q	6” meter
7-Sectors Type R	Residential
7-Sectors Type R	Non-residential 1” or less meter
7-Sectors Type R	Non-residential 1.5” or less meter
7-Sectors Type R	Non-residential 2” or less meter
7-Sectors Type R	Non-residential 3” or less meter
7-Sectors Type R	Non-residential 6” or less meter
7-Sectors Type R	Irrigation and water used through hydrant