

WATER DEMAND IN THE CHICAGO METROPOLITAN AREA

BY

TARO MIENO

B.S., Hokkaido University, 2007

THESIS

Submitted in partial fulfillment of the requirements
for the degree of Master of Science in Agricultural and Consumer Economics
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2009

Urbana, Illinois

Advisor:

Professor John Braden

Abstract

Illinois faces a legally defined quota for the amount of water that it is allowed to pump from Lake Michigan. Separately, in Northeastern Illinois, the ground water level has fallen due to pumping pressure. Together, these constraints on water supply could limit economic and population growth in the Chicago Metropolitan area. There are two alternatives to meet the area's growing demand: pumping water from distant sources, or using the available water more efficiently. The former will require huge investments in infrastructure, while the latter could postpone or circumvent those investments. In light of these facts, curbing water demand, rather than expanding water supply, seems like a promising option. The objective of study is to understand water demand in the Chicago area by examining the effects of water price, weather conditions, and socio-demographic characteristics on water use in Chicago Metropolitan Area. Economic theory tells us that water demand should be responsive to water price. For policy makers, consumer responsiveness to water price changes will be invaluable information when considering long term strategies to ensure the efficient and conservative use of Chicago's water resource.

Acknowledgments

It would not have been possible to write this thesis without help and support from a lot of people, to only some of whom it is possible to express my particular thanks here.

First and foremost, I would like to thank my advisor, Professor John Braden, who provided me guidance through every aspect of this research with his patience and knowledge while allowing me the room to work in my own way. His insight, enthusiasm, and clear explanation have made this project a lot of fun for me since I stepped into the world of water studies.

I am also greatly indebted to my other committee members, Professor Amy Ando and Professor Nicholas Brozović, who have offered thoughtful and invaluable suggestions to my thesis.

I would also like to express my gratitude to my peers in the ACE Graduate program for providing a stimulating and fun learning environment.

Last but by no means least, my family has been always very supportive of every decision I made in my life. Without their encouragement, unconditional support and love, I would not have been able to make it this far.

Table of Contents

List of Abbreviations	v
List of Tables	vi
List of Figures	viii
1. Introduction and Motivation	1
2. Specifying Water Demand	7
Dependent variable: water consumption	7
Independent variables	8
3. Data and Empirical Methodology	13
Data	13
Model construction	15
Estimation methodology	20
4. Results	22
Water price	22
Other variables	25
5. Discussions and Conclusions	27
Effects of income on water price elasticity	28
Summertime water use	29
6. Summary	31
Tables and Figures	33
References	40
Appendix A: Data Request Form	43
Appendix B: Matlab Codes	46
Appendix C: Income Calibration	47
Appendix D: Estimation Methods Selection And Potential Biases	49
Appendix E: Selected Data	58

List of Abbreviations

CMAP	Chicago Metropolitan Agency for Planning
IDNR	Illinois Department of Natural Resources
IPCC	Intergovernmental Panel on Climate Change
JAWA	Joint Action Water Agency
mgd	million gallons per day
NOAA	National Oceanic and Atmospheric Administration
RWSPG	Regional Water Supply Planning Group

List of Tables

1	Definition of variables and data source	33
2	Summary statistics	34
3	Weather stations	34
4	Regression results	35
5	Wintertime water price elasticity	36
6	Summertime water price elasticity	36
7	Necessary water price increase to achieve 3% water conservation . . .	36
8	Necessary summertime water price increase to achieve 3% water conservation	37
9	Differences in expenditures to achieve 3% water conservation	37
C-1	County level income trends	48
C-2	Income calibration for Addison	48
D-1	Regression results with OLS and fixed effects estimation	52
D-2	Regression results with different samples	53
D-3	Regression results with an added interaction term between water price and rate of renters	54
D-4	Estimation results with different independent variables	55
E-1	Historical record of average water consumption per household (by 1000 gallons): Addison	58
E-2	Historical record of average water consumption per household (by 1000 gallons): Buffalo Grove	58
E-3	Historical record of average water consumption per household (by 1000 gallons): Hoffman Estates	59
E-4	Historical record of average water consumption per household (by 1000 gallons): Libertyville	59
E-5	Historical record of average water consumption per household (by 1000 gallons): Naperville	59
E-6	Historical record of average water consumption per household (by 1000 gallons): Orland Park	59
E-7	Historical record of average water consumption per household (by 1000 gallons): Plain Field	60
E-8	Historical record of average water consumption per household (by 1000 gallons): Roselle	60
E-9	Historical water and sewer prices 1 (\$).	61

E-10 Historical water and sewer prices 2 (\$)	67
E-11 Historical precipitation 1 (inch)	73
E-12 Historical precipitation 2 (inch)	79
E-13 Historical temperature 1 ($^{\circ}F$)	85
E-14 Historical temperature 2 ($^{\circ}F$)	91

List of Figures

1	Distribution of price elasticity in winter	37
2	Distribution of price elasticity in summer	38
3	Comparison of expected water use: Addison (In Thousand Gallons) .	39
A-1	Water rate request form	44
A-2	Sewer rate request form	45
D-1	Distribution of price elasticity calculated for municipalities except both municipalities based on the estimation results from the full sample . .	56
D-2	Distribution of price elasticity calculated for municipalities except both municipalities based on the estimation results from the sample without both municipalities	56
D-3	Distribution of summertime price elasticity calculated for municipalities except both Orland Park and Libertyville, based on the estimation results from the sample without both municipalities	57

1. Introduction and Motivation

Northeastern Illinois borders Lake Michigan, one of the largest bodies of water in the U.S, and has large ground water aquifers. Water shortages have consequently rarely been a problem in the region. Other parts of the state are not as fortunate: Springfield, the capital city of Illinois, experienced a long and costly drought in 2005. In addition, a report entitled “Troubled Water: Meeting Future Water Needs in Illinois” predicts that, in the near future, some areas are likely to face water shortages because of expected increases in water demand due to population and economic growth. On January 2006, Governor Blagojevich issued Executive order 2006-01 ¹ that called for state-wide water supply planning. The Chicago Metropolitan Agency for Planning (CMAP) was commissioned by the State of Illinois Department of Natural Resources to facilitate this planning process in Northeastern Illinois. CMAP created a Regional Water Supply Planning Group (RWSPG) to lead this process and prepare a water resource management plan. In the course of the RWSPG’s work, Dziegielewski and Chowdhury (2008) forecasted that water use in the region could grow by up to 64% by 2050. However, on the supply side, the amount of water available to Illinois is physically and legally limited. After the reversal of the Chicago River in 1900, followed by a series of law suits, the U.S. Supreme Court decreed that Illinois is allowed to draw no more than 3,200 cubic feet per second (approximately 24, 000 gallons per second) of water from Lake Michigan. Starting from 1864, when the first well was drilled in Chicago, groundwater has been heavily pumped in the Northeastern Illinois region, peaking

¹<http://www.illinois.gov/PressReleases/ShowPressRelease.cfm?SubjectID=3&RecNum=4579>

at 182.9 million gallons per day (mgd) in 1979 (Visocky 1997). Consequently, considerable decreases in the aquifer water levels were observed. After 1980, when large portions of DuPage and Lake Counties shifted from groundwater to Lake Michigan water, the aquifer water levels started to rise slowly. The report by Dziegielewski, however, predicted that demand for groundwater could grow up to about 400 mgd per day by 2050 from about 150 mgd at present. Realization of this prediction would again cause groundwater extraction at unsustainable rates. Moreover, because of uncertainties in future climatic conditions at the regional scale caused by ongoing and accelerating global warming, the future physical water availability is at best uncertain. Water shortages will be likely events in the Chicago Metropolitan area if no measures to conserve water are taken. Traditionally, across the U.S., the solution to meet growing water demand has long been to increase water supply. However, supply enhancement, which involves enlarging water treatment facilities, expanding water pipes, drilling wells or creating dams, is expensive. Moreover, since the easily accessible water sources have already been developed, remaining water sources will require increasingly expensive infrastructure. Growing concern about the environment² also makes an increase in water supply less appealing because less water is left for ecological purposes. These costs associated with water supply enhancement have led water managers to consider water demand management. Water demand management is a more cost-effective way to accommodate water demand in the sense that it could delay or even avoid future expensive investments in water supply enhancement. Aware of these benefits of water demand management, RWSPG also considers it an important strategy to manage increasing future water demand in the Chicago area. In order for water managers to implement residential water demand management, it is essential to know what factors affect residential water demand. Many water

²It is worth noting that RWSPG's principal objective is to provide adequate amount of water at affordable cost to support not only resident's quality of life and economic growth but also the natural ecosystem in Northeastern Illinois.

demand studies have been done so far. The geographical focus of existent studies, however, has been largely on the arid Southwest, where people have long suffered from frequent and long-lasting water shortages (Espey et al., 1997). Water use habits in Illinois, which is blessed with relatively abundant water, might be significantly different from ones in those arid areas. A 2003 meta-analysis done by Dalhuisen et al. show that people are more responsive to changes in the water price in western areas than in eastern areas. This implies that when it comes to applying the estimation results to actual policy making, site-specific study is the most valuable. To this author's knowledge, however, only two studies have analyzed residential water consumption in Illinois (Wong, 1972; Dziegielewski and Chowdhury, 2008). Wong points out that the consumption data used in his study is unreliable because at that time, many systems had no metering. Moreover, the data are now rather dated and might not reflect current water use trends. Dziegielewski and Chowdhury studied public water (as defined by EPA) use based on annual water consumption of 37 study sites in northeastern Illinois. By its definition, public water could include residential, industrial, and commercial water uses. Therefore, applicability of the estimated water demand function for water demand management in the residential sector alone is limited. Therefore, a contemporary study of residential water demand in the Chicago metropolitan area, may assist the RWSPG as it considers demand management possibilities for the future.

Water demand is likely to be affected by many factors including price, demographic, characteristics of households, existing economic policies, climate conditions, water using technologies, and plumbing codes. Among these factors, we give special attention to the effect of water price for two main reasons. First, it is one of the few factors over which water managers have direct control. Second, water pricing is a cost-effective way to influence water use. Economists classify policies on the use of a particular good into two groups: price-based and regulatory approaches. In the area of water conservation, water managers have historically emphasized prescriptive

regulations to achieve water conservation (Olmstead and Stavins, 2008). For example, when faced with state-wide drought through the mid-1980's and early 1990's, California carried out various kinds of nonprice programs. For example, from 1980 to 1995, Los Angeles implemented public education, encouraged local government to require the adoption of water-efficient appliances, and applied direct water use restrictions on certain types of use³(Michelson et al., 1998). However, price-based approaches, in principle, have the advantage of cost-effectiveness (Pigou, 1920; Baumol and Oates, 1988). This advantage arises from heterogeneity in the marginal value of water use. For example, uniform water use restrictions inevitably make the marginal willingness to pay for water vary across households with different numbers of occupants, incomes, and preferences, thus creating dead-weight loss. Empirical studies that look at welfare implications of price-based and non-price based approaches for water demand reduction support the conclusion that price-based policies increase economic welfares (Brennan et al., 2007; Olmstead and Stavins, 2008).

Recognizing the potential of water pricing as a way of promoting efficient water conservation, RWSPG is also considering water pricing as a mean to promote efficiency and conservation in Northeastern Illinois. When it comes to implementing water pricing, it is essential to know how much water reduction could be achieved through changes in price. This information is summarized in the price elasticity of water demand-the percentage change in demand caused by a one percent price increase.

As of 2003, more than 64 studies on water demand had been published and over 300 estimates of price elasticity produced (Dalhuisen et al., 2003). A methodological focus of the existing water demand literature has been on the econometric difficulties caused by block rate pricing, which is commonly used in U.S⁴. In block

³Renwick and Green (2000) address the effect of non-market based water conservation strategies carried out in California on water reduction

⁴Having faced with chronic water scarcity, increasing number of water utilities have come to apply increasing block rates for conservation purpose (Hanemann, 1997). In fact, in 2002, one-third of residents were faced with increasing

rate structures, the marginal charge changes according to the amount of consumption. Because the water price depends on the amount of water consumption, the two are spuriously correlated in an econometric estimation. This could bias the coefficient estimate on water price unless measures are taken to deal with the problem. For example, in the case of increasing block rates, water price and water consumption are positively correlated, thus leading to underestimation of how responsive people are to price increases. Detailed discussion on this issue is to be reviewed later in the methodology section.

However, beyond this important methodological concern, few studies investigate how other factor such as socio-economic and climate factors affect the price elasticity of water demand. That information is potentially useful to water managers when implementing water pricing. For example, Carver and Boland (1980), Howe (1982), Griffin and Chang (1990), and Lyman (1992) show that the price elasticity of water demand is higher in summer than in winter. In summer, discretionary uses, like watering lawns, washing cars and filling swimming pools, comprise a larger portion of total water use than in winter, when water use is basically limited to inelastic indoor sanitary uses. This implies the possibility of seasonal water pricing, where the water rate is set higher in summer.

Despite its theoretical cost-effectiveness advantage over quantity restrictions on water use, water pricing is by no means a panacea. There are many aspects other than cost-effectiveness that water managers need to contemplate when implementing water-pricing policies. Equity is one of the important dimensions of water demand management. Water is widely held to be a basic necessity that should be available to all at reasonable cost (Mansur and Olmstead, 2007). Agthe and Billings (1987) and Mansur and Olmstead (2007) empirically show higher water price elasticity for lower-income households and argue that an equity problem arises

block rates (Olmstead et al., 2007). Also in Illinois, block rate pricing is common form of water pricing. Dziegielewski et al. (2004) directed a mail survey to 1724 water systems in Illinois and found out that out of 426 responding systems, 148 were using block rate pricing. However, only 16 were using increasing block rate and 132 were still using decreasing block rate. Therefore, instead of increasing block rate pricing, decreasing block rate is still dominant in Illinois.

because lower income households contribute a larger portion of total water reduction. Therefore, exploring what and how other factors affect water price elasticity could generate useful information for water managers who are considering water pricing as a measure to achieve water conservation.

Water use patterns in summer are particularly important. Water infrastructure is built so that it can meet the peak summertime water demand. This makes water use reduction in summer especially valuable because it would avoid or delay future costly investments in water infrastructure, the biggest contributor to the production costs of water. Therefore, insight into water use during summer is especially valuable. We specifically examine the effect of income on water demand and whether temperature and rainfall affect water demand differently in summer and winter. The contributions of this study to water demand literature are two. First, this study provides the first contemporary residential water demand analysis focused particularly on Illinois. Second, it explores a rather undeveloped field in the water demand literature: specifically, what affects water price elasticity and summertime water use.

2. Specifying Water Demand

In most water demand studies, a general water demand function can be framed as $Q_w = f(P, X)$, where Q_w , P , and X , represent water consumption, price, and other variables, respectively. The variables selection and functional form vary greatly from study to study. In this section, drawing on the water demand literature, the study develops a water demand model within this framework.

Dependent variable: water consumption

In the literature on water demand, specification of the water consumption unit has taken various forms, including per person, per household, and per community. By far the most common unit is water consumption per household. This is the basic unit of water use measurement in most communities. The level of aggregation of water consumption further differentiates how Q_w is defined. When household-level consumption data are not available and only aggregate data are available, which is the typical case for water demand studies, the average water consumption of the typical household in a community is often used. In theory, actual household level water consumption data is preferred over an aggregate proxy because it reveals the full variability of actual use and the true heterogeneity of the uses. That variability supports more precise and reliable results. However, because the data collection process often involves confidentiality issues, it is extremely hard to obtain household level data. Even if one succeeded to obtain household level consumption data, other household variables, especially income data, are difficult and costly to obtain. This

is the main reason for the dearth of water demand analyses at the household level. Some studies that managed to do this are Nieswiadomy and Molina (1989), Hewitt and Hanemann (1995), Arbués and Villanúa (2006), and Olmstead et al. (2007). The list is very short compared to large number of studies that use aggregate water consumption and demographic data. For these same reasons of data access, this study proceeds with aggregate data.

The time-frame of water quantity demand also differs between studies, ranging from daily to annual. While annual water consumption does not allow for taking into account the seasonality of water consumption, daily water consumption is rarely recorded. The time frame used in this study is monthly. Monthly data are commonly used for billing purposes and are therefore readily available. Monthly data also capture seasonal changes in water consumption. The use of monthly consumption data automatically defines the time-frame of independent variables as monthly.

Independent variables

Price

Water tariffs normally consist of two parts. One is a monthly fixed charge that each customer pays irrespective of the amount of water consumption, and the other is a non-fixed charge that depends on the amount of water consumption. The fixed charge is intended to cover the costs of infrastructure that do not vary with water use. A fixed charge reduces water demand through income effects. Since water is a normal good, an increase in the marginal price of water gives consumers an incentive to consume less water.

The marginal price of water in the model is defined as the combination of the water price and sewer price. Sewer charges are almost always proportionate to water consumption. Increases in sewer and water prices often occur at the same time.

Therefore, excluding the sewer price might result in overestimation of the absolute value of the price elasticity of water demand.

Aggregate residential water consumption data includes the amount used in rental as well as self-owned properties. While owner-occupied units can safely be assumed to bear the full cost of water prices, this is not necessarily the case for rentals. Water costs may be lumped into the basic rental charge. In such cases, residents do not directly face water prices and those prices provide no incentive to conserve water. Thus the inability to separate out water consumption by households whose water bills are fixed could result in negative bias in the absolute magnitude of water price elasticity.

Income

In addition to price, another potential driver of water demand is income. Higher-income households are more likely to have water intensive characteristics, such as larger lawns and gardens, and swimming pools. Therefore, larger income is expected to be positively correlated with water demand. Income has an interesting relationship to water price elasticity. If income increases in greater proportion than water use, water charges will represent a decreasing share of income and become a lesser concern for consumers. At the same time, for wealthier households, larger share of the water use is highly discretionary and, potentially, responsive to price changes. Therefore, there exist two opposite effect of income on water price elasticity. Income could potentially either positively or negatively affect water price elasticity depending on the relative magnitudes of the two effects. Empirically, the income level has been shown to lead to lesser responsiveness to water price. Renwick and Archibald (1998) divide their sample into 4 different income classes and estimate price elasticities for each class. They find that the price elasticity of water demand is higher for low income households than middle and high income households. Agthe and Billings (1987) and Mansur

and Olmstead (2007) also empirically show higher water price elasticity for lower-income households. They argue that the income level affects the effectiveness of water reduction achieved by increasing water price and that an increase in price causes lower-income households to contribute a disproportionately share of total water reduction. This could be a significant concern for water managers since an increase in water price inevitably raises political tension for communities. Further research on how income level influences water price elasticity is therefore useful.

Home features

Ownership of swimming pools and lot sizes have both proven to explain water demand variation (e.g, Howe and Linaweaver (1967), Nieswiadomy and Molina (1989), Hewitt and Hanemann (1995), and Dandy et al. (1997)). Unfortunately data regarding these variables are not available for Chicago-area water systems. Inclusion of an income variable will indirectly reflect at least some of the effects of these variables on water demand because income is considered to be highly correlated with these variables (Hewitt and Hanemann, 1995; Dandy et al., 1997).

Household size and characteristics

The number of people in a household also seems likely to affect water demand. Brennan et al. (2007) showed larger families consume more water, but with diminishing water consumption per additional family member because of economies of scale, for example, in dish washing and lawn watering. However, the effect of household size on water demand is rather ambiguous in this study. A larger household does not necessarily mean a larger amount of water consumption. For example, a married couple living in a large house with large garden and a swimming pool would consume more water than three college students living in a small house with no garden. Therefore, correction for these attributes of a housing unit would be required to isolate the pure effect of household size on water demand. However,

as mentioned above, no data were available for those variables.

Climate and seasonality of water use

In a temperate climate, water consumption exhibits strong seasonality. In some municipalities, water consumption in summer is two or more times as high as that in other seasons (see Appendix E). Water consumption can be decomposed into two parts: non-discretionary and discretionary. Non-discretionary water use covers basic and indispensable needs such as drinking, cooking, toilet flushing, bathing, and laundering. Water use for these purposes is needed to maintain a minimum quality of life and occurs mostly indoors. For these reasons, non-discretionary water use is considered to be relatively invariant across the year and insensitive to climate and price. Discretionary water use is for washing cars, filling swimming pools, and watering lawns and gardens. Discretionary water use is the main driver of seasonality because those uses become more active as the temperature goes up. Apart from seasonal differences in temperature that influence outdoor activities, precipitation also should affect water demand because rainfall provides lawns or gardens with water and reduces water demand.

Water use pattern in summer is considerably different compared to winter as described above. Thus, it is likely that the effect of independent variables on water demand could be substantially different between summer and winter. The key factor that differentiates water use pattern is more intensive discretionary water use in summer.

Because of higher proportion of discretionary water use in summer, people are more responsive to changes in water price in summer. The price elasticity of water demand for indoor uses is considerably lower than that for outdoor uses (Foster and Beattie, 1967; Morgan and Smolen, 1990; Mansur and Olmstead, 2007). For example, using a unique data set which differentiates indoor water use and outdoor water use, Mansur and Olmstead (2007) report elasticity estimates of -0.0727 for

indoor and -0.6836 for outdoor uses. This large difference between the price elasticities of indoor and outdoor water demand implies greater responsiveness to price in summer when the rate of discretionary water use is higher (Carver and Boland, 1980; Howe, 1982; Griffin and Chang, 1990; Lyman, 1992).

Moreover, the possession of swimming pools and larger lawns and gardens are positively correlated with income. This implies that the impact of income on water demand can be considerably larger in summer than in winter. Finally, the differences between the effects of climatic conditions in summer and winter could also be not negligible. While Michelson et al. (1998) showed climate variables has no statistically significant effects on water demand irrespective of the season, Balling. et al. (2008) showed that larger lots, swimming pools, and larger mesic landscapes are correlated with higher sensitivity to climate conditions, which implies that sensitivity of water consumption to temperature and precipitation might be higher in summertime, where outdoor uses comprise a larger part of demand than in other seasons.

3. Data and Empirical Methodology

Data

Illinois Department of Natural Resources (IDNR) has kept track of annual residential water consumptions for all the municipalities in the Chicago metropolitan area that use water from Lake Michigan. However, no intra-annual water consumption data are readily available for Chicago area municipalities. The use of monthly water consumption data is essential to capture the seasonality of water use. In addition, since water prices can change intra-annually, and billing typically is monthly or bimonthly, monthly consumption data align best with household decision-making. Unfortunately, monthly water prices also are not readily available. IDNR had conducted a water price survey every five years (1995, 2000, and 2005) for all the municipalities in the Chicago metropolitan area that use water from Lake Michigan. However, the survey produces observations at a particular point in time. In order to specify water price correctly, knowledge of exactly when price changes occurred is vital. Therefore, the most critical variables in this study were not available at a satisfactory time-scale and had to be collected.

For monthly water consumption data, we first contacted the water utilities in the Chicago metropolitan area that wholesale water to municipalities, hoping that they had kept a historical record of water sales to each municipality. The wholesalers we addressed were the City of Chicago, DuPage Water Commission, Central Lake County Joint Action Water Agency, Evanston, Northwest Suburban Municipal JAWA, Oak Lawn, and Waukegan. They did have water sales data for individual

municipalities, but, unfortunately, they were not able to distinguish residential, commercial, and industrial water uses. Parallel to this investigation, using contact information obtained from IDNR, we contacted 180 municipalities in the Chicago Metropolitan area to obtain water tariff data for the period 1995 to 2007. We requested the following information (see Appendix A for the request form):

1. Monthly water and sewer prices. For communities using block rate pricing, the amount of water at which price changes and the price in each block were also requested
2. Billing frequency-monthly, bimonthly, or otherwise.
3. Fixed cost, i.e., the payment each customer makes irrespective of the amount of water consumed
4. An e-mail address and a phone number of the person in charge

Thirty-one municipalities provided us with their water tariff data. Via e-mail, we subsequently asked for monthly residential water consumption data for the 31 municipalities for which we obtained the water tariff data. Some did not reply and others did not retain the data. In the end, eight municipalities provided complete water tariff and water consumption data: Addison, Buffalo Grove, Hoffman Estates, Libertyville, Naperville, Orland Park, Plain Field, and Roselle.

Historical mean temperatures and precipitation data in the Chicago region were obtained from NOAA weather stations around Chicago (see Table 3 for the complete list of weather stations). Because the weather stations do not necessarily correspond geographically to the municipalities of interest, the centroid of each municipality was determined using ArcGIS and the adjacent weather station data were interpolated to the centroids using Matlab (see Appendix B for the Matlab codes used).

Because consumption and price information are observed at the municipality level, consumer characteristics also are aggregated. Socio-demographic data, namely

median income, average household size, the number of households, and the number of renter-occupied housing units (a proxy for rentals), were extracted from the 2000 decennial census and 2005-2007 American Community Survey 3-Year Estimates.

The number of households and the number of renter-occupied housing units are not directly included in the model, but they are used to obtain the average water use and the rate of renter-occupied housing units, respectively. None of these variables were collected in the years 1995 through 1999 and 2001 through 2005 and 2007. For all these variables, except median income, linear interpolation and extrapolation are used to fill the missing years. For income, linear interpolation and extrapolation methods are questionable because it is susceptible to economic status. Instead, we used annual income growth rates at county level obtained from the Survey of Small Area Income & Poverty Estimates conducted by the U.S. Census Bureau⁵ (see Appendix C for more details).

The definition of the variables and summary statistics are shown in Tables 1 and 2, respectively.

Model construction

The dependent variable in this study is monthly average water consumption per household, obtained by dividing monthly total water use by the number of households. The use of monthly consumption data automatically defines the time-frame of independent variables as monthly.

Specification of the water price

The specification of the water price variable has been the most controversial issue in water demand estimation studies. Underlying the controversy is the common practice of "blockrate" pricing. With block rate price structures, the marginal

⁵<http://www.census.gov//did/www/saipe/>

charge changes according to the amount of consumption. For example, a tariff of $\$P_1/gal$ might be charged for the first 1000 gallons consumed in a month. A different tariff $\$P_2/gal$ might be applied to the next 2000 gallons, and so forth. Where $P_1 < P_2 < \dots P_n$, the price structure is termed "increasing block rate." If the inequalities are reversed, then prices would have a "decreasing block rate" structure. From a statistical perspective, price and use are correlated because marginal price is determined by use. The correlation of use and price could bias the coefficient estimate on the water price variable unless some measures are taken. In our application, there are two municipalities that did not use flat rate: Libertyville and Orland Park (see Appendix E for their price structures). Orland Park started to use increasing block rate from January, 2002. Libertyville charges minimum rate for the first 4 kilo gallons and applies uniform rate after 4 kilo gallons. For example, in 2007, minimum rate was \$22.20 and uniform rate was \$4.18 per thousand gallons. Therefore, residents face the marginal water price of 0 for the first 4 thousand gallons. In this respect, this price structure can be regarded as an increasing block rate. The inclusion of the data could bias the estimate of the coefficient on water price if left untreated.

Most early studies employed the marginal price corresponding to the block rate where the user (or with aggregate data, the typical user) consumed without taking any measures to correct for potential bias (e.g., Howe and Linaweaver (1967)). Then, in 1975, Taylor suggested adding a difference variable (D), defined as the actual total payment minus the total amount a consumer would have paid if the typical user consumed all units at the marginal price. Nordin (1976) showed that the D variable should have the opposite sign as the income coefficient but the same absolute magnitude. However, many studies that follow Nordin's specification do not support his claim that the magnitude is the same. Schefter and David (1985) attributed the inconsistency to the use of aggregate data. They pointed out that mean marginal price and mean difference are appropriate measures if the remaining

variables are averages, and that these averages must be properly weighted by the distribution of the numbers of users per block. The studies by Corral et al. (1998) and Martínez-Espiñeira (2002b) use properly weighted marginal prices partly because they are based on data for the actual water consumption of individual households, and, thus know the exact marginal price of each one. Interestingly, Martínez-Espiñeira (2002b) empirically showed that the water price elasticity estimated with Nordin's specification is not significantly different from one based on a properly weighted marginal price and D variable. Unfortunately, household data were not available for our study. So, we assume that the typical user consumes the average amount of water each month. Based on this assumption, we calculate the marginal water price and the D variable. As Schefter and David (1985) pointed out, this specification inevitably biases the estimate of water price elasticity because it assumes all households consume in the same block. The price specification in this study also precludes testing for different income effects in summer and winter. Compared to winter, more customers are expected to consume in the second block in summer. If the water use distribution were available, properly weighted marginal price could be computed and the D variable should be higher in summer and lower in winter. Instead, our approach encompasses two extreme cases. All consumers are assumed to consume in either the first price block or the second price block depending on how much water the typical household consumes in that month. Even though this is not the best way to deal with block rate pricing, this is the best that can be done with our data set.

Functional form

In water demand studies, the functional form of water consumption has usually been linear, double-log, or log-linear. The most common functional form is linear (e.g, Agthe and Billings (1980), Stevens et al. (1992), Corral et al. (1998), Pint (1999), Martínez-Espiñeira (2002a)). The linear functional form implies that the

rate of changes in water consumption to changes in the water price is constant⁶.

This implies that the elasticity of water demand decreases in absolute magnitude as price decreases along the demand curve. In contrast, the double-log functional form imposes constant price elasticity along the demand curve (e.g, Renwick and Green (2000), Nauges and Thomas (2000), Nieswiadomy (1992)). This functional form is widely used because of the ease of obtaining the price elasticity estimates. It also implies that the same absolute increases in the water price achieve larger amount of water demand reduction when the water demand level is higher and the water price level is lower⁷. The log-linear functional form implies that the same absolute increases in the water price becomes larger when the water consumption level is higher, but is not affected by the price level unlike the double-log⁸. Examples that used log-linear functional form are Lyman (1992) and Renzetti (1992).

The linear functional form implies that there exists a choke price, where water consumption is zero (Arbués et al., 2003), while the double-log and log-linear functional forms avoid this. However, this won't be of concern in this study because the ranges of the demand and water price are rather narrow.

There is no consensus on which functional form to use. Therefore, all three functional forms are tried in this study.

As noted above, water price elasticity is known to be affected by the income level. The municipality-level income data for our study have insufficient cross-sectional variation to follow the classification methodology of Renwick and Archibald (1998) or Olmstead and Stavins (2008). Moreover, real income has increased consistently throughout the years covered, making it difficult to place a municipality into a single income class throughout the studied period. Thus, instead of classifying communities by income, we interact water price with median real annual household income in order to investigate the degree to which income affects the price elasticity

⁶ $\partial AW = \beta \times \partial WP$, where β is a coefficient estimate

⁷ $\partial AW = \beta \times \frac{AW}{P} \partial WP$

⁸ $\partial AW = \beta \times AW \partial WP$

of water demand.

Discretionary water use is associated with warm weather and is the main contributor to variability in water quantity demanded throughout the year. To capture the seasonality of water consumption we include a summer dummy that takes the value of 1 in June, July, August, September, and October, otherwise 0. In addition, four terms are interacted with the summer dummy in order to capture seasonal differences of water consumption. First, water price is interacted to test for seasonal differences in water price elasticity. The second interaction is with income to capture the difference in water use in summer between higher income households and lower income households. The other interactions are with temperature and precipitation to find out the seasonal difference in the impact of climate variables on water demand. Other variables included in the models are the fixed water charge, household size, and the rate of renter-occupied housing units to total housing units. The three models to be estimated are as follows (The definition of the variables are shown in Table 1);

$$\begin{aligned}
AW = & \beta_0^1 + \beta_1^1 WP + \beta_2^1 \ln(Y) + \beta_3^1 HS + \beta_4^1 D + \beta_5^1 F + \beta_6^1 R \\
& + \beta_7^1 ST + \beta_8^1 WT + \beta_9^1 RR + \beta_{10}^1 SD + \beta_{11}^1 WP \cdot \ln(Y) \\
& + \beta_{12}^1 WP \cdot SD + \beta_{13}^1 \ln(Y) \cdot SD + \beta_{14}^1 R \cdot SD + \mu_1
\end{aligned} \tag{1}$$

$$\begin{aligned}
\ln(AW) = & \beta_0^2 + \beta_1^2 \ln(WP) + \beta_2^2 \ln(Y) + \beta_3^2 HS + \beta_4^2 D + \beta_5^2 F + \beta_6^2 R \\
& + \beta_7^2 ST + \beta_8^2 WT + \beta_9^2 RR + \beta_{10}^2 SD + \beta_{11}^2 \ln(WP) \cdot \ln(Y) \\
& + \beta_{12}^2 \ln(WP) \cdot SD + \beta_{13}^2 \ln(Y) \cdot SD + \beta_{14}^2 R \cdot SD + \mu_2
\end{aligned} \tag{2}$$

$$\begin{aligned}
\ln(AW) = & \beta_0^3 + \beta_1^3 WP + \beta_2^3 \ln(Y) + \beta_3^3 HS + \beta_4^3 D + \beta_5^3 F + \beta_6^3 R \\
& + \beta_7^3 ST + \beta_8^3 WT + \beta_9^3 RR + \beta_{10}^3 SD + \beta_{11}^3 WP \cdot \ln(Y) \\
& + \beta_{12}^3 WP \cdot SD + \beta_{13}^3 \ln(Y) \cdot SD + \beta_{14}^3 R \cdot SD + \mu_3
\end{aligned} \tag{3}$$

, where β_j^i represents the coefficient for model i on independent variable j , $\mu - i$ represents the error term.

Estimation methodology

Our data set has a panel structure with 8 cross-sectional observations and 14 years (168 months) at its longest. The panel is unbalanced, as the length of each series is not consistent. In addition, data were not available regarding ownership of swimming pools and lot sizes for each municipality. This is unfortunate because these have both shown to explain water demand variation. However, they are correlated strongly with income (e.g, Howe and Linaweaver (1967), Nieswiadomy and Molina (1989), Hewitt and Hanemann (1995), and Dandy et al. (1997)). Thus, due to omitted variables, this model violates the necessary condition for unbiased OLS estimation.

In order to minimize the bias, a fixed effects estimation method is applied. In the fixed effect model, the swimming pool and lot size variables are embedded in a municipality-specific unobserved term. By taking differences across the consecutive time periods, the municipality-specific unobserved term is eliminated. Moreover, the fixed effects model allows for correlation between the unobserved term and explanatory variables for its consistent estimation. Some water demand studies apply a random effects model, which is a more efficient estimation method for panel data (e.g., Martínez-Espíñeira (2002b)). However, the random effects model does not allow for correlation between unobserved terms and explanatory variables for consistent estimation. Since this condition will not hold for our data set, this study applies only the fixed effects model.

The elimination of the unobserved term in the fixed effect model is based on the assumption that lot sizes and possession of swimming pools did not change within a municipality over time. Therefore, even though this approach neutralizes the risk of potential omitted variable bias arising from cross-sectional variance in lot sizes and ownership of swimming pools, the fixed effects model still has a potential risk of omitted variable bias from relative changes in those characteristics over time.

Moreover, minimization of the potential risk of omitted variable bias does not come for free. Fixed effect estimation involves a loss of the cross-sectional variance in the independent variables, thus rendering the estimation less efficient.

4. Results

Three fixed effect models are estimated⁹. The results appear in Table 4. All three models are very similar in terms of the statistical significance of climate and household characteristics variables. This indicates that estimation results for those variables are robust across the functional forms. However, there exist notable differences in statistical significance when it comes to water price, income, and their interaction terms. While both water price and its interaction with income are statistically significant in the linear and log-linear models, they are not in the double-log model. However, this does not seem to indicate that double-log functional form is an inappropriate form. Rather, their statistical insignificance is likely to be the consequence of the small variance in the logarithmic transformation of the water price and income variables. The inclusion of interaction terms may also be to blame because it introduces stronger multicollinearity. For further interpretation of the results, the log-linear model is used as it shows the best fit in terms of the statistical significance.

Water price

The coefficient on the water price is negative and statistically significant. However, water price is also included in two interaction terms, so these terms must also be taken into account in order to understand the effect of changes in the water price on water demand. As can be seen from Table 4, income has a statistically

⁹see Appendix D for OLS estimation

significant positive effect (a negative absolute effect) on the price elasticity of water demand, i.e., the elasticity approaches zero as income increases. Thus, the higher the income, the less sensitive people are to a change in water price. This finding accords with the findings of Renwick and Archibald (1998), Agthe and Billings (1987), and Mansur and Olmstead (2007). In addition, summer has a statistically significant negative correlation with the price elasticity of water demand. That is, the elasticity becomes more negative and greater in absolute value in summer. This result reflects the higher proportion of discretionary use in warmer season as argued by Lyman (1992) and Arbués et al. (2003). Considering these interactions together with the direct effect of price, the point estimates of the water price elasticity of a municipality with the sample average income of \$64,506 and the water price of \$3.91 is -0.052 in winter season and -0.172 in summer. The 95% confidence interval of them are $.065$ to $-.17$ and $-.053$ to $-.292$, respectively.¹⁰ Dalhuisen et al. (2003) reports that most of the point estimates of price elasticity lies from 0 to -1 with few exceptions. The point estimates of the price elasticity in this study is also within the range.

Figures 1 and 2 show the series of point estimates of water price elasticity against income level. While in summer all the point estimates of water price elasticities are less than zero, in winter, they are greater than 0 at certain range of the income level. This result contrasts with expectations based on theory. However, 95% confidence interval in the case of the highest nominal price elasticity is $-.09$ to $.34$. Therefore, the highest estimates are not statistically significantly different from zero.

¹⁰Wintertime and summertime elasticities are calculated by plugging in the value of mean income \$64,506 and the value of mean water price \$3.91 into the following equation, respectively:

$$\frac{P}{AW} \cdot \frac{\partial AW}{\partial P} = (-.592 + .139 \times \ln(\text{Income})) * \text{WaterPrice for winter.}$$

$$\frac{P}{AW} \cdot \frac{\partial AW}{\partial P} = (-.592 + .139 \times \ln(\text{Income}) - .0308) * \text{WaterPrice for summer.}$$

Potential biases

As discussed above, point estimates for water price elasticity are larger than zero at some income levels, even though none of them are statistically significantly different from zero. This casts some doubt about the unbiasedness of the coefficient on water price-related variables. Most of the potential sources of biased estimators seem to arise from the aggregate nature of this study. Aggregating data at the municipal level has an inherent risk of biased estimators because there is a large loss of information on the true heterogeneity among households. Moreover, aggregate data prohibited us from treating block rate pricing in more sophisticated ways as the discrete continuous model used by Olmstead et al. (2007). Therefore, incorrect specification of the water price could have biased the estimation.

Another potential source of bias is the inclusion of multifamily housing units, such as apartments, that are inseparable in our aggregate consumption data. They may have been billed a fixed charge by the land owner. They do not have an incentive to conserve water when they are billed a fixed charge. The inability to separate out water consumption by households whose water bills are fixed could negatively bias the absolute value of the estimates of water price elasticity. It is possible that the higher the rate of renter households, the less responsive a municipality is to changes in the water price. In order to avoid this type of bias, we need to differentiate water consumption from those who only pay fixed amount. Alternatively, with household level data, the marginal water price could be set to zero for those who pay only fixed amount. The data for this study does not allow either correction measure. The assumption of invariant household characteristics over time within a municipality, namely, garden sizes and the possession of swimming pools might be to blame. For example, if the average garden size becomes larger while the water price becomes higher, the estimate of the coefficient on the water price would be biased positively in nominal value, thus dampening the price elasticity (Further

discussions on these issues are in Appendix D.).

Aside from potential biases, unresponsiveness to changes in the water price can be attributed to the generally high income levels of the municipalities considered in this study. According to the 2005-2007 American Community Survey 3-Year Estimates, median household income in Cook, DuPage, Lake, and Will counties were about \$52,550, \$73,820, \$77,900, and \$71,600, respectively. Addison, the least well-off among our sample, has a median household income of \$62,533. Other municipalities had median incomes greater than \$75,000. Libertyville and Plainfield, in particular, are wealthy, with median incomes of \$106,337 and \$101,958, respectively. Therefore, our study deals with municipalities with high income levels compared to the average.

Other variables

Socio-demographic variables

Because the income variable is included in logarithmic form in the third model, the coefficient on income represents the income elasticity. The coefficient on income itself is negative but is not statistically significantly different from zero. As with the water price, however, the interaction terms also need to be considered to fully understand how income affects water demand. In winter, the 95% confidence interval at mean price is -0.216 to 0.287 . This indicates that income does not have large effect on water demand in winter. This is probably because discretionary water use in winter is limited. On the other hand, in summer, the 95% confidence interval is 0.193 to 0.710 . Thus, in summer, the income elasticity of water demand is statistically different from 0 at 5% level and water demand is more sensitive to income in summer. According to Dalhuisen et al. (2003), the income elasticity in most of the studies lies from 0 to 1. Therefore, this study is in line with the previous studies.

The coefficient on household size is positive, but the impact is statistically insignificant. This is not surprising considering the inability of this study to correct for characteristics of housing units. A small amount of variability in the community averages over time and across municipalities is also probably to blame for statistical insignificance.

Weather variables

The estimated coefficient on precipitation is positive but not statistically different from zero. When the interaction with summer is included, however, the overall effect is negative and statistically significant. Thus, Chicago-area water demand is sensitive to precipitation during the summer but not in other seasons. When monthly precipitation is 1 inch below average in summer, residential water uses would increase about 1.4%.¹¹ This result is consistent with the findings of Balling. et al. (2008) and reflects the importance of outdoor water use in summer. The temperature variable and its interaction terms are included in order to investigate the sensitivity of water demand. Both variables are significant and have the expected signs. Higher temperature leads to larger amount of water use in both summer and winter. However, the magnitudes of the impact are very different. A one point rise in temperature would increase water demand by about 0.13% in winter and 1.3%¹² in summer. Thus, temperature has much larger impacts on water demand in summer than in winter. This is probably because many-water intensive activities that are sensitive to temperature do not occur in wintertime.

¹¹ $\frac{\partial AW}{\partial R} \times 100 = (-0.0156 + 0.00187) \times \partial R \times 100$
¹² $\frac{\partial AW}{\partial ST} \times 100 = (0.0113 + 0.00132) \times \partial ST \times 100$

5. Discussions and Conclusions

As stated in chapter 1, water price elasticity is of particular interest because water pricing is one demand management policy lever available to managers. In this chapter, we derive implications from our findings for water pricing strategies in the Chicago Metropolitan area. Specifically, we derive policy implications from the effects of income on water price elasticity. In addition, because water infrastructure is the biggest contributor to the production costs of water and is designed to meet the peak summertime water demand, we also pay special attention to summertime water consumption.

It is important to reiterate that our results are limited by the data available to us, particularly concerning the structure of water prices. In the U.S., an increasing number of water utilities have come to apply increasing block rates to promote conservation (Hanemann, 1997). In 1992, only 4% of residential customers faced increasing block rates. However, in 2002, one-third of them were faced with increasing block rates (Olmstead et al., 2007). In Illinois, however, flat rates are still dominant. Dziegielewski et al. (2004) reported that out of 426 systems sampled, 132 were still using decreasing block rates and only 16 were using increasing block rate. Our data set included six municipalities which use uniform prices and two that have increasing block rates. Because the data are community aggregates, we were unable to examine the potential for differences between these two rate structures. We effectively assume that all communities in the study use flat rate structures.

Effects of income on water price elasticity

Income plays a crucial role in determining water demand and has important implications for water pricing. As shown in the previous chapter, the median income level has a statistically significant positive effect on water price elasticity. Table 5 and Table 6 show wintertime and summertime water price elasticities for three municipalities: Addison, Roselle, and Naperville, respectively representing low-income, middle-income, and high income communities. As can be seen, the water price elasticity of Addison is relatively high, while that of Naperville is almost zero. This indicates that responsiveness to water price could be considerably different depending on the income level. In accord with previous studies, water price increases would have relatively more effect on consumption in municipalities with lower incomes. In higher-income municipalities, price increases could merely result in a revenue raising policy without achieving significant water demand reduction. As Olmstead and Stavins (2008) point out, the gap in water price elasticities could raise a clear equity issue, which is an important concern for water managers when implementing water pricing. Suppose RWSG set out water price increase of the same degree applied universally to municipalities in Northeastern Illinois in order to achieve 5% water use reduction. The contribution to water use reduction would be unevenly distributed among municipalities with lower income municipalities contributing more.

Table 7 shows the necessary price increase to achieve a 3% annual water conservation for each municipality. For Addison, as little as a 7.44% increase in water price would achieve the goal. On the other hand, for Naperville, an 54% increase in water price would be required to reduce water consumption by 3%. Equity on the quantity side would be accomplished at the cost of considerable differences in price adjustments. Moreover, price increases in water are known to confront strong oppositions from residents

Summertime water use

The results indicate that residential customers are more responsive to water price changes in summer than in winter. Thus, the same proportional increase in water price should achieve more water conservation in summer vis-a-vis winter. Water use reduction in summer is especially valuable since it would avoid or delay future costly investments in water infrastructures. In fact, according to the water utilities survey done by CMAP in 2008, at the time of peak demand, 42 out of 170 water supply utilities are operating at over 75% of their capacity, and 70 of them are considering expanding their capacity within 5 years. These facts suggest an advantage of seasonal pricing policy, with higher prices in the summer.

The seasonal difference in water price elasticity in these Chicago-area communities is not as large as reported in some other studies. For Moscow, ID, Lyman (1992) reports a water price elasticity of -1.354 for peak-season and -0.444 for off-peak season. For Adelaide, South Australia, Dandy et al. (1997) report a range of -0.69 to -0.86 for summer and -0.29 to -0.45 for winter. This empirical gap might be attributable to the climatic conditions where these studies were conducted. In Moscow, ID, and Adelaide, Australia, both in more arid areas, discretionary water use for landscaping in summer may be more extensive than in the Chicago area. Therefore, the relative effectiveness of seasonal water pricing would not be as high in Chicago.

Policy makers can take advantage of greater price responses in summertime. In this connection, consider two policies.

- (1) Price increases in all months to conserve 3% of annual water use.
- (2) Price increases only in summer months to conserve 3% of annual water use.

Table 8 compares the year-round and summer water price increases required to produce these reductions in the representative communities. The difference between water price increases of the two cases is the smallest for Naperville. This is

because its residents are highly unresponsive to water prices in winter time due to high income that the amount of water conservation in winter season is limited. Table 9 calculates the annual household expenditures for water for the two cases. The first column shows the annual expenditures in 2007 for the three municipalities. The second and third columns represent the annual expenditure for water a household would face, respectively, for the cases 1 and 2. The summertime-only pricing hurts households' budget less than annual pricing even though they achieve the same amount of water conservation. The difference in the expenditures of the two cases becomes more striking as the seasonal price elasticity differential increases. Naperville would benefit most from summertime pricing. In addition, an immediate and important consequence of summertime pricing instead of non-seasonal pricing is lower water use in the peak load summer period. Figure 3 compares expected water uses in summer months for the two policies in Addison. The peak demand in case 2 is less than that in case 1 because, in case 2, contributions to the 3% water conservation come only from summer months. Summertime water pricing could do more to slow the need for added system capacity. Moreover, as Mansur and Olmstead (2007) show, the difference in water price elasticities between summer and winter can be attributable to the intensiveness of outdoor water use, implying that summertime water conservation comes mainly from discretionary uses. Therefore, summertime water pricing might not harm basic needs as much as non-seasonal pricing.

6. Summary

The main objective of this study was to determine what factors affect water demand in the Chicago Metropolitan area in particular and add to water demand literature concerning how water price elasticity varies with income level and seasons. Higher income municipalities were shown to be less responsive to changes in the water price as shown in Renwick and Archibald (1998), Agthe and Billings (1987), and Mansur and Olmstead (2007). This implies that the use of water pricing for conservation raises equity issues for consumers. Water use exhibits strong seasonality because of the higher proportion of discretionary water use in summer. Because of this, summertime water demand is much more sensitive to many factors. First, the water price elasticity was shown to be higher in absolute value in summer compared to winter, which suggests a seasonal pricing strategy with higher prices in summer. Second, in summer, higher-income municipalities consume more water than lower-income communities probably because higher-income municipalities tend to have more water-intensive amenities. Finally, water demand in summer is much more sensitive to climate variables, namely, rainfall and temperature. Even though important insights into residential water demand in the Chicago Metropolitan area were derived from this study, a lack of data limited this study. Specifically, the small size of the sample, the use of aggregate rather than household-level observations, and the lack of data on lot sizes and swimming pools compromised the analysis. Complete historical data on the latter variables, in particular, could enable us to use random effects estimation, which is more efficient

estimation than fixed effects estimation. The use of household level data would free the estimation from biases that aggregate data inevitably introduce and allow for more rigorous treatments of block rate pricing as in Olmstead et al. (2007).

Tables and Figures

Table 1: Definition of variables and data source

Variables	Description/unit	Source
AW	Monthly average water usage (1000 gallons) per household, gained by dividing monthly total residential water usage by the number of households.	Mail Survey
WP	Residential water price (\$), obtained by combining water and sewer prices. Deflated by CPI to 1995 dollars.	Mail Survey
Y	Median real household income (\$1000), deflated by CPI to 1995 dollars.	Decennial census 2000 & 2005-2007 American community survey 3-year estimates
HS	Average household size	Decennial census 2000 & 2005-2007 American community survey 3-year estimates
RR	The rate of renter-occupied housing units to the total housing units	Decennial census 2000 & 2005-2007 American community survey 3-year estimates
D	Difference variable (\$) as defined by Nordin (1976)	
FC	Fixed charge imposed on each customer, deflated by CPI to 1995 dollars (\$)	Mail survey
R	Monthly precipitation (inches)	National Climatic Data Center
T	Mean temperature calculated with the method mentioned above	National Climatic Data Center
$\ln(P) \cdot \ln(Y)$	Interaction term between $\ln(P)$ and $\ln(Y)$	
$\ln(P) \cdot SD$	Interaction term between $\ln(P)$ and SD	
$\ln(Y) \cdot SD$	Interaction term between $\ln(Y)$ and SD	
$R \cdot SD$	Interaction term between R and SD	
$T \cdot SD$	Interaction term between T and SD	

Table 2: Summary statistics

Variable	Observations	Mean	Sd	Min	Max
Average water use (AWU)	877	5.731833	1.947344	5.731833	16.29822
Water price (WP)	877	3.89865	1.674118	3.89865	7.39244
Income (Y)	877	62.2053	10.98587	62.2053	84.57707
Household size (HS)	877	2.858792	.1926469	2.858792	5.121
Fixed charge (FC)	877	3.198557	4.52037	3.198557	17.48934
Precipitation (R)	877	2.906299	1.890755	2.906299	12.03
Temperature (T)	877	49.78191	17.82221	49.78191	79.376
Rate of renters (RR)	877	.17834	.0724916	.17834	.3450043

Table 3: Weather stations

Station	State	County	Station	State	County
Barrington 3SW	IL	Cook	Yorkville 3 SW	IL	Kendall
Chicago Botanical GDN	IL	Cook	Antioch	IL	Lake
Chicago Ohare INT LAP	IL	Cook	Barrington 3SW	IL	Cook
Chicago Northerly IS	IL	Cook	Gurnee Public Works	IL	Lake
Chicago Midway AP	IL	Cook	Lake Villa 2NE	IL	Lake
Chicago Midway AP 3SW	IL	Cook	Libertyville 4 NNW	IL	Lake
Elk Grove Village	IL	Cook	Mundelein 4WSW	IL	Lake
La Grange	IL	Cook	Waukegan	IL	Lake
Lansing	IL	Cook	Waukegan 2	IL	Lake
Little Red School HSE	IL	Cook	Crown Point 1N	IN	Lake
Mt Prospect	IL	Cook	Hobart 2 WNW	IN	Lake
Park Forest	IL	Cook	Lowell	IN	Lake
Park Ridge	IL	Cook	Merrillville 2 W	IN	Lake
Streamwood	IL	Cook	Crystal Lake 4 NW	IL	Mchenry
De Kalb	IL	Dekalb	Harvard	IL	Mchenry
Genoa 2 SW	IL	Dekalb	Marengo	IL	Mchenry
Shabbona 3S	IL	Dekalb	Mchenry Stratton L&D	IL	Mchenry
Glen Ellyn 4S	IL	DuPage	Spring Grove	IL	Mchenry
Lisle-Morton Arboretum	IL	DuPage	Woodstock 5 NW	IL	Mchenry
Oak Brook 2W	IL	DuPage	Hales Corners-Whitnall	WI	Milwaukee
Wheaton 3 SE	IL	DuPage	Milwaukee Mt Mary Col	WI	Milwaukee
Channahon Dresden IS	IL	Grundy	Milwaukee Mitchell AP	WI	Milwaukee
Gebhard Woods SP	IL	Grundy	South Milwaukee WWTP	WI	Milwaukee
Morris 1 NW	IL	Grundy	West Allis	WI	Milwaukee
Aurora	IL	Kane	Bartonville 5SW	IL	Peoria
Elburn	IL	Kane	Chillicothe	IL	Peoria
Elgin	IL	Kane	Peoria AP 3SW	IL	Peoria
Hampshire 8 SE	IL	Kane	Peoria 5NW	IL	Peoria
St Charles 7 NW	IL	Kane	Peoria GTR Peoria AP	IL	Peoria
Bourbonnais 3NW	IL	Kankakee	Princeville 2W	IL	Peoria
Chebanse	IL	Kankakee	Trivoli	IL	Peoria
Chebanse 5 E River	IL	Kankakee	Elwood 8 NW	IL	WILL
Kankakee Metro WWTP	IL	Kankakee	Joliet Brandon RD Dam	IL	WILL
Momence 5 ENE	IL	Kankakee	Manhattan 4 SW	IL	WILL
Reddick 2 NE	IL	Kankakee	Monee RSVR	IL	WILL
St Anne	IL	Kankakee	Peotone	IL	WILL
Newark 2 SSE	IL	Kendall	Plainfield 3 NE	IL	WILL
Planc	IL	Kendall	Romeoville Lewis Univ AP	IL	WILL

Table 4: Regression results

	Linear AWU	Double-log ln(AWU)	Log-linear ln(AWU)
Water Price	-3.853 (-1.95)		-0.592* (-2.24)
ln(Water Price)		-1.581 (-1.45)	
ln(Income)	-3.406 (-1.57)	-0.359 (-0.95)	-0.501 (-1.72)
Water Price×ln(Income)	0.921* (1.96)		0.139* (2.21)
ln(Water Price)×ln(Income)		0.343 (1.32)	
Water Price×Summer Dummy	-0.199*** (-4.55)		-0.0308*** (-5.27)
ln(Water Price)×Summer Dummy		-0.0923*** (-4.56)	
ln(Income)×Summer Dummy	3.455*** (8.51)	0.413*** (7.54)	0.402*** (7.39)
D	-0.404*** (-4.49)	-0.0597*** (-4.64)	-0.0495*** (-4.11)
Fixed Charge	0.0748 (1.11)	0.0224* (2.12)	0.0181* (2.01)
Summer Dummy	-17.09*** (-9.54)	-1.996*** (-8.23)	-1.946*** (-8.11)
Precipitation	0.0120 (0.39)	0.00165 (0.40)	0.00187 (0.45)
Precipitation×Summer Dummy	-0.116** (-2.85)	-0.0156** (-2.85)	-0.0159** (-2.91)
Temperature	0.00624 (1.45)	0.00132* (2.27)	0.00132* (2.28)
Temperature×Summer Dummy	0.0898*** (11.66)	0.0113*** (10.94)	0.0113*** (11.00)
Household Size	0.190 (0.38)	0.0185 (0.28)	0.0195 (0.29)
Rate of Renters	-3.239 (-1.13)	-0.489 (-1.25)	-0.541 (-1.40)
Constant	18.70* (1.98)	3.165 (1.96)	3.644** (2.88)
R^2	0.6159	0.6604	0.6632
N	877	877	877

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Wintertime water price elasticity

Municipalities	Real income (\$1000)	Point estimate	Upper bound	Lower bound
Addison	45.9	-.320	-.032	-.649
Roselle	58.0	-.189	.042	-.419
Naperville	71.4	.002	.092	-.088

Table 6: Summertime water price elasticity

Municipalities	Real income (\$1000)	Point estimate	Upper bound	Lower bound
Addison	45.9	-.513	-.206	-.820
Roselle	58.0	-.394	-.162	-.627
Naperville	71.4	-.088	.004	-.180

Table 7: Necessary water price increase to achieve 3% water conservation

Municipalities	Increase in WP(%)	Current price(\$)	price after(\$)
Addison	7.44	7.70	8.27
Roselle	11.16	8.92	9.92
Naperville	54.33	4.00	6.17

Table 8: Necessary summertime water price increase to achieve 3% water conservation

Municipalities	Price increases throughout a year	Price increases only in summertime
Addison	7.44%	12.93%
Roselle	11.16%	17.62%
Naperville	54.33%	55.57%

Table 9: Differences in expenditures to achieve 3% water conservation

Municipalities	No price increase	Expenditure for year-round pricing	Expenditure for summertime only pricing
Addison	\$359.9	\$375.1	\$369.6
Roselle	\$524.2	\$580.9	\$547.4
Naperville	\$318.0	\$573.6	\$434.0

Figure 1: Distribution of price elasticity in winter

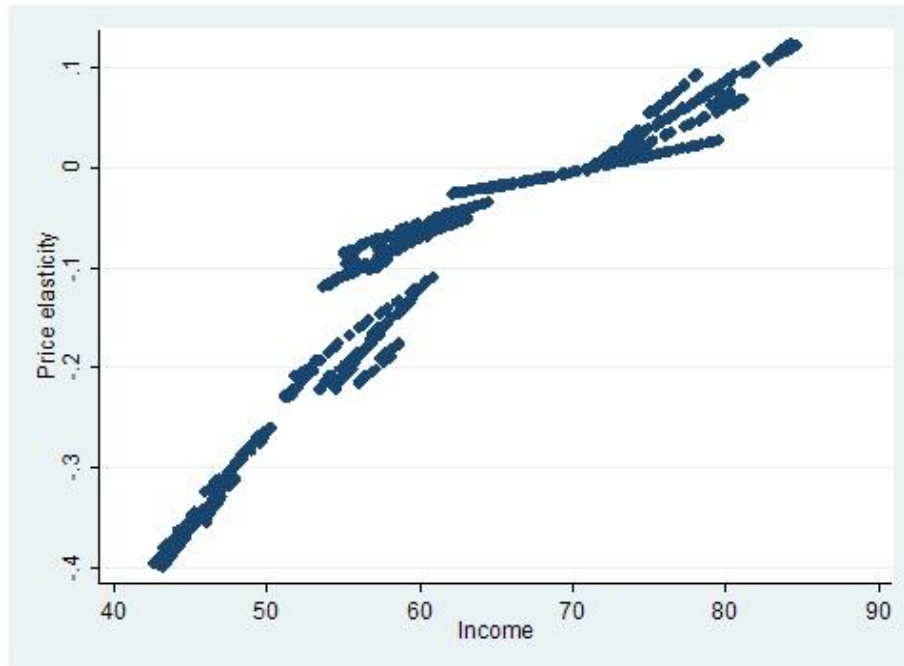


Figure 2: Distribution of price elasticity in summer

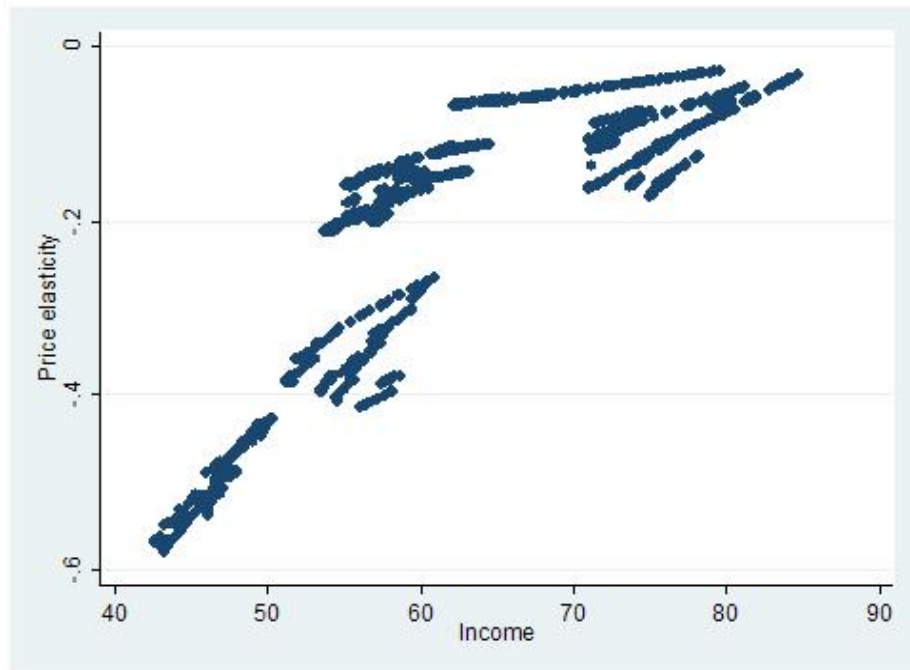
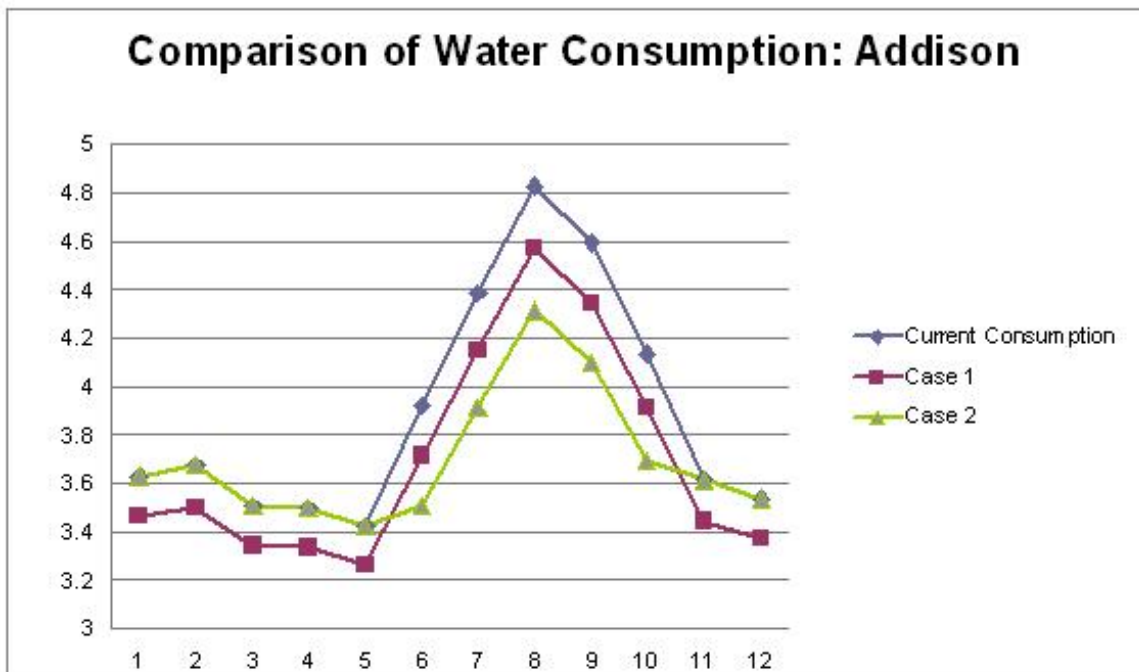


Figure 3: Comparison of expected water use: Addison (In Thousand Gallons)



References

- Agthe, D. and Billings, R. (1980). Dynamic models of residential water demand. *Water Resources Research*, 16(3):476–480.
- Agthe, D. and Billings, R. (1987). Equity, price elasticity, and household income under increasing block rates for water. *American Journal of Economics and Sociology*, 46(3):273–286.
- Arbués, F., García-Valiñas, M. A., and Martínez-Espiñeira, R. (2003). Estimation of residential water demand: a state-of-the-art review. *The Journal of Socio-Economics*, 32(1):81–102.
- Arbués, F. and Villanúa, I. (2006). Potential for pricing policies in water resource management: Estimation of urban residential water demand in zaragoza, spain. *Urban Studies*, 43(13):2421–2442.
- Balling., R. C., Gober, P., and Jones, N. (2008). Sensitivity of residential water consumption to variations in climate: An intraurban analysis of phoenix, arizona. *Water Resources Research*, 44.
- Baumol, W. J. and Oates, W. E. (1988). *The Theory of Environmental Policy*, 2nd ed., volume 51.
- Brennan, D., Tapsuwan, S., and Ingram, G. (2007). The welfare costs of urban outdoor water restrictions. *Australian Journal of Agricultural and Resource Economics*, 51:243–261.
- Carver, P. and Boland, J. (1980). Short-run and long-run effects of price on municipal water use. *Water Resources Research*, 16(4):609–616.
- CMAP (2008). 2008 survey of water utilities: Northeastern illinois.
- Corral, L., Fisher, A. C., and Hatch, N. W. (1998). Price and non-price influences on water conservation: An econometric model of aggregate demand under nonlinear budget constraint. 1998 Annual meeting, August 2-5, Salt Lake City, UT 20958, American Agricultural Economics Association (New Name 2008: Agricultural and Applied Economics Association).
- Dalhuisen, J. M., Florax, R. J., de Groot, H. L., and Nijkamp, P. (2003). Price and income elasticities of residential water demand: A meta-Analysis. *Land Economics*.

- Dandy, G., Nguyen, T., and Davies, C. (1997). Estimating residential water demand in the presence of free allowances. *Land Economics*, 73(1):125–139.
- Dziegielewski, B. and Chowdhury, F. J. (2008). Regional water demand scenarios for northeastern illinois:2005-2050.
- Dziegielewski, B., Kiefer, J., and Bik, T. (2004). Water rates and ratemaking practices in community water systems in illinois.
- Espey, M., Espey, J., and Shaw, W. D. (1997). Price elasticity of residential demand for water: A meta-analysis. *Water Resources Research*, 33(6):1369–1374.
- Foster, H. and Beattie, B. (1967). The impact of price on residential water demand and its relationship to system design and price structure. *Water Resources Bulletin*, 3(1):13–32.
- Griffin, R. and Chang, C. (1990). Pretest analysis of water demand in thirty communities. *Water Resources Research*, 26(10):2251–2255.
- Hanemann, W. (1997). *Urban Water Demand Management and Planning*, chapter Price and Rate Structures, pages 137–179. McGraw-Hill, New York.
- Hewitt, J. and Hanemann, W. (1995). A discrete/continuous choice approach to residential water demand under block rate pricing. *Land Economics*, 71(2):173–192.
- Howe, C. (1982). The impact of price on residential water demand: some new insights. *Water Resources Research*, 18(4):713–716.
- Howe, C. and Linaweaver, F. (1967). The impact of price on residential water demand and its relationship to system design and price structure. *Water Resources Research*, 3(1).
- Lyman, R. (1992). Peak and off-peak residential water demand. *Water Resources Research*, 28(9):2159–2167.
- Mansur, E. T. and Olmstead, S. M. (2007). The value of scarce water: Measuring the inefficiency of municipal regulations. NBER Working Papers 13513, National Bureau of Economic Research, Inc.
- Martínez-Espiñeira, R. (2002a). Residential water demand in the northwest of spain. *Environmental & Resource Economics*, 21(2):161–187.
- Martínez-Espiñeira, R. (2002b). Estimating water demand under increasing-block tariffs using aggregate data and proportions of users per block. *Environmental & Resource Economics*, 26(1):5–23.
- Michelson, A. M., McGuckin, J. T., and Stumpf, D. M. (1998). *Effectiveness of Residential Water Conservation Price and Nonprice Programs*. AWWA Research Foundation and American Water Works Association.
- Morgan, W. and Smolen, J. (1990). Climatic indicators in the estimation of municipal water demand. *Water Resources Bulletin*, 12(3):511–518.

- Nauges, C. and Thomas, A. (2000). Privately-operated water utilities, municipal price negotiation, and estimation of residential water demand: the case of france. *Land Economics*, 76(1):68–85.
- Nieswiadomy, M. (1992). Estimating urban residential demand: effects of price structure, conservation and education. *Water Resources Research*, 28(3):609–615.
- Nieswiadomy, M. and Molina, D. (1989). Comparing residential water estimates under decreasing and increasing block rates using household data. *Land Economics*, 65(3):280–289.
- Nordin, J. A. (1976). A proposed modification of taylor’s demand analysis: Comment. *Bell Journal of Economics*, 7(2):719–721.
- Olmstead, S. and Stavins, R. (2008). Comparing price and non-price approaches to urban water conservation. Working Paper Series rwp08-034, Harvard University, John F. Kennedy School of Government.
- Olmstead, S. M., Michael Hanemann, W., and Stavins, R. N. (2007). Water demand under alternative price structures. *Journal of Environmental Economics and Management*, 54(2):181–198.
- Pigou, A. (1920). The economics of welfare. *Macmillan & Co., London*.
- Pint, E. (1999). Household responses to increased water rates during the california drought. *Land Economics*, 75(2):246–266.
- Renwick, M. and Archibald, S. (1998). Demand side management policies for residential water use: who bears the conservation burden? *Land Economics*, 74(3):343–359.
- Renwick, M. E. and Green, R. D. (2000). Do residential water demand side management policies measure up? An analysis of eight california water agencies. *Journal of Environmental Economics and Management*, 40(1):37–55.
- Renzetti, S. (1992). Evaluating the welfare effects of reforming municipal water prices. *Journal of Environmental Economics and Management*, 22(1):147–163.
- Scheffer, J. and David, E. (1985). Estimating residential water demand under multi-tariffs using aggregate data. *Land Economics*, 61(3):272–280.
- Stevens, T., Miller, J., and Willis, C. (1992). Effect of price structure on residential water demand. *Water Resources Bulletin*, 28(4):681–685.
- Taylor, L. D. (1975). The demand for electricity: A survey. *Bell Journal of Economics*, 6(1):74–110.
- Wong, S. T. (1972). A model on municipal water demand: A case study of northeastern illinois. *Land Economics*, 48:34–44.

Appendix A: Data Request Form

Appendix B: Matlab Codes

```
1 fid=fopen('centroids_small.txt');
2 c = textscan(fid,...
3     '%f %f %f',...
4     'delimiter', ',', 'HeaderLines', 1);
5 fclose(fid);
6
7 ppt = zeros(size(c{1},1),12);
8
9 for i=1:12
10
11     s = ['year1995m' int2str(i) 'Meantemp.txt'];
12
13
14
15
16     fid = feval(@fopen,s);
17     p = textscan(fid,...
18         '%f %f %f',...
19         'delimiter', ',', 'HeaderLines', 1);
20     fclose(fid);
21
22     [XI YI] = meshgrid(-87.30:-.001:-88.30,41.40:.001:42.5);
23     ZI = griddata(p{2},p{1},p{3},XI,YI);
24
25     ppt(:,i) = interp2(XI,YI,ZI,c{1},c{2},'cubic');
26
27 end
28 csvwrite('Meantemp_1995.csv',[double(c{3}) ppt]);
```

Appendix C: Income Calibration

Table C-1 shows historical record of county level median incomes. Directly applying the county level growth rates to municipality level median incomes for 1999 results in mismatched incomes at 2006, as the case of Addison shown in Table C-2. In the table, in 2006, the median income from the Census is 62.35, while that obtained by simply applying the income growth rate is 59.98. Therefore, this rates needs to be adjusted in order for the 2006 median income data to match up. The process of adjustment is following;

$$\text{Adjusted growth rate} = 1 + (\text{growth rate} - 1) \times \frac{62.35 - 54.09}{59.98 - 54.09}$$

We applied this adjusted income growth rates to fill the missing years except 1996, where no county level income data is available. To obtain the value of income at 1996, we simply interpolate the value at 1995 and 1997.

Table C-1: County level income trends

Year	Cook	DuPage	Lake	Will
1995	37.82	59.60	59.53	52.28
1997	40.18	62.83	63.35	54.06
1998	41.82	64.37	63.47	57.16
1999	43.13	66.45	65.55	60.49
2000	45.24	68.69	66.69	62.94
2001	43.57	67.38	67.50	62.76
2002	42.86	64.35	68.09	63.07
2003	42.72	64.38	66.45	63.47
2004	43.58	66.70	67.04	66.42
2005	48.92	70.61	69.17	68.59
2006	50.68	73.69	75.16	72.86
2007	52.55	73.82	77.90	71.60

Source: Survey of Small Area Income & Poverty Estimates

Table C-2: Income calibration for Addison

	1999	2000	2001	2002	2003	2004	2005	2006
Income from Census	54.09	NA	NA	NA	NA	NA	NA	62.53
Income with non-adjusted Income growth rate	54.09	55.91	54.85	52.38	52.40	54.29	57.47	59.98
Growth rate	1.000	1.034	1.014	0.968	0.969	1.004	1.063	1.109
Adjusted growth rate	1.000	1.048	1.020	0.955	0.955	1.005	1.090	1.156
Calibrated income	54.09	56.70	55.18	51.64	51.67	54.38	58.94	62.53

Appendix D: Estimation Methods Selection And Potential Biases

Estimation methods

Table D-1 show the regression results with OLS and fixed effects estimation methods. In order to see clearly the sign of the coefficient on the water price, its interaction with income is dropped out from the model. As, can be seen in Table D-1, OLS estimation gives the statistically significantly positive coefficient on the water price. This is probably because lot sizes and ownership of swimming pools are positively correlated cross-sectionally with the water price, thus biasing the effect of the water price on water demand positively. On the other hand, fixed effects estimator gives the negative coefficient estimate of the water price, even though it is not statistically significantly different from zero. Therefore, OLS seems to be an inappropriate estimation method in this study.

Potential biases

Mistreatment of block rate pricing could have biased the estimate of the coefficient on variables related to the water price. For an experimental purpose, we drop the observations of Orland Park and Libertyville, which use block rate pricing, and rerun the model. Even though dropping a part of the observations always accompanies potential risk of sample selection bias, the results might give us some insights into potential bias from block rate pricing. Table D-2 compares the regression results between the full sample and the sample without Orland Park and

Libertyville. The magnitude of coefficients on the water price and its interaction with income are larger compared to the full sample. Moreover, the 95% confidence intervals of them are also larger. These are probably because the accuracy of estimation went down because of the smaller sample size. Figures D-1 and D-2 compare the distribution of wintertime price elasticity of municipalities without Orland Park and Libertyville against income levels, calculated based on the estimation results from the full sample and the sample without Orland park and Libertyville, respectively. The latter still has positive point estimates of price elasticity and has wider range of price elasticities. According to these facts, it seems block rate pricing might not have strongly biased the estimators in winter. However, when it comes to water price elasticities in summer, there are distinctive differences. As shown in Table D-2, when Libertyville and Orland Park are dropped out of the full sample, an interaction between the water price and summer dummy is no longer statistically significant. Figures D-3 show the distributions of the summertime price elasticity for the sample without the two municipalities. As can be seen, at higher income levels, point estimates of water price elasticities are over zero. This contrasts to the fact that all of them are below zero for the full sample as shown in 2. This might be because either sample selection bias, bias from block rate pricing, or combination of both factors. However, statistical insignificance of the interaction term between the water price and summer dummy for the subsample is rather odd because empirical studies, Lyman (1992), Olmstead et al. (2007), and Dandy et al. (1997) consistently show that people are much more elastic in summer compared to winter. This indicates the existence of another potential source of bias. Specifically, the assumption of invariant household characteristics over time within a municipality, namely, garden sizes and the possession of swimming pools might be responsible. For example, if the average garden size becomes larger while the water price becomes higher, the estimate of the coefficient on the water price would be biased positively in nominal value, thus dampening the price elasticity. In fact, this

explains the fact that the estimate of summertime water price elasticity is more susceptible for selection of samples, because garden sizes and possession of swimming pools are related to higher water consumption in summer but not as much in winter. Therefore, price elasticity might be negatively biased in absolute value, especially in summer.

Table D-3 shows the regression results for a version of the model that adds an interaction term between the water price and the rate of renter-occupied housing units. If this interaction term is an accurate proxy, it should have a positive coefficient. However, it is negative and statistically insignificant. In this study, it would appear that the rate of renter-occupied housing units primarily reflects the rate of low-income households.

Table D-4 compares estimation results of the model without all the interaction terms and the original model. As can be seen, when all the interaction terms are left out, the water price does not have statistically significant effect on water demand. However, we know that water price elasticity could have statistically significant impact on water demand depending on the income level and the season, as discussed in the results section. Moreover, Table D-4 tells that both temperature and precipitation has statistically significant effect on water demand throughout a year when the interactions with summer dummy are not included. However, inclusion of interaction terms reveals that water demand is actually not sensitive to both of them in winter, while it is in summer. Therefore, not including the interaction terms could be misleading as well as lack of policy implications.

Table D-1: Regression results with OLS and fixed effects estimation

	OLS	Fixed effects
Water price	0.0325*** (6.23)	-0.00853 (-0.56)
ln(Income)	0.450*** (7.67)	0.0852 (0.70)
Water price×Summer dummy	-0.0276*** (-3.95)	-0.0317*** (-5.42)
ln(Income)×Summer dummy	0.424*** (6.50)	0.401*** (7.36)
D	-0.0854*** (-6.21)	-0.0490*** (-4.06)
Fixed Charge	-0.00958*** (-5.68)	0.00946 (1.16)
Summer dummy	-2.066*** (-7.18)	-1.934*** (-8.05)
Precipitation	0.000720 (0.15)	0.00131 (0.32)
Precipitation×Summer dummy	-0.0133* (-2.04)	-0.0153** (-2.80)
Temperature	0.00173* (2.51)	0.00138* (2.39)
Temperature×Summer dummy	0.0113*** (9.15)	0.0112*** (10.88)
Household Size	-0.154*** (-4.07)	0.0344 (0.52)
Rate of renters	-1.127*** (-10.02)	-0.206 (-0.58)
Constant	0.184 (0.73)	1.095* (2.08)
<i>N</i>	877	877

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table D-2: Regression results with different samples

	Full Sample	Without Orland Park and Libertyville
Water price	-0.592* (-2.24)	-1.213*** (-4.32)
ln(Income)	-0.501 (-1.72)	-1.541*** (-4.45)
Water price×ln(Income)	0.139* (2.21)	0.288*** (4.31)
Water price×Summer dummy	-0.0308*** (-5.27)	0.00268 (0.40)
ln(Income)×Summer dummy	0.402*** (7.39)	0.641*** (10.42)
D	-0.0495*** (-4.11)	0 (.)
Fixed charge	0.0181* (2.01)	0.0421*** (4.08)
Summer dummy	-1.946*** (-8.11)	-3.002*** (-11.00)
Precipitation	0.00187 (0.45)	0.00356 (0.81)
Precipitation×Summer dummy	-0.0159** (-2.91)	-0.0135* (-2.31)
Temperature	0.00132* (2.28)	0.00107 (1.71)
Temperature×Summer dummy	0.0113*** (11.00)	0.0101*** (9.16)
Household size	0.0195 (0.29)	-0.0138 (-0.22)
Rate of renters	-0.541 (-1.40)	-0.445 (-1.22)
Constant	3.644** (2.88)	7.972*** (5.35)
R^2	0.6632	0.6555
N	877	656

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table D-3: Regression results with an added interaction term between water price and rate of renters

	Original Model	With the interaction
Water price	-0.592* (-2.24)	-0.181 (-0.39)
ln(Income)	-0.501 (-1.72)	-0.0877 (-0.18)
Water price×ln(Income)	0.139* (2.21)	0.0509 (0.50)
Water price×Summer dummy	-0.0308*** (-5.27)	-0.0312*** (-5.33)
Water price×Rate of renters		-0.341 (-1.09)
ln(Income)×Summer dummy	0.402*** (7.39)	0.401*** (7.38)
D	-0.0495*** (-4.11)	-0.0467*** (-3.79)
Fixed charge	0.0181* (2.01)	0.0221* (2.27)
Summer dummy	-1.946*** (-8.11)	-1.940*** (-8.09)
Precipitation	0.00187 (0.45)	0.00198 (0.48)
Precipitation×Summer dummy	-0.0159** (-2.91)	-0.0161** (-2.96)
Temperature	0.00132* (2.28)	0.00131* (2.27)
Temperature×Summer dummy	0.0113*** (11.00)	0.0113*** (11.00)
Household size	0.0195 (0.29)	0.0141 (0.21)
Rate of renters	-0.541 (-1.40)	1.318 (0.75)
Constant	3.644** (2.88)	1.668 (0.75)
R^2	0.6632	0.6637
N	877	877

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table D-4: Estimation results with different independent variables

	Without interaction terms	With interaction terms
Water Price	-0.0175 (-1.03)	-0.592* (-2.24)
ln(Income)	0.247 (1.83)	-0.501 (-1.72)
D	-0.0503*** (-3.71)	-0.0495*** (-4.11)
Fixed Charge	0.0103 (1.13)	0.0181* (2.01)
Summer Dummy	0.196*** (11.31)	-1.946*** (-8.11)
Precipitation	-0.0128*** (-4.27)	0.00187 (0.45)
Temperature	0.00488*** (9.57)	0.00132* (2.28)
Household Size	-0.00910 (-0.12)	0.0195 (0.29)
Rate of renters	-0.295 (-0.74)	-0.541 (-1.40)
Water Price×ln(Income)		0.139* (2.21)
Water Price×Summer Dummy		-0.0308*** (-5.27)
ln(Income)×Summer Dummy		0.402*** (7.39)
Precipitation×Summer Dummy		-0.0159** (-2.91)
Temperature×Summer Dummy		0.0113*** (11.00)
Constant	0.506 (0.86)	3.644** (2.88)
<i>N</i>	877	877

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure D-1: Distribution of price elasticity calculated for municipalities except both municipalities based on the estimation results from the full sample

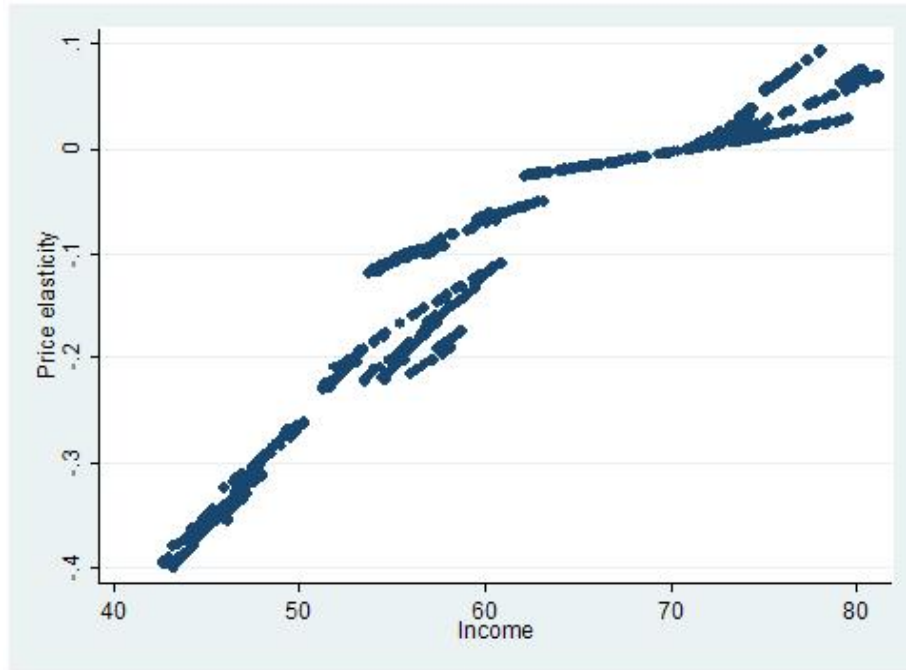


Figure D-2: Distribution of price elasticity calculated for municipalities except both municipalities based on the estimation results from the sample without both municipalities

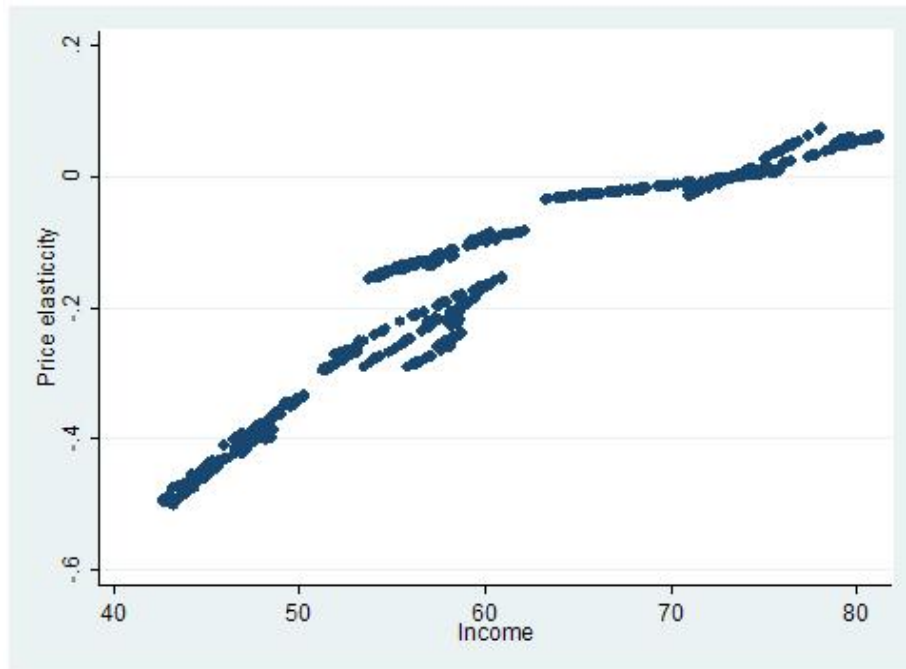
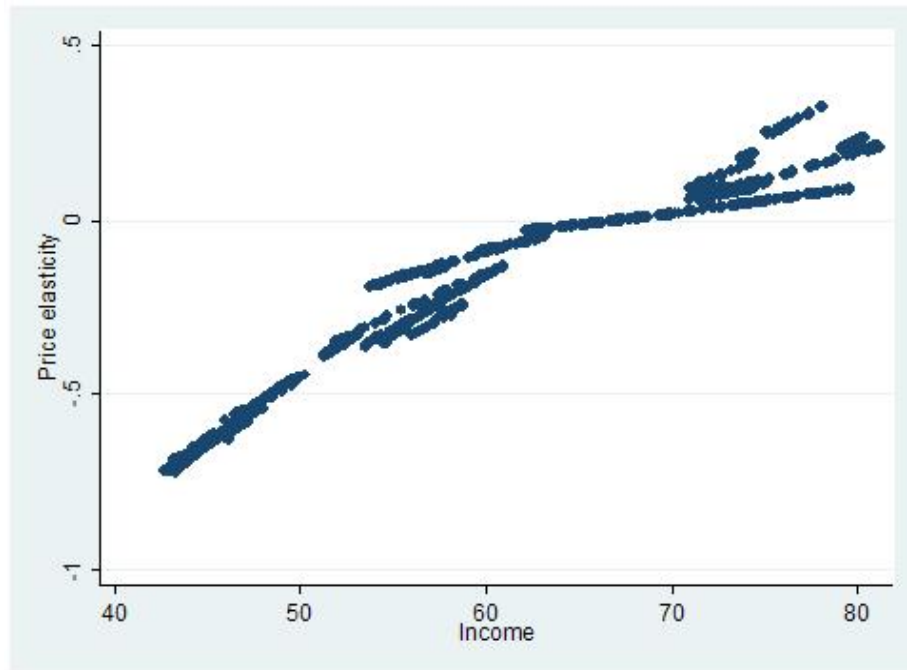


Figure D-3: Distribution of summertime price elasticity calculated for municipalities except both Orland Park and Libertyville, based on the estimation results from the sample without both municipalities



Appendix E: Selected Data

Water consumption

Table E-1: Historical record of average water consumption per household (by 1000 gallons): Addison

year/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	3.69	4.12	4.29	3.28	3.32	4.25	4.65	5.1	4.52	4.1	4.1	3.58
1996	3.68	3.44	3.42	3.28	3.73	3.62	3.82	5.19	5	4.46	4.02	3.58
1997	3.7	4.04	4.17	3.62	3.67	3.87	2.81	4.89	4.79	4.52	3.87	3.8
1998	3.77	4.13	4.08	3.43	3.57	3.69	3.71	4.99	4.13	3.21	4.04	2.58
1999	3.73	3.96	3.52	3.37	3.72	4.23	4.26	5.53	4.78	4.72	3.94	3.94
2000	3.95	4.39	3.56	3.56	3.81	4.13	3.87	5.13	4.92	4.87	3.9	3.97
2001	3.87	4.06	3.86	3.61	3.62	4.22	3.99	4.52	4.54	4.86	4.03	4.21
2002	4.75	4.47	3.25	3.86	3.76	3.99	4.1	5.64	5.15	4.55	3.9	3.84
2003	3.76	3.78	3.46	3.57	3.71	4.11	3.61	5.6	5.32	4.87	3.98	3.71
2004	3.86	4.22	3.91	3.7	3.62	4.29	3.57	4.63	4.51	4.54	3.85	3.93
2005	4.16	4.28	3.15	3.08	3.69	3.96	4.17	4.62	4.5	4.78	3.86	3.81
2006	4.15	3.93	3.38	3.43	3.71	4.17	5.04	6.53	3.18	4.37	3.8	3.39
2007	3.63	3.68	3.5	3.5	3.42	3.92	4.39	4.83	4.59	4.13	3.61	3.54

Table E-2: Historical record of average water consumption per household (by 1000 gallons): Buffalo Grove

year/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	4.59	4.37	4.2	4.29	5.28	6.5	7.6	6.65	5.57	5.43	4.63	4.49
1996	4.5	4.4	4.36	4.62	4.75	5.29	7.48	7.21	6.06	5.65	4.62	4.62
1997	4.48	4.75	4.92	4.47	4.89	5.48	6.56	6.32	5.41	5.39	4.82	4.37
1998	4.1	4.38	4.57	4.62	5.71	6.14	7.14	7.46	6.2	5.26	4.55	4.43
1999	4.16	4.44	4.55	4.72	5.58	6.15	8.51	8.68	6.79	5.96	4.85	4.6
2000	4.3	4.16	4.24	4.78	5.29	5.2	6.63	6.86	5.73	5.13	4.61	4.69
2001	3.99	3.86	4.39	4.55	5.11	5.96	7.86	7.37	5.36	5.02	4.29	4.16
2002	4.23	4.14	4.14	4.15	4.79	6.19	9.13	8.46	5.98	5.2	4.27	4.47
2003	4.43	4.19	4.28	4.61	5.41	5.67	6.26	6.45	6.01	5.26	4.01	4.13
2004	4.27	4.06	4.04	4.23	4.8	5.26	5.98	5.98	5.86	5.55	4.39	4.3
2005	4	3.55	3.66	4.07	5.58	7.15	9.47	8.72	5.87	4.96	4.22	4.17
2006	3.93	3.77	3.68	4.01	4.96	5.08	6.54	6.76	4.76	4.41	4.09	

Table E-3: Historical record of average water consumption per household (by 1000 gallons): Hoffman Estates

year/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	4.8	4.17	4.54	4.59	5.29	5.59	7.68	6.56	5.58	5.18	4.5	4.59
2002	4.41	4.46	3.9	4.16	4.84	5.61	7.44	6.95	5.01	4.55	4.29	4.34
2003	4.51	4.59	4.05	4.14	4.47	5.34	6.21	5.73	5.29	4.76	4.12	4.52
2004	4.43	3.98	3.87	4.59	4.64	4.88	5.88	5.54	5.76	4.82	3.88	4.53
2005	4.25	4	4.08	4.26	4.66	6.64	8.45	7.08	6.43	4.52	4.15	4.29
2006	4.06	3.79	4.04	4.14	4.65	5.28	5.31	5.23	5	4.07	3.96	4.14

Table E-4: Historical record of average water consumption per household (by 1000 gallons): Libertyville

year/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002					6.05	7.73	8.69	9.21	8.38	6.28	5.65	5.71
2003	6.33	6.39	5.91	5.79	5.76	6.67	7.28	7.93	7.93	6.27	5.65	5.98
2004	5.95	5.54	5.27	5.3	5.54	6.05	6.82	7.91	8.14	7.22	6.01	5.46
2005	5.82	5.7	5.3	5.27	5.89	8.24	9.72	9.99	9.28	7.12	5.97	5.83
2006	5.89	5.56	5.37	5.5	5.87	6.98	7.92	8.08	7.08	5.56	5.5	5.79
2007	5.61	5.35	5	5.1	5.95	7.48	8.14	7.63	6.79	6.41	6.06	5.4

Table E-5: Historical record of average water consumption per household (by 1000 gallons): Naperville

year/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	6.53	4.84	5.5	6.13	6.24	7.64	10.16	10.26	8.98	6.81	5.56	5.4
2000	5.96	5.37	5.04	5.15	6.09	6.8	8.05	9.37	10.03	6.1	5.3	5.75
2001	5.23	5.18	4.69	5.64	6.63	7.19	12.44	11.44	7.23	6.63	4.67	5.02
2002	5.3	5.32	4.85	4.39	5.36	7.33	11.77	10.42	9.41	7.36	4.82	5.62
2003	4.83	5.31	4.94	5.33	6.13	7.64	9.66	8.21	9.72	6.76	5.53	5.05
2004	5.15	5.31	5.43	4.63	6.08	6.94	8.41	8.73	8.39	8.02	4.6	4.88
2005	5.89	4.94	4.6	4.34	6.06	8.72	14.74	12.52	11.02	8.24	5.21	5.49
2006	5.25	3.94	4.89	4.6	5.31	8.54	9.06	8.85	7.58	5.14	4.01	5.1
2007	4.82	5.13	4.97	4.32	5.4	9.3	11.57	8.99	8.05	8.22	4.91	4.04

Table E-6: Historical record of average water consumption per household (by 1000 gallons): Orland Park

year/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	5.8	5.45	4.95	5.79	5.88	8.51	12.12	11.99	11.49	9.59	6.65	6.06
1996	5.57	5.24	5.61	5.6	6.16	6.96	10.4	12.55	12.53	7.98	6.1	5.72
1997	6.26	5.58	5.2	4.89	6.61	7.79	11.63	10.22	9.92	7.19	6.72	5.78
1998	5.85	5.18	5.25	5.35	7.88	8.37	12.22	11.2	11.1	7.59	6.65	5.02
1999	6.09	5.45	5.4	5.39	6.41	6.79	12.27	11.32	13.08	8.64	6.47	5.64
2000	6.22	4.69	6.02	5.26	6.34	6.58	9.72	8.43	11.59	8.3	6.73	5.46
2001	5.72	5.19	5.55	4.67	6.97	7.57	11.86	10.19	9.98	5.11	6.75	5.18
2002	5.53	4.74	5.92	4.81	5.67	7.28	13.25	11.08	14.24	7.45	6.45	5.04
2003	6.05	5.01	5.61	4.85	7.04	6.86	10.24	8.63	9.13	5.89	6.26	4.83
2004	5.88	4.99	5.26	5.03	6.44	5.87	9.78	8.94	9.69	7.26	6.15	4.37
2005	5.64	4.99	5.05	4.8	6.88	8.66	12.42	11.35	12.26	8.74	6.72	4.43
2006	5.29	4.85	4.91	4.67	6.7	7.23	10.67	9.24	8.32	5.15	5.33	4.16
2007	5.15	4.77	4.96	4.29	6.8	8.56	11.2	7.81	8.44			

Table E-7: Historical record of average water consumption per household (by 1000 gallons): Plain Field

year/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003			4.13	4.06	5.47	6.83	8.82	6.23	7.38	7.19	5.5	5.03
2004	4.53	4.58	4.2	5.05	5.38	6.2	8.53	7.88	8.18	8.13	5.05	4.88
2005	4.72	4.46	5.49	5.61	7.95	16.3	12.39	11.74	7.61	6.36	5.86	5.85
2006	5	4.77	5.88	5.2	8.94	10.68	9.19	10.27	6.34	5.32	5.76	

Table E-8: Historical record of average water consumption per household (by 1000 gallons): Roselle

year/month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	3.71	3.33	3.72	3.89	4.39	4.83	5.55	4.8	4.62	4.7	4.89	5.04
1998	4.93	4.4	4.98	5.05	6.71	6.21	6.85	5.87	5.45	5.31	5.17	5.58
1999	5.57	4.82	5.33	5.17	5.87	6.06	6.93	6.33	6.42	5.45	5.3	5.64
2000	5.57	5	5.33	5.34	5.78	5.88	6.45	6.42	5.72	5.34	5.33	5.69
2001	5.37	4.79	5.3	5.2	5.69	6.69	7.38	6.32	5.19	5.3	5.03	5.32
2002	5.47	4.78	5.23	5.02	5.57	6.4	7.4	6.07	5.56	5.11	5.01	5.36
2003	5.31	4.68	5.16	5.07	5.59	6.25	6.01	6.02	5.51	5.18	4.95	5.25
2004	6.39	4.03	4.83	5.01	5.28	5.85	6.49	5.86	5.58	5.07	4.97	5.21
2005	5.35	4.47	4.71	4.8	5.8	7.26	7.68	6.59	5.57	5.06	4.64	5.11
2006	4.74	4.2	5.16	4.81	5.32	5.89	5.81	5.39	4.66	4.62	4.6	5.71
2007	3.78	4.24	4.66	4.69	5.3	5.77	5.9	5.1	4.71	4.85	5.2	4.62

Historical record of water and sewer prices

Table E-9: Historical water and sewer prices 1 (\$)

	Addison		Buffalo Grove		Hoffman Estates		Libertyville	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Jan-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Feb-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Mar-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Apr-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
May-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jun-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jul-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Aug-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Sep-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Oct-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Nov-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Dec-95	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jan-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Feb-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Mar-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Apr-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
May-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jun-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jul-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Aug-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Sep-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Oct-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Nov-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Dec-96	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jan-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Feb-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40

Continued on Next Page...

Table E-9 – Continued

	Addison		Buffalo Grove		Hoffman Estates		Libertyville	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Mar-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Apr-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
May-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jun-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jul-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Aug-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Sep-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Oct-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Nov-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Dec-97	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jan-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Feb-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Mar-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Apr-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
May-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jun-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jul-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Aug-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Sep-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Oct-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Nov-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Dec-98	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Jan-99	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Feb-99	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Mar-99	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
Apr-99	3.35	2.55	1.57	0.23	2.40	0.60	NA	2.40
May-99	3.42	2.69	1.57	0.23	2.40	0.60	NA	2.40
Jun-99	3.42	2.69	1.57	0.23	2.40	0.60	NA	2.40

Continued on Next Page...

Table E-9 – Continued

	Addison		Buffalo Grove		Hoffman Estates		Libertyville	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Jul-99	3.42	2.69	1.57	0.23	2.40	0.60	NA	2.40
Aug-99	3.42	2.69	1.57	0.23	2.40	0.60	NA	2.40
Sep-99	3.42	2.69	1.57	0.23	2.40	0.60	NA	2.40
Oct-99	3.42	2.69	1.57	0.23	2.40	0.60	NA	2.40
Nov-99	3.42	2.69	1.57	0.23	2.40	0.60	NA	2.40
Dec-99	3.42	2.69	1.57	0.23	2.73	0.69	NA	2.40
Jan-00	3.42	2.69	1.57	0.23	2.73	0.69	NA	2.40
Feb-00	3.42	2.69	1.57	0.23	2.73	0.69	NA	2.40
Mar-00	3.42	2.69	1.57	0.23	2.73	0.69	NA	2.40
Apr-00	3.42	2.69	1.57	0.23	2.73	0.69	NA	2.40
May-00	3.46	2.87	1.57	0.23	2.73	0.69	NA	2.40
Jun-00	3.46	2.87	1.57	0.23	2.73	0.69	NA	2.40
Jul-00	3.46	2.87	1.57	0.23	2.73	0.69	NA	2.40
Aug-00	3.46	2.87	1.57	0.23	2.73	0.69	NA	2.40
Sep-00	3.46	2.87	1.57	0.23	2.73	0.69	NA	2.40
Oct-00	3.46	2.87	1.57	0.23	2.73	0.69	NA	2.40
Nov-00	3.46	2.87	1.57	0.23	2.73	0.69	NA	2.40
Dec-00	3.46	2.87	1.57	0.23	2.80	0.71	NA	2.40
Jan-01	3.46	2.87	1.57	0.23	2.80	0.71	NA	2.40
Feb-01	3.46	2.87	1.57	0.23	2.80	0.71	NA	2.40
Mar-01	3.46	2.87	1.57	0.23	2.80	0.71	NA	2.40
Apr-01	3.46	2.87	1.57	0.23	2.80	0.71	NA	2.40
May-01	3.49	3.07	1.57	0.23	2.80	0.71	NA	2.40
Jun-01	3.49	3.07	1.57	0.23	2.80	0.71	NA	2.40
Jul-01	3.49	3.07	1.57	0.23	2.80	0.71	NA	2.40
Aug-01	3.49	3.07	1.57	0.23	2.80	0.71	NA	2.40
Sep-01	3.49	3.07	1.57	0.23	2.80	0.71	NA	2.40
Oct-01	3.49	3.07	1.57	0.23	2.80	0.71	NA	2.40

Continued on Next Page...

Table E-9 – Continued

	Addison		Buffalo Grove		Hoffman Estates		Libertyville	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Nov-01	3.49	3.07	1.57	0.23	2.80	0.71	NA	2.40
Dec-01	3.49	3.07	1.57	0.23	2.87	0.73	NA	2.40
Jan-02	3.49	3.07	1.57	0.23	2.87	0.73	NA	2.40
Feb-02	3.49	3.07	1.57	0.23	2.87	0.73	NA	2.40
Mar-02	3.49	3.07	1.57	0.23	2.87	0.73	NA	2.40
Apr-02	3.49	3.07	1.57	0.23	2.87	0.73	NA	2.40
May-02	3.54	3.26	1.57	0.23	2.87	0.73	NA	2.40
Jun-02	3.54	3.26	1.57	0.23	2.87	0.73	NA	2.40
Jul-02	3.54	3.26	1.57	0.23	2.87	0.73	3.69>4k	2.40
Aug-02	3.54	3.26	1.57	0.23	2.87	0.73	3.69>4k	2.40
Sep-02	3.54	3.26	1.57	0.23	2.87	0.73	3.69>4k	2.40
Oct-02	3.54	3.26	1.57	0.23	2.87	0.73	3.69>4k	2.40
Nov-02	3.54	3.26	1.57	0.23	2.87	0.73	3.69>4k	2.40
Dec-02	3.54	3.26	1.57	0.23	2.94	0.75	3.69>4k	2.40
Jan-03	3.54	3.26	1.57	0.23	2.94	0.75	3.88>4k	2.40
Feb-03	3.54	3.26	1.57	0.23	2.94	0.75	3.88>4k	2.40
Mar-03	3.54	3.26	1.57	0.23	2.94	0.75	3.88>4k	2.40
Apr-03	3.54	3.26	1.57	0.23	2.94	0.75	3.88>4k	2.40
May-03	3.58	3.47	1.57	0.23	2.94	0.75	3.88>4k	2.40
Jun-03	3.58	3.47	1.57	0.23	2.94	0.75	3.88>4k	2.40
Jul-03	3.58	3.47	1.57	0.23	2.94	0.75	4.18>4k	2.40
Aug-03	3.58	3.47	1.57	0.23	2.94	0.75	4.18>4k	2.40
Sep-03	3.58	3.47	1.57	0.23	2.94	0.75	4.18>4k	2.40
Oct-03	3.58	3.47	1.57	0.23	2.94	0.75	4.18>4k	2.40
Nov-03	3.58	3.47	1.57	0.23	2.94	0.75	4.18>4k	2.40
Dec-03	3.58	3.47	1.57	0.23	3.01	0.77	4.18>4k	2.40
Jan-04	3.58	3.47	1.57	0.23	3.01	0.77	4.18>4k	2.40
Feb-04	3.58	3.47	1.57	0.23	3.01	0.77	4.18>4k	2.40

Continued on Next Page...

Table E-9 – Continued

	Addison		Buffalo Grove		Hoffman Estates		Libertyville	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Mar-04	3.58	3.47	1.57	0.23	3.01	0.77	4.18>4k	2.40
Apr-04	3.58	3.47	1.57	0.23	3.01	0.77	4.18>4k	2.40
May-04	3.58	3.59	1.57	0.23	3.01	0.77	4.18>4k	2.40
Jun-04	3.58	3.59	1.57	0.23	3.01	0.77	4.18>4k	2.40
Jul-04	3.58	3.59	1.57	0.23	3.01	0.77	4.18>4k	2.50
Aug-04	3.58	3.59	1.57	0.23	3.01	0.77	4.18>4k	2.50
Sep-04	3.58	3.59	1.57	0.23	3.01	0.77	4.18>4k	2.50
Oct-04	3.58	3.59	1.57	0.23	3.01	0.77	4.18>4k	2.50
Nov-04	3.58	3.59	1.57	0.23	3.01	0.77	4.18>4k	2.50
Dec-04	3.58	3.59	1.57	0.23	3.20	0.80	4.18>4k	2.50
Jan-05	3.58	3.59	1.57	0.23	3.20	0.80	4.18>4k	2.50
Feb-05	3.58	3.59	1.57	0.23	3.20	0.80	4.18>4k	2.50
Mar-05	3.58	3.59	1.57	0.23	3.20	0.80	4.18>4k	2.50
Apr-05	3.58	3.59	1.57	0.23	3.20	0.80	4.18>4k	2.50
May-05	3.71	3.72	1.57	0.23	3.20	0.80	4.18>4k	2.50
Jun-05	3.71	3.72	1.57	0.23	3.20	0.80	4.18>4k	2.50
Jul-05	3.71	3.72	1.57	0.23	3.20	0.80	4.18>4k	2.50
Aug-05	3.71	3.72	1.57	0.23	3.20	0.80	4.18>4k	2.50
Sep-05	3.71	3.72	1.57	0.23	3.20	0.80	4.18>4k	2.50
Oct-05	3.71	3.72	1.57	0.23	3.20	0.80	4.18>4k	2.50
Nov-05	3.71	3.72	1.57	0.23	3.20	0.80	4.18>4k	2.50
Dec-05	3.71	3.72	1.57	0.23	3.40	0.83	4.18>4k	2.50
Jan-06	3.71	3.72	1.57	0.23	3.40	0.83	4.18>4k	2.50
Feb-06	3.71	3.72	1.57	0.23	3.40	0.83	4.18>4k	2.50
Mar-06	3.71	3.72	1.57	0.23	3.40	0.83	4.18>4k	2.50
Apr-06	3.71	3.72	1.57	0.23	3.40	0.83	4.18>4k	2.50
May-06	3.63	3.85	1.57	0.23	3.40	0.83	4.18>4k	2.50
Jun-06	3.63	3.85	1.57	0.23	3.40	0.83	4.40>4k	2.50

Continued on Next Page...

Table E-9 – Continued

	Addison		Buffalo Grove		Hoffman Estates		Libertyville	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Jul-06	3.63	3.85	1.57	0.23	3.40	0.83	4.40>4k	2.50
Aug-06	3.63	3.85	1.57	0.23	3.40	0.83	4.40>4k	2.50
Sep-06	3.63	3.85	1.57	0.23	3.40	0.83	4.40>4k	2.50
Oct-06	3.63	3.85	1.57	0.23	3.40	0.83	4.40>4k	2.50
Nov-06	3.63	3.85	1.57	0.23	3.40	0.83	4.40>4k	2.50
Dec-06	3.63	3.85	1.57	0.23	3.62	0.86	4.40>4k	2.50
Jan-07	3.63	3.85	1.57	0.23	3.62	0.86	4.40>4k	2.50
Feb-07	3.63	3.85	1.57	0.23	3.62	0.86	4.40>4k	2.50
Mar-07	3.63	3.85	1.57	0.23	3.62	0.86	4.40>4k	2.50
Apr-07	3.63	3.85	1.57	0.23	3.62	0.86	4.40>4k	2.50
May-07	3.78	3.92	1.57	0.23	3.62	0.86	4.40>4k	2.50
Jun-07	3.78	3.92	1.57	0.23	3.62	0.86	4.40>4k	2.50
Jul-07	3.78	3.92	1.57	0.23	3.62	0.86	4.40>4k	2.50
Aug-07	3.78	3.92	1.57	0.23	3.62	0.86	4.40>4k	2.50
Sep-07	3.78	3.92	1.57	0.23	3.62	0.86	4.40>4k	2.50
Oct-07	3.78	3.92	1.57	0.23	3.62	0.86	4.40>4k	2.50
Nov-07	3.78	3.92	1.57	0.23	3.62	0.86	4.40>4k	2.50
Dec-07	3.78	3.92	1.57	0.23	3.86	0.89	4.40>4k	2.50

Table E-10: Historical water and sewer prices 2 (\$)

	Naperville		Orland Park		Plain Field		Roselle	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Jan-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Feb-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Mar-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Apr-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
May-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Jun-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Jul-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Aug-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Sep-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Oct-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Nov-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Dec-95	2.94	1.51	2.15	0.35	NA	NA	3.49	2.55
Jan-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Feb-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Mar-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Apr-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
May-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Jun-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Jul-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Aug-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Sep-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Oct-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Nov-96	2.94	1.51	2.15	0.35	NA	NA	3.40	2.64
Dec-96	2.94	1.51	2.15	0.35	NA	NA	3.26	2.78
Jan-97	2.94	1.51	2.20	0.35	NA	NA	3.26	2.78
Feb-97	2.94	1.51	2.20	0.35	NA	NA	3.26	2.78
Mar-97	2.94	1.51	2.20	0.35	NA	NA	3.26	2.78

Continued on Next Page...

Table E-10 – Continued

	Naperville		Orland Park		Plain Field		Roselle	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Apr-97	2.94	1.47	2.20	0.35	NA	NA	3.26	2.78
May-97	2.70	1.47	2.20	0.35	NA	NA	3.26	2.78
Jun-97	2.70	1.47	2.20	0.35	NA	NA	3.26	2.78
Jul-97	2.70	1.47	2.20	0.35	NA	NA	3.26	2.78
Aug-97	2.70	1.47	2.20	0.35	NA	NA	3.26	2.78
Sep-97	2.70	1.47	2.20	0.35	NA	NA	3.26	2.78
Oct-97	2.70	1.47	2.20	0.35	NA	NA	3.26	2.78
Nov-97	2.70	1.47	2.20	0.35	NA	NA	3.26	2.78
Dec-97	2.70	1.47	2.20	0.35	NA	NA	3.26	2.78
Jan-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
Feb-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
Mar-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
Apr-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
May-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
Jun-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
Jul-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
Aug-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
Sep-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
Oct-98	2.70	1.47	2.20	0.35	NA	NA	3.26	2.64
Nov-98	2.70	1.47	2.24	0.35	NA	NA	3.26	2.64
Dec-98	2.70	1.47	2.24	0.35	NA	NA	3.26	2.64
Jan-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Feb-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Mar-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Apr-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
May-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Jun-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Jul-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58

Continued on Next Page...

Table E-10 – Continued

	Naperville		Orland Park		Plain Field		Roselle	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Aug-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Sep-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Oct-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Nov-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Dec-99	2.70	1.47	2.24	0.35	NA	NA	3.12	2.58
Jan-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
Feb-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
Mar-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
Apr-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
May-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
Jun-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
Jul-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
Aug-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
Sep-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
Oct-00	2.70	1.47	2.33	0.35	NA	NA	2.92	2.78
Nov-00	2.70	1.47	2.33	0.35	2.63	1.96	2.92	2.78
Dec-00	2.70	1.47	2.33	0.35	2.63	1.96	2.92	2.78
Jan-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
Feb-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
Mar-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
Apr-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
May-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
Jun-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
Jul-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
Aug-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
Sep-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
Oct-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78
Nov-01	2.70	1.47	2.41	0.35	2.63	1.96	2.92	2.78

Continued on Next Page...

Table E-10 – Continued

	Naperville		Orland Park		Plain Field		Roselle	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Dec-01	2.70	1.47	2.41	0.36	2.63	1.96	2.92	2.78
Jan-02	2.70	1.47	2.45 (2.87>16k)	0.36	2.63	1.96	2.92	2.78
Feb-02	2.70	1.47	2.45 (2.87>16k)	0.36	2.63	1.96	2.92	2.78
Mar-02	2.70	1.47	2.45 (2.87>16k)	0.36	2.63	1.96	2.92	2.78
Apr-02	2.70	1.47	2.45 (2.87>16k)	0.36	2.63	1.96	2.92	2.78
May-02	2.70	1.47	2.45 (2.87>16k)	0.36	2.63	1.96	2.92	2.78
Jun-02	2.70	1.47	2.45 (2.87>16k)	0.36	2.63	1.96	3.10	2.95
Jul-02	2.70	1.47	2.45 (2.87>16k)	0.36	2.63	1.96	3.10	2.95
Aug-02	2.70	1.47	2.45 (2.87>16k)	0.36	2.63	1.96	3.10	2.95
Sep-02	2.70	1.47	2.45 (2.87>16k)	0.36	2.63	1.96	3.10	2.95
Oct-02	2.70	1.47	2.51 (2.94>16k)	0.39	2.63	1.96	3.10	2.95
Nov-02	2.70	1.47	2.51 (2.94>16k)	0.39	2.63	2.72	3.10	2.95
Dec-02	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.72	3.10	2.95
Jan-03	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.72	3.10	3.05
Feb-03	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.72	3.10	3.05
Mar-03	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.72	3.10	3.05
Apr-03	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.80	3.10	3.05
May-03	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.80	3.10	3.05
Jun-03	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.80	3.10	3.05
Jul-03	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.80	3.10	3.05
Aug-03	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.80	3.10	3.05
Sep-03	2.70	1.47	2.51 (2.94>16k)	0.39	3.64	2.80	3.10	3.05
Oct-03	2.70	1.47	2.57 (3.02>16k)	0.41	3.64	2.80	3.10	3.05
Nov-03	2.70	1.47	2.57 (3.02>16k)	0.41	3.64	2.80	3.10	3.05
Dec-03	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	2.80	3.10	3.05
Jan-04	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	2.80	3.10	3.05
Feb-04	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	2.80	3.10	3.05
Mar-04	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	2.80	3.10	3.05

Continued on Next Page...

Table E-10 – Continued

	Naperville		Orland Park		Plain Field		Roselle	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Apr-04	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	3.98	3.10	3.05
May-04	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	3.98	3.10	3.05
Jun-04	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	3.98	3.10	3.05
Jul-04	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	3.98	3.20	3.05
Aug-04	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	3.98	3.20	3.05
Sep-04	2.70	1.47	2.57 (3.02>16k)	0.41	3.74	3.98	3.20	3.05
Oct-04	2.70	1.47	2.61 (3.09>16k)	0.41	3.74	3.98	3.20	3.05
Nov-04	2.70	1.47	2.61 (3.09>16k)	0.41	3.74	3.98	3.20	3.05
Dec-04	2.70	1.47	2.61 (3.09>16k)	0.41	5.32	3.98	3.20	3.05
Jan-05	2.70	1.47	2.61 (3.09>16k)	0.41	5.32	3.98	3.20	3.05
Feb-05	2.70	1.47	2.61 (3.09>16k)	0.41	5.32	3.98	3.20	3.05
Mar-05	2.70	1.47	2.61 (3.09>16k)	0.41	5.32	3.98	3.20	3.05
Apr-05	2.70	1.47	2.74 (3.25>16k)	0.41	5.32	3.98	3.20	3.05
May-05	2.70	1.47	2.74 (3.25>16k)	0.41	5.32	3.98	3.20	3.05
Jun-05	2.70	1.47	2.74 (3.25>16k)	0.41	5.32	3.98	3.20	3.05
Jul-05	2.70	1.47	2.74 (3.25>16k)	0.41	5.32	3.98	3.20	3.05
Aug-05	2.70	1.47	2.74 (3.25>16k)	0.41	5.32	3.98	3.20	3.05
Sep-05	2.70	1.47	2.74 (3.25>16k)	0.41	5.32	3.98	3.20	3.05
Oct-05	2.70	1.47	3.02 (3.58>16k)	0.41	5.32	3.98	3.20	3.05
Nov-05	2.70	1.47	3.02 (3.58>16k)	0.41	5.32	3.98	3.20	3.05
Dec-05	2.70	1.47	3.02 (3.58>16k)	0.41	5.32	3.98	3.20	3.05
Jan-06	2.70	1.47	3.02 (3.58>16k)	0.41	5.32	3.98	3.20	3.80
Feb-06	2.70	1.47	3.02 (3.58>16k)	0.41	5.32	3.98	3.20	3.80
Mar-06	2.70	1.47	3.02 (3.58>16k)	0.41	5.32	3.98	3.20	3.80
Apr-06	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	3.80
May-06	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	3.80
Jun-06	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	3.80
Jul-06	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	3.80

Continued on Next Page...

Table E-10 – Continued

	Naperville		Orland Park		Plain Field		Roselle	
	Water	Sewer	Water	Sewer	Water	Sewer	Water	Sewer
Aug-06	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	3.80
Sep-06	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	3.80
Oct-06	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	3.80
Nov-06	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	3.80
Dec-06	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	3.80
Jan-07	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	4.17
Feb-07	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	4.17
Mar-07	2.51	1.47	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	4.17
Apr-07	2.51	1.49	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	4.17
May-07	2.51	1.49	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	4.17
Jun-07	2.51	1.49	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	4.17
Jul-07	2.51	1.49	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	4.17
Aug-07	2.51	1.49	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	4.17
Sep-07	2.51	1.49	3.03 (3.59>16k)	0.41	5.32	3.98	3.20	4.17
Oct-07	2.51	1.49	3.03 ¹	0.49	5.32	3.98	3.20	4.17
Nov-07	2.51	1.49	3.03	0.49	5.32	3.98	3.20	4.17
Dec-07	2.51	1.49	3.03	0.49	5.32	3.98	3.20	4.17

¹ Orland Park started to use three-block increasing rate from October 2007.

\$3.03 (< 10k), \$3.79 (10k < 18k), and \$4.55 (> 18k)

Precipitation

Table E-11: Historical precipitation 1 (inch)

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Jan-95	0.98	2.09	3.02	2.33
Feb-95	0.41	0.33	0.27	0.31
Mar-95	1.45	1.90	2.03	1.96
Apr-95	6.56	5.65	5.60	5.47
May-95	5.37	4.26	5.06	4.04
Jun-95	2.06	0.88	1.75	0.64
Jul-95	4.56	4.05	4.17	3.94
Aug-95	5.32	5.22	5.82	5.20
Sep-95	1.52	1.77	1.86	1.83
Oct-95	4.80	4.42	5.18	4.34
Nov-95	3.47	3.47	4.00	3.46
Dec-95	1.02	0.92	0.72	0.90
Jan-96	0.60	1.54	1.37	1.75
Feb-96	1.01	0.75	0.88	0.68
Mar-96	0.30	0.80	0.71	0.92
Apr-96	2.73	2.84	2.57	2.88
May-96	9.56	8.85	9.00	8.60
Jun-96	6.66	6.19	5.55	6.02
Jul-96	5.40	4.19	4.36	4.19
Aug-96	1.12	1.78	4.90	1.92
Sep-96	2.20	1.88	2.05	1.85
Oct-96	2.35	2.63	2.16	2.70
Nov-96	0.54	1.09	1.28	1.23
Dec-96	0.87	1.88	1.77	2.10
Jan-97	1.00	1.96	1.18	2.18
Feb-97	3.64	3.74	5.25	3.77
Mar-97	1.41	1.44	1.87	1.48

Continued on Next Page...

Table E-11 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Apr-97	1.26	2.38	1.60	2.65
May-97	2.41	3.50	5.18	3.68
Jun-97	3.10	5.75	2.82	6.40
Jul-97	2.70	2.13	2.79	2.01
Aug-97	4.43	3.99	4.23	3.98
Sep-97	1.07	2.11	2.13	2.32
Oct-97	2.17	1.89	2.27	1.83
Nov-97	1.12	1.91	1.53	2.08
Dec-97	0.70	1.51	1.31	1.68
Jan-98	2.33	3.07	3.34	3.24
Feb-98	2.17	1.93	1.60	1.86
Mar-98	2.10	3.13	2.55	3.40
Apr-98	5.04	4.89	5.22	4.81
May-98	3.29	3.22	3.87	3.24
Jun-98	4.66	4.63	5.46	4.64
Jul-98	1.24	1.73	1.57	1.88
Aug-98	6.78	4.20	4.43	3.69
Sep-98	1.93	2.03	3.15	2.11
Oct-98	5.26	5.25	6.07	5.26
Nov-98	1.28	1.57	1.85	1.64
Dec-98	1.05	1.02	1.68	1.01
Jan-99	4.36	3.83	2.92	4.15
Feb-99	1.62	1.16	1.19	1.27
Mar-99	0.21	1.10	0.46	1.32
Apr-99	7.19	6.69	7.70	6.56
May-99	3.58	2.74	3.28	2.67
Jun-99	5.21	5.04	7.75	5.32
Jul-99	4.40	1.60	3.46	1.43
Aug-99	2.85	4.34	2.82	3.52

Continued on Next Page...

Table E-11 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Sep-99	2.84	3.51	4.86	4.03
Oct-99	0.95	0.91	1.14	0.93
Nov-99	0.39	0.35	0.57	0.41
Dec-99	2.26	1.91	2.27	1.85
Jan-00	0.66	1.46	1.38	1.57
Feb-00	0.29	1.46	1.17	1.70
Mar-00	0.98	1.22	1.33	1.25
Apr-00	0.83	4.53	4.32	4.44
May-00	3.08	5.89	4.87	6.17
Jun-00	4.16	7.34	6.43	7.64
Jul-00	3.21	5.80	4.20	5.32
Aug-00	2.67	2.43	2.93	2.14
Sep-00	2.40	5.30	5.99	5.26
Oct-00	1.65	1.40	1.61	1.46
Nov-00	3.66	3.77	4.31	3.52
Dec-00	0.32	2.39	2.35	2.57
Jan-01	0.81	1.06	1.34	1.10
Feb-01	1.57	2.32	2.58	2.33
Mar-01	1.34	0.92	0.95	1.02
Apr-01	3.09	3.19	3.60	3.37
May-01	3.58	4.49	4.15	4.55
Jun-01	5.28	2.90	3.67	2.70
Jul-01	1.59	2.81	1.77	2.69
Aug-01	6.02	3.96	4.27	4.04
Sep-01	6.53	5.30	6.01	5.00
Oct-01	7.89	7.51	7.45	7.05
Nov-01	1.57	1.31	1.79	1.39
Dec-01	1.21	0.97	1.33	0.97
Jan-02	0.73	0.98	1.38	1.08

Continued on Next Page...

Table E-11 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Feb-02	1.55	1.56	1.32	1.62
Mar-02	2.47	2.17	2.03	1.96
Apr-02	4.22	2.74	3.39	3.14
May-02	5.32	3.16	4.32	2.90
Jun-02	5.27	3.84	4.98	3.92
Jul-02	2.24	0.83	1.40	1.06
Aug-02	6.49	6.42	9.95	5.27
Sep-02	0.25	3.49	2.32	3.48
Oct-02	2.75	1.90	1.93	2.24
Nov-02	1.34	0.71	0.98	0.76
Dec-02	2.36	0.84	0.85	0.86
Jan-03	0.32	0.37	0.41	0.41
Feb-03	0.06	0.20	0.37	0.18
Mar-03	1.06	1.64	1.48	1.71
Apr-03	1.45	2.41	2.15	2.51
May-03	6.91	6.99	7.46	6.39
Jun-03	2.28	2.29	1.55	2.33
Jul-03	4.25	5.03	4.88	5.43
Aug-03	5.50	1.28	1.75	1.56
Sep-03	1.78	1.92	2.02	1.83
Oct-03	1.09	1.83	1.92	1.69
Nov-03	5.25	5.12	5.57	4.96
Dec-03	2.29	2.39	2.72	2.49
Jan-04	0.75	0.90	0.76	0.98
Feb-04	0.82	0.87	1.00	0.99
Mar-04	4.32	4.88	5.00	4.61
Apr-04	1.24	1.88	1.71	1.98
May-04	7.79	8.69	8.47	8.83
Jun-04	4.80	4.25	4.22	4.59

Continued on Next Page...

Table E-11 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Jul-04	1.62	2.83	2.07	2.63
Aug-04	3.81	2.66	3.87	2.78
Sep-04	0.21	0.51	0.77	0.67
Oct-04	2.95	2.38	2.65	2.38
Nov-04	3.23	3.24	3.19	3.28
Dec-04	1.42	1.67	2.05	1.56
Jan-05	3.68	3.65	3.58	3.59
Feb-05	2.05	1.90	1.76	2.03
Mar-05	1.04	0.85	0.86	0.90
Apr-05	2.13	1.82	2.50	1.75
May-05	1.88	2.91	2.62	2.51
Jun-05	1.14	0.67	0.67	0.64
Jul-05	2.11	2.75	1.55	2.36
Aug-05	3.29	2.88	3.52	3.04
Sep-05	2.30	2.64	2.36	2.62
Oct-05	1.33	0.62	0.75	0.65
Nov-05	2.84	2.96	2.83	2.98
Dec-05	1.29	1.20	1.06	1.28
Jan-06	2.61	2.78	2.83	2.80
Feb-06	1.64	1.19	1.30	1.04
Mar-06	3.21	3.81	3.68	3.78
Apr-06	3.67	2.78	3.24	2.70
May-06	3.93	4.22	4.51	4.04
Jun-06	4.27	3.40	4.30	3.21
Jul-06	5.03	4.10	3.72	3.66
Aug-06	2.70	4.06	3.65	3.52
Sep-06	5.07	3.50	3.93	3.72
Oct-06	4.34	5.34	4.95	5.13
Nov-06	3.05	2.72	2.74	2.67

Continued on Next Page...

Table E-11 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Dec-06	2.88	3.09	3.08	3.11
Jan-07	1.81	1.32	1.54	1.39
Feb-07	1.57	2.61	2.08	2.51
Mar-07	3.26	3.68	3.24	3.52
Apr-07	3.72	4.29	4.05	4.26
May-07	1.83	1.60	2.42	1.66
Jun-07	2.37	3.44	3.36	3.86
Jul-07	4.19	3.34	5.73	3.33
Aug-07	11.40	12.29	14.63	12.03
Sep-07	1.78	1.23	1.03	1.46
Oct-07	2.58	2.48	2.96	2.64
Nov-07	0.88	0.84	0.95	0.80
Dec-07	3.25	3.81	3.30	3.81

Table E-12: Historical precipitation 2 (inch)

Month-year	Naperville	Orland Park	Plain Field	Roselle
Jan-95	3.31	2.75	3.38	2.58
Feb-95	0.35	0.61	0.33	0.57
Mar-95	1.79	1.74	1.77	1.55
Apr-95	5.81	6.04	5.75	5.97
May-95	4.85	5.16	4.98	4.99
Jun-95	2.36	1.70	2.52	1.88
Jul-95	4.42	3.47	3.93	5.28
Aug-95	5.79	4.21	4.79	7.76
Sep-95	2.06	1.28	2.21	1.71
Oct-95	5.30	4.67	5.02	5.63
Nov-95	3.88	3.87	3.91	3.64
Dec-95	0.81	0.64	0.79	0.90
Jan-96	1.34	1.39	1.15	1.69
Feb-96	0.74	0.52	0.79	0.56
Mar-96	0.65	0.84	0.60	0.80
Apr-96	2.56	2.64	2.67	2.50
May-96	6.76	6.89	5.84	8.72
Jun-96	5.72	5.45	5.28	6.21
Jul-96	11.97	7.76	17.09	3.71
Aug-96	2.72	1.43	2.18	2.68
Sep-96	2.83	2.58	3.26	2.04
Oct-96	2.09	2.33	2.24	1.93
Nov-96	2.05	1.60	2.28	1.53
Dec-96	1.45	1.23	1.53	1.28
Jan-97	1.59	1.60	1.85	1.69
Feb-97	5.50	5.19	5.61	4.62
Mar-97	1.87	2.01	1.81	1.95
Apr-97	2.07	1.68	2.29	1.51

Continued on Next Page...

Table E-12 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
May-97	4.49	3.11	4.49	3.90
Jun-97	2.82	3.44	2.48	3.76
Jul-97	1.60	2.92	1.69	2.01
Aug-97	4.57	5.38	4.36	4.61
Sep-97	1.74	1.55	1.70	1.51
Oct-97	2.35	2.34	2.35	2.24
Nov-97	1.52	1.59	1.63	1.56
Dec-97	1.70	1.36	2.05	1.05
Jan-98	3.01	2.80	3.08	2.62
Feb-98	1.65	1.59	1.74	1.64
Mar-98	2.65	3.49	2.99	2.38
Apr-98	5.20	4.40	5.48	4.67
May-98	3.37	3.76	3.17	3.44
Jun-98	4.96	4.51	5.25	4.12
Jul-98	2.50	2.00	3.01	1.76
Aug-98	4.88	6.83	5.25	4.61
Sep-98	3.05	3.13	3.39	1.93
Oct-98	6.22	5.46	5.74	7.02
Nov-98	1.55	1.64	1.53	1.51
Dec-98	1.55	1.39	1.58	1.26
Jan-99	3.35	4.32	3.06	4.33
Feb-99	1.38	1.55	1.27	1.62
Mar-99	0.88	1.36	0.80	1.04
Apr-99	6.75	7.23	6.46	6.77
May-99	3.92	4.48	4.05	3.93
Jun-99	5.57	5.48	5.32	6.03
Jul-99	3.28	3.08	3.69	2.66
Aug-99	2.56	2.78	2.90	2.09
Sep-99	3.99	3.04	4.34	3.36

Continued on Next Page...

Table E-12 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
Oct-99	1.06	1.02	0.99	1.08
Nov-99	0.56	0.41	0.59	0.49
Dec-99	2.57	2.62	2.77	2.26
Jan-00	0.79	1.22	0.51	1.10
Feb-00	2.09	1.20	2.69	1.03
Mar-00	0.89	1.12	0.94	0.84
Apr-00	4.12	4.27	4.06	3.53
May-00	4.20	4.29	4.29	3.83
Jun-00	6.01	5.39	6.25	5.32
Jul-00	3.34	3.75	3.63	2.91
Aug-00	3.25	2.50	3.34	3.05
Sep-00	4.97	3.86	4.46	5.16
Oct-00	1.59	1.47	1.66	1.52
Nov-00	3.29	3.46	3.03	3.68
Dec-00	1.53	1.88	1.57	1.20
Jan-01	1.34	1.16	1.36	1.22
Feb-01	2.51	2.66	2.67	2.10
Mar-01	0.98	1.31	0.95	1.07
Apr-01	3.24	3.61	3.53	2.78
May-01	3.59	3.70	3.46	3.75
Jun-01	2.60	3.07	2.62	3.09
Jul-01	1.84	2.99	1.22	2.51
Aug-01	4.77	7.28	4.13	5.85
Sep-01	6.94	5.70	6.36	7.71
Oct-01	7.80	8.55	7.15	8.59
Nov-01	1.75	1.53	1.82	1.63
Dec-01	1.15	1.08	1.08	1.26
Jan-02	1.19	1.19	1.26	1.01
Feb-02	1.27	1.12	1.29	1.31

Continued on Next Page...

Table E-12 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
Mar-02	2.42	2.91	2.51	2.23
Apr-02	3.54	4.09	3.77	3.32
May-02	4.97	4.57	4.97	5.05
Jun-02	4.15	4.60	4.11	4.42
Jul-02	1.60	2.90	1.53	1.74
Aug-02	7.55	6.56	7.82	7.09
Sep-02	2.13	1.53	1.79	2.25
Oct-02	1.91	2.00	2.00	1.94
Nov-02	0.74	1.12	0.65	0.95
Dec-02	0.85	1.92	0.93	0.98
Jan-03	0.41	0.47	0.41	0.38
Feb-03	0.35	0.29	0.36	0.27
Mar-03	1.51	1.57	1.62	1.29
Apr-03	2.49	2.88	2.63	2.13
May-03	8.33	6.53	8.16	8.33
Jun-03	2.14	1.53	2.01	2.12
Jul-03	4.17	5.23	4.65	3.34
Aug-03	3.33	4.18	2.82	3.59
Sep-03	2.22	2.26	2.39	1.88
Oct-03	1.46	1.80	1.58	1.55
Nov-03	6.19	5.38	6.65	5.42
Dec-03	2.65	2.13	2.83	2.38
Jan-04	0.76	0.92	0.77	0.73
Feb-04	0.90	0.74	0.94	0.83
Mar-04	4.68	3.84	4.69	4.62
Apr-04	1.43	1.05	1.48	1.33
May-04	8.28	6.36	8.67	7.82
Jun-04	4.95	4.02	4.79	5.14
Jul-04	1.54	2.77	1.53	1.49

Continued on Next Page...

Table E-12 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
Aug-04	3.61	4.82	3.62	3.57
Sep-04	0.37	0.33	0.47	0.21
Oct-04	2.97	2.69	3.00	2.95
Nov-04	3.32	4.08	3.46	3.07
Dec-04	1.55	1.59	1.56	1.48
Jan-05	3.77	4.32	3.81	3.66
Feb-05	2.17	2.20	2.25	2.03
Mar-05	1.01	1.36	1.03	0.97
Apr-05	2.19	1.98	2.15	2.24
May-05	2.18	1.95	2.39	1.86
Jun-05	1.11	1.19	1.02	1.21
Jul-05	2.30	2.58	2.34	2.17
Aug-05	3.50	2.54	3.58	3.41
Sep-05	1.99	2.32	1.84	2.23
Oct-05	1.04	1.14	0.88	1.31
Nov-05	2.78	2.55	2.69	2.93
Dec-05	1.30	1.48	1.30	1.28
Jan-06	2.96	2.91	3.19	2.59
Feb-06	1.39	1.65	1.25	1.61
Mar-06	3.18	2.72	3.13	3.28
Apr-06	3.65	3.65	3.63	3.68
May-06	4.77	4.50	4.51	4.02
Jun-06	4.53	5.00	4.57	4.36
Jul-06	3.69	3.22	2.78	5.18
Aug-06	2.79	3.30	2.83	2.68
Sep-06	5.44	5.55	5.77	4.94
Oct-06	4.78	5.35	4.90	4.46
Nov-06	2.93	3.64	2.89	2.96
Dec-06	2.98	3.13	3.08	2.83

Continued on Next Page...

Table E-12 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
Jan-07	1.82	2.05	1.78	1.84
Feb-07	1.92	1.97	2.12	1.59
Mar-07	3.42	3.28	3.60	3.18
Apr-07	4.15	4.17	4.35	3.79
May-07	1.67	1.70	1.57	1.83
Jun-07	2.63	2.54	2.77	2.40
Jul-07	5.72	3.74	6.72	4.22
Aug-07	10.81	9.38	10.35	11.62
Sep-07	1.47	1.22	1.23	1.85
Oct-07	3.40	2.08	3.84	2.73
Nov-07	0.99	1.33	1.07	0.84
Dec-07	3.33	3.43	3.40	3.22

Temperature

Table E-13: Historical temperature 1 ($^{\circ}F$)

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Jan-95	22.45	22.14	21.12	22.13
Feb-95	24.87	23.96	23.73	23.78
Mar-95	38.57	37.83	37.67	37.77
Apr-95	44.12	43.16	43.51	43.13
May-95	57.58	56.61	56.82	56.60
Jun-95	71.97	70.45	70.80	70.28
Jul-95	76.46	75.10	75.07	74.97
Aug-95	78.68	76.89	77.50	76.57
Sep-95	61.20	60.74	60.18	60.74
Oct-95	52.40	51.93	51.88	51.81
Nov-95	31.33	30.86	30.50	30.84
Dec-95	24.51	23.81	23.73	23.72
Jan-96	21.52	20.46	20.38	20.25
Feb-96	23.74	23.44	22.78	23.52
Mar-96	29.41	29.01	28.72	29.08
Apr-96	43.82	43.32	43.57	43.38
May-96	54.43	53.55	53.88	53.48
Jun-96	68.33	66.92	67.56	66.86
Jul-96	69.49	68.95	69.20	68.85
Aug-96	71.89	71.44	71.23	71.43
Sep-96	62.52	62.85	62.03	63.00
Oct-96	51.41	51.10	50.80	51.03
Nov-96	31.20	31.30	30.63	31.45
Dec-96	25.91	25.94	25.17	25.92
Jan-97	17.45	17.38	16.40	17.50
Feb-97	27.29	27.29	26.34	27.34
Mar-97	36.68	35.94	36.44	35.82

Continued on Next Page...

Table E-13 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Apr-97	44.22	44.08	44.11	44.19
May-97	52.58	52.14	52.64	52.14
Jun-97	68.30	67.37	68.06	67.36
Jul-97	72.79	71.70	72.61	71.53
Aug-97	68.28	67.68	68.13	67.64
Sep-97	62.90	62.71	62.98	62.70
Oct-97	51.49	52.11	51.48	52.31
Nov-97	35.01	35.19	35.04	35.13
Dec-97	29.87	30.12	29.76	30.11
Jan-98	27.32	27.42	27.02	27.49
Feb-98	37.15	36.62	37.05	36.62
Mar-98	36.88	36.97	36.82	37.11
Apr-98	48.50	48.37	48.53	48.44
May-98	63.82	63.09	63.75	63.10
Jun-98	68.65	67.90	68.61	67.81
Jul-98	73.28	72.66	73.14	72.64
Aug-98	73.09	72.98	73.17	72.98
Sep-98	66.48	67.10	66.82	67.24
Oct-98	52.89	53.44	53.08	53.64
Nov-98	42.35	42.82	42.25	42.99
Dec-98	32.99	32.91	33.11	32.91
Jan-99	19.34	19.11	18.63	19.19
Feb-99	32.04	32.64	32.28	32.80
Mar-99	34.05	34.60	34.11	34.81
Apr-99	48.46	48.47	49.01	48.55
May-99	60.81	60.49	60.92	60.56
Jun-99	69.67	69.02	69.94	68.96
Jul-99	77.34	77.28	77.35	77.30
Aug-99	69.00	69.36	68.91	69.49

Continued on Next Page...

Table E-13 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Sep-99	61.69	62.41	61.86	62.73
Oct-99	50.29	50.91	50.25	51.12
Nov-99	43.23	44.45	43.95	44.73
Dec-99	27.13	28.17	27.32	28.53
Jan-00	22.93	23.30	22.65	23.36
Feb-00	30.51	31.87	30.98	32.26
Mar-00	42.00	43.14	43.22	43.17
Apr-00	45.57	46.44	47.13	46.53
May-00	60.04	60.57	61.11	60.43
Jun-00	65.83	66.96	66.55	66.84
Jul-00	69.47	70.15	71.18	70.00
Aug-00	70.53	70.96	71.10	71.14
Sep-00	62.91	63.55	63.34	63.43
Oct-00	54.55	55.42	55.01	55.33
Nov-00	35.78	37.07	36.52	36.93
Dec-00	14.29	15.12	14.45	15.21
Jan-01	22.81	23.50	22.62	23.77
Feb-01	23.41	24.09	24.14	24.04
Mar-01	31.92	32.53	32.93	32.74
Apr-01	51.03	51.33	51.85	51.36
May-01	59.51	60.24	60.40	59.89
Jun-01	66.10	67.00	66.53	67.02
Jul-01	73.54	73.84	74.34	73.84
Aug-01	72.14	73.20	72.87	73.03
Sep-01	60.11	61.09	60.93	61.10
Oct-01	50.47	51.31	50.88	51.31
Nov-01	45.92	47.79	47.33	47.92
Dec-01	31.12	33.07	32.41	33.01
Jan-02	28.80	30.10	29.48	30.31

Continued on Next Page...

Table E-13 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Feb-02	29.67	31.15	30.22	31.30
Mar-02	33.38	32.57	32.69	32.52
Apr-02	48.84	48.29	48.38	48.22
May-02	54.39	53.00	53.77	53.16
Jun-02	70.76	69.76	70.07	69.65
Jul-02	77.10	76.59	76.07	76.34
Aug-02	73.20	72.84	72.46	72.80
Sep-02	66.91	66.59	65.97	66.68
Oct-02	49.80	49.08	49.78	48.72
Nov-02	36.21	37.06	36.72	37.15
Dec-02	28.49	28.89	28.58	29.10
Jan-03	19.59	19.35	18.61	19.62
Feb-03	22.54	21.80	21.57	21.96
Mar-03	36.29	35.38	35.12	35.26
Apr-03	47.49	45.94	47.37	45.88
May-03	56.71	54.90	56.56	54.89
Jun-03	65.91	64.88	66.02	65.00
Jul-03	71.91	71.73	72.53	71.58
Aug-03	73.85	73.27	74.41	73.05
Sep-03	63.16	63.06	63.47	62.87
Oct-03	50.74	51.00	50.86	51.11
Nov-03	40.51	40.56	40.64	40.53
Dec-03	30.30	30.99	30.14	30.93
Jan-04	18.83	18.43	18.18	18.43
Feb-04	26.18	26.10	25.54	26.54
Mar-04	40.30	40.51	39.89	40.20
Apr-04	49.67	49.23	50.01	49.28
May-04	59.76	57.74	58.59	57.88
Jun-04	66.94	65.77	66.01	65.80

Continued on Next Page...

Table E-13 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Jul-04	71.36	69.89	70.33	69.99
Aug-04	67.17	66.19	66.03	66.47
Sep-04	66.50	66.51	65.86	66.55
Oct-04	52.43	52.36	51.81	52.57
Nov-04	42.31	41.99	41.51	42.05
Dec-04	26.37	26.35	25.69	26.81
Jan-05	24.17	22.54	23.28	22.51
Feb-05	31.28	30.85	30.72	30.87
Mar-05	32.98	32.72	33.03	33.09
Apr-05	51.52	50.07	51.56	50.22
May-05	56.45	55.55	56.16	55.74
Jun-05	74.28	72.69	73.48	72.89
Jul-05	75.27	73.67	74.60	73.90
Aug-05	74.06	73.00	73.12	73.13
Sep-05	69.40	68.54	68.27	68.59
Oct-05	53.73	53.63	52.90	53.99
Nov-05	40.37	40.25	39.74	40.42
Dec-05	22.18	21.71	20.96	22.05
Jan-06	34.17	33.20	33.29	33.23
Feb-06	26.65	25.57	25.69	25.57
Mar-06	36.91	35.74	36.09	35.81
Apr-06	52.61	51.23	52.04	51.38
May-06	58.74	58.42	58.51	58.53
Jun-06	67.97	66.42	67.00	66.51
Jul-06	76.09	74.55	74.66	74.81
Aug-06	73.32	72.23	72.19	72.62
Sep-06	61.34	60.99	60.78	61.19
Oct-06	47.75	47.19	47.07	47.32
Nov-06	42.33	42.10	41.48	42.16

Continued on Next Page...

Table E-13 – Continued

Month-year	Addison	Buffalo Grove	Hoffman Estates	Libertyville
Dec-06	32.33	31.31	30.39	31.43
Jan-07	27.33	27.40	25.75	26.62
Feb-07	16.69	16.58	14.44	15.48
Mar-07	41.77	41.79	40.26	39.70
Apr-07	46.47	46.40	45.34	45.13
May-07	63.64	63.57	62.38	61.69
Jun-07	71.32	71.21	69.61	69.41
Jul-07	73.21	73.00	71.21	71.59
Aug-07	74.47	74.38	72.91	73.12
Sep-07	66.30	65.97	65.48	66.17
Oct-07	57.61	57.42	57.10	57.68
Nov-07	37.60	37.35	37.55	38.08
Dec-07	25.53	25.20	24.33	24.91

Table E-14: Historical temperature 2 ($^{\circ}F$)

Month-year	Naperville	Orland Park	Plain Field	Roselle
Jan-95	21.45	23.87	21.17	22.23
Feb-95	23.87	26.97	23.64	24.67
Mar-95	38.24	40.41	38.33	38.36
Apr-95	45.86	46.42	46.79	43.89
May-95	58.19	58.95	58.65	57.42
Jun-95	71.59	72.28	71.66	71.93
Jul-95	75.80	77.37	75.72	76.29
Aug-95	77.30	79.38	76.86	78.65
Sep-95	60.99	62.64	61.11	61.02
Oct-95	52.19	54.41	52.18	52.26
Nov-95	32.04	32.69	32.41	31.12
Dec-95	24.54	26.25	24.65	24.25
Jan-96	21.47	23.60	21.55	21.28
Feb-96	24.19	26.60	24.64	23.44
Mar-96	30.07	31.50	30.50	29.26
Apr-96	44.59	46.07	45.06	43.68
May-96	54.84	55.86	55.18	54.40
Jun-96	69.05	69.08	69.51	68.44
Jul-96	70.15	70.35	70.44	69.46
Aug-96	72.35	72.70	72.59	71.86
Sep-96	63.06	63.88	63.33	62.41
Oct-96	51.40	52.91	51.52	51.41
Nov-96	31.44	33.01	31.64	30.87
Dec-96	25.92	27.74	25.97	25.66
Jan-97	17.47	19.72	17.61	17.10
Feb-97	27.23	29.45	27.39	27.08
Mar-97	37.01	39.07	37.23	36.58
Apr-97	44.53	45.67	44.75	44.11

Continued on Next Page...

Table E-14 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
May-97	53.03	54.53	53.27	52.45
Jun-97	68.83	69.49	69.12	68.38
Jul-97	73.03	74.22	73.08	72.80
Aug-97	68.67	70.14	68.85	68.15
Sep-97	63.66	64.87	63.97	62.76
Oct-97	52.23	53.65	52.61	51.28
Nov-97	35.33	36.70	35.43	34.84
Dec-97	29.84	31.44	29.76	29.64
Jan-98	27.58	29.46	27.72	26.99
Feb-98	37.88	39.05	38.17	36.96
Mar-98	37.50	39.06	37.86	36.59
Apr-98	48.90	50.25	49.15	48.34
May-98	64.18	65.58	64.43	63.73
Jun-98	68.87	69.70	68.95	68.58
Jul-98	73.53	74.61	73.58	73.11
Aug-98	73.28	74.30	73.25	73.09
Sep-98	67.40	68.56	67.73	66.36
Oct-98	53.44	55.25	53.75	52.51
Nov-98	42.49	44.62	42.62	42.00
Dec-98	32.92	34.85	32.87	32.76
Jan-99	19.53	22.26	19.74	18.86
Feb-99	32.56	34.54	32.81	31.80
Mar-99	34.69	36.13	34.95	33.87
Apr-99	49.53	50.48	50.00	48.35
May-99	61.47	62.76	61.81	60.74
Jun-99	70.11	71.00	70.34	69.60
Jul-99	77.42	78.81	77.44	77.22
Aug-99	68.81	71.01	68.76	68.86
Sep-99	61.68	63.90	61.68	61.48

Continued on Next Page...

Table E-14 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
Oct-99	50.62	53.35	50.88	49.96
Nov-99	43.84	46.01	44.09	43.02
Dec-99	27.59	30.14	27.85	26.76
Jan-00	22.81	25.54	22.77	22.62
Feb-00	31.31	34.18	31.74	30.02
Mar-00	42.91	45.00	43.34	41.74
Apr-00	46.93	48.33	47.50	45.41
May-00	61.08	62.58	61.58	59.81
Jun-00	66.42	68.20	66.69	65.68
Jul-00	70.50	71.57	70.88	69.27
Aug-00	71.30	73.22	71.67	70.32
Sep-00	63.69	65.49	63.99	62.71
Oct-00	54.80	56.98	54.92	54.39
Nov-00	36.04	37.73	36.04	35.65
Dec-00	14.23	16.89	14.13	14.11
Jan-01	22.22	25.04	21.91	22.58
Feb-01	24.31	26.98	24.58	23.09
Mar-01	32.79	34.76	33.23	31.63
Apr-01	52.21	53.53	52.71	50.89
May-01	60.25	61.45	60.58	59.53
Jun-01	67.00	68.29	67.43	65.97
Jul-01	74.61	75.45	74.92	73.45
Aug-01	73.44	74.00	73.86	72.04
Sep-01	62.06	62.91	62.85	59.92
Oct-01	51.75	53.01	52.22	50.30
Nov-01	47.70	48.50	48.45	45.62
Dec-01	32.81	33.87	33.46	30.83
Jan-02	30.63	32.08	31.37	28.38
Feb-02	31.30	32.84	31.93	29.36

Continued on Next Page...

Table E-14 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
Mar-02	34.26	35.33	34.49	33.25
Apr-02	49.90	50.84	50.38	48.75
May-02	55.58	56.14	56.14	54.33
Jun-02	72.13	71.79	72.73	70.77
Jul-02	77.73	77.72	78.00	77.14
Aug-02	74.01	73.86	74.26	73.24
Sep-02	68.48	67.74	69.18	66.86
Oct-02	50.66	50.15	50.93	49.82
Nov-02	37.66	37.94	38.19	36.04
Dec-02	28.79	30.04	28.95	28.24
Jan-03	20.43	21.27	20.81	19.35
Feb-03	23.64	23.92	24.09	22.41
Mar-03	37.50	37.37	37.98	36.28
Apr-03	50.02	49.24	51.03	47.43
May-03	58.30	57.13	58.91	56.82
Jun-03	67.20	65.93	67.68	65.99
Jul-03	72.60	72.26	72.84	71.83
Aug-03	74.48	73.69	74.61	73.88
Sep-03	63.67	63.48	63.78	63.13
Oct-03	51.70	51.95	52.28	50.60
Nov-03	41.03	42.51	41.25	40.36
Dec-03	30.83	31.83	31.05	30.13
Jan-04	19.32	20.63	19.51	18.65
Feb-04	26.90	27.73	27.25	26.03
Mar-04	40.80	41.95	41.12	40.23
Apr-04	50.44	51.18	50.82	49.61
May-04	61.44	61.01	62.25	59.79
Jun-04	67.68	67.55	68.12	66.94
Jul-04	71.69	71.59	71.76	71.41

Continued on Next Page...

Table E-14 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
Aug-04	67.60	67.79	67.77	67.15
Sep-04	67.14	66.63	67.39	66.51
Oct-04	53.32	54.05	53.78	52.24
Nov-04	42.46	43.56	42.64	42.11
Dec-04	27.17	29.19	27.71	26.04
Jan-05	24.16	24.96	24.13	24.16
Feb-05	31.98	32.87	32.33	31.13
Mar-05	34.41	34.99	35.05	32.68
Apr-05	52.74	52.55	53.21	51.57
May-05	57.43	57.59	57.85	56.39
Jun-05	75.12	74.44	75.41	74.31
Jul-05	75.78	75.58	75.87	75.23
Aug-05	74.48	74.16	74.61	74.01
Sep-05	70.05	69.71	70.30	69.42
Oct-05	54.38	55.26	54.74	53.53
Nov-05	41.12	42.34	41.50	40.16
Dec-05	21.90	23.47	21.80	22.01
Jan-06	34.56	35.92	34.74	33.95
Feb-06	27.07	28.64	27.35	26.46
Mar-06	37.59	38.42	37.95	36.73
Apr-06	53.36	53.53	53.75	52.57
May-06	59.61	59.61	59.98	58.62
Jun-06	68.41	68.32	68.68	67.93
Jul-06	76.38	76.38	76.53	76.03
Aug-06	73.20	73.62	73.24	73.14
Sep-06	61.89	62.45	62.19	61.20
Oct-06	47.95	49.06	48.08	47.70
Nov-06	42.32	43.23	42.33	42.27
Dec-06	32.00	33.91	31.99	32.13

Continued on Next Page...

Table E-14 – Continued

Month-year	Naperville	Orland Park	Plain Field	Roselle
Jan-07	26.85	28.32	26.73	27.28
Feb-07	16.01	17.70	15.90	16.49
Mar-07	42.33	42.71	42.63	41.68
Apr-07	46.88	46.52	47.14	46.41
May-07	64.11	63.50	64.46	63.60
Jun-07	71.21	70.90	71.24	71.28
Jul-07	72.73	72.81	72.66	73.09
Aug-07	74.34	74.43	74.37	74.41
Sep-07	67.33	66.86	67.91	65.98
Oct-07	58.40	58.37	58.83	57.38
Nov-07	38.22	38.56	38.56	37.30
Dec-07	26.02	26.77	26.33	25.13