WATER DEMAND PROJECTIONS

EAST SIDE WATER TREATMENT SUPPLY PLANNING AND PROJECT DEVELOPMENT

Madison Water Utility
Madison, Wisconsin
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Madison, WI 53713

Black & Veatch Corporation
B&V Project 169092.0100
B&V File 41.0100

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1. BACKGROUND

The Madison Water Utility (MWU) is developing a plan to continue to provide a reliable supply of high quality water cost effectively to the City of Madison's (City's) Zone 6 - East Service Area. The Zone 6 - East Service Area is served by six wells including Unit Well Nos. 7, 8, 9, 11, 13, 15, 23, 25 and 29.

As part of the East Side Water Supply Planning and Project Development Project (East Side Project), the purpose of this memorandum is to:

- Discuss conservation planning for the MWU and how it compares to other similar communities
- Document the assumptions used in developing and updating water demand projections and peaking factors for the MWU for Design Years 2010, 2015, 2030 and Buildout.
- Compare projected demands with existing available water supply.

2. STUDY AREA

The study area for this project is the City's East Service area including service zones 1, 3, 4, 5, and 6E. For the water demand projections, however, the boundary is the same as the 2006 Master Plan. The study areas referenced in this document are shown in Attachment A at the end of this memo and include the following:

- The City of Madison
- The Village of Maple Bluff (Maple Bluff)
- The Village of Shorewood Hills (Shorewood Hills)
- The Town of Madison
- Growth areas described in the City's 2005 Comprehensive Plan.
- East Service Area

3. CONSERVATION

Traditionally the north Midwestern United States has had abundant water supplies for municipal use and conservation has not been a priority. However, growing demand for water supply is beginning to put a strain on water resources and affect water quality. In addition, a growing understanding of the cost of wasteful water use including: capital improvements, water treatment, and declining water quality as a result of over pumping are prompting many communities to place an increased emphasis on conservation.

Although indoor water usage tends to be fairly stable throughout the year, outdoor water demand varies significantly seasonally and responds directly to weather patterns. Crediting only conservation without taking climatic trends into account for an overall reduction in water demand in the past 5 years may be pre-mature due to the wet cool summer weather pattern that has been prevalent in the Madison area. It is difficult to quantify the success of conservation efforts based on the total demand in the short-term since typically outdoor water demands vary considerably from year to year in response to temperatures and rainfall. Water demands will continue to be monitored over the next decade to evaluate overall conservation success.

3.1. MWU Conservation Efforts

Water conservation is not a new concept to MWU. Water conservation in Madison has a tradition reaching back more than 30 years to appropriate water use control techniques including but not limited to: metered water usage for all customers, leak detection and abatement programs, and an outdoor water use restriction ordinance (to control water use during emergency conditions). As a result, the City has relatively low per capita water use and water loss rates. In response to declining aquifer levels, impacts of well pumping on surface water features, and a desire to preserve the aquifer for generations to come, MWU adopted a Water Conservation and Sustainability Plan (Conservation Plan) in 2008. The Plan has a primary goal of maintaining the current annual rate of groundwater withdrawal in existing areas and secondary goals of:

- Residential: reduce residential water use by 20 percent by 2020 to an average use of 58 gallons per capita per day
- Commercial: promote water conservation through rebate promotions and education.
- Industrial: develop a water conservation plan for each industrial customer.
- Municipal: enact water savings programs for all government buildings that support the primary goal.

Interest in conservation has been in response to numerous factors including: reducing the need for adding additional or maintaining existing well capacity to the system, declining aquifer levels, impacting surface water features, contaminant transport, and the potential of declining water quality. In addition, there is a growing public awareness and demand for using natural resources in a sustainable manner. Water conservation not only saves water, it also reduces chemical usage and can provide a significant energy savings to a utility. Ultimately water conservation reduces MWU's overall carbon footprint. To be successful conservation efforts are implemented as a combination of public education, institutional regulations, monetary incentives and physical changes which results in a change in water use patterns within the general public.

In its Conservation Plan, MWU outlined the recommendations summarized in Table 1. In order to reduce residential usage by 20 percent, MWU will need to reduce the per capita usage from a 2002 – 2006 average of 73 gallons per capita per day (gpcd) to 58 gpcd (about 15 gpcd). Based on information from *Handbook of Water Use and Conservation: Homes, Landscapes, Industries, Businesses, Farms* (Amy Vickers, 2001) changing from standard toilets to high efficiency toilets will reduce water usage by approximately 10.3 gpcd, which is one of the easiest and most effective indoor water use conservation steps.

Table 1 - MWU Conservation Recommendations

Recommendation [1]	Description	Priority
Residential		
High efficiency toilets	MWU implemented a $100 per household and apartment rebate program to replace old toilets with high efficiency "Water Sense" toilets	10/08[2]
Install an Advanced Metering Infrastructure (AMI)billing system	Install an AMI-system and start monthly billing.	Short Term[3]
Provide customers with current	Instruct customers on tracking their water usage	Short Term[3]

Table 1 - MWU Conservation Recommendations

Recommendation [1]	Description	Priority
consumption data through the AMI system	through meter reading.	
Inclining rate structure	Change the MWU rate structure to an inverted rate structure to reward low water usage and penalize high water usage	Short Term
Outdoor Water Usage Restrictions	Restrict outdoor water usage when pumping exceeds 50 mgd for 2 consecutive days.	Short Term
Residential water audit program	Allow individual residential customers to request an on-site or individual water audit of their home.	Long Term
High efficiency washing machines/dishwashers	Develop a financial incentive program for washing machines and dishwashers similar to the Utility's toilet rebate program	Long Term
Industrial		
Water Conservation Plans	Perform individual audits and develop water conservation plans for industrial customers	Short Term
Commercial		
Education	Target high-use customers with education/ outreach to promote water conservation	Short Term
Landscaping ordinance	Enact landscaping ordinance with water limiting requirements and drought resistant plantings for new development/major redevelopment	Intermediate
Appliance Upgrade Program	Develop appliance upgrade program for heavy water use commercial clients	Long Term
Certification Program	Develop a certification program for water-efficient buildings	Long Term
Car Wash Reclamation Ordinance	Enact an ordinance requiring car washes to use water reclamation.	Long Term
Municipal		
Quantify Water Use	Improve record keeping to quantify water use for municipal accounts	Short Term
Minimize Reservoir Dumping	Improve operational control of water reservoirs to minimize dumping	Short Term
Leak-Detection Program	Expand leak detection program to identify and correct leaks	Short Term
Water Utility Bill	Upgrade water utility billing with new software	Short Term
Meter Raw Water Pumping	Install use meters in well buildings	Intermediate
Water Conservation Plans	Perform individual audits and develop water conservation plans for other government buildings	Intermediate
Reduce Hydrant Flushing	Reduce the Utility's annual unidirectional flushing program as well filters are installed, operational changes are implemented and overall water quality in the distribution system is improved	Short term to Intermediate

[1] Recommendations from the Conservation Plan, Summary of Conservation Goals Table.
[2] Recommendation has been implemented by MWU.
[3] Madison will begin implementing a two-year AMI program in 2011 which will allow the Utility to move to monthly billing.

As MWU implements the Conservation Plan recommendations, the overall effectiveness of the program will be evaluated and the program will be refined and expanded as needed.

3.2. Conservation Efforts in Other Northern North American Communities

Although MWU has seen a reduction in water demands in the last couple of years, due to recent weather patterns, it is too early to evaluate the long-term effectiveness of the conservation program. For comparison, other northern mid-sized cities with established conservation programs and published results were selected and evaluated. Table 2 summarizes the conservation results from these communities.

The MWU Conservation Plan includes recommendations similar to other communities. Based on the City's historic demand rates and these examples, it will likely be difficult for Madison to achieve its 20 percent residential demand reduction goal by 2020 without a significant commitment of area residents to water conservation, an effective widespread education program, restrictions on outdoor water usage, the development of other conservation programs, and an expansion of the toilet retrofit rebate program.

Table 2 - Comparison of Conservation Programs for Northern North American Communities

Utility	Start Year	Programs	Estimated Reduction in Water Demand
Lincoln, NE[1]	1988	• Increasing block rate structure • Public Education	7 %
Waterloo, Ontario[2]	Early 1980s	• Toilet retrofit • Water efficient shower heads	13 %
Wichita, KS[3]	1990s	• Toilet retrofit • 2 day per week watering • School education program • Proposed increasing block rate structure	13% (projected)
Barrie, Ontario[4]	1994	• Toilet retrofit • Water efficient shower heads	7 % (16.5 gpcd)
Waukesha, WI[5]	2006	• Toilet retrofit • Daytime irrigation ban • 2 day per week watering restriction • School education program • Proposed increasing block rate structure	11%

[1] From www.lincoln.ne.gov/city/pworks/water/conserve/ and 2007 Facilities Master Plan Update (Black & Veatch, 2009).
[2] From *Regional Case Studies: Best Practices for Water Conservation in the Great Lakes-St. Lawrence Region* (Great Lakes Commission, June 2004)
[3] From "IRP: A Case Study From Kansas," *Journal of the American Water Works Association* 87, No. 6 (June1995): pp.57-71.
[4] From *Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs* (United States Environmental Protection Agency, 2002).
[5] From "Waukesha, WI Promotes Water Conservation, Environmentally Responsible Water Supply Planning" by Mayor Larry Nelson, *U.S. Mayor Newspaper*, March 23, 2009 and "Proposed Waukesha Water Rates Encourage Conservation" by Lisa Kaiser, www.expressmilwaukee.com, Wednesday, May 20, 2009.

4. POPULATION AND EMPLOYMENT

Population and employment are important factors in evaluating existing water usage and projecting future water usage. Population and employment data by Traffic Analysis Zone (TAZ) are also used to develop an understanding of the spatial component (geography) of demands.

4.1. Historical, Existing, and Future Service Population

Estimates of existing service population were developed from Dane County TAZ projections and census estimates obtained from the Wisconsin Demographic Service Center and compared.

4.1.1 Methodology 1 –Demographic Service Center

The State of Wisconsin – Department of Administration Demographic Service Center (www.doa.state.wi.us) develops annual total population estimates for counties, towns, cities, and villages. Population estimates by year for the City, Maple Bluff, Shorewood, and the Town of Madison were obtained. In addition, to the incorporated areas served by MWU, there are approximately 8,000 customers located in unincorporated areas, called expansion areas. The Demographic Service Center does not provide employment information. Table 3 summarizes the historical population using this approach.

Table 3 - Historical Population Estimates from Demographic Service Center

Year[1]	Town of Madison	City	Maple Bluff	Shorewood Hills	Expansion Area [2]	Service Population
2000	6,611	207,248	1,339	1,659	8,000	224,857
2000 Census[3]	7,005	208,054	1,358	1,732	8,000	226,149
2001	6,999	210,377	1,357	1,730	8,000	228,463
2002	6,974	213,679	1,357	1,729	8,000	231,739
2003	6,952	215,697	1,351	1,721	8,000	233,721
2004	6,936	217,935	1,350	1,724	8,000	235,945
2005	6,128	221,735	1,349	1,717	8,000	238,929
2006	6,104	223,280	1,342	1,711	8,000	240,437
2007	6,086	224,810	1,380	1,706	8,000	241,982
2008	6,033	226,650	1,378	1,699	8,000	243,760
2009	6,017	227,700	1,382	1,705	8,000	244,804
2010	5,923	228,200	1,384	1,701	8,000	245,208

[1] Estimated population as of January 1st of the indicated year.
[2] Expansion population was assumed and held constant based on a review of the 2006 Master Plan demographic data
[3] 2000 United States Census Results.

4.1.2 Methodology 2 – Interpolation of TAZ Data

The Madison Area Transportation and Planning Board provided population and employment data by TAZ for years 2000, 2030, and 2035. The advantage of the TAZ data is that it provides not only a total service area population, but also provides information on the spatial distribution of the population and employment. TAZ data was combined with current city limit and anticipated service area boundaries to develop the population and employment projections for the service area. Linear interpolation was used between 2000 and 2035 to determine intermediate year values. This data is summarized on Table 4. Since the 2005 Comprehensive Plan developed by the Planning Department of the City of Madison is still in effect, there has been no change in the long-term land use projection. The buildout projections from the 2006 Water Master Plan have not changed and are still appropriate for use.

Using the TAZ data and East Side Area boundary, the population and employment growth for the East Side was also calculated and summarized in Table 4.

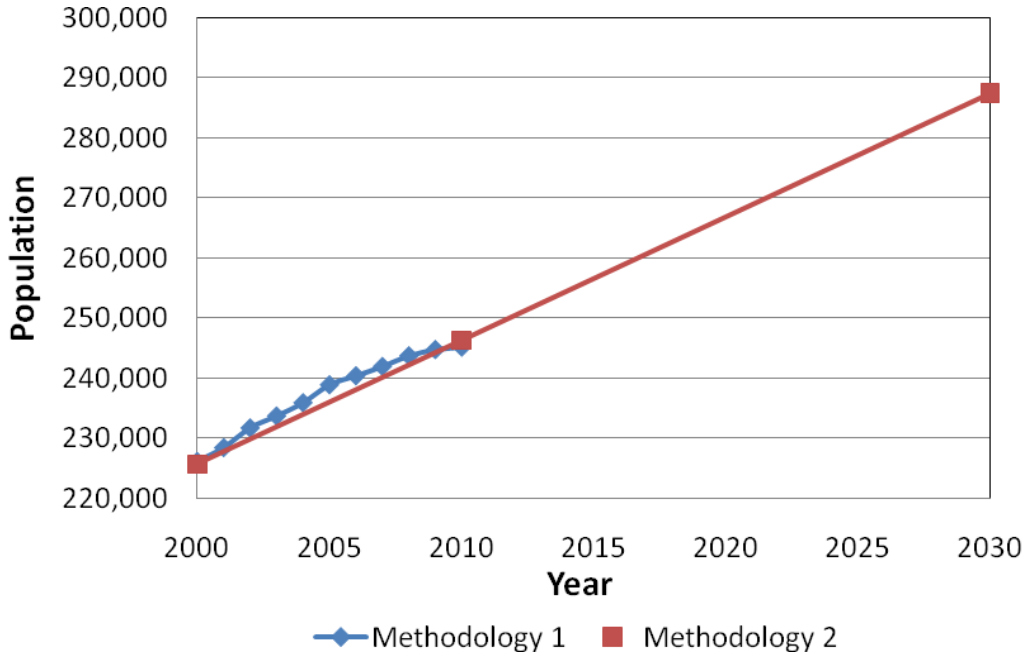
Table 4 - Projected Population and Employment

Year	System-Wide		East Side Area	
	Population[1]	Employment[1]	Population[2]	Employment[2]
2000	225,600	190,800	--	--
2010	246,300	214,400	85,300	66,100
2015	256,600	226,300	89,500	72,300
2030	287,500	261,700	102,100	90,900
Buildout[3]	381,200	322,500	178,600	142,600

[1] Projection = {(2030 Projection – 2000 Projection)/30*(year – 2000)} + 2000 Projection
[2] Includes pressure zones 1, 3, 4, 5, and 6E.
[3] Madison Water Utility Plan (Black & Veatch, December 2008), Table 2-5 and Table 2-15

The two approaches are shown graphically on Figure 1. Methodology 2 produces a population projections that is less than one percent higher (about 1,000 people) than projections from the Demographic Services Center. Because the TAZ projections are similar to the Demographic Services Center projections and also provide employment information and spatial distribution of population, Methodology 2 will be used for estimating existing population and employment.

Figure 1 - Population Methodology Comparison



Attachment B includes detailed information on population and employment by TAZ (and neighborhood for the East Side) along with a map identifying the TAZ locations.

5. WATER DEMANDS

Projected water demands are developed from existing water demands and the anticipated impact of growth and conservation on the demand.

5.1. Definitions and Usage

A water utility must be able to supply water at rates that fluctuate over a wide range. Yearly, seasonally, monthly, weekly, daily, and hourly variations in water demand occur in all water systems, with higher water use typically occurring during hot, dry weather due to increased outdoor use. Water use rates follow a daily (diurnal) pattern that will vary by season and day of the week. Water demand is typically lowest at night and greatest in the early morning and late afternoon. The importance of the key demand rates to the hydraulic design and operation of a water supply and distribution system are as follows:

- Average Day (AD) Demand: The AD demand rate is used primarily as the basis from which to estimate maximum day (MD) and maximum hour (MH) demands. The AD rate is also used to estimate future revenues and operating costs. The AD demand rate is calculated as the total volume of water used during the year, divided by the number of days in the year.
- Summer Demand (SD): This gives insight into the additional pumping required in the summer and the amount of water used in outdoor applications. It is calculated as the water volume used during the highest 3 months of pumping divided by 90.
- Maximum 30 Day (M30D) Demand: Also called maximum month, the average rate of use during the M30D is a good indicator of the period in which the MD use rate will be found. It also indicates the season of elevated use over a prolonged period, which is used to evaluate the ability of the source of supply to yield adequate quantities of water over extended periods. It is calculated as the maximum volume of water used in a single month divided by 30.
- Maximum 10 Day (M10D) Demand: The M10D is the average rate of use during the maximum 10 day period. It is calculated as the maximum value of water used in a 10 day period divided by 10. The M10D demand will be used in hydraulic modeling efforts in future tasks of this project. This demand level is typically indicative of what happens when the system is highly stressed and serves to demonstrate the water systems ability to meet MWUs level of service.
- Maximum 7 Day (M7D) Demand: The M7D is the average rate of use during a maximum 7 day period. It is calculated as the maximum value of water used in a 7 day period divided by 7.
- Maximum Day: The MD rate is used to size water supply and treatment facilities, and booster pumping stations when equalization storage is properly sized. The MD demand distribution is combined with fire flow demand at selected locations to assess the maximum hydraulic capacity of the distribution system to satisfactorily serve required fire demand. It is calculated as the maximum volume of water used during a single day of the year.
- Maximum Hour: Since minimum distribution system pressures are usually experienced during MH, the sizes and locations of distribution facilities are generally determined on the basis of this condition. MH water requirements are partially met through the use of strategically located system storage. The use of system storage minimizes the required

capacity of transmission mains and permits a more uniform and economical operation of the water supply, treatment, and pumping facilities. It is calculated as the maximum volume of water used during a single hour, multiplied by 24 hours.

- Minimum Day (MinD): Minimum day usage is becoming increasingly significant relative to issues of water quality in the distribution system. It is the basis for evaluating the maximum water age in the distribution system, which coincides with greatest degradation of water quality. It is calculated at the minimum volume of water used during a single day.

5.2. Historical Water Demands

Historical water production and water billing data was used in combination with population and employment to develop an understanding of historical water use in the Service Area.

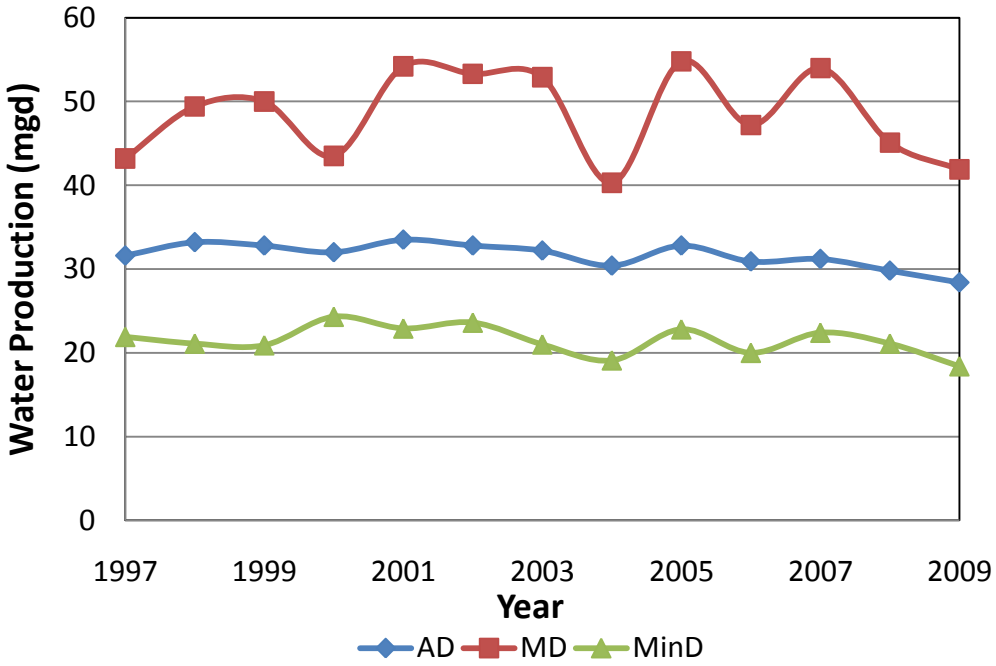
5.2.1 Historical Production

Table 5 summarizes historical water production by MWU with the characteristics provided for AD, MD, and MinD, which are shown graphically on Figure 2. Although population has increased by approximately 9 percent since 1997, the AD demand does not show a similar increasing trend.

Table 5 - Historical Water Production

Year	AD (mgd)	MD (mgd)	MD:AD Ratio	MinD (mgd)	MinD:AD Ratio
1997	31.6	43.2	1.37	21.9	0.69
1998	33.2	49.4	1.49	21.1	0.64
1999	32.8	50.0	1.52	20.9	0.64
2000	32.0	43.5	1.36	24.3	0.76
2001	33.5	54.2	1.62	22.9	0.68
2002	32.8	53.3	1.62	23.6	0.72
2003	32.2	52.9	1.64	21.0	0.65
2004	30.4	40.3	1.33	19.1	0.63
2005	32.8	54.8	1.67	22.8	0.69
2006	30.9	47.2	1.53	20.0	0.65
2007	31.2	54.0	1.73	22.4	0.72
2008	29.8	45.1	1.51	21.1	0.71
2009	28.4	41.9	1.48	18.4	0.65
Average	**31.7**	**48.4**	**1.53**	**21.5**	**0.68**
Maximum	**33.5**	**54.8**	**1.73**	**24.3**	**0.76**
Minimum	**28.4**	**40.3**	**1.33**	**18.4**	**0.63**
mgd – million gallons per day					

Figure 2 - Historical Water Production



The decreasing trend in AD demands in the past few years, despite the growth in population, cannot fully be attributed to conservation efforts as summer climate characteristics are also a factor in water usage. Table 6 and Figure 3 summarize the SD water production, average temperature, and precipitation data for years 1999 through 2009. As can be seen from this information, water demand can vary as a function of temperature or rainfall. For example, 2005 represents a relatively hot and dry year with higher water demand rates. A series of figures detailing the 7-day averages of production, temperature, precipitation are provided in *Attachment C*.

Table 6 - Summer Production vs. Climate Data

Year	Summer [1] Demand (mgd)	Average Summer [1] Temperature (˚F)	Summer [1] Rainfall (inches)
1999	38.2	67	9.6
2000	35.8	67	9.1
2001	39.4	67	16.1
2002	40.0	69	7.8
2003	39.3	68	9.1
2004	33.5	66	11.0
2005	39.8	70	7.1
2006	35.7	67	13.0
2007	37.4	69	20.3
2008	35.1	68	9.3
2009	32.2	67	8.6
Average	**36.9**	**68**	**11.0**
Maximum	**40.0**	**70**	**20.3**
Minimum	**32.2**	**66**	**7.1**

[1] Data from July - September

Figure 3 - Water Production and Climate Influence

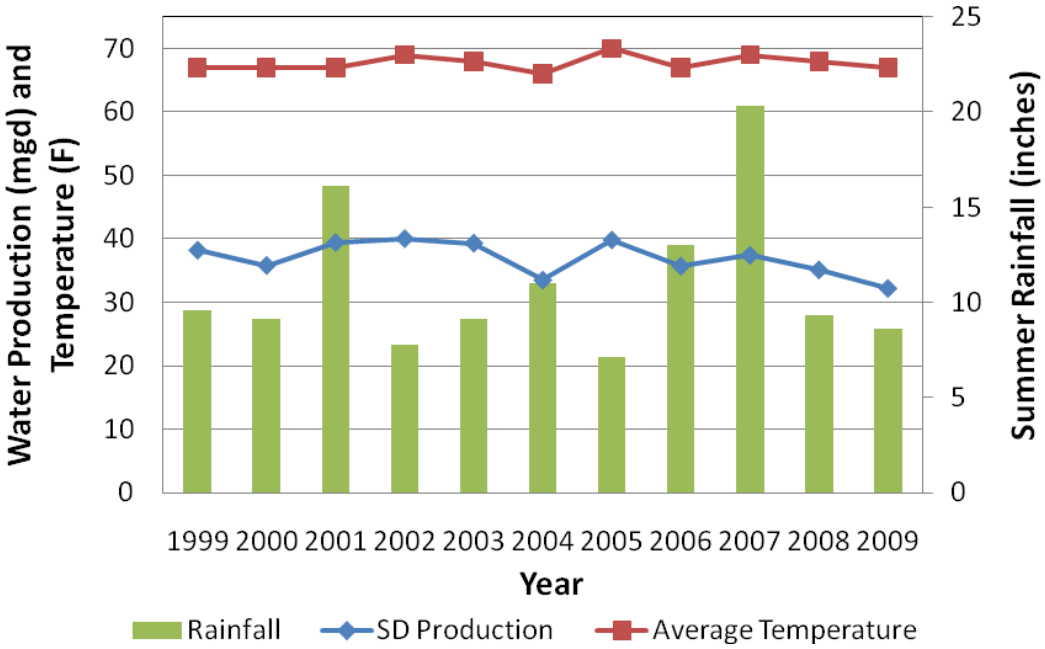


Figure 3 seems to indicate that there is no obvious direct correlation between cumulative summer rainfall (labeled on the secondary y-axis) and summer demand. Other summer

precipitation factors may impact summer water demand such as time of rainfall or other unidentified spring climatic conditions. It appears that there may be a correlation between summer demand and average summer temperature. In any case, historical water demand records indicate a significant variation in summer demands. Making long term water demand projections based on short term trends may not be appropriate.

5.2.2 Non-Revenue Water

In addition to billed water use, there is an unaccounted-for (or non-revenue) water component. Non-revenue water is defined as the difference between total water production and metered sales. The American Water Works Association (AWWA) Manual 36 – Water Audits and Loss Control Programs (Third Edition 2009) identifies two types of non-revenue water, real losses and apparent losses. Real losses include incidents where the water is never put to a beneficial use, such as pipeline leaks and tank overflow spills. Apparent losses include losses related to meter inaccuracies and non-metered water use, such as system flushing, fire fighting, or unauthorized connections.

As shown in Table 7, estimated non-revenue water in the MWU system varies between 6.9 and 12.8 percent. This is within industry standards for a well operated water distribution system. An average non-revenue water of 10 percent will be assumed for future water production projections. The implementation of AMI and monthly billing will provide a much higher level of detail regarding water use patterns. When this information is available, the MWU may want to complete a water audit to identify the sources and possible options for reduction of non-revenue water.

Table 7 - Historical Non-Revenue Water

Year	Non-Revenue Water (mgd)	Non-Revenue Water (percent)
1997	3.1	9.7
1998	3.3	9.9
1999	2.4	7.2
2000	2.9	8.9
2001	3.9	11.7
2002	3.7	11.1
2003	3.5	10.8
2004	3.4	11.1
2005	4.2	12.8
2006	2.2	6.9
2007	3.4	10.7
2008	3.1	10.4
2009	2.2	7.6
2010	2.5	10.0
Average	**3.1**	**9.9**
Maximum	**4.2**	**12.8**
Minimum	**2.2**	**6.9**

5.2.3 Demand by User Class

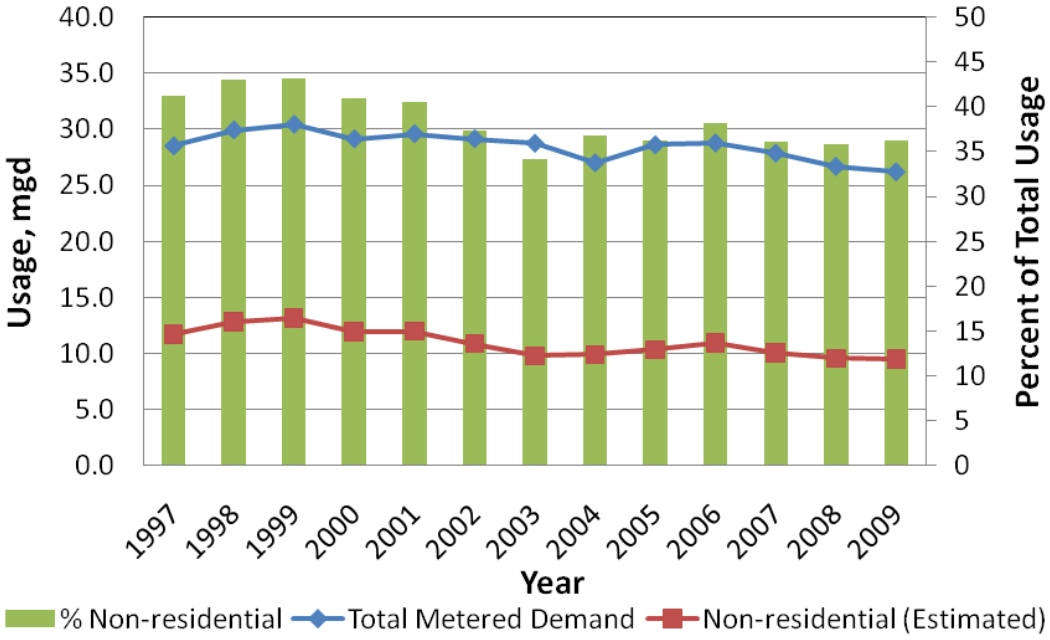
Year end reports provided to the Public Service Commission (PSC) detail metered water sales data for residential and non-residential (commercial, wholesale, industrial, and other use categories). Residential include single family and duplex housing. Multi-family use is included as commercial sales in these reports. Based on MWU information on multi-family accounts, it was assumed that approximately 75 percent of the water recorded as commercial (but not other non-residential use) was related to multi-family use. Table 8 summarizes the historical water use characteristics for residential and non-residential categories. As can be seen from this table, the average ratio of non-residential water use to the total metered use is approximately 38 percent. Figure 4 graphically depicts the ratio of non-residential water use to the total use.

Table 8 - Historical Metered Water - Residential vs. Non-Residential

	Average Day (mgd)			
	All Residential			
Year [1]	Residential Meters (Single Family & Duplexes)	Commercial Meters (Apartments) [2]	Non Residential	Total
1997	8.8 (31%)	7.9 (28%)	11.8 (41%)	28.5
1998	9.0 (30%)	8.1 (27%)	12.9 (43%)	29.9
1999	9.1 (30%)	8.2 (27%)	13.1 (43%)	30.4
2000	9.1 (31%)	8.2 (28%)	11.9 (41%)	29.2
2001	9.3 (31%)	8.3 (28%)	12.0 (41%)	29.6
2002	9.6 (33%)	8.7 (30%)	10.9 (37%)	29.1
2003	10.0 (35%)	9.0 (31%)	9.8 (34%)	28.7
2004	9.0 (33%)	8.1 (30%)	9.9 (37%)	27.1
2005	9.9 (35%)	8.3 (29%)	10.4 (36%)	28.6
2006	9.4 (33%)	8.4 (29%)	11.0 (38%)	28.8
2007	9.4 (34%)	8.4 (30%)	10.1 (36%)	27.9
2008	9.0 (34%)	8.1 (30%)	9.6 (36%)	26.7
2009	8.8 (33%)	8.0 (30%)	9.5 (36%)	26.2
2010	8.4 (33%)	8.0 (32%)	8.9 (35%)	25.3
Average	**9.2 (33%)**	**8.3 (29%)**	**10.8 (38%)**	**28.3**
Maximum	**10.0**	**9.0**	**13.1**	**30.4**
Minimum	**8.4**	**7.9**	**8.9**	**25.3**

[1] Year 1997 -2004 data from 2006 Master Plan, Table 3-4.
[2] Estimated as approximately 75 percent of metered commercial sales

Figure 4 - Historical Non-residential Usage



5.2.4 Large Users

Large water users, non-residential customers that use more than 100,000 gpd on an annual average basis, make up nearly 75 percent of the total non-residential demand. These include the University of Wisconsin, Oscar Mayer Foods, hospitals, government entities, and wholesale customers. Table 9 summarizes large user demands over the last 10 years. Generally a large water user's demand is fairly consistent. The University of Wisconsin – Madison has been actively pursuing water conservation for the last few years and has seen a significant decrease in demand since 2002. In addition to water demands for the University buildings, there is also a Cogeneration Facility on campus that typically uses cooling water from Lake Mendota, but could put a demand as large as 2 mgd on the system during a drought when lake levels are inadequate to supply cooling water. The wholesale customers: Shorewood Hills and Maple Bluff see a more significant change from year to year, which is likely because their service area is primarily residential customers with variable seasonal demands.

In the distribution system computer model, large user demands will be point loaded so that the model properly handles these usually large demands. It is assumed that large user demand will be reduced in the future consistent with other non-residential water conservation efforts.

Table 9 - Existing Largest Water Customers

Water Customer	AD Demand (mgd)										
	2000[1]	2001[1]	2002[1]	2003[1]	2004[1]	2005[1]	2006	2007	2008[2]	2009[2]	Average
University of Wisconsin[3]	4.18	4.15	4.02	3.74	3.72	3.00	3.25	2.78	2.96	2.78	3.46
Oscar Mayer Foods	1.30	1.54	1.10	1.00	0.85	1.59	1.6	1.34	1.45	1.34	1.31
Government (Federal, State, County)[3]	--	--	--	--	--	--	0.81	0.78	0.72	0.67	0.75
City of Madison[3]	--	--	--	--	--	--	0.64	0.70	0.72	0.61	0.67
Covance	0.11	0.12	0.12	0.18	0.17	0.17	0.16	0.15	0.21	0.19	0.16
Meriter/Madison General Hospital	0.16	0.14	0.13	0.15	0.14	0.15	0.12	0.17	0.15	0.19	0.15
St. Mary's Hospital	0.13	0.14	0.17	0.17	0.11	0.12	0.14	0.15	0.14	0.15	0.14
Webcrafters, Inc.	0.16	0.15	0.11	0.21	0.16	0.16	0.13	0.15	0.13	0.13	0.15
Airgas Merchant Gases[4]	0.12	0.12	0.13	0.16	0.13	0.13	0.12	0.11	0.11	0.11	0.12
V.A. Hospital	--	--	--	--	--	--	--	0.08	0.10	0.09	0.08
Aramark	0.17	0.16	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.11
Forest Products Lab	--	--	--	--	0.11	0.11	0.09	0.09	0.09	0.09	0.10
Superior Health Linens	--	--	--	--	--	--	--	0.08	0.09	0.08	0.08
Danisco, USA	--	--	--	--	--	--	--	0.09	0.09	0.09	0.09
American Family Insurance	--	--	--	--	--	--	0.09	0.08	0.08	0.08	0.08
Shorewood Hills[5]	0.25	0.22	0.38	0.17	0.16	0.21	0.21	0.16	0.19	0.16	0.19
Maple Bluff[6]	0.16	0.20	0.18	0.18	0.20	0.18	0.31	0.24	0.17	0.23	0.19
Waunona Sanitary District No. 2	0.14	0.14	0.12	0.10	0.14	0.14	0.13	0.09	0.12	0.14	0.13

Notes: -- Unavailable or unreported.

1 2006 Master Plan, Table 36

2 Email from MWU October 14, 2010

3 Multiple facilities.

4 Previously AGA Gas

5 Village of Shorewood Hills experienced a large system leak in 2002. Average does not include 2002 data.

6 Village of Maple Bluff had very high usage in 2006. Average does not include 2006 data.

5.2.5 Historical Unit Demands

In order to determine the appropriate residential unit demand and determine the sensitivity of the assumptions related to the multi-family usage, two methodologies were used to compare residential unit demand results.

The first methodology was based on the assumptions from the 2006 Master Plan. The residential usage (single family and duplexes) was used in conjunction with the number of residential metered accounts and an assumed housing density to determine a residential per-capita unit water use. This data is shown in Table 10 and is only representative of single-family and duplex residential use. The housing density used in this table beginning at 2.43 persons per household for year 1997 with a decreasing trend is based on the City 2005 Comprehensive Plan, Volume I where the data shows that in 2000 the single-family household density is 2.4 persons per household and has been declining at a rate of .01 persons per year since 1980. The limitation of this methodology is that it only provides information on the residential unit usage for single-family and duplex use and it is also highly dependent upon the household density assumptions.

Table 10 - Unit Residential Water Use Calculations (Method 1)

Year	Average Residential Metered Use (mgd)	Number of Residential Metered Accounts	Single Family Housing Density [1]	Calculated Residential Metered Population	Per-Capita Residential Water Use (gpcd)
1997	8.8	46,944	2.43	114,100	77.3
1998	9.0	47,513	2.42	115,000	78.0
1999	9.1	48,143	2.41	116,000	78.3
2000	9.1	49,029	2.4	117,700	77.3
2001	9.3	50,033	2.39	119,600	77.5
2002	9.7	51,250	2.38	122,000	78.8
2003	10.0	52,391	2.37	124,200	80.3
2004	9.0	53,454	2.36	126,200	71.6
2005	9.9	53,454	2.35	125,600	78.9
2006	9.4	55,270	2.34	129,300	72.7
2007	9.4	55,730	2.33	129,900	72.2
2008	9.0	56,033	2.32	130,000	69.2
2009	8.8	56,244	2.31	129,900	67.3
2010	8.4	56,448	2.30	129,830	64.70
Average	**9.2**	**--**	**--**	**--**	**71.7**
Maximum	**10.0**	**--**	**--**	**--**	**80.3**
Minimum	**8.4**	**--**	**--**	**--**	**64.7**

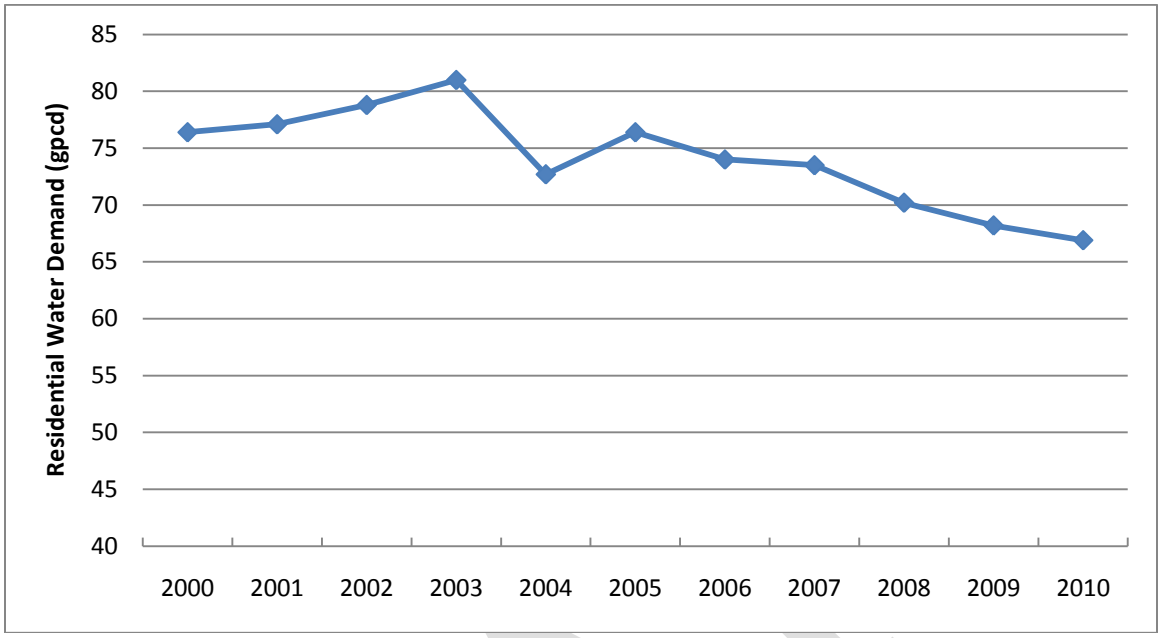
[1] Housing Density is declining as described in the Madison Comprehensive Plan

The second methodology used to estimate residential unit water demand uses the service area population estimates provided in Table 3 and the estimated total residential usage provided in Table 8. The resulting data is provided in Table 11. Both methods produce similar results, but since Method 2 is able to incorporate all residential use and is less dependent on household density assumptions it was used for estimating historical water use. As shown in Figure 5, there is currently a downward trend in per capita residential water use. This is primarily the result of water saving fixtures and increased conservation awareness. Results for 2003 and 2005, however, show that there can still be years with higher demands. In order to ensure adequate capacity for a higher demand year, a unit demand of 74 gpcd was chosen for future demands without conservation (High). This is consistent with the highest demand year out of the last 5 years of available data.

Table 11 - Unit Residential Water Use Calculations (Method 2)

Year	Residential Usage (mgd)	Service Population	Per-Capita Residential Water Use (gpcd)
2000	17.3	226,149	76.4
2001	17.6	228,463	77.1
2002	18.3	231,739	78.8
2003	18.9	233,721	81.0
2004	17.2	235,945	72.7
2005	18.3	238,929	76.4
2006	17.8	240,437	74.0
2007	17.8	241,982	73.5
2008	17.1	243,760	70.2
2009	16.7	244,804	68.2
2010	16.4	245,208	66.9
Average	**17.6**	**--**	**74.1**
Maximum	**18.9**	**--**	**81.0**
Minimum	**16.4**	**--**	**66.9**

Figure 5- Historical Residential Water Demand



5.2.6 System Peaking Factors

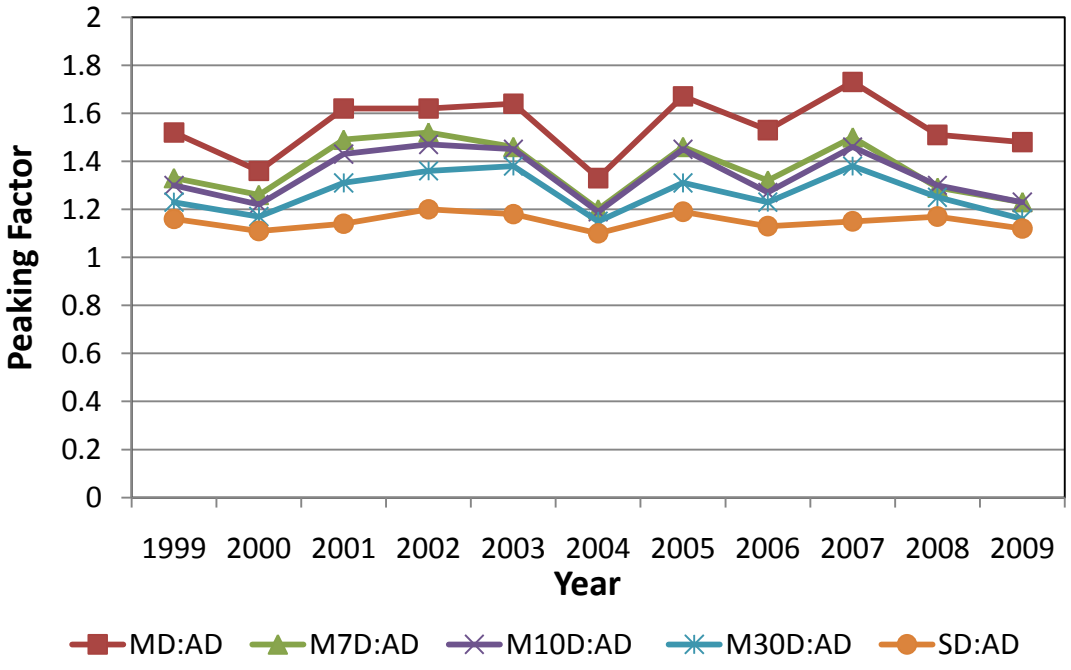
In order to determine typical system peaking factors, pumping data from years 1999 to 2009 was evaluated. Peaking factors for each year of data were calculated and summarized in Table 12 and are shown in Figure 6 for the following conditions:

- MD Demand vs. AD Demand
- M7D Demand vs. AD Demand
- M10D Demand vs. AD Demand
- M30D Demand vs. AD Demand
- SD Demand vs. AD Demand

Table 12 - Historical Peaking Characteristics from Well Pumping Data

Year	Peaking Period				
	MD:AD	M7D:AD	M10D:AD	M30D:AD	SD:AD
1999	1.52	1.33	1.30	1.23	1.16
2000	1.36	1.26	1.22	1.17	1.11
2001	1.62	1.49	1.43	1.31	1.14
2002	1.62	1.52	1.47	1.36	1.20
2003	1.64	1.46	1.45	1.38	1.18
2004	1.33	1.20	1.19	1.15	1.10
2005	1.67	1.46	1.45	1.31	1.19
2006	1.53	1.32	1.27	1.23	1.13
2007	1.73	1.50	1.46	1.38	1.15
2008	1.51	1.29	1.30	1.25	1.17
2009	1.48	1.23	1.23	1.16	1.12
Average	**1.53**	**1.37**	**1.34**	**1.27**	**1.15**
Maximum	**1.73**	**1.52**	**1.47**	**1.38**	**1.20**
Minimum	**1.33**	**1.20**	**1.19**	**1.15**	**1.10**

Figure 6 - Historical Summer Peaking Factors



The 11 years of peaking factor data shows that there is no trending and that the MD:AD factors show considerable variability. This data supports the system overall MD:AD design peaking factor of 1.74 used in the 2006 Master Plan.

5.2.7 Existing Demands by Service Zone

The spatial distribution of usage by service zone was evaluated and compared to the characteristics presented in the 2006 Master Plan. Consumption and demand distribution characteristics by service zone were evaluated for the AD, M7D, and MD where SCADA data allowed for the evaluation of the spatial distribution in demand.

Table 13 presents the distribution in metered consumption for the AD condition based upon the metered sales data. As indicated in this table, the percent of total AD consumption by service zone in 2003 is similar to the percent of total AD consumption by service zone in 2008. Notable exceptions are service zones with growth and/or boundary modifications (Zone 1, Zone 3, Zone 10, and Zone 11).

Table 13 - Consumption by Service Zone (AD)

Service Zone	2003 AD Consumption [1] (mgd)	Percent of System Consumption (%)	2008 AD Consumption [2] (mgd)	Percent of System Consumption (%)
1	0.29	0.9	0.37	1.4
2 [3]	0.12	0.4	0.88	3.4
3 [3]	0.19	0.6		
4	1.24	3.8	1.08	4.1
5	0.05	0.2	0.03	0.1
6W [4]	22.54	69.6	10.13	38.7
6E [4]			6.84	26.1
7	4.19	12.9	3.19	12.2
8	2.52	7.8	2.21	8.5
9	0.66	2.0	0.59	2.3
10	0.49	1.5	0.67	2.6
11	0.08	0.3	0.18	0.7
Total	**32.37**	**100.0**	**26.18**	**100.0**

[1] From Metered Sales Allocated for the 2006 Master Plan
[2] From 2008 Metered Sales Allocation but using current Service Zone Boundaries
[3] Zone 2 and Zone 3 were merged in 2010 (called Zone 3) with some of Zone 6E being incorporated
[4] Zone 6 was essential split by the closure of isthmus valves into Zone 6E and Zone 6W

Table 14 presents the spatial distribution of demand by service zone for a M7D demand condition for 2003 and a week of high demand in August of 2010. At the time of this study not all information had been evaluated for 2010 but it is assumed that this week

presents a condition comparable to a M7D demand condition. This table is based upon the compilation of SCADA data with estimates of booster pump station flows. As can be seen from this table the spatial distribution of demand during the M7D is similar in 2010 to the week in 2003 except that there has been a slight increase in Zone 9. The spatial distribution of demand is also slightly greater in Zone 3 but this is likely due to incorporation of some of Zone 6E into Zone 3.

Table 14 - Demand by Service Zone (M7D)

Service Zone	Year 2003 M7D Demand (mgd) [1]	Percent of System Demand (%)	Year 2010 Week of Aug 1 Demand (mgd) [2]	Percent of System Demand (%)
1	0.6	1.4	0.41	1.2
2 [3]	0.33	0.8	1.31	3.8
3 [3]	0.48	1.1		
4	1.77	4.3	1.48	4.3
5	0.07	0.2	0.04	0.1
6W [4]	26.8	64.5	10.11	29.6
6E [4]			10.23	29.3
7	3.38	8.1	3.67	10.6
8	5.66	13.6	4.34	12.6
9	0.91	2.2	1.73	5.0
10	1.16	2.8	0.91	2.6
11	0.42	1.0	0.28	0.8
Total	**41.58**	**100**	**34.52**	**100.0**

[1] Year 2003 from 2006 Master Plan based upon previous evaluation of SCADA information
[2] Year 2010 estimated from SCADA information for week of August 1
[3] Zone 2 and Zone 3 were merged in 2010 (called Zone 3) with some of Zone 6E being incorporated
[4] Zone 6 was essential split by the closure of 3 of 4 isthmus valves in 2006 into Zone 6 E and Zone 6 W

Table 15 presents the spatial distribution of demand by service zone for a MD demand condition in 2003 and a 24-hour period of high demand between August 3rd and August 4th of 2010. The calculated demands are based upon the compilation of SCADA data with estimates for booster pump station flows. This table shows that the spatial distribution of demand during the MD in 2003 is similar to the day in 2010. The spatial distribution of demand is slightly greater in Zone 3 but this is due to incorporation of some of Zone 6E into Zone 3. Note that some data for Booster Pump Station 106 did not appear to be captured correctly in the SCADA system in 2010 and therefore estimates were made regarding the run times of this Booster Pump Station using best judgment based on typical operations. Since these estimates effect the spatial distribution calculations for Zone 7 and Zone 6 W, underestimates could result in the lowered calculated percent of total demand for Zone 7 in 2010.

Table 15 - Demand by Service Zone (MD)

Service Zone	Year 2003 MD Demand (mgd) [1]	Percent of System Demand (%)	Year 2010 August 3-4 Daily Demand (mgd) [2]	Percent of System Demand (%)
1	0.76	1.4	.44	1.2
2 [3]	0.42	0.8	1.28	3.5
3 [3]	0.61	1.2		
4	2.25	4.3	1.55	4.2
5	0.09	0.2	0.03	0.1
6W [4]	34.09	64.5	13.38	36.0
6E [4]			10.66	28.7
7 [5]	4.3	8.1	2.27	6.1
8	7.19	13.6	4.65	12.5
9	1.15	2.2	1.72	4.6
10	1.48	2.8	0.93	2.5
11	0.53	1.0	0.29	0.8
Total	**52.87**	**100.00**	**37.17**	**100.00**

[1] Year 2003 from 2006 Master Plan based upon previous evaluation of SCADA information
[2] Year 2010 estimated from SCADA information for August 3-4.
[3] Zone 2 and Zone 3 were merged in 2010 (called Zone 3) with some of Zone 6E being incorporated
[4] Zone 6 was divided by the closure of isthmus valves into Zone 6E and Zone 6W
[5] Missing data from Booster Pump Station 106 required some assumptions on run times for this station. Consequently demands may be underestimated for Zone 7 and overestimated for Zone 6W.

Tables 13 through 15 support the assumptions used in the 2006 Master Plan regarding the spatial distribution of demand by service zone and indicate that using the design values indicated in the 2006 Master Plan will be appropriate to project the future spatial distribution of demand and the peaking factors in conjunction with TAZ population and employment data.

5.3. Future Water Demands

A range of water demand projections were developed using the criteria and information provided in previous sections of this memorandum, information from the 2006 Master Plan, and the TAZ population and employment projections provided by the planning department.

Since MWU recently implemented a conservation plan, its ultimate effectiveness is unknown. Therefore, a range of water demand rates was considered including: High – no conservation, Medium – half of goal, and Low – full conservation. Based on the goals in the MWU Conservation Plan, it was assumed that conservation (based on the activities outlined in the MWU Conservation Plan) will be achieved by 2020. Additional calculation details are included in Attachment D.

5.3.1 Residential Unit Demands

The residential unit demands that were used to determine projected water demands are based on the information provided in Tables 11 and 12 and the recommended conservation unit demand. The residential unit demands to be used are listed below:

- High: All design years (2010, 2015, 2030, and Buildout) – 74 gpcd
- Mean: (halfway between the high and low residential unit demands)
  - 2010 – 74 gpcd
  - 2015 – 71 gpcd
  - 2030 and Buildout – 67 gpcd
- Low:
  - 2010 – 72 gpcd – This value is based on the average of the last five years of data and assumes that conservation has had a slight impact in residential unit demands in this average.
  - 2015 – 65 gpcd. This value is based on the assumption that half of the conservation will be achieved by 2015 (i.e. halfway between no 72 gpcd at 2010 , and conservation goals achieved fully in 2020 or 58 gpcd. This breaks down to 72 +58 divided by 2, or 65 gpcd)
  - 2030 and Buildout – 58 gpcd (achieved by 2020)

5.3.2 Non-residential Demands

To determine the non-residential demand component, an initial non-residential to total metered demand percentage of 38 percent was used for year 2010 (high – 11.2 mgd, medium – 11.2 mgd, and low – 10.9 mgd). This is the average value of the last 10 years, as shown in Table 8. Based on the implementation of conservation practices, it was assumed that between now and 2020 this demand volume would stay constant. (demand from increased employment would be off-set by increased conservation).

To project the non-residential water use for years 2030 and Buildout, the 2020 gallons-per-employee-per-day (gped) unit usage was calculated using the 2020 non-residential water use and the 2020 total employment from the TAZ data. The 2020 non-residential unit usage rate was calculated as 46.8 gped for the high and mean (11.2 mgd divided by 238,000 employess) and 45.7 for the low value (10.9 mgd divided by 238,000 employees).

5.3.3 System-Wide Average Day Demands

Using the residential unit demands provided in Section 5.3.1, the non-residential demand assumptions described in the previous section, and a non-revenue component of 10 percent, the range of water demands was calculated and is provided in Table 16 and is shown graphically in Figure 6. Although the low, mean, and high total demand for 2010 in Table 16 are higher than recent metered water use shown in Table 8, this is due to the addition of non-revenue demand and the need for water demand projections to reflect likely demands in a warmer and drier than average year.

Table 16 – System-Wide Average Day Water Demand Projections (mgd)

Design Year	Range Category	Residential Demand	Non-Residential Demand	Non-Revenue Demand	Total Demand
Year 2010	High	18.2	11.2	3.3	32.7
	Mean	18.2	11.2	3.3	32.7
	Low	17.7	10.9	3.2	31.8
Year 2015	High	19.0	11.2	3.4	33.5
	Mean	18.2	11.2	3.3	32.7
	Low	16.7	10.9	3.1	30.7
Year 2030	High	21.3	12.3	3.7	37.3
	Mean	19.3	12.3	3.5	35.1
	Low	16.7	12.0	3.2	31.9
Buildout	High	28.2	15.1	4.8	48.1
	Mean	25.5	15.1	4.5	45.1
	Low	22.1	14.7	4.1	41.0

Figure 7 – Average Day Projected Demands

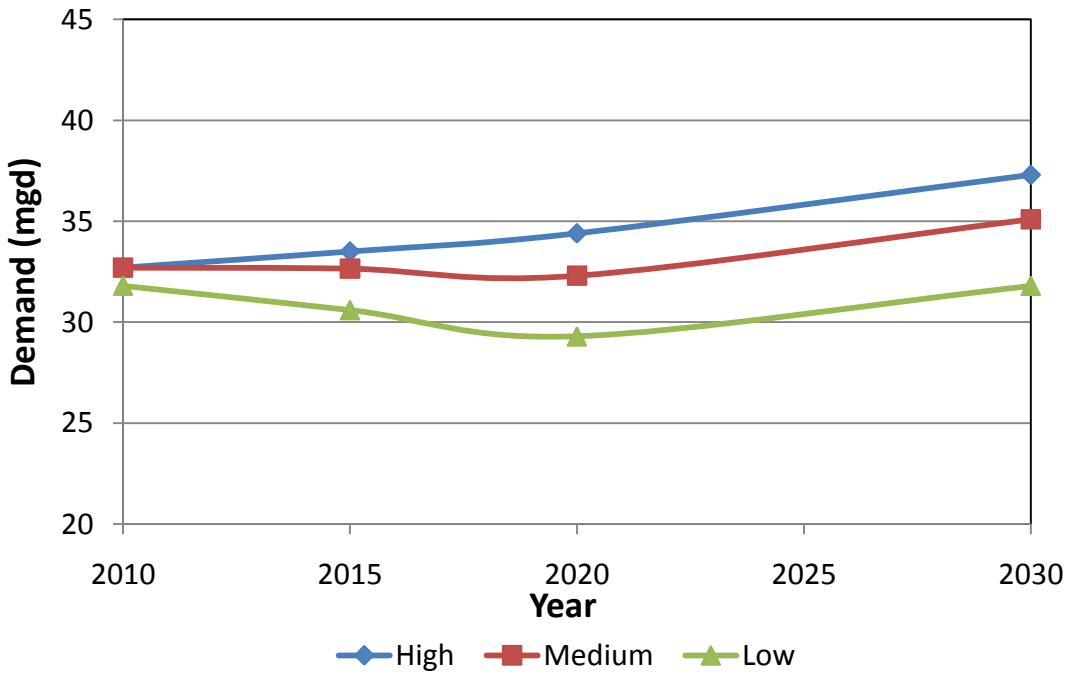


Figure 6 provides an illustration of the AD demand projections following the criteria outlined in the previous sections. This figure illustrates that for the low demand projections (conservation goals are fully achieved) the AD water use in 2030 will be approximately the same as current water use. Conservation gains will compensate for the additional projected demand resulting from residential and non-residential growth.

Although MWU and the public have embraced the Conservation Plan and have already begun to see some results, the ability to reach and maintain the low demand assumptions has not been shown. The demand range for mean and low will be used as the basis for the future projections and recommendations. MWU should monitor progress on conservation goals and adjust demand assumptions if needed on future distribution system evaluations.

5.3.4 System Design Peaking Factors

The system design peaking factors for MD, and MH are presented in the 2006 Master Plan and have not changed for this study as they have been supported by the evaluations presented in this memorandum. The M10D peaking factor, which was not used in the 2006 Master Plan, was determined for this project as the 90th percentile value (10-year return interval) using the last eleven years of data shown in Attachment E. The M10D peaking factors were added to the evaluation for use during water age hydraulic analyses. Table 17 lists the system-wide design peaking factors based on existing water usage and Table 18 summarizes the system-wide demand projections.

Table 17 - System Peaking Factors

Condition	Peaking Factor
M10D[1]	1.47
MD[2]	1.74
MH[2]	2.15

[1] 90th percentile value from past 11 years of data
[2] From the 2006 Master Plan

Table 18 - System Wide Water Demand Projection Range (mgd)

Design Year	AD[1]	M10D[2]	MD[2]	MH[2]
Year 2010	31.8 – 32.7	46.4 – 47.7	55.3 – 56.8	68.3 – 70.2
Year 2015	30.6 – 32.7	44.7 – 47.7	53.3 – 56.8	66.8 – 70.2
Year 2030	31.8 – 35.1	46.5 – 51.3	55.4 – 61.1	68.5 – 75.4
Buildout	40.9 – 45.1	59.8 – 66.0	71.1 – 78.6	87.9 – 97.1

[1] From Table 16 (Mean and Low Range Category)
[2] Peaking Factor from Table 17.

6. EAST SERVICE AREA DEMAND AND SUPPLY ANALYSIS

Although understanding the system-wide demand and peaking factors is an important step in establishing overall demands, the East Service Area is the focus of this project. The demands and peaking factors for each service zone (zone) were determined so that the facility needs for each zone can be properly evaluated.

The East Service Area includes all MWU facilities east of the Yahara River shown in Attachment A. The East Service Area includes zones: 1, 3, 4, 5, and 6E. Since MWU has plans to combine zones 1 and 3 and call it Zone 3, these areas will be referred to as Zone 3 for this memo. Because of the need to maintain a mass balance in the hydraulic model for the entire system both the East and West Service Area demands and peaking factors are included in the discussion and projections in this section.

6.1. East Service Area Average Day Demand

In order to divide the projected demand up by zone, GIS was used to combine population and employment by TAZ with the zone boundaries. The demands for large users were assigned to the proper TAZ so that they were also included in the demand projections. Table 19 summarizes the demands by zone.

Table 19 – Average Day Demand Projections by Zone (mgd)

Zone	2010	2015	2030	Build Out
East Service Area				
3	2.2	2.3 - 2.4	3.2 – 3.5	7.5 – 8.3
4	1.3	1.2 - 1.3	1.4 – 1.5	4.0 – 4.4
5	0.1	0.1	0.1	0.1
6E	7.0 – 7.2	6.6 – 7.1	6.5 – 7.2	7.2 – 8.0
East Service Area Total	**10.6 – 10.8**	**10.2 – 10.9**	**11.2 – 12.3**	**18.7 – 20.8**
West Service Area				
6W	12.4 - 12.7	11.8 - 12.5	11.0 – 12.0	11.2 – 12.3
7	3.8 – 4.0	3.6 - 3.9	3.4 – 3.9	3.4 – 3.8
8	3.3 – 3.4	3.2 – 3.4	3.5 – 3.8	3.9 – 4.2
9	0.7	0.7	0.8 – 0.9	0.6 – 0.7
10	0.9	1.0 – 1.1	1.7 – 1.8	2.6 – 2.9
11	0.1	0.2	0.3	0.4 – 0.5
West Service Area Total	**21.2 – 21.8**	**20.4 - 21.8**	**20.7 – 22.7**	**22.2 – 24.4**
System-Wide Total	**31.8 – 32.6**	**30.6 – 32.7**	**31.9 – 35.0**	**40.9 – 45.2**

6.2. Peaking Factor by Service Zone

Peaking factors vary by zone across the water distribution system as a function of the size and the mix of residential and non-residential customers. In general, as the amount of demand within a zone increases its peaking factors will decrease. This section describes the methodology used to project peaking factors for each zone. Table 20 summarizes the selected peaking factors.

Developing peaking factors for each zone requires reviewing both the existing peaking factors for each zone and balancing the rate of growth between zones. In addition, in order to satisfy the mass balance equations in the hydraulic model, the weighted average of the peaking factors must match the system-wide peaking factors selected in Section 5.3.4

Table 20 – Peaking Factor by Zone

Zone	M10D	MD	MH
East Service Area			
3	1.57	1.87	2.31
4	1.51	1.80	2.22
5	3.23	3.85	4.76
6E	1.34	1.60	1.98
West Service Area			
6W	1.28	1.52	1.88
7	1.67	1.99	2.46
8	1.65	1.96	2.42
9	2.02	2.40	2.97
10	1.83	2.18	2.69
11	2.52	3.00	3.71
System-Wide	**1.47**	**1.74**	**2.15**

6.2.1 Maximum Day Peaking Factors

During the 2006 Master Plan two curves were developed that predict the MD to AD peaking factors for a zone based on the demand within the zone (2006 Master Plan, Figure 3-10). Because of water use characteristics, zones 6 and 4 use a curve with lower peaking factors than the remainder of the zones. These curves were used as the first step to predict the peaking factor for each zone. For each zone, the average AD demand for 2010, 2015, and 2030 was used and the corresponding MD/AD peaking factor read. Finally, the peaking factors for all zones were adjusted to meet the MD demand.

6.2.2 Maximum 10 Day and Maximum Hour Peaking factors.

Once the MD/AD peaking factors were determined the M10D and MH peaking factors were calculated by maintaining the same ratios of M10D/MD and MH/MD that can be derived from the peaking factors in Table 17:

- M10D to MD: 0.84
- MH to MD: 1.24

6.3. Design Demand Condition

Table 21 summarizes the projected demand conditions for each service area. Note that the sum of the individual zones will not be exactly equal to the demand projected for the system-wide as a result of the methodology used to select the peaking factors by zone and the different rates of growth in the various zones. Checks made confirm that the sum of the zones is within 2 percent (most are within 1 percent) of the system-wide projected demand.

Table 21 – Projected Demand Summary by Service Area

Zone	2010			2015			2030		
	M10D	MD	MH	M10D	MD	MH	M10D	MD	MH
Low Demand									
East Side									
3	3.4	4.1	5.0	3.6	4.2	5.2	5.0	6.0	7.4
4	1.9	2.3	2.8	1.9	2.2	2.7	2.1	2.5	3.1
5	0.2	0.3	0.3	0.2	0.3	0.3	0.2	0.2	0.3
6E	9.5	11.3	13.9	8.9	10.6	13.1	8.8	10.5	12.9
East Side Total	**15.0**	**18.0**	**22.0**	**14.6**	**17.3**	**21.3**	**16.1**	**19.2**	**23.7**
West Side									
6W	15.8	18.8	23.3	15.1	17.9	22.1	14.1	16.7	20.7
7	6.4	7.6	9.5	6.0	7.2	8.9	5.8	6.9	8.5
8	5.4	6.4	7.9	5.3	6.3	7.8	5.8	6.9	8.5
9	1.4	1.7	2.1	1.4	1.6	2.0	1.6	1.9	2.3
10	1.7	2.0	2.4	1.8	2.2	2.7	3.0	3.6	4.5
11	0.3	0.4	0.50	0.4	0.5	0.6	0.6	0.7	0.9
West Side Total	**31.0**	**36.8**	**45.7**	**29.9**	**35.6**	**44.1**	**30.9**	**36.7**	**45.4**
System-Wide Total	**46.0**	**54.8**	**67.7**	**44.5**	**52.9**	**65.4**	**47.0**	**55.9**	**69.1**
Mean Demand									
East Side									
3	3.5	4.2	5.2	3.8	4.5	5.6	5.6	6.6	8.2
4	2.0	2.3	2.9	2.0	2.4	2.9	2.3	2.7	3.3
5	0.2	0.3	0.3	0.2	0.3	0.4	0.2	0.3	0.3
6E	9.7	11.5	14.3	9.5	11.3	14.0	9.7	11.5	14.3
East Side Total	**15.4**	**18.3**	**22.7**	**15.5**	**18.5**	**22.9**	**17.8**	**21.1**	**26.1**
West Side									
6W	16.3	19.4	23.9	16.0	19.0	23.5	15.3	18.3	22.6
7	6.6	7.9	9.7	6.5	7.7	9.6	6.5	7.7	9.5
8	5.6	6.6	8.2	5.6	6.7	8.2	6.3	7.5	9.3
9	1.4	1.7	2.1	1.5	1.8	2.2	1.8	2.1	2.6
10	1.7	2.0	2.5	2.0	2.3	2.9	3.4	4.0	5.0
11	0.3	0.4	0.5	0.4	0.5	0.6	0.7	0.9	1.1
West Side Total	**31.9**	**38.0**	**46.9**	**32.0**	**38.0**	**47.0**	**34.0**	**40.5**	**50.1**
System-Wide Total	**47.3**	**56.3**	**69.6**	**47.5**	**56.5**	**69.9**	**51.8**	**61.6**	**76.2**

6.4. Well Capacity Analysis

The final evaluation of well supply and water distribution system capacity will be done in conjunction with the hydraulic modeling when the impact of system interaction and operation on the ability to meet demands can be looked at more holistically. This evaluation compares only the well capacity with the demands. It does not consider operational or vulnerability issues associated with the unit wells, storage, booster pumping or pressure reducing valves. In addition, this evaluation assumes the unit wells can pump at the design rate for an extended period of time.

The Level of Service Memo written for the East Side Project identified two criteria for evaluating well capacity in the East Service Area:

- AD demand is ≤ 50 percent of well capacity
- MD demand is ≤ well capacity with one well out of service (2 wells for Zone 6E)

The more stringent MD requirements for Zone 6E, with respect to well outages is based on: MWUs operational experience, there are currently 7 operating wells in Zone 6E, and Zone 6E wells provide service or backup service to Zones 3, 4, and 5. Experience indicates that a single well out of service in Zone 6E due to planned maintenance or mechanical breakdown occurs annually. For engineering planning purposes to ensure system reliability, considering a second well outage in Zone 6E due to a power outage or other natural disaster is reasonable and prudent.

Table 22 summarizes the target capacities for the various zones based on their connections to other zones and projected demands.

Table 22 – East Side Required Well Capacity (mgd)

Zone	2010		2015		2030	
	AD[1]	**MD[2]**	**AD[1]**	**MD[2]**	**AD[1]**	**MD[2]**
3	4.4	4.1 – 4.2	4.6 - 4.8	4.2 – 4.5	6.4 – 7.1	6.0 – 6.6
4	2.6	2.3	2.4 - 2.6	2.2 – 2.4	2.8 – 3.0	2.5 – 2.7
5	--	--	--	--	--	--
6E[3]	14.2 – 14.6	11.6 – 11.9	13.4 - 14.3	10.9 – 11.6	13.1 – 14.4	10.7 – 11.8
East Side Total	**21.2 – 21.6**	**19.0 – 19.4[4]**	**20.4 - 21.7**	**18.3 – 19.5[4]**	**22.3 – 24.5**	**20.2 – 22.1[4]**

[1] Two times AD demand
[2] MD demand
[3] Totals include Zone 5 demand
[4] Based on recommendations in the 2006 Water Master Plan this total includes 1.0 mgd that is transferred to Zone 6W from Zone 6E on MD

Table 23 summarizes the available well capacity available to meet demands by zone. Note that the well capacity is based on current production and could change in the future as a result of changes in aquifer water quality or production capacity.

Table 23 – East Service Area 2010 Well Capacity

Zone	Unit Well	Capacity (mgd)	Capacity with largest well out of service
3	25	3.0	0.0[3]
4	9	2.5	0.0[3]
5	--	--	--
6E	7[1] 8[1] 11 13 15 23 29 6E Total	3.0 2.4 3.0 3.0 3.0 1.4 1.5[2] **17.3**	11.3[4]
East Service Area Total		**22.8**	**16.8[5] – 18.4[7]** **13.8[6] – 15.4[7]**

[1] Treatment needs to be added to wells 7 and 8 to meet water quality goals.
[2]There are plans to expand the production capacity of this well to 3.1 mgd
[3] Supply would be provided from Zone 6E
[4] Two wells out of service
[5]Assumes that one well is out in 6E and Well 25 is out of service
[6] Assumes that two wells are out in 6E and Well 25 is out of service
[7] Takes into account increasing capacity of Well 29 to 3.1 mgd

A brief evaluation of the ability of the existing unit wells to meet the level of service criteria for each zone follows.

6.4.1 Service Zone 3 Well Capacity Evaluation

Well 25 is currently the only well serving Zone 3. A booster pump station near Well 29 provides limited ability to transfer water from Zone 6E. Based on the projections in Table 22 and the established supply criteria, Zone 3 relies on Zone 6E for 1.4 mgd supply on the average day. In the event that Well 25 is taken out of service, Zone 3 will be entirely dependent on Zone 6E. The Zone 3 demands will be included in the Zone 6E supply capacity analysis. The 2006 Water Master Plan provides for a new pump station to transfer water from Zone 6E to Zone 3 so this is projected to be a long term supply arrangement. Several additional wells are included in the 2006 Master Plan to meet future demands in Zone 3 and reduce reliance on Zone 6E. Currently for planning purposes, 1.4 mgd will be assumed to be provided to Zone 3 from Zone 6E.

6.4.2 Service Zone 4 Well Capacity Evaluation

Zone 4 is currently served by a single well, Well 9. Current water demand projections for Zone 4 indicate that well capacity falls slightly short of meeting the AD water supply criteria. If Well 9 is out of service, at the present time Zone 4 will be completely reliant on Zone 6E. MWU is in the process of adding a second well to Zone 4. It is anticipated that the new well will be in production by 2013 and have a capacity of 3.1 mgd. This additional well will reduce the Zone 4 reliance on Zone 6E and provide capacity to support growth in Zone 4. A pump station that would move water from Zone 4 to Zone 6E is proposed in the 2006 Water Master Plan. Following construction of the new well in Zone 4, Zone 4 will have adequate capacity to meet AD and MD demands through 2030.
Service Zone 5 Well Capacity Evaluation

Zone 5 does not have any unit wells and is served entirely from Zone 6E. Zone 5 serves a small area with limited growth potential. The projected water demands in Zone 5 are small and can be easily met from Zone 6E facilities.

6.4.3 Service Zone 6E Well Capacity Evaluation

The existing water demand in Zone 6E is approximately double the sum of the other 3 east side zones combined. Additionally Zone 6E wells provide water supply support zones 3 and 5 and some water also flows from Zone 6E to Zone 6W across the Yahara River to meet peak demands. To adequately assess the water supply capacity on the east side, all of these water transfers must be considered in the planning process.

The projected average day capacity requirement for the East Side varies from 21.2 to 21.6 for 2010 demands and 22.4 – 24.5 for 2030 demands. Firm supply capacity from existing wells, depending on assumptions and criteria and the increase in capacity at Well 29, ranges from 13.8 mgd to 18.4 mgd. This results in an estimated short fall range from 2.8 to 10.7 mgd for Zone 6E. To meet minimum estimated water supply requirements for reliability and redundancy considering that the conservation program is successful, a minimum of one well is required in Zone 6E for existing demands and additional wells may be required in the future if Well 29 cannot be expanded or conservation goals are not met.

This well supply evaluation only takes into account the basic supply capacity of the east side wells. It does not consider the hydraulic capacity of the distribution system and its ability to effectively move water around the system. It is anticipated that system capacity and ability to move water around to where it is needed will dictate the number and location of any additional wells in Zone 6E that will be required to meet 2030 water supply demands. Computer modeling will determine siting and pumping capacity required for proposed facilities.

7. SUMMARY AND CONCLUSIONS

This memorandum presents water demand projections for a range of conditions. These water demand projections were developed based on the following data sources:

- Population and employment projections and spatial distributions provided by the Madison Area Transportation and Planning Board
- Population estimates from the State of Wisconsin – Department of Administration Demographic Service Center
- Daily well pump data from 1999 through 2009
- 2006 Water Master Plan
- MWU Conservation Plan
- Historical usage, Production, and Meter data provided to the Public Service Commission of Wisconsin (PSCW) and presented in the Year End Reports.

The water demand projections provided in this memorandum are intended to represent a range of demands that the utility can expect to experience. Based on MWU and the community's commitment to conservation the mean and low projections were chosen for future demands. The MWU should monitor progress on conservation goals and adjust demand assumptions if needed on future distribution system evaluations.

Because the items identified in the Conservation Plan are primarily aimed at reducing indoor water usage, they will primarily impact AD demands. Peak water demands associated with summer irrigation may not change significantly resulting in higher peaking factors. Although existing peaking factors were used for this evaluation, MWU should continue to monitor peaking factors to identify any trends in demand patterns.
To provide a preliminary evaluation of the well capacity for the East Side, the existing well capacity was compared to the projected demands through 2030 and the level of service criteria. This evaluation only compared the well capacity with the demands. It did not consider operational or vulnerability issues associated with the unit wells, storage, booster pumping or pressure reducing valves. The well capacity evaluation highlighted the importance of Zone 6E facilities to increase the reliability of zones 3, 4, and 5 and identified an existing minimum shortfall of about 3.0 mgd in Zone 6E.

Based on the information gathered and developed during this study, it is recommended that MWU:

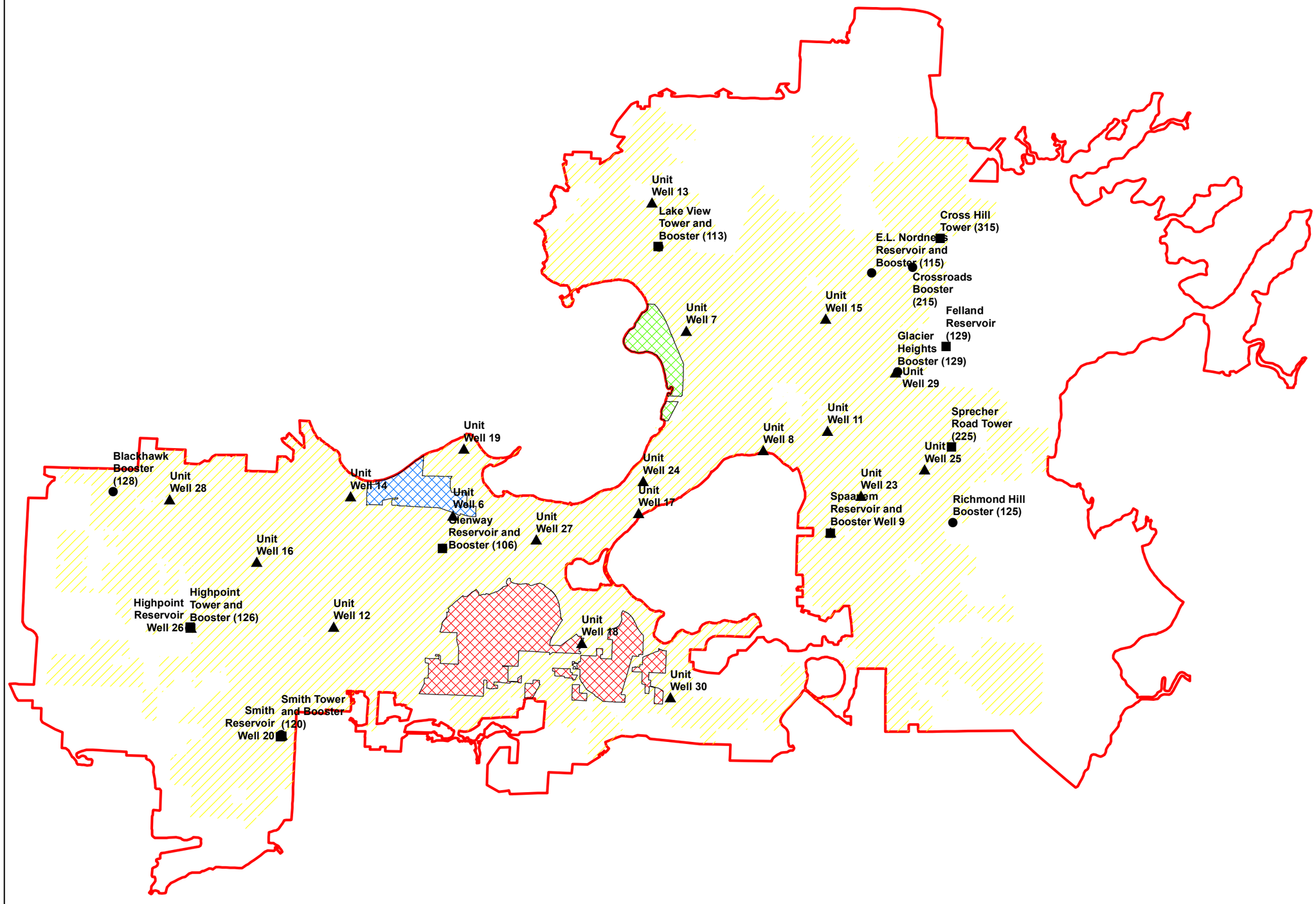
1. Monitor demands and peaking factors, as they implement theConservation Plan
2. Monitor the impact of weather patterns on outdoor water use
3. Plan for a replacement well for Well 3 (Well 45)to replace lost system capacity
4. Investigate the feasibility of increasing the filtration capacity of Well 29
5. In the event that the capacity at Well 29 cannot be increased, consider adding a well in Zone 3 in the near term that can supplement supply to Zone 6E

More information on supply requirements regarding well location will be developed during the distribution system computer model evaluation

ATTACHMENT A

Technical Memorandum
Water Demand Projections

Attachment A



Legend

- Floating Storage
- Booster Pump Station
- Well
- City of Madison
- Town of Madison
- Village of Maple Bluff
- Village of Shorewood Hills
- Study Area Boundary

N
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S

0 1 2 Miles

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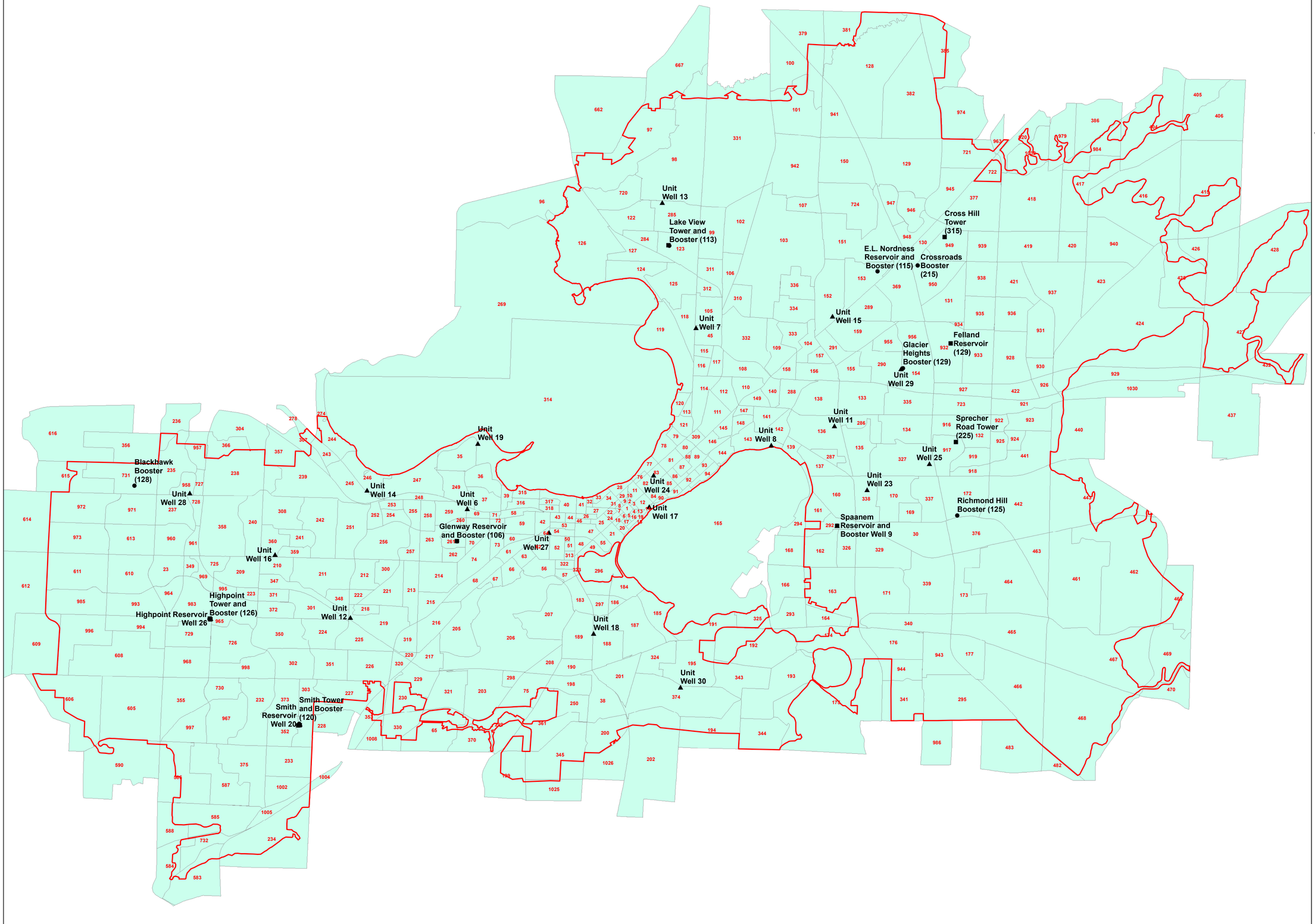
Madison Water Utility

ATTACHMENT B

Technical Memorandum
Water Demand Projections

Attachment B



Legend

- ■ Floating Storage
- ● Booster Pump Station
- ▲ Well
- Study Area Boundary
- TAZ

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ATTACHMENT C

Attachment C, Table 1: Population and Employment from TAZ Data

Pressure Zone	Count of TAZ in PZ	2010 Population	2015 Population	2030 Population	Buildout Population	2010 Employment	2015 Employment	2030 Employment	Buildout Employment
	16	3	3	3	3	0	0	0	0
1	38	4,749	5,755	8,777	41,773	9,690	11,524	17,031	26,765
10	33	8,120	10,189	16,376	24,669	4,501	6,363	11,951	20,455
11	7	1,592	2,108	3,651	6,320	95	124	208	413
3	50	13,767	15,875	22,191	32,557	2,733	3,742	6,771	25,668
4	41	7,865	8,225	9,303	37,228	11,313	12,435	15,799	31,900
5	3	758	759	761	763	200	200	200	200
6E	109	58,171	58,906	61,103	66,304	42,209	44,431	51,096	58,077
6W	159	84,090	84,918	87,393	90,813	100,543	101,666	106,240	105,578
7	78	38,707	39,532	42,001	40,846	13,240	13,551	14,489	14,415
8	58	20,095	21,255	24,744	26,931	28,860	30,792	36,613	38,103
8_2	11	448	625	1,160	3,432	32	25	0	0
9	21	7,903	8,443	10,061	9,535	1,036	1,397	2,482	590
Total		**246,265**	**256,590**	**287,521**	**381,171**	**214,452**	**226,250**	**262,880**	**322,164**
Employment/Population System-wide Ratio			(E/P System-wide Ratio)			0.87	0.88	0.91	0.85

Attachment C, Table 2: 2020 & 2025 Population and Employment Estimates

Pressure Zone	2020 Population	2025 Population	2020 Employment	2025 Employment
1	6762	7770	13360	15195
10	12251	14314	8226	10088
11	2622	3137	152	180
3	17980	20086	4752	5761
4	8584	8944	13556	14678
5	760	760	200	200
6E	59638	60371	46653	48874
6W	85743	86568	103191	104715
7	40355	41178	13864	14176
8	22418	23581	32732	34673
8_2	803	982	17	8
9	8982	9522	1759	2120
Total	**266,900**	**277,211**	**238,460**	**250,670**
			0.89	0.90 E/P System-wide Ratio

Attachment C, Table 3: Demand Calculations

Assumptions	Pressure Zone	Adjusted Employment/ Population Ratio 2010 (Employment/Population)/System-wide Ratio	Pop 2010 (From Table 1)	Res High (Pop * Res High)	Res Low (Pop * Res Low)	Res Mean (Pop* Res Low)	ICI High Res High * 0.62 * Adj E/P Ratio	ICI Low Res Low * 0.62 * Adj E/P Ratio	ICI Mean Res Mean * 0.62 * Adj E/P Ratio	Non-Revenue High (Res High + ICI High) * .111	Non-Revenue Low (Res Low + ICI Low) * .111	Non-Revenue Mean (Res Mean + ICI Mean) * .111	Total High	Total Low	Total Mean
2010															
Residential	1	2.34	4,749	0.35	0.34	0.35	0.50	0.49	0.50	0.10	0.09	0.10	0.95	0.93	0.95
74 gpcd - High	10	0.64	8,120	0.60	0.58	0.60	0.23	0.23	0.23	0.09	0.09	0.09	0.93	0.90	0.93
74 gpcd - Mean	11	0.07	1,592	0.12	0.11	0.12	0.00	0.00	0.00	0.01	0.01	0.01	0.14	0.13	0.14
72 gpcd - Low	3	0.23	13,767	1.02	0.99	1.02	0.14	0.14	0.14	0.13	0.13	0.13	1.29	1.26	1.29
	4	1.65	7,865	0.58	0.57	0.58	0.59	0.57	0.59	0.13	0.13	0.13	1.30	1.27	1.30
ICI	5	0.30	758	0.06	0.05	0.06	0.01	0.01	0.01	0.01	0.01	0.01	0.07	0.07	0.07
38% of Residential + ICI	6E	0.83	58,171	4.30	4.19	4.30	2.20	2.14	2.20	0.72	0.70	0.72	7.23	7.03	7.23
61% of Resdiential	6W	1.37	84,090	6.22	6.05	6.22	5.24	5.10	5.24	1.27	1.24	1.27	12.73	12.39	12.73
	7	0.39	38,707	2.86	2.79	2.86	0.69	0.67	0.69	0.39	0.38	0.39	3.95	3.84	3.95
Non-Revenue	8	1.65	20,095	1.49	1.45	1.49	1.50	1.46	1.50	0.33	0.32	0.33	3.32	3.23	3.32
10% of Total Demand	8_2	0.08	448	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04
11% of Res + ICI	9	0.15	7,903	0.58	0.57	0.58	0.05	0.05	0.05	0.07	0.07	0.07	0.71	0.69	0.71
			246,265	**18.22**	**17.73**	**18.22**	**11.17**	**10.87**	**11.17**	**3.27**	**3.18**	**3.27**	**32.66**	**31.78**	**32.66**
2015							**(same as 20210)**	**(same as 20210)**	**(same as 20210)**						
Residential	1	2.27	5,755	0.43	0.37	0.41	0.50	0.49	0.50	0.10	0.10	0.10	1.03	0.96	1.01
74 gpcd - High	10	0.71	10,189	0.75	0.66	0.72	0.23	0.23	0.23	0.11	0.10	0.11	1.10	0.99	1.06
71 gpcd - Mean	11	0.07	2,108	0.16	0.14	0.15	0.00	0.00	0.00	0.02	0.02	0.02	0.18	0.16	0.17
65 gpcd - Low	3	0.27	15,875	1.17	1.03	1.13	0.14	0.14	0.14	0.15	0.13	0.14	1.46	1.30	1.41
	4	1.71	8,225	0.61	0.53	0.58	0.59	0.57	0.59	0.13	0.12	0.13	1.33	1.23	1.30
ICI	5	0.30	759	0.06	0.05	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.07	0.07	0.07
Same as 2010	6E	0.86	58,906	4.36	3.83	4.18	2.20	2.14	2.20	0.73	0.66	0.71	7.29	6.63	7.09
	6W	1.36	84,918	6.28	5.52	6.03	5.24	5.10	5.24	1.28	1.18	1.25	12.80	11.79	12.52
	7	0.39	39,532	2.93	2.57	2.81	0.69	0.67	0.69	0.40	0.36	0.39	4.02	3.60	3.88
Non-Revenue	8	1.64	21,255	1.57	1.38	1.51	1.50	1.46	1.50	0.34	0.32	0.33	3.42	3.16	3.35
10% of Total Demand	8_2	0.05	625	0.05	0.04	0.04	0.00	0.00	0.00	0.01	0.00	0.01	0.05	0.05	0.05
11% of Res + ICI	9	0.19	8,443	0.62	0.55	0.60	0.05	0.05	0.05	0.08	0.07	0.07	0.75	0.67	0.73
			256,590	**18.99**	**16.68**	**18.22**	**11.17**	**10.87**	**11.17**	**3.35**	**3.06**	**3.27**	**33.51**	**30.61**	**32.65**
2020							**(same as 20210)**	**(same as 20210)**	**(same as 20210)**						
Residential	1	2.21	6,762	0.50	0.39	0.45	0.50	0.49	0.50	0.11	0.10	0.11	1.12	0.98	1.06
74 gpcd - High	10	0.75	12,251	0.91	0.71	0.82	0.23	0.23	0.23	0.13	0.10	0.12	1.27	1.04	1.17
67 gpcd - Mean	11	0.06	2,622	0.19	0.15	0.18	0.00	0.00	0.00	0.02	0.02	0.02	0.22	0.17	0.20
58 gpcd - Low	3	0.30	17,980	1.33	1.04	1.20	0.14	0.14	0.14	0.16	0.13	0.15	1.64	1.31	1.50
	4	1.77	8,584	0.64	0.50	0.58	0.59	0.57	0.59	0.14	0.12	0.13	1.36	1.19	1.29
ICI	5	0.29	760	0.06	0.04	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.07	0.06	0.07
Same as 2010	6E	0.88	59,638	4.41	3.46	4.00	2.20	2.14	2.20	0.73	0.62	0.69	7.35	6.22	6.88
	6W	1.35	85,743	6.34	4.97	5.74	5.24	5.10	5.24	1.29	1.12	1.22	12.87	11.19	12.20
	7	0.38	40,355	2.99	2.34	2.70	0.69	0.67	0.69	0.41	0.33	0.38	4.08	3.35	3.77
Non-Revenue	8	1.63	22,418	1.66	1.30	1.50	1.50	1.46	1.50	0.35	0.31	0.33	3.51	3.07	3.34
10% of Total Demand	8_2	0.02	803	0.06	0.05	0.05	0.00	0.00	0.00	0.01	0.01	0.01	0.07	0.05	0.06
11% of Res + ICI	9	0.22	8,982	0.66	0.52	0.60	0.05	0.05	0.05	0.08	0.06	0.07	0.80	0.64	0.73
			266,900	**19.75**	**15.48**	**17.88**	**11.17**	**10.87**	**11.17**	**3.44**	**2.93**	**3.23**	**34.36**	**29.28**	**32.28**
	2030 Demands														
2030							**(2030 Emp * 46.8)**	**(2030 Emp * 45.6)**	**(2030 Emp * 46.8)**						
Residential	1	2.12	8,777	0.65	0.51	0.59	0.80	0.78	0.80	0.16	0.14	0.15	1.61	1.43	1.54
74 gpcd - High	10	0.80	16,376	1.21	0.95	1.10	0.56	0.54	0.56	0.20	0.17	0.18	1.97	1.66	1.84
67 gpcd - Mean	11	0.06	3,651	0.27	0.21	0.24	0.01	0.01	0.01	0.03	0.02	0.03	0.31	0.25	0.28
58 gpcd - Low	3	0.33	22,191	1.64	1.29	1.49	0.32	0.31	0.32	0.22	0.18	0.20	2.18	1.77	2.00
ICI	4	1.86	9,303	0.69	0.54	0.62	0.74	0.72	0.74	0.16	0.14	0.15	1.59	1.40	1.51
46.84 gped - High	5	0.29	761	0.06	0.04	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.07	0.06	0.07
46.84 gped - Mean	6E	0.91	61,103	4.52	3.54	4.09	2.39	2.33	2.39	0.77	0.65	0.72	7.68	6.53	7.21
45.57 gped - Low	6W	1.33	87,393	6.47	5.07	5.86	4.98	4.84	4.98	1.27	1.10	1.20	12.71	11.01	12.04
	7	0.38	42,001	3.11	2.44	2.81	0.68	0.66	0.68	0.42	0.34	0.39	4.21	3.44	3.88
Non-Revenue	8	1.62	24,744	1.83	1.44	1.66	1.71	1.67	1.71	0.39	0.34	0.37	3.94	3.45	3.75
10% of Total Demand	8_2	0.00	1,160	0.09	0.07	0.08	0.00	0.00	0.00	0.01	0.01	0.01	0.10	0.07	0.09
11% of Res + ICI	9	0.27	10,061	0.74	0.58	0.67	0.12	0.11	0.12	0.10	0.08	0.09	0.96	0.77	0.88
			287,521	**21.28**	**16.68**	**19.26**	**12.31**	**11.98**	**12.31**	**3.73**	**3.18**	**3.51**	**37.32**	**31.84**	**35.09**
Buildout							**(BO Emp * 46.8)**	**(BO Emp * 45.6)**	**(BO Emp * 46.8)**						
Residential	1	0.76	41,773	3.09	2.42	2.80	1.25	1.22	1.25	0.48	0.40	0.45	4.83	4.05	4.50
74 gpcd - High	10	0.98	24,669	1.83	1.43	1.65	0.96	0.93	0.96	0.31	0.26	0.29	3.09	2.63	2.90
67 gpcd - Mean	11	0.08	6,320	0.47	0.37	0.42	0.02	0.02	0.02	0.05	0.04	0.05	0.54	0.43	0.49
58 gpcd - Low	3	0.93	32,557	2.41	1.89	2.18	1.20	1.17	1.20	0.40	0.34	0.38	4.01	3.40	3.76
ICI	4	1.01	37,228	2.75	2.16	2.49	1.49	1.45	1.49	0.47	0.40	0.44	4.72	4.01	4.43
46.84 gped - High	5	0.31	763	0.06	0.04	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.07	0.06	0.07
46.84 gped - Mean	6E	1.04	66,304	4.91	3.85	4.44	2.72	2.65	2.72	0.85	0.72	0.80	8.47	7.21	7.96
45.57 gped - Low	6W	1.38	90,813	6.72	5.27	6.08	4.95	4.81	4.95	1.30	1.12	1.23	12.96	11.20	12.26
	7	0.42	40,846	3.02	2.37	2.74	0.68	0.66	0.68	0.41	0.34	0.38	4.11	3.36	3.79
Non-Revenue	8	1.67	26,931	1.99	1.56	1.80	1.78	1.74	1.78	0.42	0.37	0.40	4.20	3.66	3.99
10% of Total Demand	8_2	0.00	3,432	0.25	0.20	0.23	0.00	0.00	0.00	0.03	0.02	0.03	0.28	0.22	0.26
11% of Res + ICI	9	0.07	9,535	0.71	0.55	0.64	0.03	0.03	0.03	0.08	0.06	0.07	0.81	0.64	0.74
			381,171	**28.21**	**22.11**	**25.54**	**15.09**	**14.68**	**15.09**	**4.81**	**4.09**	**4.51**	**48.11**	**40.88**	**45.14**

Attachment C - Peak Projections

Low Projections

1) AD Demand by service zone (low projections)

Service Zone	2010	2015	2030	BO
3	2.18	2.26	3.20	7.45
4	1.27	1.23	1.40	4.01
5	0.07	0.07	0.06	0.06
6E	7.03	6.63	6.53	7.21
6W	12.39	11.79	11.01	11.20
7	3.84	3.60	3.44	3.36
8	3.27	3.21	3.52	3.89
9	0.69	0.67	0.77	0.64
10	0.90	0.99	1.66	2.63
11	0.13	0.16	0.25	0.43
Total East Side	10.55	10.19	11.18	18.73
Total All Zones	31.78	30.61	31.84	40.88

2) From 2006 MP to gauge PF by zone

Demand	Zone 4 & 6 (trend)	All other zones (trend)
0.01	5.2	6.75
0.02	4.2	5.62
0.04	3.5	4.6
0.08	2.87	3.85
0.1	2.68	3.65
0.2	2.38	3.05
0.4	2.1	2.67
0.8	1.89	2.32
1	1.83	2.22
2	1.74	2.02
4	1.65	1.82
8	1.57	1.68
10	1.54	1.63
20	1.47	1.56
40	1.43	1.53
80	1.41	1.5
100	1.4	1.5

4)

MD:MD	1
MH:MD	1.24
MD:M10D	0.84

3)	**5)** MD PF
2.55	1.87
1.30	1.80
0.07	3.85
6.73	1.60
11.73	1.52
3.63	1.99
3.33	1.96
0.71	2.40
1.18	2.18
0.18	3
	1.74

6)

M10D PF	MD PF	MH PF
1.57	1.87	2.31
1.51	1.80	2.22
3.23	3.85	4.76
1.34	1.60	1.98
1.28	1.52	1.88
1.67	1.99	2.46
1.65	1.96	2.42
2.02	2.40	2.97
1.83	2.18	2.69
2.52	3.00	3.71
1.46	1.74	2.15

7)

Service Zone	2010 M10D	2010 MD	2010 MH	2015 M10D	2015 MD	2015 MH	2030 M10D	2030 MD	2030 MH	BO M10D	BO MD	BO MH
3	3.43	4.08	5.04	3.55	4.23	5.23	5.03	5.99	7.40	11.69	13.92	17.20
4	1.91	2.28	2.82	1.86	2.22	2.74	2.12	2.52	3.11	6.07	7.23	8.93
5	0.23	0.28	0.34	0.21	0.25	0.31	0.19	0.23	0.28	0.19	0.23	0.28
6E	9.45	11.25	13.90	8.91	10.61	13.11	8.77	10.44	12.90	9.70	11.54	14.26
6W	15.82	18.83	23.27	15.06	17.93	22.15	14.06	16.74	20.68	14.30	17.02	21.03
7	6.42	7.65	9.45	6.02	7.17	8.85	5.75	6.85	8.46	5.62	6.69	8.27
8	5.38	6.41	7.92	5.28	6.29	7.77	5.80	6.91	8.53	6.40	7.62	9.41
9	1.39	1.66	2.05	1.35	1.60	1.98	1.56	1.86	2.30	1.30	1.55	1.91
10	1.65	1.97	2.43	1.81	2.16	2.66	3.04	3.62	4.47	4.81	5.72	7.07
11	0.33	0.40	0.49	0.40	0.47	0.58	0.62	0.74	0.91	1.08	1.28	1.59
Total East Side	15.02	17.88	22.10	14.54	17.31	21.39	16.11	19.17	23.69	27.65	32.92	40.68
Total All Zones	46.03	54.79	67.70	44.45	52.92	65.39	46.94	55.88	69.04	61.15	72.80	89.96
Projected System-wide	**46.44**	**55.29**	**68.32**	**44.73**	**53.26**	**65.80**	**46.54**	**55.40**	**68.46**	**59.75**	**71.13**	**87.89**

Difference between overall PF * overall AD and sum of individual zone PF * individual zone PF (should be reasonable,~1 mgd or less

-0.42	-0.50	-0.62	-0.28	-0.34	-0.41	0.40	0.48	0.59	1.41	1.68	2.07

MD PFs **5)** would have changed by BO so okay

1) based on low AD demand from Population and employment splits per zone (from ByZone sheet)
2) based on 2006 MP trend provided in appendix
3) based on average of **1)** for years 2010, 2015, and 2030 by service zone
4) based on ratios in the memo
5) based on using the average of projections **1)** by zone and applying the appropriate trend from **2)**
6) based on multiplying **4)** and **5)** together
7) based on multiplying individual zone adjusted demand PFs **6)** with the AD demand **1)**

Mean Projections

1) AD Demand by service zone (mean projections)

Service Zone	2010	2015	2030	BO
3	2.24	2.43	3.54	8.26
4	1.30	1.30	1.51	4.43
5	0.07	0.07	0.07	0.07
6E	7.23	7.09	7.21	7.96
6W	12.73	12.52	12.04	12.26
7	3.95	3.88	3.88	3.79
8	3.36	3.40	3.83	4.24
9	0.71	0.73	0.88	0.74
10	0.93	1.06	1.84	2.90
11	0.14	0.17	0.28	0.49
Total East Side	10.84	10.89	12.33	20.72
Total All Zones	32.66	32.65	35.09	45.14

3)	**5)** MD PF
2.74	1.87
1.37	1.80
0.07	3.85
7.17	1.60
12.43	1.52
3.90	1.99
3.53	1.96
0.77	2.40
1.28	2.18
0.20	3
	1.74

6)

M10D PF	MD PF	MH PF
1.57	1.87	2.31
1.51	1.80	2.22
3.23	3.85	4.76
1.34	1.60	1.98
1.28	1.52	1.88
1.67	1.99	2.46
1.65	1.96	2.42
2.02	2.40	2.97
1.83	2.18	2.69
2.52	3.00	3.71
1.46	1.74	2.15

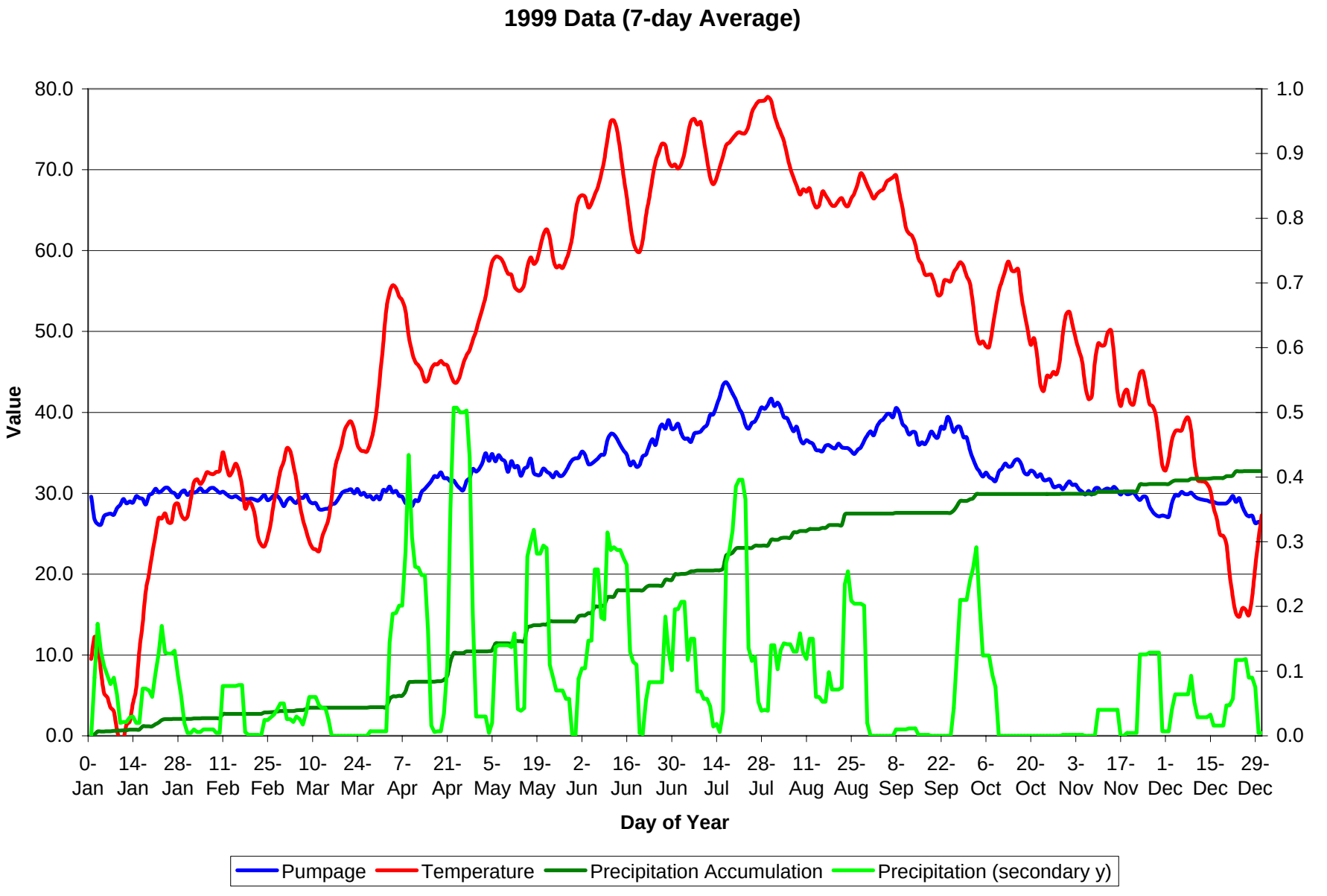
7)

Service Zone	2010 M10D	2010 MD	2010 MH	2015 M10D	2015 MD	2015 MH	2030 M10D	2030 MD	2030 MH	BO M10D	BO MD	BO MH
3	3.52	4.19	5.18	3.81	4.54	5.60	5.57	6.63	8.19	12.98	15.45	19.09
4	1.97	2.34	2.89	1.97	2.35	2.90	2.29	2.73	3.37	6.70	7.98	9.86
5	0.24	0.28	0.35	0.23	0.28	0.34	0.22	0.26	0.32	0.22	0.26	0.32
6E	9.71	11.56	14.29	9.53	11.34	14.02	9.69	11.53	14.25	10.70	12.73	15.73
6W	16.26	19.35	23.91	15.98	19.03	23.51	15.37	18.29	22.60	15.65	18.63	23.02
7	6.60	7.86	9.71	6.49	7.73	9.55	6.49	7.72	9.54	6.34	7.54	9.32
8	5.53	6.59	8.14	5.59	6.66	8.23	6.31	7.51	9.29	6.99	8.32	10.28
9	1.43	1.70	2.10	1.46	1.74	2.15	1.77	2.11	2.60	1.49	1.78	2.20
10	1.70	2.02	2.50	1.95	2.32	2.87	3.37	4.01	4.96	5.31	6.32	7.81
11	0.34	0.41	0.51	0.43	0.52	0.64	0.71	0.85	1.05	1.24	1.48	1.82
Total East Side	15.44	18.38	22.71	15.54	18.50	22.86	17.76	21.15	26.13	30.59	36.42	45.00
Total All Zones	47.30	56.31	69.58	47.46	56.50	69.81	51.78	61.64	76.17	67.61	80.49	99.45
Projected System-wide	**47.73**	**56.83**	**70.22**	**47.72**	**56.82**	**70.20**	**51.28**	**61.05**	**75.43**	**65.98**	**78.55**	**97.06**

Difference between overall PF * overall AD and sum of individual zone PF * individual zone PF (should be reasonable,~1 mgd or less

-0.43	-0.51	-0.63	-0.27	-0.32	-0.39	0.50	0.60	0.74	1.63	1.94	2.39

MD PFs **5)** would have changed by BO so okay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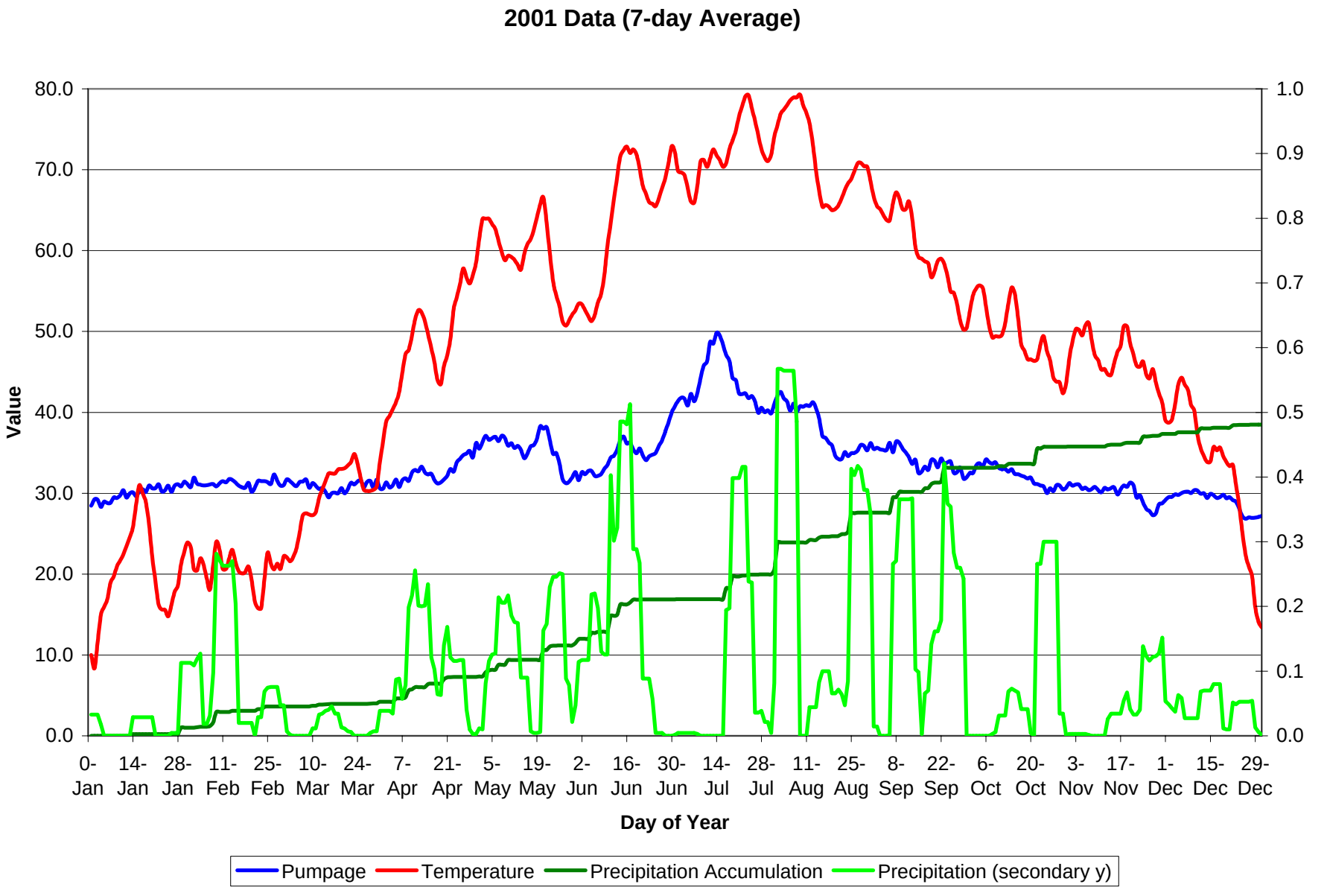
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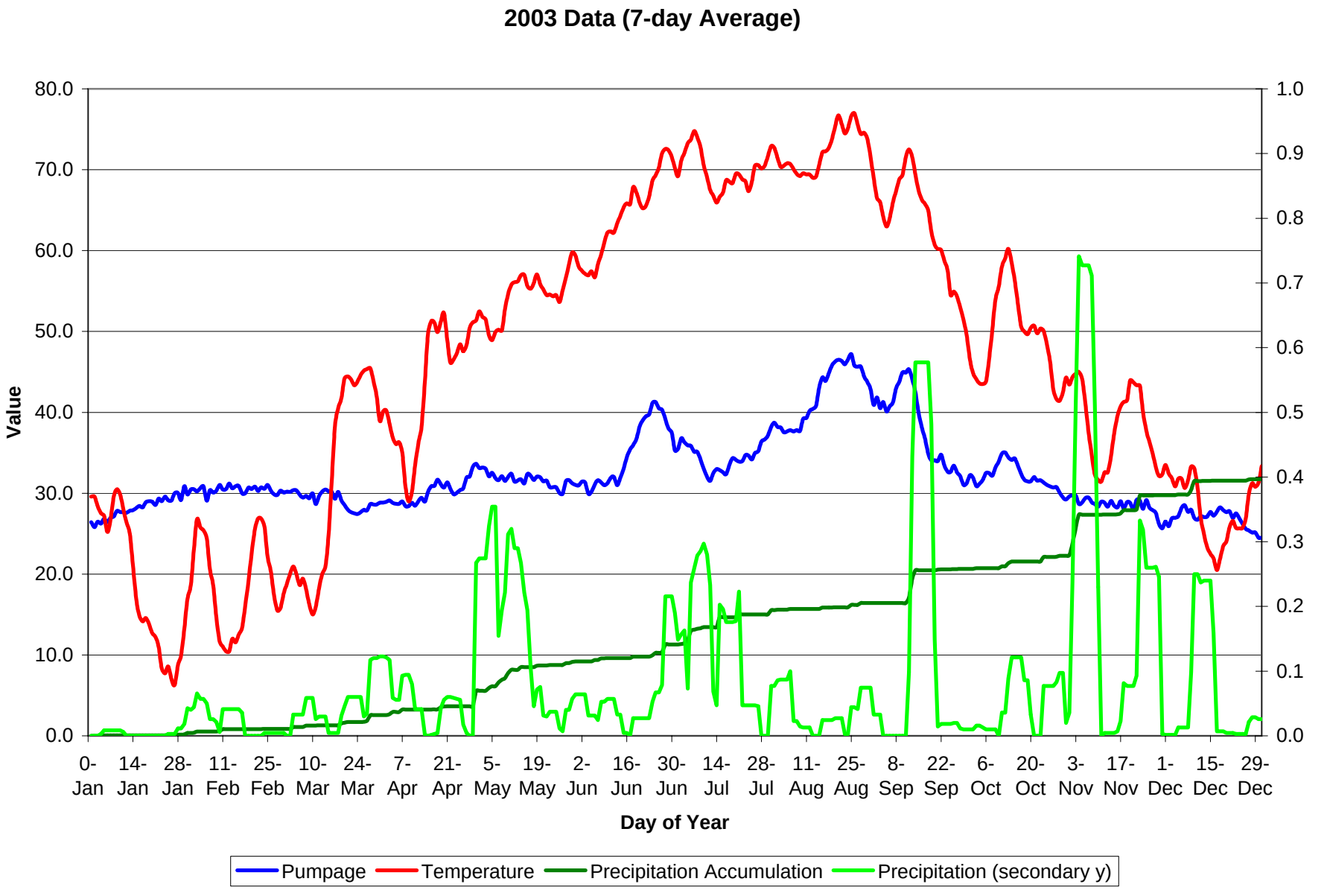
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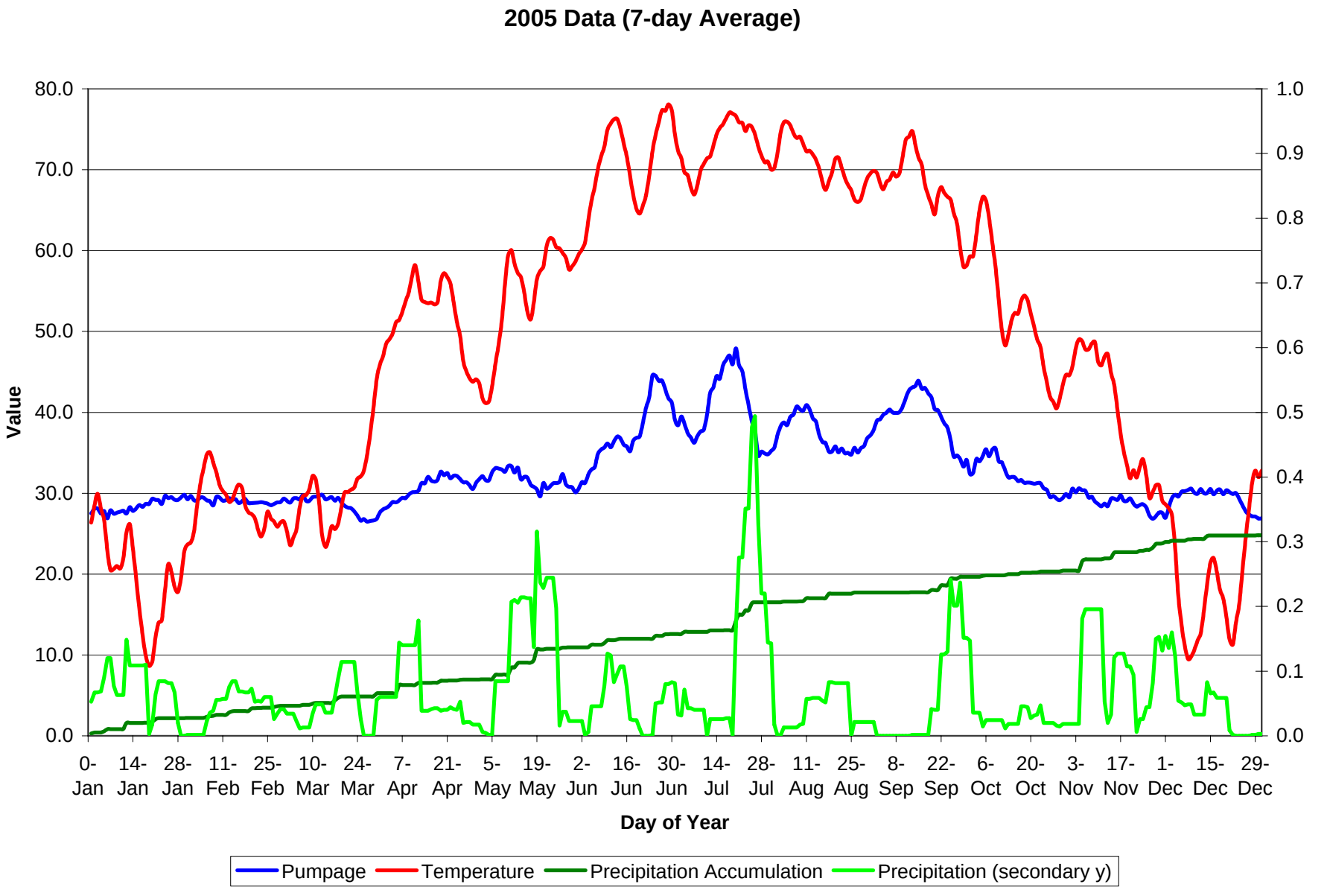
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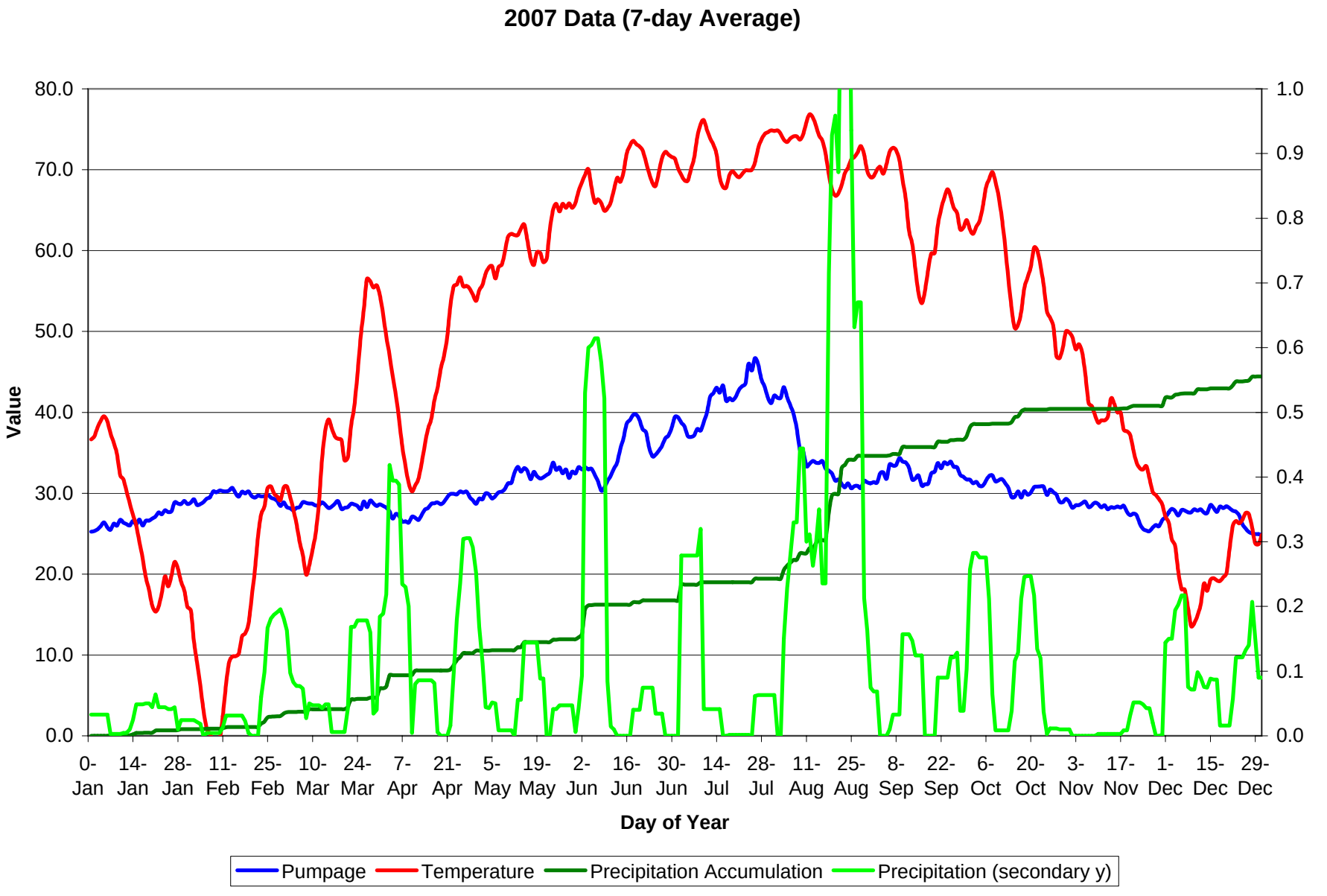
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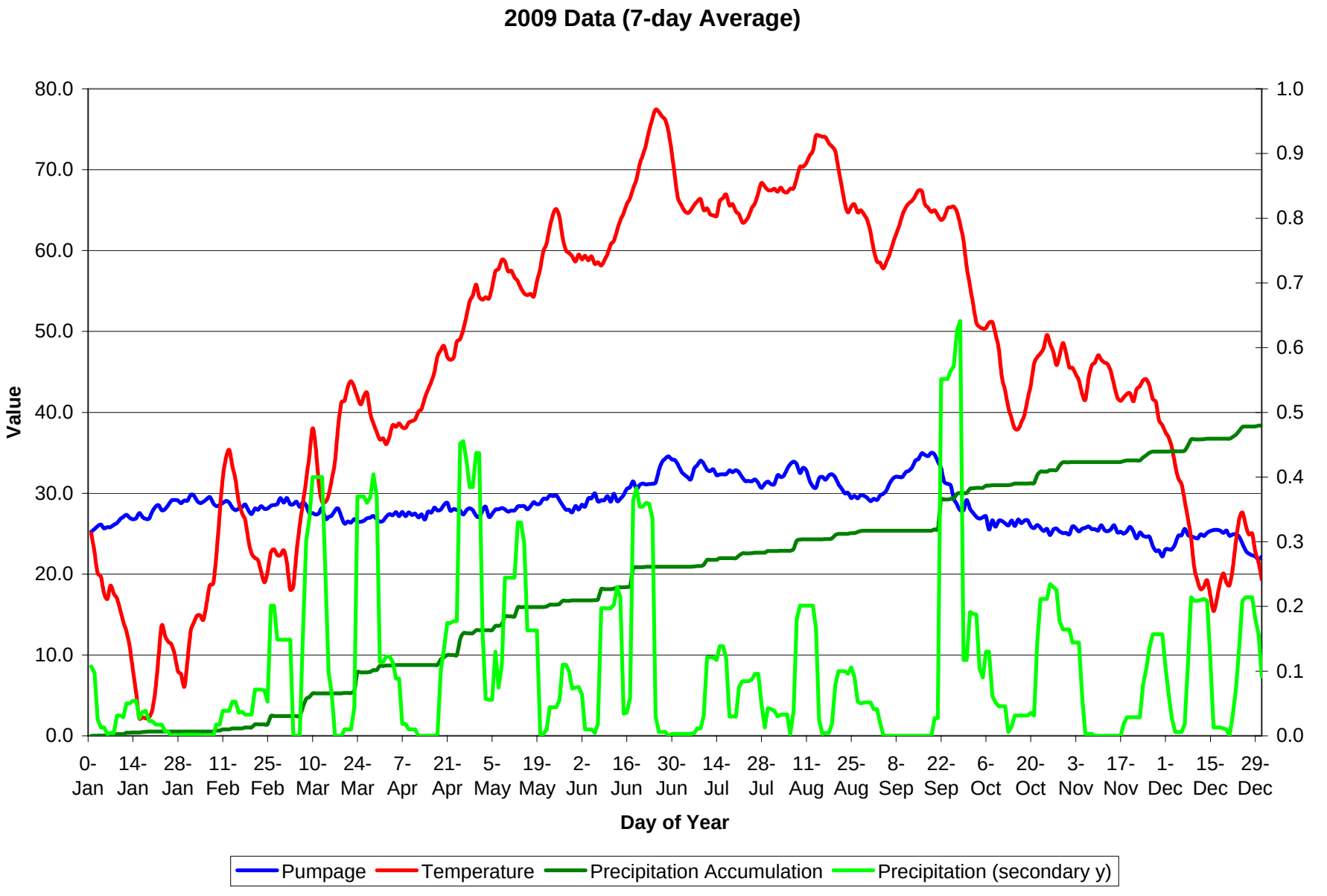
Temperature
Precipitation Accumulation
Precipitation (secondary y)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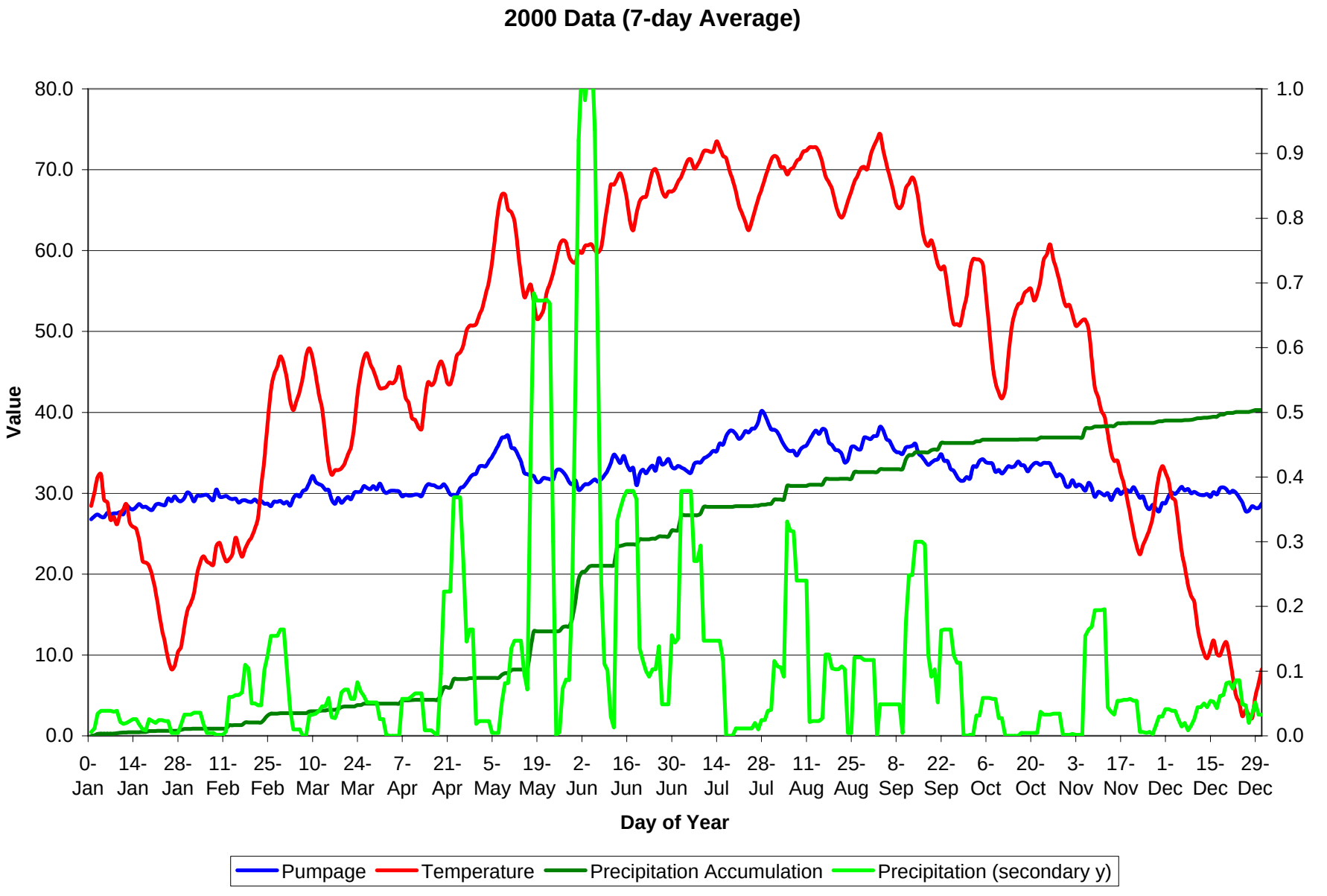
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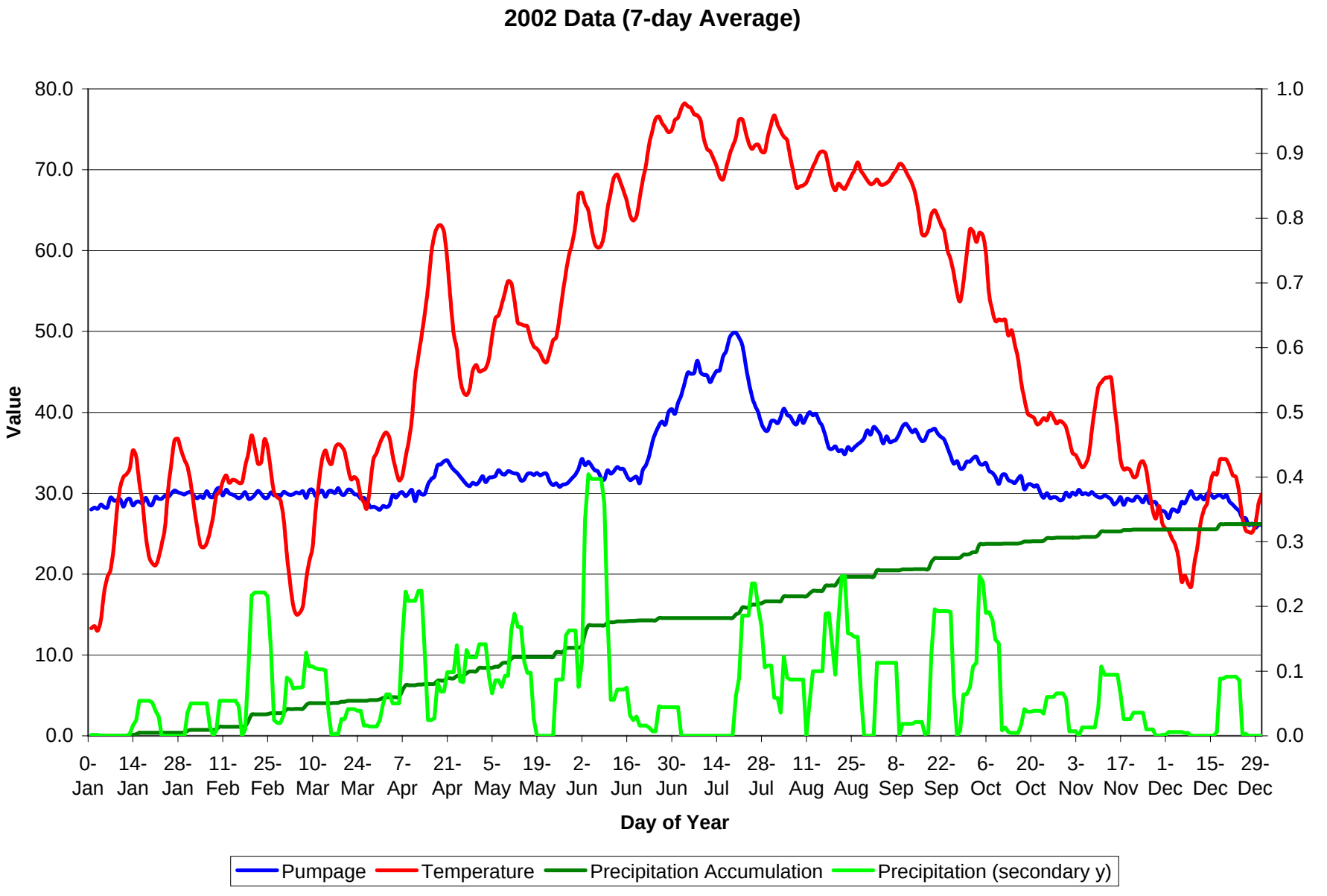
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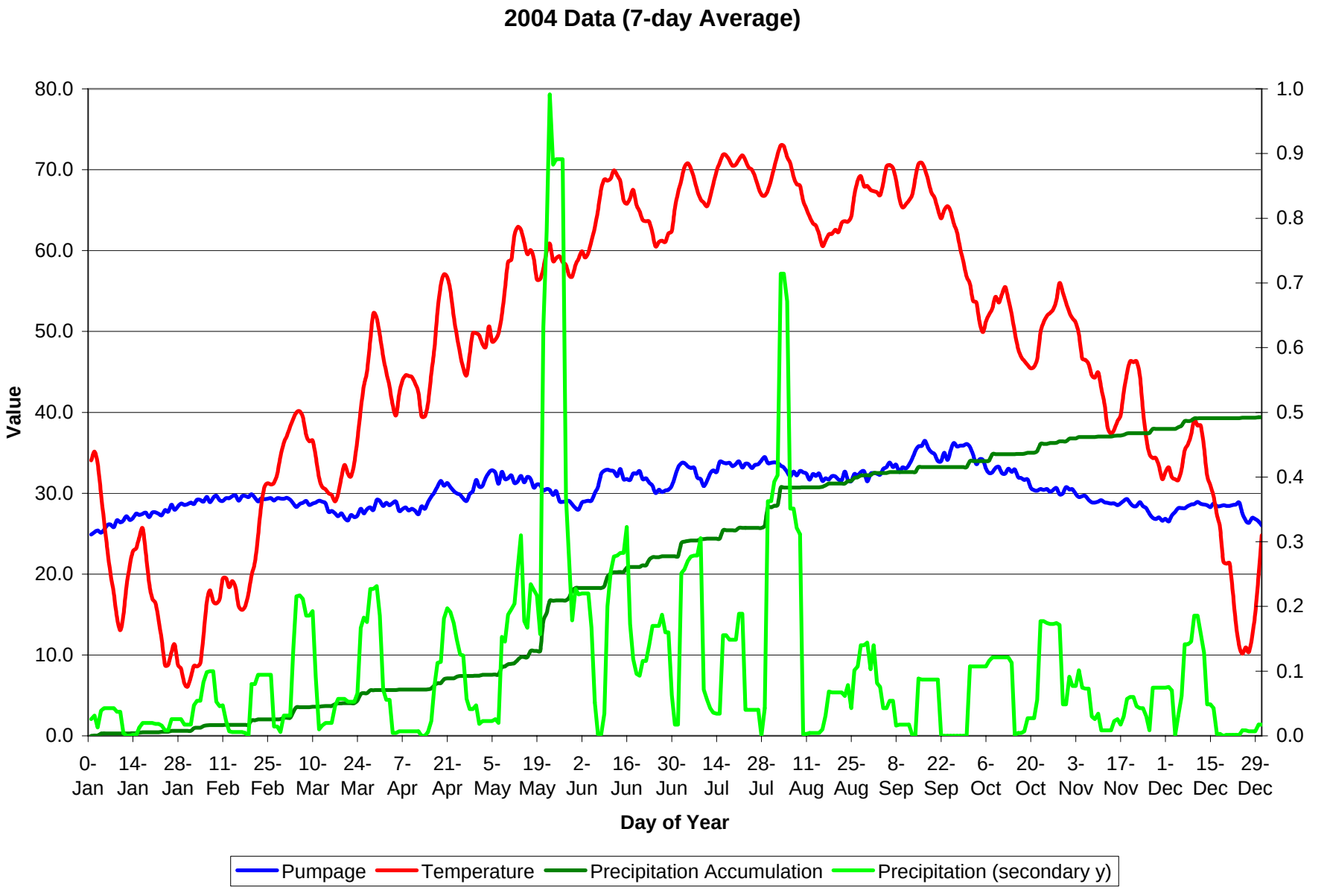
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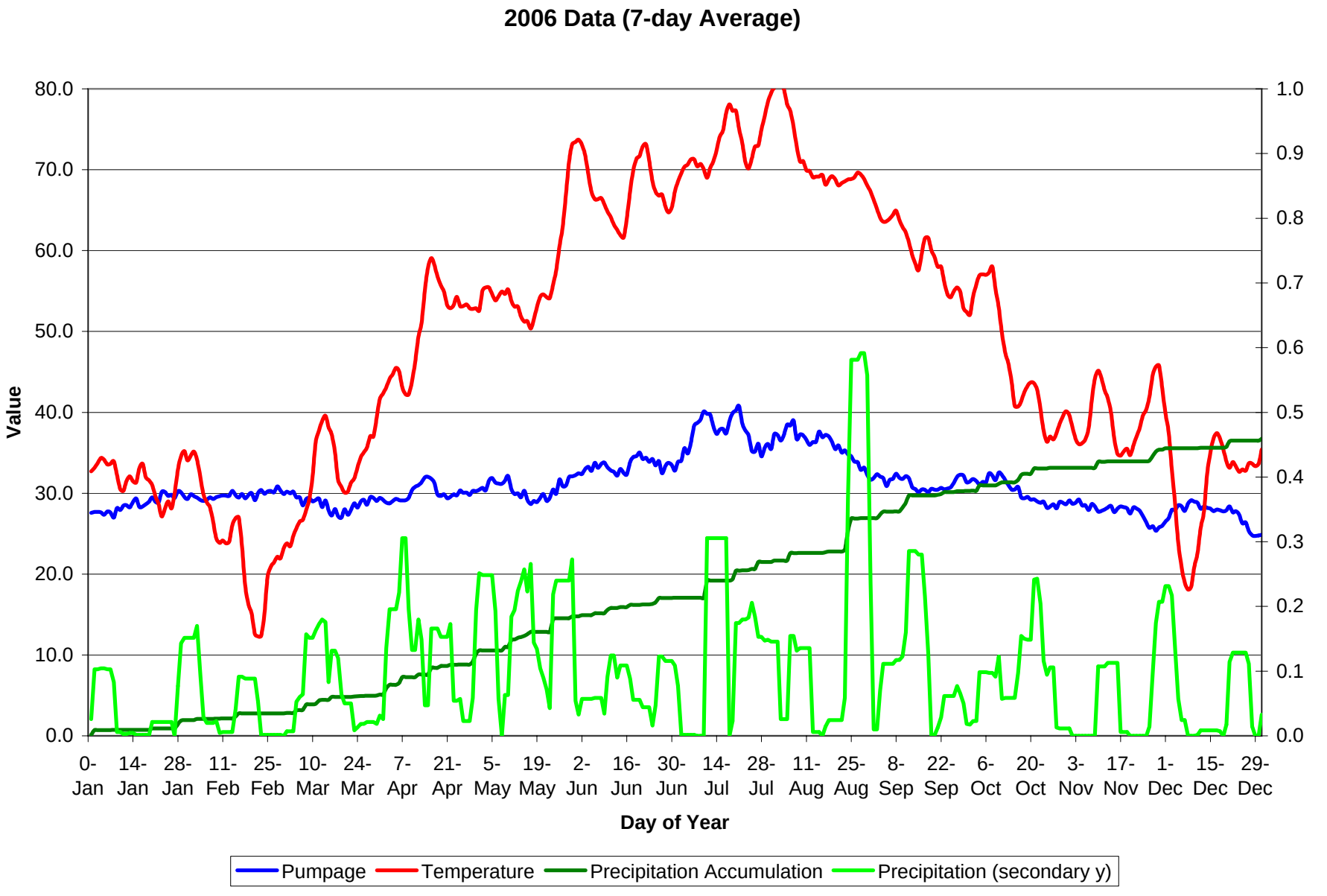
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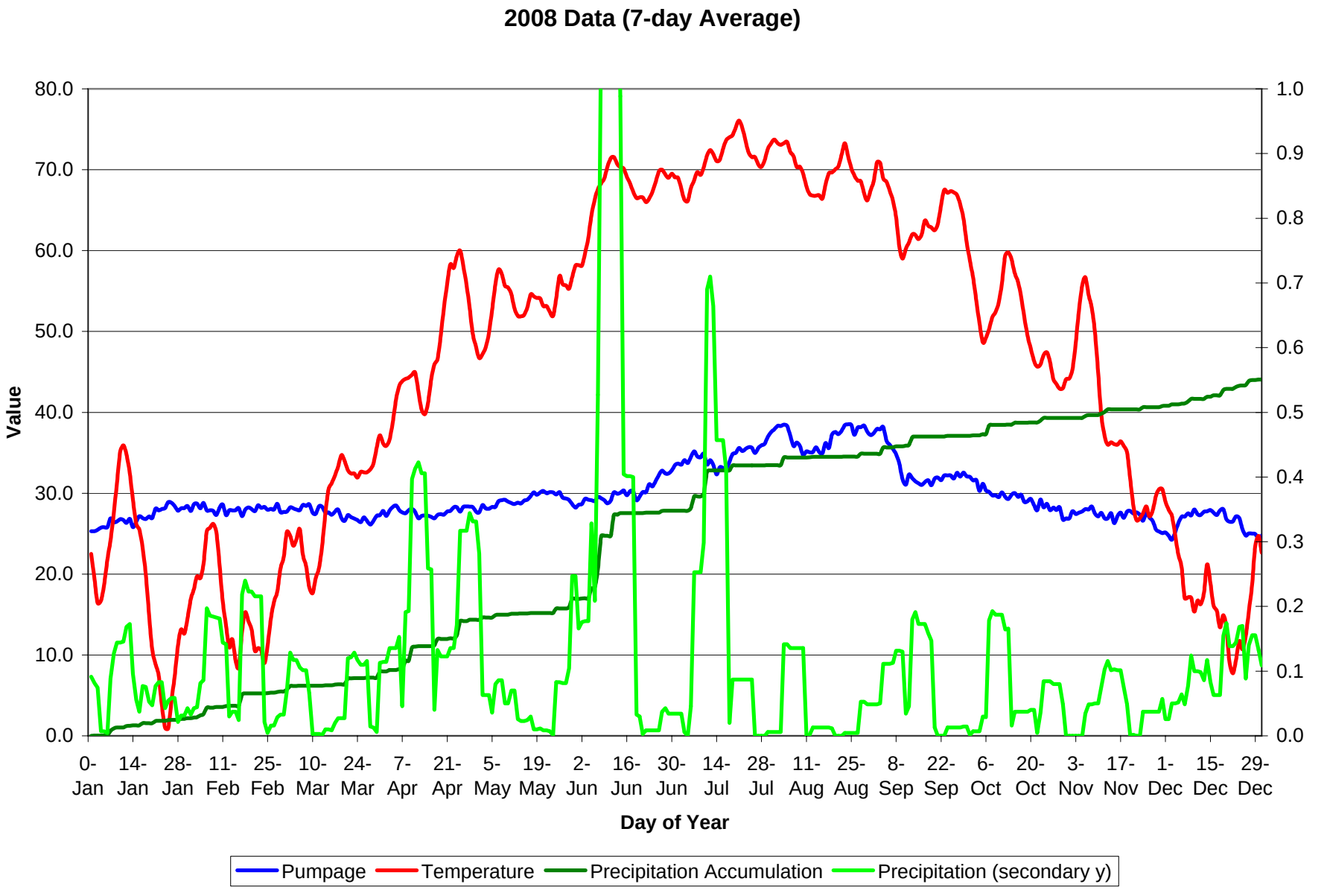
0-Jan
14-Jan
28-Jan
11-Feb
25-Feb
10-Mar
24-Mar
7-Apr
21-Apr
5-May
19-May
2-Jun
16-Jun
30-Jun
14-Jul
28-Jul
11-Aug
25-Aug
8-Sep
22-Sep
6-Oct
20-Oct
3-Nov
17-Nov
1-Dec
15-Dec
29-Dec
Day of Year
Pumpage
Temperature
Precipitation Accumulation
Precipitation (secondary y)


2008 Data (7-day Average)
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0.8
0.7
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0.4
0.3
0.2
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0-Jan
14-Jan
28-Jan
11-Feb
25-Feb
10-Mar
24-Mar
7-Apr
21-Apr
5-May
19-May
2-Jun
16-Jun
30-Jun
14-Jul
28-Jul
11-Aug
25-Aug
8-Sep
22-Sep
6-Oct
20-Oct
3-Nov
17-Nov
1-Dec
15-Dec
29-Dec
Day of Year
Pumpage
Temperature
Precipitation Accumulation
Precipitation (secondary y)

Attachment D

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
1	0	0	0	0	0	0	364	364	364
2	50	100	114	215	300	342	460	460	460
3	0	0	0	0	0	0	1468	1518	1518
4	0	0	0	0	0	0	805	1215	1280
5	10	10	10	10	10	10	580	930	1791
6	0	85	85	0	150	150	776	426	776
7	50	50	50	125	125	125	609	634	634
8	10	60	60	10	95	95	1016	1041	1041
9	0	0	0	0	0	0	1006	1106	1106
10	50	50	50	90	90	90	0	0	0
11	840	965	965	1455	1670	1670	377	387	387
12	340	515	515	495	795	795	3695	3695	3751
13	15	126	126	25	210	210	238	188	188
14	20	195	195	45	345	345	1537	1537	1537
15	0	0	0	0	0	0	154	154	154
16	0	0	0	0	0	0	1965	1965	1965
17	180	180	180	650	650	650	1014	1014	1410
18	0	400	400	0	680	680	1815	1915	1915
19	45	45	45	60	60	60	1403	1403	1403
20	435	585	585	770	1020	1020	332	332	332
21	1145	1345	1345	1945	2285	2285	381	401	401
22	265	265	265	390	390	390	916	966	966
23	0	0	0	0	0	0	0	2900	4070
24	65	415	415	65	690	690	952	1002	1002
25	855	1005	1022	2035	2305	2344	327	342	342
26	325	675	675	710	1335	1335	737	1512	1800
27	495	770	794	1110	1590	1640	1508	1508	1508
28	505	505	505	730	730	730	635	635	635
29	365	365	445	830	830	1012	285	285	285
30	745	745	745	2240	2240	2240	177	177	180
31	10	10	10	20	20	20	510	510	534
32	460	460	460	1240	1240	1240	435	435	435
33	995	995	1014	2680	2680	2731	302	302	302
34	950	1050	1050	2350	2525	2525	815	840	915
35	1045	1045	1045	2830	2830	2830	11	11	11
36	0	0	0	0	0	0	0	1375	1375
37	4	4	4	11	11	11	8145	8395	8395
38	4	4	8	15	15	30	553	663	920
39	0	0	0	0	0	0	105	105	105
40	718	718	718	1975	1975	1975	3520	3270	3270
41	10	10	61	20	20	122	2970	2720	2720
42	4	4	4	8	8	8	1270	1270	1270
43	100	125	125	145	185	185	2020	2025	2025
44	135	135	135	370	370	370	1020	920	920
45	340	340	348	770	770	788	178	178	189
45	340	340	348	770	770	788	178	178	189
46	862	1162	1162	2585	3485	3485	88	88	88
47	95	470	615	200	1240	1623	2252	2627	3543

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
48	415	415	415	835	835	835	639	639	639
49	240	240	240	415	415	415	4	4	4
50	0	0	0	0	0	0	315	340	340
51	110	110	110	190	190	190	3280	3480	3480
52	545	545	545	1530	1530	1530	190	190	190
53	495	520	520	1110	1165	1165	405	440	440
54	505	505	566	1640	1640	1838	548	548	581
55	65	215	215	100	360	360	757	807	1193
56	135	135	135	315	315	315	5	5	5
57	80	70	111	230	200	317	2203	2338	2500
58	845	895	895	1435	1520	1520	456	256	256
59	685	685	685	2100	2100	2100	201	201	201
60	140	140	140	385	385	385	66	66	66
61	370	420	420	870	960	960	215	215	215
62	470	470	470	1155	1155	1155	386	386	386
63	235	235	235	690	690	690	178	178	178
64	160	160	160	370	370	370	180	180	180
65	315	440	440	1045	1395	1395	45	45	45
66	110	110	110	305	305	305	521	521	600
67	210	210	210	380	380	380	173	173	173
68	670	670	670	1530	1530	1530	333	333	333
69	300	300	300	600	600	600	217	217	217
70	270	270	270	630	630	630	26	26	26
71	215	215	215	325	325	325	306	306	306
72	150	150	150	355	355	355	305	305	305
73	220	220	220	605	605	605	52	52	52
74	45	45	45	125	125	125	15	15	15
75	1065	1065	1146	2080	2080	2238	1474	1574	1574
76	165	165	165	335	335	335	4	4	4
77	380	380	380	805	805	805	83	83	83
78	535	535	535	1190	1190	1190	45	45	45
79	0	0	0	0	0	0	0	0	0
80	185	185	185	285	285	285	572	572	572
81	405	405	405	715	715	715	391	391	391
82	270	370	370	525	710	710	348	448	498
83	180	505	505	380	930	930	199	159	159
84	10	10	10	10	10	10	579	679	879
85	0	300	300	0	500	500	723	858	923
86	50	100	128	105	190	243	306	316	316
87	0	0	0	0	0	0	615	615	615
88	0	0	0	0	0	0	0	0	0
89	190	265	300	365	495	560	527	527	527
90	195	195	195	325	325	325	618	618	618
91	265	280	280	445	470	470	117	127	127
92	320	320	346	640	640	692	226	241	241
93	270	280	280	575	595	595	190	190	190
94	545	545	545	1025	1025	1025	60	60	60
97	75	75	75	165	165	165	64	69	69

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
98	845	855	855	1655	1675	1675	189	189	189
99	225	425	425	590	1040	1040	71	71	71
101	20	20	20	60	60	60	143	243	260
102	0	0	0	0	0	0	58	458	458
103	4	0	4	10	0	0	854	914	1086
104	165	165	165	285	285	285	983	1033	1059
105	550	550	550	1200	1200	1200	114	114	114
106	345	345	349	500	500	506	178	178	266
107	0	0	0	0	0	0	0	0	0
108	640	640	640	1415	1415	1415	79	104	104
109	305	355	355	705	820	820	42	42	42
110	670	670	670	1250	1250	1250	243	243	262
111	625	625	625	1380	1380	1380	364	364	375
112	445	445	445	775	775	775	229	229	229
113	315	315	315	580	580	580	205	205	205
114	120	120	121	185	185	187	1669	1719	1721
115	10	10	19	50	50	95	526	526	561
116	25	25	25	25	25	25	230	230	263
117	10	10	10	10	10	10	2293	2293	2350
118	955	955	955	1695	1695	1695	162	162	162
119	485	485	485	1195	1195	1195	220	220	220
120	65	65	65	170	170	170	29	29	29
121	840	840	840	1560	1560	1560	129	129	129
122	630	630	630	1565	1565	1565	66	66	66
123	665	665	665	1450	1450	1450	393	393	393
124	475	505	505	1065	1132	1132	10	10	10
125	20	20	21	35	35	37	38	38	46
126	380	475	475	1450	1670	1670	1939	1939	1939
127	665	665	665	1750	1750	1750	168	168	168
128	65	80	1332	145	181	2734	30	30	84
129	75	205	210	175	470	481	3500	6000	6415
130	0	0	0	0	0	0	377	402	454
131	9	834	834	20	1520	2019	58	358	408
132	54	269	295	122	622	681	0	0	0
133	655	655	770	1470	1470	1728	1024	1029	1029
134	565	585	585	1730	1790	1790	79	79	79
135	205	205	205	540	540	540	2006	2206	2256
136	1010	1010	1012	2270	2270	2274	711	711	771
137	325	325	341	680	680	713	356	356	402
138	0	175	204	0	305	356	959	1259	1259
139	0	0	0	0	0	0	0	0	0
140	230	230	230	650	650	650	62	62	62
141	450	470	470	790	825	825	728	738	738
142	140	140	140	320	320	320	70	70	70
143	765	776	776	1790	1810	1810	322	322	322
144	410	410	410	880	880	880	260	260	261
145	385	435	435	690	775	775	398	413	413
146	350	475	483	700	900	915	560	580	580

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
147	85	505	505	165	865	865	335	235	235
148	400	400	400	745	745	745	62	62	62
149	340	340	340	700	700	700	227	227	288
150	9	0	9	18	0	0	0	3000	3346
151	1380	1480	1497	3060	3215	3252	799	804	804
152	205	205	205	430	430	430	570	605	618
153	880	880	880	2100	2100	2100	1172	1172	1180
154	163	513	527	456	1251	1285	117	117	121
155	80	83	83	235	242	242	319	469	653
156	240	240	242	505	505	509	505	505	550
157	125	125	125	240	240	240	335	335	335
158	125	125	125	305	305	305	311	311	325
159	20	120	120	70	245	245	900	1175	1225
160	740	740	740	1570	1570	1570	330	330	330
161	90	90	90	230	230	230	140	140	140
162	70	70	70	165	165	165	338	338	344
163	975	975	975	2215	2215	2215	747	747	747
165	370	370	370	910	910	910	78	78	78
169	225	225	225	650	650	650	16	16	16
170	740	740	740	1675	1675	1675	242	242	242
171	4	4	4	10	10	10	2050	2700	3484
172	540	975	990	1200	2050	2082	55	75	75
173	0	0	0	0	0	0	742	1142	1142
174	85	85	85	135	135	135	837	867	867
175	45	60	60	100	135	135	341	376	376
176	20	20	20	70	70	70	146	946	1079
177	30	30	30	40	40	40	115	265	265
183	365	365	365	795	795	795	1413	1413	1413
184	310	310	310	565	565	565	418	418	418
185	10	10	10	30	30	30	517	592	731
186	0	0	0	0	0	0	39	39	39
187	70	70	70	200	200	200	650	675	700
188	1255	1255	1255	2785	2785	2785	670	670	698
189	610	660	660	1635	1722	1722	1779	2114	2170
190	465	465	471	1430	1430	1448	757	757	825
191	330	330	330	730	730	730	78	78	78
192	0	0	0	0	0	0	3225	3627	3627
193	0	0	0	0	0	0	0	0	2
194	0	0	0	0	0	0	0	0	0
195	320	335	338	580	615	621	1505	1505	1541
198	0	0	0	0	0	0	2296	2331	2360
199	18	562	562	47	1421	1421	944	2972	2972
200	12	12	12	32	32	32	53	53	53
201	640	640	640	1610	1610	1610	451	451	451
202	35	976	976	70	2122	2122	17	1330	1700
203	890	925	925	1980	2035	2035	1147	1142	1198
205	125	125	125	355	355	355	90	90	90
206	60	60	60	75	75	75	1008	1023	1023

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
207	230	230	230	555	555	555	98	98	98
208	0	0	0	0	0	0	1411	1411	1491
209	0	0	0	0	0	0	3249	3249	3633
210	0	0	0	0	0	0	2100	2325	2325
211	255	555	605	555	1065	1161	1992	6192	6192
212	75	75	75	180	180	180	2217	2792	2792
213	460	460	460	1050	1050	1050	27	27	27
214	645	645	691	1570	1570	1682	374	374	374
215	280	280	280	570	570	570	23	23	23
216	505	505	505	1295	1295	1295	219	219	219
217	410	410	410	1035	1035	1035	191	191	191
218	105	105	105	230	230	230	0	0	0
219	45	45	45	170	170	170	41	41	41
220	90	90	90	95	95	95	102	102	102
221	485	485	485	1070	1070	1070	68	68	68
222	35	35	35	80	80	80	655	655	655
223	0	0	0	0	0	0	501	501	515
224	290	290	292	830	830	836	39	39	42
225	430	430	433	830	830	836	197	197	255
226	535	535	537	1520	1520	1526	780	780	802
227	730	730	811	1715	1715	1905	92	92	92
229	395	395	500	800	800	1013	274	274	283
230	985	985	1117	2870	2870	3255	309	309	309
232	1235	1235	1235	2925	2925	2925	207	222	222
233	611	711	825	1342	1567	1818	31	41	537
234	85	90	90	290	305	305	27	27	27
235	131	131	144	166	166	182	3629	4629	4729
236	165	615	665	230	855	925	465	955	2124
237	282	592	643	539	1134	1233	0	275	359
238	1210	1435	1472	2810	3220	3304	478	513	513
239	555	590	590	1310	1393	1393	121	121	121
240	535	535	535	1550	1550	1550	1440	1490	1569
241	205	205	205	615	615	615	10	10	10
242	475	475	475	1085	1085	1085	2811	2811	2811
243	105	105	105	180	180	180	15	15	15
244	205	205	205	460	460	460	155	155	155
245	560	560	577	1130	1130	1164	792	792	792
246	405	405	405	895	895	895	120	120	120
247	280	280	280	760	760	760	86	86	86
248	45	45	45	110	110	110	2104	2104	2104
249	290	290	290	715	715	715	1020	1020	1020
250	0	0	0	0	0	0	1286	1371	1695
251	570	570	586	1275	1275	1311	366	366	412
252	595	605	605	1045	1063	1063	112	112	112
253	0	0	0	0	0	0	2034	2034	2056
254	1240	1240	1240	1790	1790	1790	180	180	180
255	175	345	345	225	495	495	2486	2626	2699
256	620	620	620	1485	1485	1485	216	216	216

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
257	235	235	235	490	490	490	5	5	5
258	305	305	305	585	585	585	313	313	330
259	680	680	680	1255	1255	1255	503	503	612
260	40	40	40	110	110	110	10	10	10
261	165	165	165	360	360	360	6	6	6
262	180	180	180	390	390	390	90	90	90
263	445	445	445	925	925	925	135	135	135
284	200	200	200	625	625	625	26	26	28
285	635	785	801	1750	2045	2087	276	276	277
286	340	340	341	825	825	827	26	26	37
287	195	195	195	390	390	390	37	37	37
288	450	450	453	875	875	881	119	119	201
289	10	10	10	35	35	35	2645	2945	2995
290	725	725	727	1649	1649	1654	315	315	356
291	275	275	275	615	615	615	101	111	343
292	215	215	215	490	490	490	356	356	356
293	585	595	595	1200	1222	1222	356	356	356
294	600	600	600	1025	1025	1025	198	198	198
295	132	932	1065	476	2176	2487	33	33	33
296	500	500	500	845	845	845	148	148	148
297	190	190	190	355	355	355	347	347	387
298	115	115	115	185	185	185	315	330	330
299	1020	1245	1245	2440	2915	2915	258	508	508
300	320	320	320	645	645	645	25	25	25
301	355	355	355	530	530	530	992	1317	1317
302	855	855	855	2330	2330	2330	41	41	41
303	335	335	374	915	915	1022	85	85	85
307	210	210	210	600	600	600	229	229	229
308	390	397	397	1035	1054	1054	162	162	162
309	0	0	0	0	0	0	144	144	144
310	0	0	0	0	0	0	1529	1879	1879
311	655	655	655	1425	1425	1425	281	281	383
312	305	339	339	665	720	720	230	230	230
313	125	125	125	295	295	295	106	106	106
314	30	30	30	55	55	55	0	0	0
315	535	535	535	1470	1470	1470	355	355	355
316	0	0	0	0	0	0	1320	1420	1420
317	0	0	0	0	0	0	1245	1095	1095
318	0	0	0	0	0	0	3310	2960	2960
319	290	290	290	590	590	590	23	23	23
320	0	0	0	0	0	0	179	329	431
321	130	130	130	460	460	460	17	17	17
322	215	215	215	565	565	565	94	94	94
323	45	45	45	115	115	115	75	75	92
324	135	135	135	410	410	410	675	1025	1025
325	675	675	702	1310	1310	1362	520	520	541
326	325	325	325	760	760	760	476	476	494
327	870	870	870	2180	2180	2180	330	330	378

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
329	4	4	4	20	20	20	2282	2932	3488
330	95	120	138	265	325	374	0	0	0
331	40	190	190	105	440	440	30	30	30
332	0	0	0	0	0	0	287	787	787
333	130	130	130	395	395	395	369	369	398
334	0	0	0	0	0	0	2456	3956	3956
335	715	715	715	1785	1785	1785	60	60	60
336	10	10	10	15	15	15	900	1200	2415
337	505	515	515	1385	1413	1413	43	43	43
338	220	220	221	590	590	593	423	423	485
339	10	10	10	25	25	25	1012	1912	1912
340	75	75	75	165	165	165	645	995	995
341	17	542	629	31	1206	1400	532	552	552
343	0	0	0	0	0	0	0	0	0
344	4	3	3	25	25	25	0	0	0
345	5	280	280	13	698	698	105	105	105
347	0	0	0	0	0	0	1846	1846	2296
348	0	0	0	0	0	0	1450	1450	1480
349	0	0	0	0	0	0	473	773	773
350	1020	1020	1020	2460	2460	2460	309	369	369
351	410	410	410	875	875	875	290	295	295
352	655	655	655	1620	1620	1620	98	98	110
353	510	510	510	1080	1080	1080	995	995	995
355	18	293	505	58	658	1135	6	6	6
357	460	460	472	1425	1425	1462	303	304	379
358	1790	1790	1790	3590	3590	3590	905	905	909
360	175	175	175	375	375	375	377	402	467
361	520	570	570	880	978	978	954	954	954
366	210	210	210	545	545	545	205	205	205
369	0	150	198	0	270	356	1371	2121	2246
371	0	0	0	0	0	0	580	755	755
372	460	460	556	625	625	755	1260	1275	1417
373	620	630	630	1570	1595	1595	100	100	100
374	1290	1290	1290	2885	2885	2885	48	48	48
375	530	955	1048	1260	2085	2288	110	385	385
376	15	65	73	30	140	157	55	55	55
377	4	4	124	11	11	341	55	255	419
379	0	0	0	0	0	0	560	810	810
381	20	20	20	70	70	70	45	45	45
382	250	275	1485	610	670	3280	40	40	173
385	214	384	572	687	1212	1793	57	57	351
404	84	434	459	282	932	978	786	936	1471
415	40	45	45	90	102	102	4	4	4
416	34	34	34	94	94	94	15	15	15
417	10	10	10	20	20	20	25	30	30
418	55	55	55	130	130	130	4	4	4
419	60	60	60	220	220	220	93	93	93
420	35	35	35	105	105	105	10	10	10

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
421	32	32	32	67	67	67	0	0	0
422	1	1	107	2	2	208	0	100	965
423	14	14	14	23	23	23	0	0	0
424	108	158	182	340	465	526	43	143	189
425	0	0	0	0	0	0	0	0	0
426	40	40	40	95	95	95	0	0	0
427	45	70	82	145	210	242	0	85	126
428	20	25	25	30	40	40	9	9	9
432	20	25	25	45	56	56	136	136	136
440	135	135	135	308	308	308	0	0	0
441	22	507	518	22	982	1004	0	7	7
442	25	325	375	85	620	715	15	15	15
443	75	75	75	165	165	165	68	73	73
460	80	100	110	260	325	357	107	132	145
461	55	205	205	165	465	465	20	35	35
462	60	90	90	160	240	240	9	9	9
463	10	10	10	20	20	20	19	19	19
464	15	365	365	30	715	715	80	130	130
465	0	0	0	0	0	0	73	108	108
466	35	40	40	105	120	120	15	15	15
467	45	45	45	125	125	125	32	232	232
468	30	30	30	90	90	90	29	29	29
583	455	505	553	1260	1380	1511	65	80	80
584	335	345	349	790	815	824	325	340	540
585	45	45	45	150	150	150	263	263	263
586	30	350	461	60	810	1067	125	200	213
587	50	800	915	95	1645	1881	25	25	30
590	65	810	1115	190	1920	2634	5	602	648
605	15	255	275	20	505	545	78	83	86
606	45	50	50	95	107	107	12	12	12
608	0	1025	1073	0	2150	2251	0	15	15
609	50	175	175	145	495	495	56	59	59
610	7	1157	1789	9	2159	3338	0	2400	2784
611	3	178	323	8	383	696	0	1150	1334
613	19	519	872	69	1119	1880	0	550	641
615	10	175	200	15	375	429	46	46	46
720	0	0	0	0	0	0	0	5	5
721	0	0	0	0	0	0	121	221	253
722	2	2	2	5	5	5	249	269	1003
723	10	195	243	10	370	461	8	608	708
724	0	215	245	0	475	541	14	364	418
725	405	530	530	625	825	825	822	822	834
726	440	540	649	1025	1350	1623	0	0	0
727	0	0	0	0	0	0	423	548	573
728	0	0	0	0	0	0	205	1105	1105
729	22	272	355	30	515	672	0	0	0
730	7	132	174	22	247	325	0	0	0
731	305	855	924	720	1930	2086	2	47	62

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
732	0	0	0	0	0	0	0	0	0
916	20	160	192	45	340	407	10	10	10
917	1	766	848	2	1402	1552	14	34	643
918	83	193	202	162	357	373	9	44	44
919	40	435	443	78	938	956	0	0	0
920	12	262	312	30	505	600	0	700	884
921	7	157	179	8	268	305	0	1000	1166
922	0	250	259	0	455	472	0	40	50
923	0	315	355	0	615	692	0	20	25
924	0	220	222	0	450	454	0	0	0
925	1	66	66	2	152	152	0	70	70
926	24	24	24	43	43	43	4	4	4
927	6	6	169	14	14	334	10	160	2301
928	3	3	1266	6	6	2561	0	150	191
929	62	62	62	195	295	195	41	41	41
930	6	10	215	13	23	467	4	4	4
931	14	14	14	29	54	29	0	0	0
932	30	180	304	68	363	674	0	300	237
933	29	329	1449	66	681	3022	0	350	631
934	1	1	1	2	67	2	0	0	0
935	13	176	176	29	393	504	0	35	41
936	0	0	0	0	0	0	0	0	0
937	16	81	81	27	202	202	0	0	0
938	7	107	107	16	236	236	41	41	41
939	4	4	4	11	11	11	4	4	4
940	11	11	11	31	31	31	0	0	0
941	1	0	1	2	0	0	361	1761	1988
942	15	15	15	45	45	45	3	503	586
943	8	8	8	29	29	29	0	1200	1399
944	8	58	66	14	124	141	181	481	1298
945	0	300	300	0	525	525	0	550	641
946	0	0	0	0	0	0	420	3420	3918
947	0	0	0	0	0	0	0	2500	2900
948	0	0	0	0	0	0	468	1568	1618
949	11	261	433	28	478	793	54	254	491
950	165	390	464	335	740	880	1192	1842	1940
955	205	205	205	466	466	466	0	0	18
956	347	547	565	809	1244	1285	0	0	0
957	0	0	0	0	0	0	1014	2014	2181
958	14	14	74	29	29	153	1106	1206	1206
960	213	913	1029	396	1646	1855	107	172	182
961	0	0	0	0	0	0	638	638	712
963	0	0	0	0	0	0	0	500	645
964	1	201	229	2	357	407	0	2750	2750
965	1137	1137	1141	2359	2359	2367	169	169	170
967	711	961	1049	1800	2335	2549	0	0	0
968	3	703	1177	5	1280	2144	0	50	65
969	0	0	52	0	0	126	47	247	321

CITY OF MADISON WATER UTILITY 2010 PLANNING AREA									
	HOUSEHOLDS			POPULATION			TOTAL EMPLOYMENT		
2004 TAZ	2000	2030	2035	2000	2030	2035	2000	2030	2035
971	0	675	885	0	1450	1901	8	23	23
972	21	221	371	76	511	858	0	25	35
973	0	175	310	0	360	639	0	1400	1632
979	492	617	617	872	1097	1097	0	0	6
983	170	420	545	365	890	1154	0	0	98
984	1	1	1	3	3	3	5	5	51
985	12	162	287	32	357	631	77	77	77
993	16	866	1245	28	1778	2556	18	568	659
994	12	462	667	28	968	1398	0	50	259
995	478	478	478	901	901	901	0	0	0
996	33	383	543	82	867	1229	13	13	13
997	4	429	479	10	900	1005	15	2078	2269
998	30	105	230	70	202	442	82	82	127
1002	40	415	482	88	938	1089	3	3	3
1005	0	0	0	0	0	0	151	151	151
1032	0	1300	1569	0	3150	3802	0	410	800
TOTAL	107,325	142,278	156,140	243,728	315,170	345,151	207,628	273,982	301,604

Prepared by MATPB, a Metropolitan Planning

Attachment E

Attachment E
Peaking Factor Sensitivity

MD

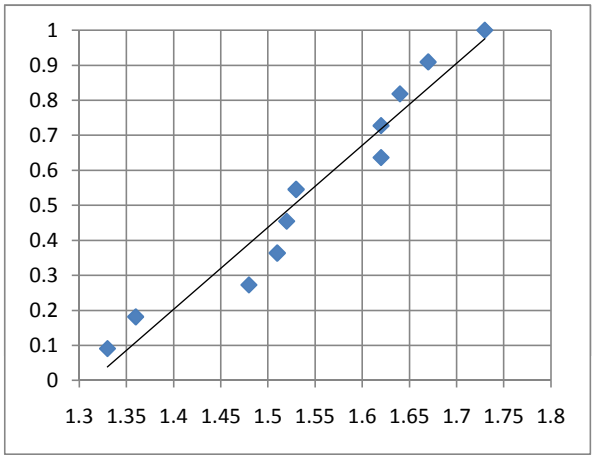
YR	PF	Rank	%
2004	1.33	1	0.090909
2000	1.36	2	0.181818
2009	1.48	3	0.272727
2008	1.51	4	0.363636
1999	1.52	5	0.454545
2006	1.53	6	0.545455
2001	1.62	7	0.636364
2002	1.62	8	0.727273
2003	1.64	9	0.818182
2005	1.67	10	0.909091
2007	1.73	11	1

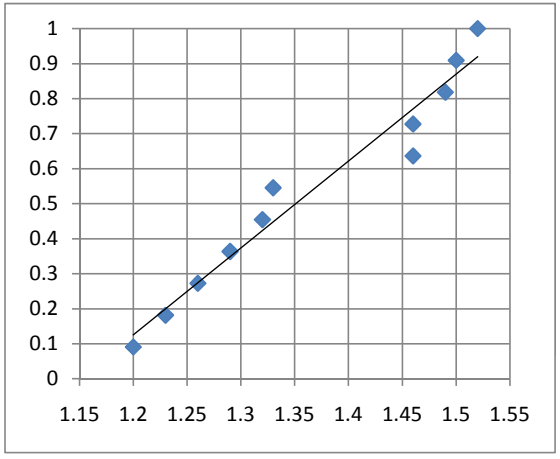
M7D

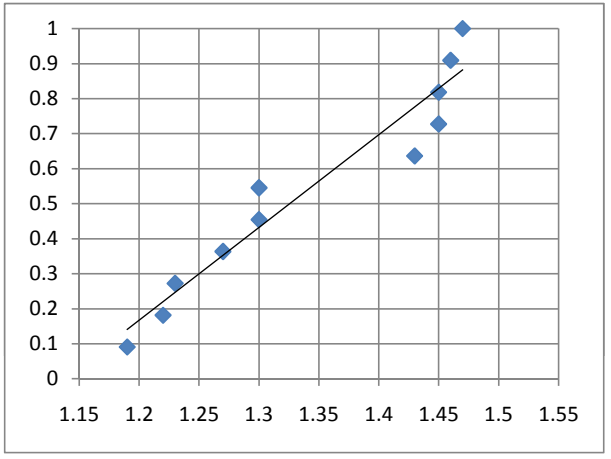
YR	PF	Rank	%
2004	1.2	1	0.090909
2009	1.23	2	0.181818
2000	1.26	3	0.272727
2008	1.29	4	0.363636
2006	1.32	5	0.454545
1999	1.33	6	0.545455
2003	1.46	7	0.636364
2005	1.46	8	0.727273
2001	1.49	9	0.818182
2007	1.5	10	0.909091
2002	1.52	11	1

M10D

YR	PF	Rank	%
2004	1.19	1	0.090909091
2000	1.22	2	0.181818182
2009	1.23	3	0.272727273
2006	1.27	4	0.363636364
1999	1.3	5	0.454545455
2008	1.3	6	0.545454545
2001	1.43	7	0.636363636
2003	1.45	8	0.727272727
2005	1.45	9	0.818181818
2007	1.46	10	0.909090909
2002	1.47	11	1







Attachment E
Peaking Factor Sensitivity

M30D

YR	PF	Rank	%
2004	1.15	1	0.090909
2009	1.16	2	0.181818
2000	1.17	3	0.272727
1999	1.23	4	0.363636
2006	1.23	5	0.454545
2008	1.25	6	0.545455
2001	1.31	7	0.636364
2005	1.31	8	0.727273
2002	1.36	9	0.818182
2003	1.38	10	0.909091
2007	1.38	11	1

SD

YR	PF	Rank	%
2004	1.1	1	0.090909
2000	1.11	2	0.181818
2009	1.12	3	0.272727
2006	1.13	4	0.363636
2001	1.14	5	0.454545
2007	1.15	6	0.545455
1999	1.16	7	0.636364
2008	1.17	8	0.727273
2003	1.18	9	0.818182
2005	1.19	10	0.909091
2002	1.2	11	1