Water System Demand and Capacity Analysis

Water Treatment Plant No. 5

Edina, Minnesota

SEH No. EDINA 125040

October 23, 2013

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RE: Water Treatment Plant No. 5
Water System Demand and Capacity Analysis
Edina, Minnesota
SEH No. EDINA 125040

Ross Bintner, Environmental Engineer
City of Edina
7450 Metro Boulevard
Edina, MN 55439

Dear Mr. Bintner:

I am pleased to present to you the enclosed report on the results from our planning study for Water Treatment Plant No. 5. We have reviewed current water system operations and facilities for this study, from the perspective of evaluating the need for expanding water treatment plant capacity with the construction of Water Treatment Plant No. 5. My meetings with you and Dave Goergen have been very helpful in guiding this study, and providing a greater understanding of the goals and concerns of the Edina Utilities Division, as they relate to water supply and distribution.

We appreciate the opportunity to continue to provide water system engineering services to the City of Edina. If you should have any questions on this report, I will be available to review it with you at your convenience. Thanks.

Sincerely,

John D. Chlebeck, PE
Project Engineer

jdc
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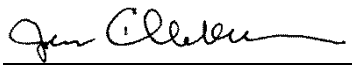
Water Treatment Plant No. 5
Water System Demand and Capacity Analysis
Edina, Minnesota

SEH No. EDINA 125040

October 23, 2013

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



John D. Chlebeck, PE

Date: 10/22/13 Lic. No.: 47125

Short Elliott Hendrickson Inc.
3535 Vadnais Center Drive
Saint Paul, MN 55110

Executive Summary

The City of Edina is planning to begin construction on Water Treatment Plant No. 5 in 2017 per the current capital improvement plan. The facility would provide iron and manganese removal for Wells 5 and 18, through oxidation and granular filtration. A site has been selected near the City's existing water tower at 69th Street and France Avenue. This study was undertaken to evaluate the current timeline for construction of Water Treatment Plant No. 5, along with the hydraulic impacts to the distribution system of putting the planned facility online at the selected location.

This study evaluates current supply and treatment facility capacity in comparison with existing and projected water system demands through 2030. In addition, impacts from the use of unfiltered wells such as Wells 5 and 18 are considered. This includes a review of well water iron and manganese concentrations in comparison with established regulatory guidelines for these naturally-occurring chemicals in drinking water. The City's existing water distribution system computer hydraulic model was used to evaluate the geographic extent of unfiltered water coming from Wells 5 and 18 during peak water demand conditions.

Wells 5 and 18 both have iron and manganese concentrations that exceed the Secondary Maximum Contaminant Levels (SMCLs) for these chemicals. Iron in the wells is relatively low compared with other wells in Edina, but manganese is relatively high. The SMCLs are not enforceable regulations, but recommended standards to avoid aesthetic concerns in the water distribution system. These aesthetic concerns include taste and odor, discoloration, staining of laundry, and fouling of plumbing fixtures. In addition, the Minnesota Department of Health (MDH) has established Risk Assessment Advice for manganese, which provides recommended maximum concentrations to avoid potential neurotoxicity effects. Two values have been established by MDH, one for infants under one year of age, and a second for the remainder of the population. The manganese levels for Wells 5 and 18 exceed the guideline for infants according to water analysis from 2007.

The City's four existing water treatment plants provide a total treatment capacity of **9.66 million gallons per day (MGD)** for water supplied from eight wells. An additional ten wells provide water directly to the distribution system without filtration, and are used as needed to meet peak water demands typically encountered in the summer. By 2014, Wells 9 and 15 are expected to be connected to Water Treatment Plant No. 6, which will increase treated water capacity to **13.75 MGD**. The planned addition of Water Treatment Plant No. 5 to provide treatment for Wells 5 and 18 will increase treated water capacity to **16.63 MGD**.

Average daily demands on the Edina water system have ranged from **6.8 MGD** to **8.2 MGD** over the previous ten years. Maximum daily demands have ranged from **13.1 MGD** to **21.8 MGD** over the same period. Supply and treatment facilities are often sized to meet maximum daily demands, with peaks in water usage over the course of a given day met by storage reserves. When the capacity of the City's water treatment plants cannot meet the daily demand during peak water use periods, the City currently utilizes unfiltered wells such as Wells 5 and 18 to make up the difference.

A review of daily pumping records for the City indicates that it is typical for the City to utilize unfiltered wells to meet water demands approximately 120 days of the year. Population and associated water demands are expected to increase in Edina through 2030 and beyond. The 2010 recorded population of 47,941 is projected to increase to 51,500 by 2030. The corresponding potential maximum daily demand rate is projected to increase to 23.57 MGD by 2030. This is expected to increase the typical number of days with demand exceeding treatment capacity to 140 days per year given the existing treatment capacity. With the expansion of treatment capacity at Water Treatment Plant No. 6, and the planned construction of Water Treatment Plant No. 5, this is expected to be reduced to approximately 5 days per year.

Based on the analysis conducted for this study, it is recommended that the City maintain its current plan to begin work on Water Treatment Plant No. 5 in 2017. During preliminary design for the water treatment plant, the costs and benefits of increasing the capacity of Water Treatment Plant No. 5 should also be considered. Adding filtration capacity that could accommodate future wells could be a cost effective means to provide additional treated water capacity as water demands continue to increase, and might allow the construction of Water Treatment Plant No. 7 to be delayed for a longer period of time while continuing to meet water quality goals.

The chosen site for Water Treatment Plant No. 5 also appears to be a good location for the plant from a hydraulic point of view. The water system hydraulic model indicates that the distribution system around the proposed location is equipped to handle potential flow rates from the facility.

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Prepared for City of Edina

1.0 Background

The Edina municipal water system serves its customers, the residents and businesses of the City of Edina, through a combination of wells located throughout the city. The water from these wells varies in quality and chemical composition. The City has continued to add water treatment capacity to the water system as economically feasible, to make continued improvement to the quality of water supplied to its customers. The water treatment processes at the City's four existing water treatment plants function to address aesthetic concerns such as iron and manganese minerals from the well water, as well as health concerns such as those posed by radium and vinyl chloride.

The City has been planning for some time to construct a fifth water treatment plant (Water Treatment Plant No. 5) to provide filtration for the water supplied from Wells 5 and 18 in the southeastern portion of the system. A site has been identified for this plant near the City's existing water tower on 69th Street and France Avenue. Raw water transmission main has been previously constructed, as it was convenient in conjunction with road improvements, to bring water from Wells 5 and 18 to this planned site.

Wells 5 and 18 are currently used to provide water during peak summer demands. The wells contain levels of iron and manganese that exceed the EPA Secondary Maximum Contaminant Levels for drinking water. Secondary Maximum Contaminant Levels are recommended values for water constituents that cause aesthetic concerns in drinking water. They are not enforced, and are not based on health impacts.

Iron and manganese are naturally-occurring minerals that are commonly found in Minnesota groundwater supplies. They are common sources of complaints from utility customers, causing taste and odor, laundry staining, and fouling of plumbing fixtures. Complaints in Edina have been kept to a minimum by limiting the use of Wells 5 and 18, along with other unfiltered wells on the water system.

Water system operations staff maintain constant awareness of which wells are pumping, and need to frequently shift the sequencing of wells in the controls system to minimize impact from iron and manganese in the system. This has caused increased operational complexity while limiting the use of existing well infrastructure. It has also put additional burden on those wells that do pump to water treatment plants, causing some of these wells to be operated continuously throughout the year. This causes shortened equipment life expectancies, and reduces operational flexibility to regularly take equipment out of service for maintenance.

Current projections indicate a strong demand for high density and mixed use redevelopment in Edina over the next 20 years. Much of this redevelopment activity is expected in the southeastern portion of the City, which is served by Wells 5 and 18. There is concern that with planned growth, the accompanying increase in water demand will cause a need to utilize Wells 5 and 18 more frequently. Therefore, it will be more difficult over time to maintain system water quality through operational adjustments.

This study examines the City's current use of unfiltered well water and the potential impacts within the distribution system. In addition, projected growth in water demand and water use patterns are presented in order to quantify how the use of Wells 5 and 18 will increase and how additional use will impact the water system and its customers. The study aims to clarify the rationale used in deciding when to construct the planned Water Treatment Plant No. 5. Additional distribution system hydraulic analysis was also conducted as part of this study to further evaluate the current plan to construct Water Treatment Plant No. 5 at the 69th Street and France Avenue site.

2.0 Water System Supply and Treatment Facilities

The City of Edina's water supply is provided by a network of wells and water treatment plants that are distributed throughout the City. The wells provide groundwater from two aquifer systems: the Prairie du Chien - Jordan system and the Mount Simon - Hinkley system, with the majority of the City's water supply coming from the Prairie du Chien - Jordan aquifer system.

Water is processed at four existing water treatment facilities. Plants 2, 3, and 4 are filtration plants that are designed primarily for the removal of iron and manganese through oxidation and granular filtration. Plant 6 is the most recent addition to the system. This plant was designed to remove vinyl chloride that was impacting Well No. 7.

Vinyl chloride is a contaminant that entered the aquifer from activities at the land surface, and a plume of the chemical was migrating into Edina from an unknown source in St. Louis Park. The treatment process at Plant 6 includes air stripping which effectively removes vinyl chloride from the water supply. The plant also contains facilities for radium removal, and will be used to treat water from Wells 9 and 15 in the near future. These wells contain radium from natural sources, and are currently on emergency reserve status.

A summary of well and treatment capacities follows in Table 1.

Table 1
Existing Well and Water Treatment Capacities

Water Treatment Plant	Well ID	Well Depth (ft)	Aquifer System*	Well Capacity (gpm)	Plant Capacity (gpm)	Plant Capacity (MGD)
2	Well 4	500	OPCJ	720	1,680	2.42
	Well 6	503	OPCJ	960		
3	Well 10	1,001	CMSH	450	1,550	2.23
	Well 11	403	OPCJ	1,100		
4	Well 12	1,080	CMSH	900	1,800	2.59
	Well 13	495	OPCJ	900		
6	Well 2	448	OPCJ	1,000	1,680	2.42
	Well 7	547	OPCJ	680		
Currently Not Filtered	Well 3	421	OPCJ	680		
	Well 5	443	OPCJ	1,000		
	Well 8	472	OPCJ	825		
	Well 9	1,130	CMSH	1,130		
	Well 15	405	OPCJ	2,000		
	Well 16	381	OPCJ	1,000		
	Well 17	461	OPCJ	950		
	Well 18	446	OPCJ	1,000		
	Well 19	520	OPCJ	1,000		
	Well 20	467	OPCJ	1,000		
Existing Filtered Water Total Capacity					**6,710**	**9.66**

*OPCJ: Prairie Du Chien - Jordan, CMSH: Mount Simon - Hinkley

3.0 Iron and Manganese

Both iron and manganese are minerals that are commonly found in ground water sources in Minnesota. The EPA has set Secondary Maximum Contaminant Levels (SMCLs) for both of these minerals. SMCLs are established as guidelines to assist public water systems in managing their drinking water for aesthetic considerations such as taste, color, and odor. These contaminants are not considered to present a risk to human health at the SMCL. Therefore, these standards are not regulated or enforced by EPA or the Minnesota Department of Health.

Iron and manganese are both common causes for customer complaints at water utilities in Minnesota. Complaints are typically related to staining or fouling of plumbing fixtures. Taste and odor can also be a concern with iron or manganese above the SMCL.

In addition to aesthetic issues, more recent research by the Minnesota Department of Health (MDH) indicates there may be potential health impacts due to the consumption of manganese in water at high concentrations. In 2011, MDH began a review of recent human and animal studies related to manganese exposure. Based on that review, a tiered manganese guidance was issued for drinking water in 2012. This guidance established a Risk Assessment Advice for manganese concentrations of less than 0.1 mg/L for infants less than one year of age, and less than 0.3 mg/L for children greater than one year of age and adults.

Manganese is a known neurotoxin at high concentrations. MDH has established the Risk Assessment Advice to protect populations from nervous system damage. The levels are not regulated at the current time, but are recommendations for human consumption based on a review of manganese exposure research. Additional information on MDH and EPA health advisories related to manganese can be found on the MDH website: http://www.health.state.mn.us/divs/eh/risk/guidance/gw/manganese.html

Table 2 lists the iron and manganese levels measured in Edina's wells in 2007, along with the SMCL for each.

Table 2
Iron and Manganese Concentrations in Edina Wells

	Concentration (mg/L)	
Well No.	**Iron**	**Manganese**
SMCL	**0.3**	**0.05**
2	0.95	0.21
3*	0.65	0.072
4	0.71	0.048
5*	**0.51**	**0.19**
6	0.56	0.085
8*	0.53	0.28
10	0.82	0.021
11	0.56	0.054
12	4.0	0.086
13	0.68	0.052
15*	1.5	0.16
16*	0.5	0.04
17*	1.1	0.048
18*	**0.53**	**0.18**
19*	0.58	0.038

*Currently unfiltered

Table 2 indicates that all of the water sources in Edina have iron levels that exceed the SMCL, and most have manganese levels that exceed the SMCL. Through the City's current filtration processes, many of the problems that could result from these mineral concentrations have been mitigated. However, current filtration capacities do not meet all water demand conditions on the system.

Wells 5 and 18, for which treatment is planned with Water Treatment Plant No. 5, have similar levels of iron and manganese as measured in 2007. Both wells are on the lower end of the spectrum for iron levels, but have relatively high manganese levels.

4.0 Water Demand Analysis

4.1 Historical Water Demand

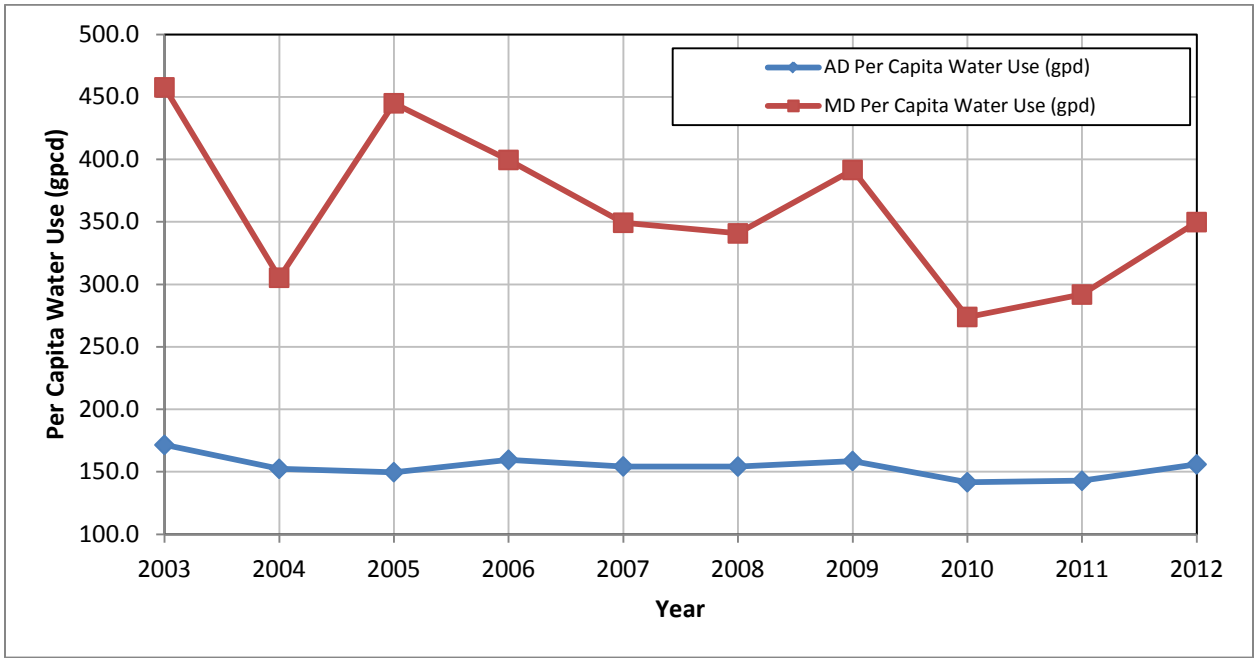
The City of Edina had a population of 47,941 in 2010, according to the US Census Bureau. The total water use in 2010 was 2,478,000,000 gallons. This results in an average daily (AD) demand rate of 7.61 million gallons per day (MGD). On a per capita basis, the water use in Edina in 2010 averaged 142 gallons per capita per day (gpcd).

Water demand comes not only from residential sources, but also from commercial, industrial, and institutional land uses. However, where the relative proportion of these land uses remains fairly constant, it is a sound assumption that the water use per capita will also remain constant. Per capita water demand has ranged from 142 gpcd and 171 gpcd between 2003 and 2012. For future water use projections of AD demand, a value of 171 gpcd is used in this study. This value is representative of the highest of the previous ten years. Using the highest expected per capita demand is a common practice in utility infrastructure planning, to ensure that future budgets are adequate to meet potential needs of the system.

Maximum daily (MD) demands, representing the highest daily water use on the system over a given year, are often of greater interest to utility planners. This is because supply facilities typically need to be able to meet MD demands reliably in order to provide continuous water service. The per capita MD demand has ranged from 274 gpcd to 458 gpcd between 2003 to 2012. The fluctuation is typically correlated to climate parameters, such as precipitation and temperature. This is due to the fact that the majority of peak water use serves lawn irrigation, especially in suburban communities. For future water use projections of MD demand, a value of 458 gpcd is used in this study.

The historic per capita water use for Edina over the last ten years is presented graphically in Figure 1. There is a slight downward trend in per capita water use in Edina over the last ten years. However, it is unclear if this is related to normal climate variation, or if it is indicative of changes in water use behavior.

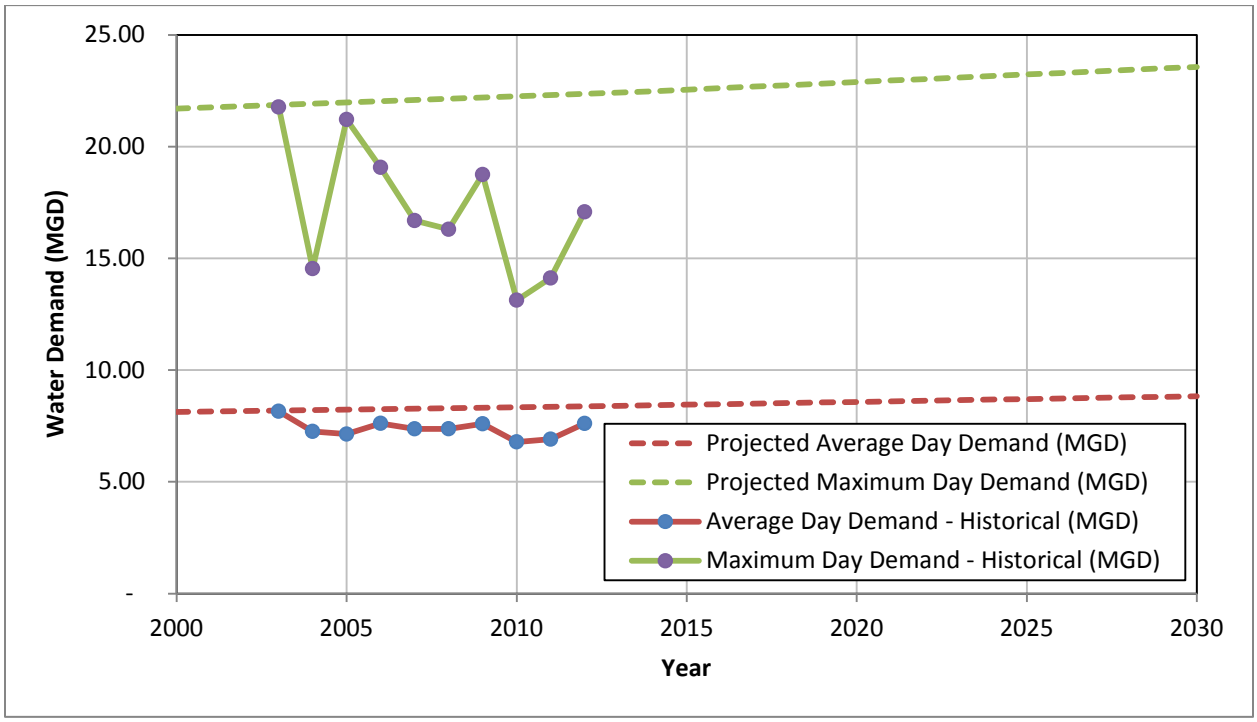
Figure 1 – Trends in Per Capita Demand and Demand Peaking



4.2 Projected Water Demand

The population of Edina is expected to increase to 51,500 by 2030, based on the City's most current planning estimates. Based on the assumptions discussed previously of a constant per capita average day demand of 171 gpcd and a per capita maximum day demand of 458 gpcd, the potential maximum day demand rate is projected to increase to 23.57 MGD by 2030. This is represented graphically, along with historical water demands of the previous ten years, in Figure 2.

Figure 2 – Water Demand Projections



It should be noted that recently-released preliminary Metropolitan Council population projections show a potential population for the City of Edina of 70,800 by 2040. This projected population growth is not considered likely by City planners. It is mentioned here, however, as a possible outcome. If population was to increase to that level by 2040 by a linear growth trajectory, the projected population for 2030 would be 62,953 rather than 51,500. This outcome could result in a maximum daily demand of 28.8 MGD as compared to the 23.6 MGD projected in this study. It is recommended that these projections are revisited in five years to reevaluate the population trajectory of the City.

5.0 Filter Plant Capacity Evaluation

The capacities of existing wells and water treatment plants were listed in Table 1. Future planned water treatment plant capacities are presented in Table 3. The existing plant capacity of 9.66 MGD will be increased by 2014 to 13.75 MGD with the addition of Wells 9 and 15 to Water Treatment Plant No. 6. Water Treatment Plant No. 5 is currently in the City's capital improvement plan for 2017, with an estimated start-up date of 2019. The total treatment plant capacity with the addition of Plant 5 would be 16.63 MGD. With the future construction of Plant 7, the total plant capacity would rise to 20.95 MGD.

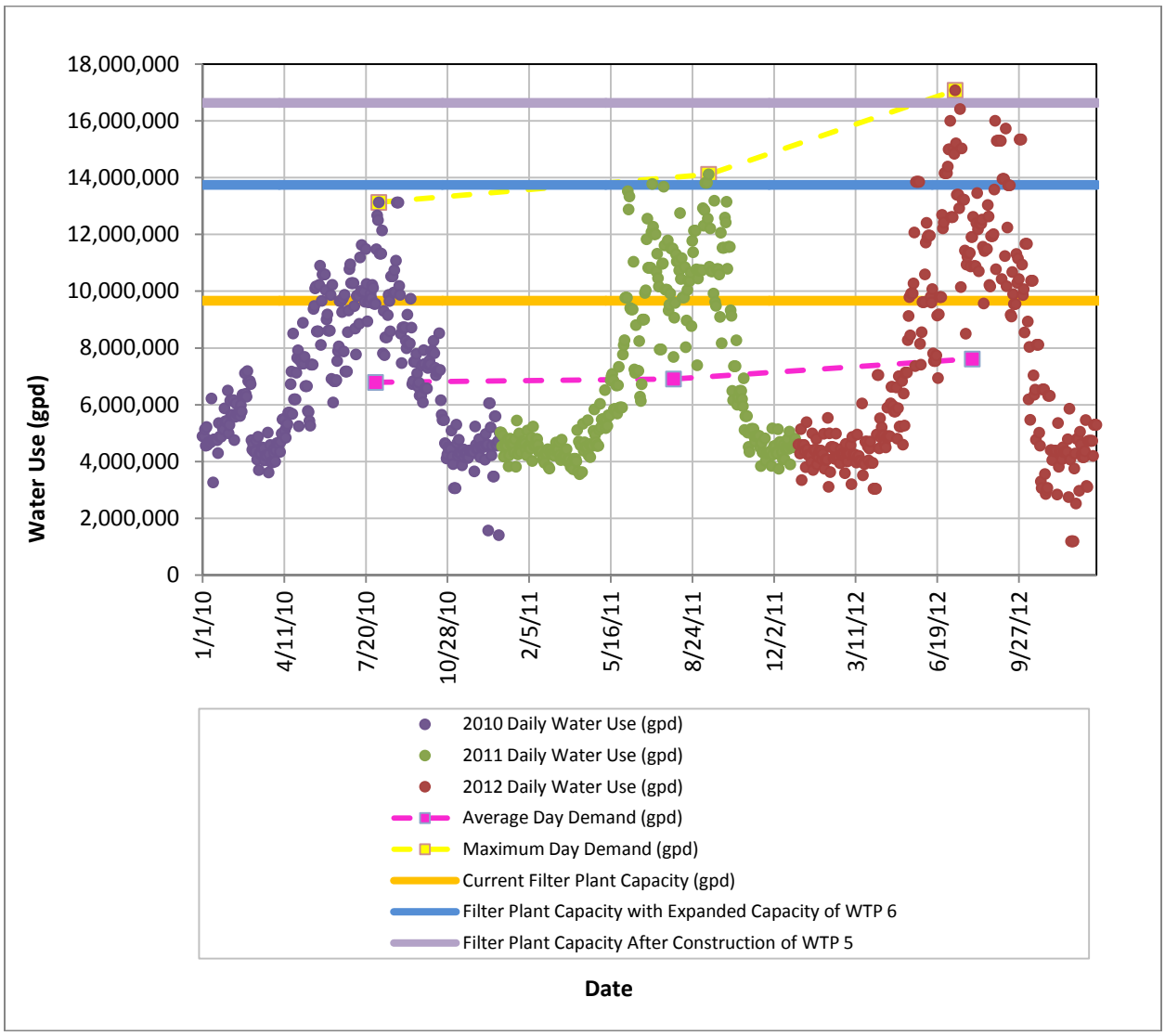
Table 3
Planned Water Treatment Facilities

Water Treatment Plant	Well ID	Well Depth (ft)	Aquifer System*	Well Capacity (gpm)	Plant Capacity (gpm)	Plant Capacity (MGD)
2	Well 4	500	OPCJ	720	1,680	2.42
	Well 6	503	OPCJ	960		
3	Well 10	1,001	CMSH	450	1,550	2.23
	Well 11	403	OPCJ	1,100		
4	Well 12	1,080	CMSH	900	1,800	2.59
	Well 13	495	OPCJ	900		
6	Well 2	448	OPCJ	1,000	4,520	6.51
	Well 7	547	OPCJ	680		
	Well 9 (2014)	1,130	CMSH	840		
	Well 15 (2013)	405	OPCJ	2,000		
5	Well 5	443	OPCJ	1,000	2,000	2.88
	Well 18	446	OPCJ	1,000		
7	Well 16	381	OPCJ	1,000	3,000	4.32
	Well 19	520	OPCJ	1,000		
	Well 20	467	OPCJ	1,000		
Not Filtered	Well 3	421	OPCJ	680		
	Well 8	472	OPCJ	825		
	Well 17	461	OPCJ	950		
Planned Filtered Water Total Capacity					**14,550**	**20.95**

*OPCJ: Prairie Du Chien - Jordan, CMSH: Mount Simon - Hinkley

The maximum daily water use has fluctuated between 13.13 MGD and 21.77 MGD over the previous ten years. With the existing water treatment capacity, a certain amount of water is supplied from system wells such as Wells 5 and 18 during peak summer demands, which provide unfiltered water to the system. The previous three years of daily pumping data from all of the wells was analyzed to evaluate the frequency of use of unfiltered system wells. Figure 3 shows a graph of the daily pumping data along with AD demand and MD demand for each of the three years for which data were available. The current water treatment plant capacity is shown for comparison.

Figure 3 – Daily Water Use (2010 - 2012)



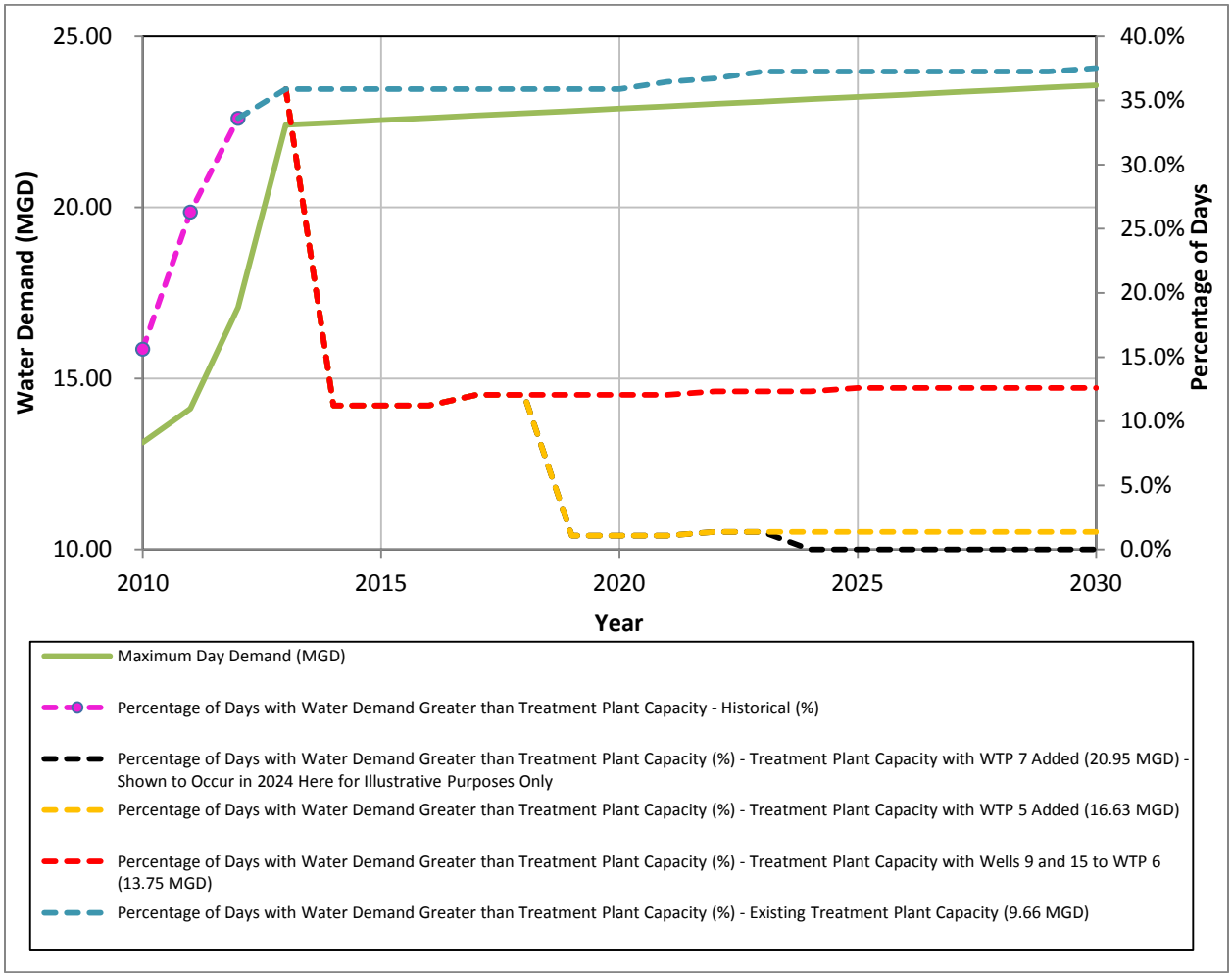
It is apparent in looking at Figure 3 that there are a number of days each year during which unfiltered water is supplied from the system wells to meet peak demands. The number of days each year in which demand exceeds plant capacity is clearly related to the maximum daily demand and the level of peak season water usage. Table 4 lists the number of days exceeding plant capacity, along with demand parameters for each of the three years.

Table 4
Summary of Daily Pumping Data

Year	No. of Days Demand Exceeded Plant Capacity	Percentage of Days Demand Exceeded Plant Capacity (%)	AD Demand (MGD)	MD Demand (MGD)	Estimated Per Capita AD Demand (gpd)	Estimated Per Capita MD Demand (gpd)
2010	57	15.6%	6.789	13.13	141.6	273.9
2011	96	26.3%	6.910	14.12	142.8	291.8
2012	123	33.6%	7.614	17.08	155.9	349.8

Of the three years for which daily pumping data were available, 2012 is viewed as a more typical year - with a per capita MD demand closer to the 10-year average of 360, and a per capita AD demand closer to the 10-year average of 154 gpd. For this reason, the daily distribution of water demands for 2012 was used as a model for future years. The total daily water demand for each day in 2012 was divided through by the average daily demand for the year, thus producing a demand multiplier for each day of the year. These daily multipliers can then be applied to future projected values of average daily demand in order to estimate the number of days in future years that are expected to exceed the water treatment plant capacity. The results are shown in Figure 4.

Figure 4 – Projected Percentage of Days with Demand Exceeding Water Treatment Plant Capacity

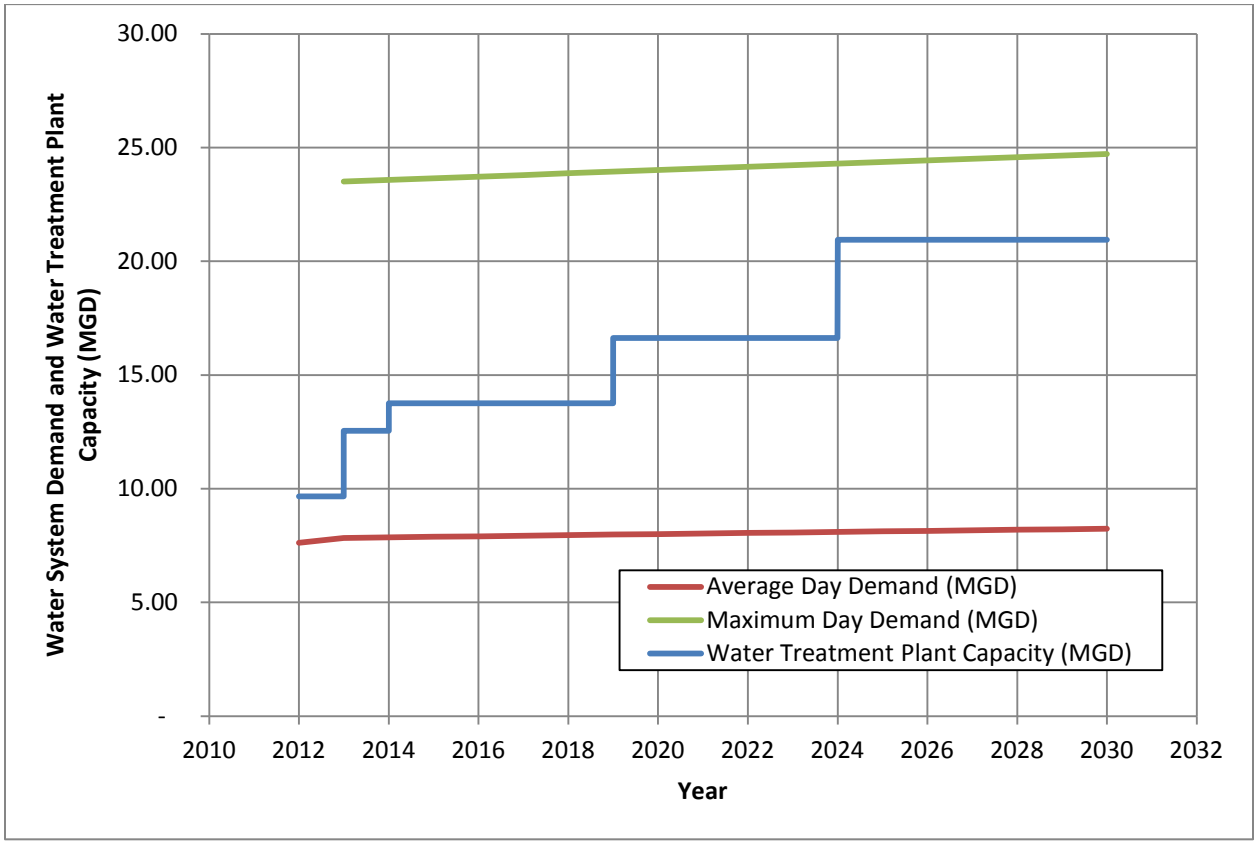


The results of this analysis show that under a typical year such as 2012, with system water demands projected to increase as previously discussed, and with the current water treatment plant capacity of 9.66 MGD, the number of days in which water demands would exceed plant capacity would increase from a current level of about 130 days per year (36% of days) to approximately 140 days per year (38% of days). With the planned connection of Wells 9 and 15 to Water Treatment Plant No. 6, this is expected to drop to about 41 days in 2014 (11% of days) and range up to 46 days by 2030 (13% of days). With the construction of Water Treatment Plant No. 5 to provide iron and manganese removal for Wells 5 and 18, the days

with demand exceeding plant capacity drops further to about 5 days per year (1% of days). The ultimate plan to construct Water Treatment Plant No. 7 for the treatment of Wells 16, 19, and 20 would allow the City to meet nearly all demand conditions projected through 2030.

Figure 5 presents another perspective on the water treatment capacity. Many communities set the goal of meeting maximum day demands with their water treatment plant capacity, thereby allowing all water provided to the distribution system to be filtered.

Figure 5 – Projected Demands and Water Treatment Plant Capacity

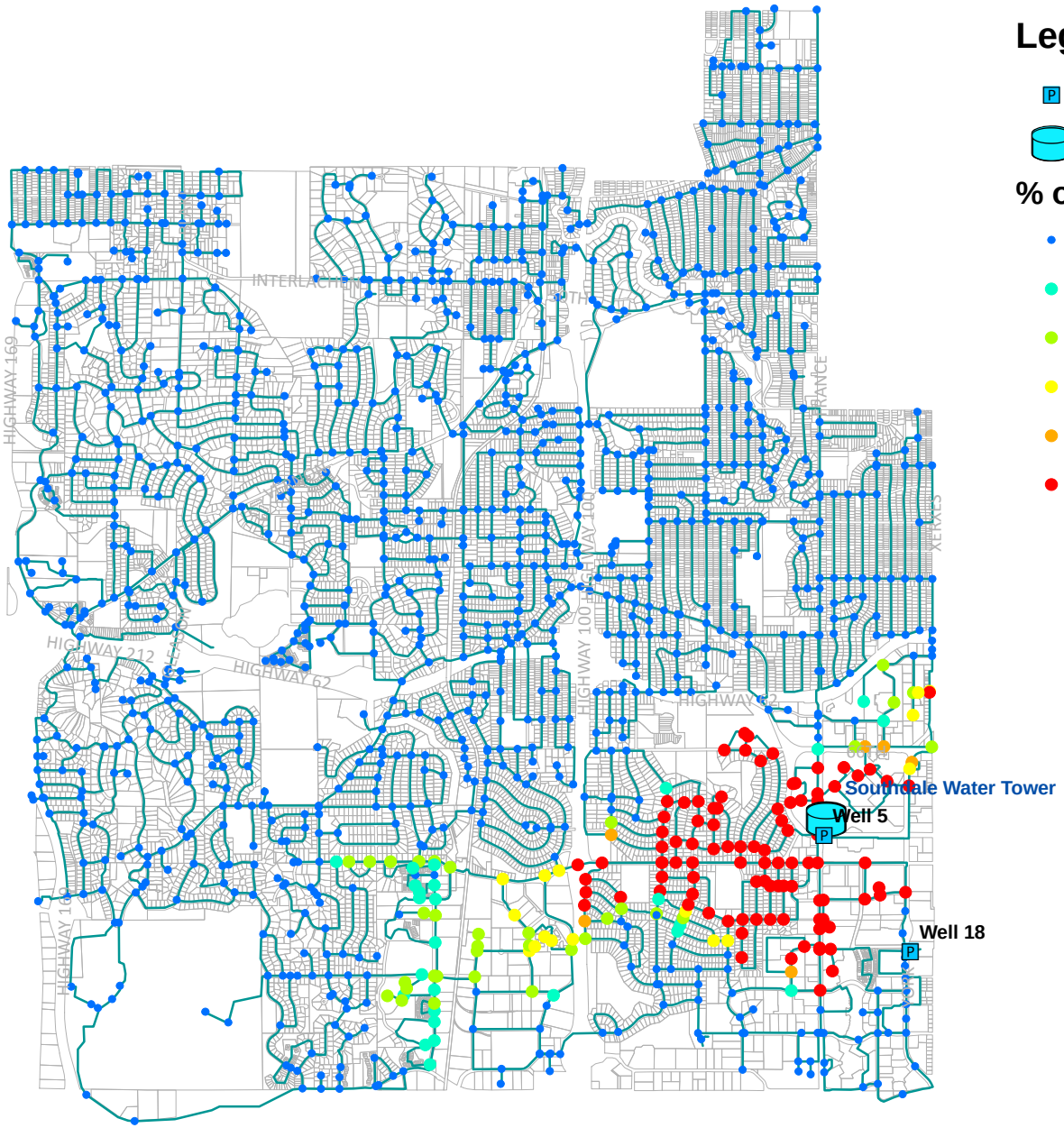


This chart shows the current water treatment plant capacity of 9.66 MGD, the planned addition of Wells 9 and 15 in 2013 and 2014 respectively, the addition of Water Treatment Plant No. 5 to filter Wells 5 and 18 in 2019, and the addition of Water Treatment Plant No. 7 to filter Wells 16, 19, and 20 in 2024. Water Treatment Plant No. 5 is currently on the City's capital improvement plan for 2017, which could allow the plant to come online in 2019.

6.0 System Impacts from Pumping Wells 5 and 18

In order to gain an understanding of the geographic extent of impacts of the use of Wells 5 and 18 in the distribution system, the City's existing computer hydraulic model of the distribution system was used to run a source trace analysis under a series of peak demand days. The source trace calculates the amount of water at any node in the distribution system model that comes from a given source of supply. In this case, the sources of supply tracked were Wells 5 and 18. Figures 6 and 7 show the results of this analysis.

The geographic distribution of water from Wells 5 and 18 is dependent on system hydraulic parameters such as the demands assigned geographically throughout the network, the hydraulic properties of the well pumps, the pipe sizes in the water main network, and the location of other supply or storage facilities. As water use fluctuates over the course of a day, the distribution of water from these wells will expand and contract. The results presented represent the maximum distribution over three days with maximum day demands on the water system.



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Project: EDINA 125040
Print Date: 09/19/2013

Map by: JDC
Projection: Hennepin County
Source: City of Edina InfoWater

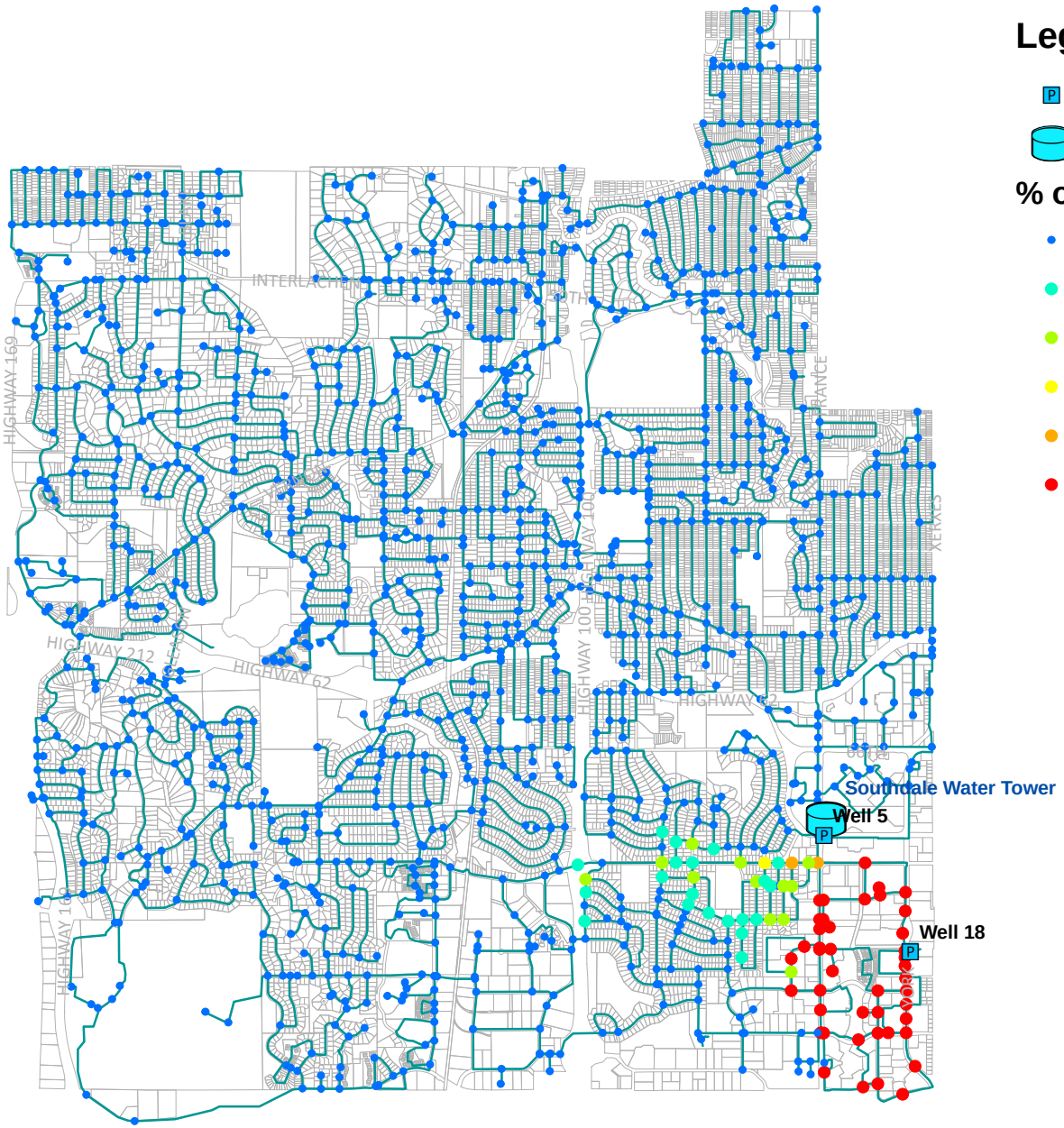
GEOGRAPHIC EXTENT OF WATER FROM WELL 5

WATER SYSTEM DEMAND AND CAPACITY ANALYSIS

Water Treatment Plant No. 5

Edina, Minnesota

Figure 6



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Map by: JDC
Projection: Hennepin County
Source: City of Edina InfoWater

GEOGRAPHIC EXTENT OF WATER FROM WELL 18

WATER SYSTEM DEMAND AND CAPACITY ANALYSIS

Water Treatment Plant No. 5

Edina, Minnesota

Figure 7

7.0 Hydraulic Impacts of Water Treatment Plant No. 5

Adding a new water treatment plant as planned, at the northeast quadrant of the intersection of 69th Street and France Avenue, will change the hydraulic balance of the distribution system to some degree. First, the distribution system will need to handle greater flow rates from the location of the new water treatment plant. This tends to cause greater frictional energy losses in the distribution system, and to increase pressures locally around the water treatment plant location in order to overcome the greater frictional losses.

Second, with the addition of Water Treatment Plant No. 5, the City will want to utilize this facility to a greater degree than current Wells 5 and 18 due to improved water quality. The wells and plant high service pumps will be placed higher in the priority list for use. This could create a concern due to the plant's proximity to the Southdale water tower. The water produced by Water Treatment Plant No. 5 will tend to fill the Southdale tower quickly, which could cause the other towers on the system to lag the Southdale tower.

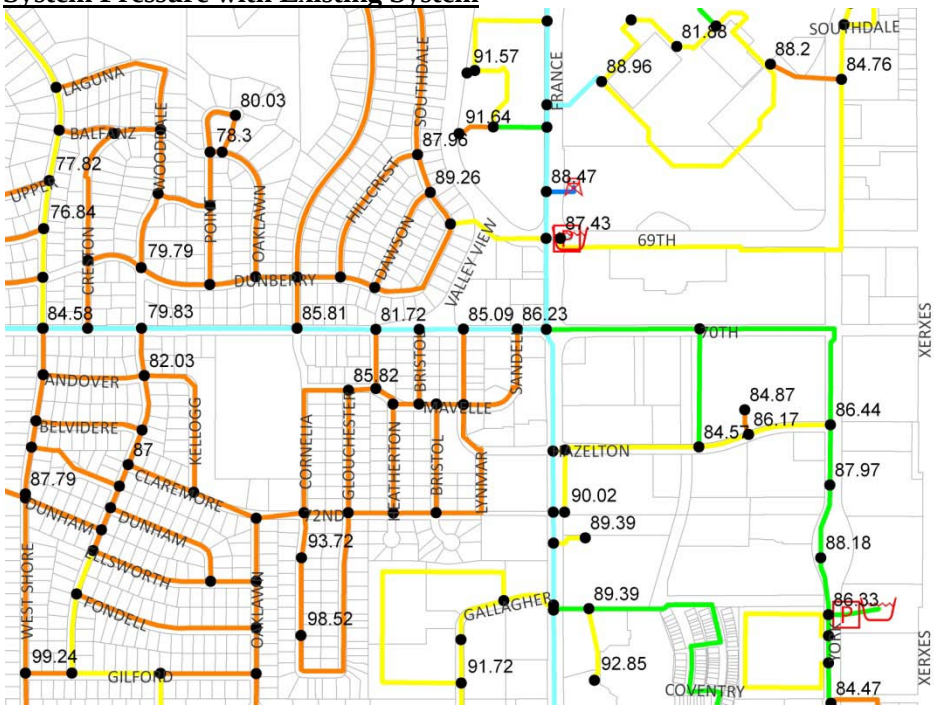
The existing computer hydraulic model of the distribution system was used to evaluate the hydraulic impacts of operating the new water treatment plant at the planned location. The first concern of increased distribution system pressure is easily evaluated in a hydraulic model. Pressures in the distribution system around Southdale were examined in the model with the existing system and with the proposed system after Water Treatment Plant No. 5 is added. Both scenarios were run with average day demands on the system, with water towers at 2 feet below overflow, with the high service pumps at Water Treatment Plant No. 6 producing about 2600 gpm, and with Well 4 on at Water Treatment Plant No. 2. The new water treatment plant was modeled as an input to the network of 2000 gpm at the intersection of 69th Street and France Avenue. The comparison is shown in Figure 8, with pressures at model nodes shown in psi.

Due to the proximity of the Southdale tower, the distribution system frictional losses are minimized at the planned location for Water Treatment Plant No. 5. It can be seen in Figure 8 that pressures in the vicinity of the water treatment plant can be expected to increase around 1-2 psi with the additional pumping at that location.

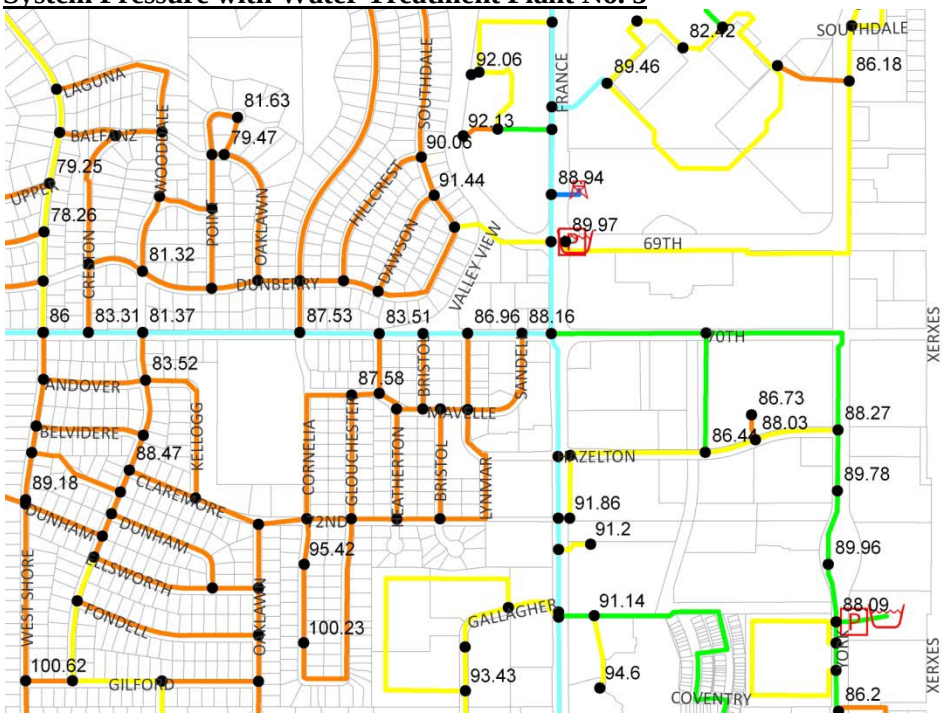
Evaluation of the effect on hydraulic balance of the water towers on the distribution system is a little more difficult as it depends on many factors such as the geographic distribution of system demands and on the accuracy of pump controls. Most often, it is during peak demand conditions that tower balance becomes a concern. This is because there is a greater amount of water being moved through the distribution system from supply sources and storage facilities to points of use. Under these conditions it becomes more difficult to push water long distances, and towers tend to drain quickly during periods of the day when demands are highest. Therefore it becomes difficult to keep some towers full without overflowing other towers under these conditions.

Figure 8 – Distribution System Pressure Impacts of Water Treatment Plant No. 5

System Pressure with Existing System



System Pressure with Water Treatment Plant No. 5



For the purposes of this analysis, a typical peak operation control scheme for the well and water treatment plant high service pumps was obtained from the City. This was input into the model to control pumps in an extended period simulation (EPS). The model was run for three consecutive days, with average July water demand, to evaluate tower levels over time. Water Treatment Plant No. 5 was placed in the pump sequencing as the last water treatment plant to be run, but before any unfiltered wells were used to maintain water tower levels.

The comparative EPS results are shown in Figures 9 and 10. Due to the distribution of water demand in the model, the Southdale tower is drawn down faster than the other towers during peak demand periods. This is apparent in Figure 9. Because the Southdale tower is lagging the other towers in the existing condition, the addition of Water Treatment Plant No. 5, and the increased pumping at that location actually helps with tower balance. Figure 10 shows the results of the EPS with the addition of Water Treatment Plant No. 5 to the model.

Figure 9 – Extended Period Simulation Results - Existing Average July Day

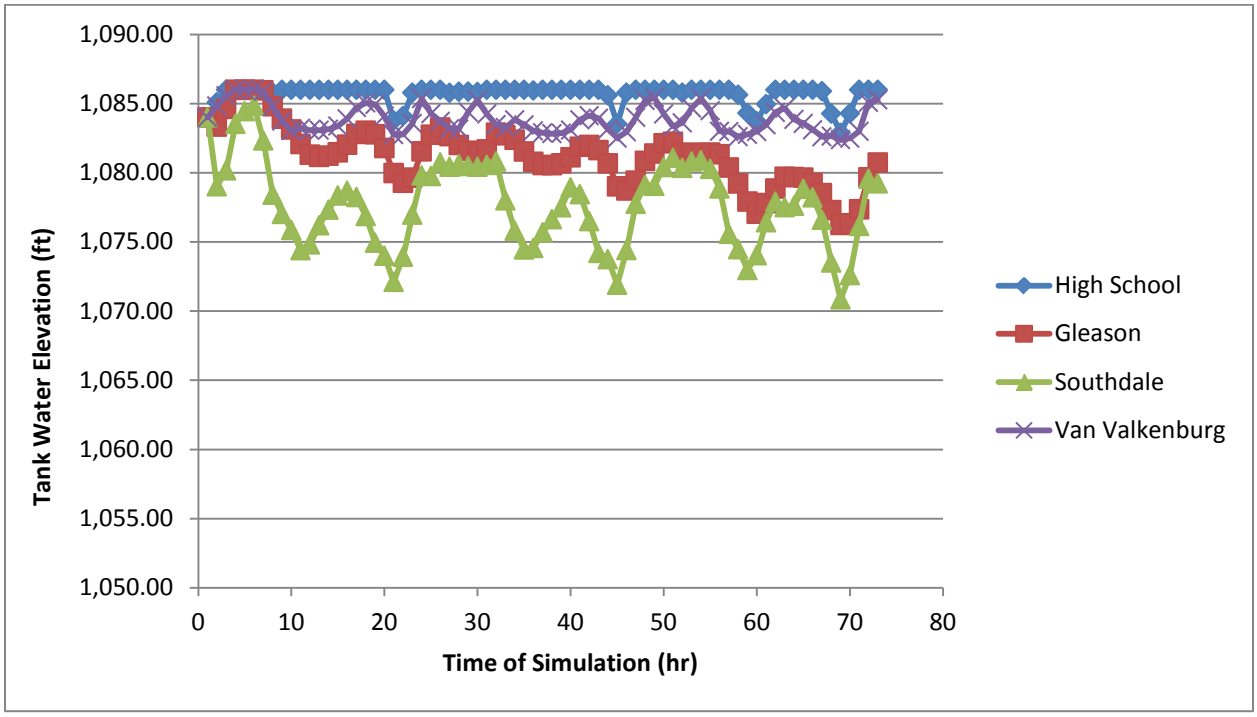
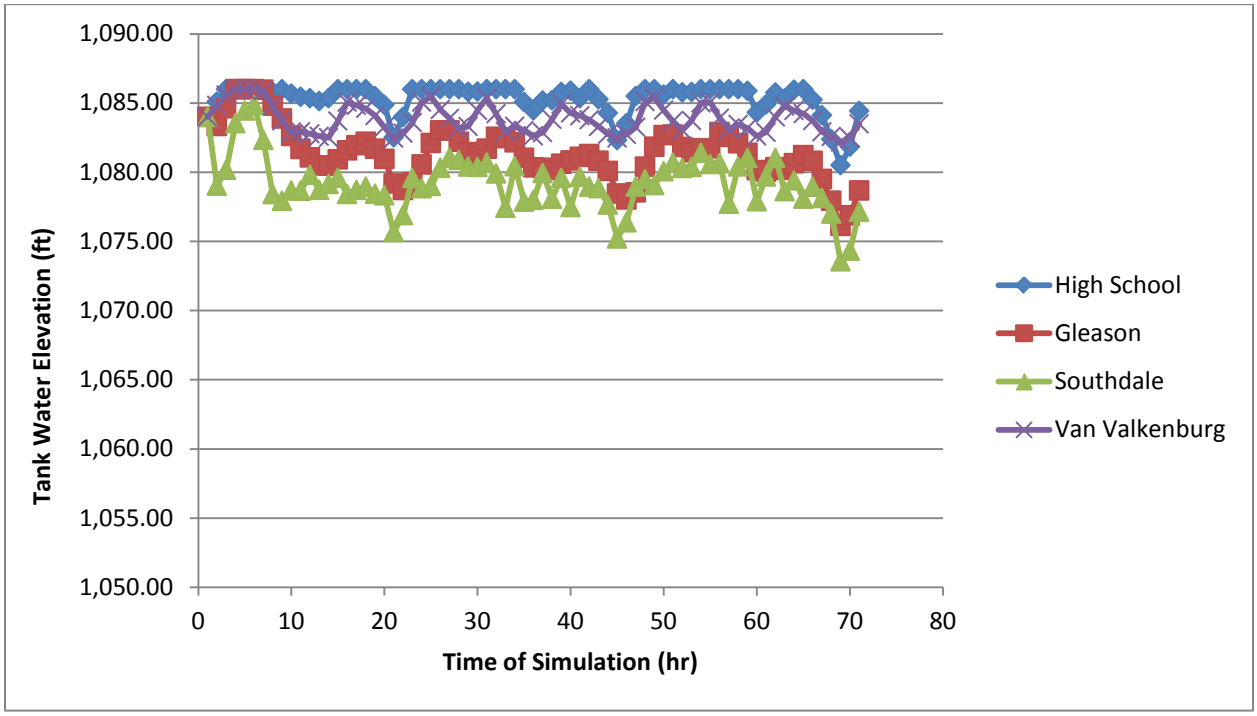


Figure 10 – Extended Period Simulation Results - Average July Day with Water Treatment Plant No. 5



8.0 Cost Estimates

An updated preliminary cost estimate is provided in Table 5 for Water Treatment Plant No. 5. These costs are based on projects of similar scale and scope completed by SEH recently. These preliminary numbers are conservative, with a high level of contingency due to unknowns about the site and project-specific requirements. It is recommended that the City review planned expenditures in the current capital improvement plan, as construction costs for water treatment plants have increased significantly in the last two years.

Table 5
Preliminary Cost Estimate for Water Treatment Plant No. 5

Item	Cost Estimate
Construction Cost Estimate (3 MGD Pressure Filter Plant)	$4,800,000
Contingency (20%)	$960,000
Engineering, Administrative, and Legal (20%)	$1,152,000
Total Estimated Project Cost	**$6,912,000**

9.0 Conclusion

Water system operations personnel have been successful in minimizing complaints on the Edina water system. However, they have reported difficulty with current operations, requiring constant vigilance in ensuring that the use of system wells, which are currently not filtered, is minimized during the summer season. Examination of prior pumping records shows that there are a significant number of days each year in which water system demands exceed the capacity provided by the City's existing water treatment plants. In addition, the wells that are currently sent to filtration plants are being over-utilized, limiting operational flexibility, reliability, and equipment life expectancy.

The City of Edina has set a goal of continuing to improve on the existing water quality and operational constraints through the expansion of water treatment plant capacity where it is economically feasible, ultimately eliminating the need to pump unfiltered well water into the distribution system under most demand conditions. With projected population and associated water demand increases in Edina over the next 20 years, additional water treatment plant capacity will be needed to meet this goal.

The current plan to add two additional wells to Water Treatment Plant 6 by 2014 will help the City to reduce the number of days under which filtration capacity does not meet demand by about 60%. Water Treatment Plant No. 5 has been planned for some time, to filter water from Wells 5 and 18. This facility is on the current water utility capital improvement plan for 2017. The additional filtration capacity provided by Plant 5 will further reduce the need to pump unfiltered water into the distribution system, providing filtration capacity to meet approximately 99% of demand days.

Hydraulic analysis indicates that the planned location for Water Treatment Plant No. 5 will allow the planned facility to pump greater than 2000 gpm to the distribution system without negative impacts on system pressures or hydraulic balance. The proximity to the Southdale water tower limits frictional backpressure at the proposed facility location. Modeling of system operations with the new facility indicates that the proximity to the Southdale tower will also help to keep that storage tank full during peak demands. Therefore, the proposed location appears to be hydraulically feasible without significant distribution system modifications.

Based on the results of this analysis, it seems as though the current plan to begin construction in 2017 for Water Treatment Plant No. 5 is a sound course for the City to continue to make progress on the improvement of water quality and system operations. While there has been discussion about the construction of a future Water Treatment Plant No. 7, to provide treatment for Wells 16, 19, and 20, a date has not been established for that facility.

During the feasibility study phase for Water Treatment Plant No. 5, consideration should also be given to building additional treatment capacity into the plant - to expand treatment to other future wells in the vicinity of the plant. While this study looked at water demand projections through 2030, prior planning documents have indicated the potential for redevelopment activities to continue to increase the population of the City of Edina beyond the values considered here. The most recent preliminary population projections from the Metropolitan Council also indicate a potentially higher rate of population increase in Edina.

With continued growth in the City, there will be additional needs for water treatment capacity. This added capacity might be built more cost effectively in conjunction with Water Treatment Plant No. 5 as opposed to additional facilities in the future. Additional capacity at

Plant 5 may also allow the City to delay the construction of Plant 7 further, while achieving the same water quality results.

jdc