Chapter 8: Water Supply Plan

Executive Summary

The Water Supply Plan describes the City's existing water distribution system and historical water demand, projects future water demand through the year 2040, and proposes infrastructure improvements to accommodate that demand. This Plan has been prepared according to the guidelines established by the Metropolitan Council and the Minnesota Department of Natural Resources (DNR). The Local Water Supply Plan that follows the template provided by the DNR was submitted to the DNR in 2016, while this Comprehensive Water Supply Plan expands upon the template and provides further information for City and Metropolitan Council planning.

The City of Savage water distribution system provides approximately 900 million gallons of water each year to nearly 9,973 service connections. The system includes eight active wells, two water treatment plants (WTPs), two ground storage reservoirs, three water towers, and ten interconnections with neighboring systems.

The population of the City of Savage has grown steadily over the last decade. Despite this growth, the average daily water demand and the per capita water demand have shown a slight decreasing trend. Improved appliances, reduced irrigation, general attitudes toward conservation, and rainfall likely all play a role in these trends.

The Metropolitan Council projects that the City of Savage will continue to develop and grow over the lifetime of this Plan. The water distribution system is projected to serve 41,100 people by the year 2040, at which time the projected total per capita water use of 85 gallons per capita per day will result in an average day demand of 3.5 million gallons per day and a maximum day demand of 9.8 million gallons per day.

The City is planning for one new well and additional treatment capacity between 2025 and 2030 should there be a need for additional capacity to serve areas within Credit River Township. The City is also considering one new interconnection, or the expansion of an existing interconnection. Finally, trunk watermain will need to be expanded as development continues in the southwestern corner of the City.

INTRODUCTION

Approval of a Water Supply Plan, formerly called a Water Emergency and Conservation Plan, is required by the Minnesota Department of Natural Resources (DNR) for any public water supplier that provides service to more than 1,000 people. The plans are to be updated by the public water suppliers once every ten years after the initial plan was developed in 1996 (Minnesota Statutes 103G.219). The plans must address supply and demand reduction measures and allocation priorities, as well as identify alternative sources of water for use in an emergency. The DNR provides a template for preparing a plan that fulfills the requirements set forth by Minnesota Statutes. The City of Savage Water Supply Plan following that template was submitted to the DNR in December 2016.

The Metropolitan Council also requires communities within the Twin Cities Metropolitan Area to provide a Water Supply Plan as part of the Comprehensive Planning process. In addition to the information required by the DNR, the plan must be consistent with Metropolitan Council Planning, currently the Thrive MSP 2040 Plan. The review by the Metropolitan Council will focus on the short- and long- term impact of water use on the water supply of the Metropolitan region. Studies have shown that there is sufficient water available for the Metropolitan area except during times of drought, contamination and/or problems within individual communities.

Background

The City of Savage is located in Scott County. Utility services for the City of Savage are provided by the Utilities Services Division. Savage covers an area of approximately 17 square miles and is located 16 miles south of downtown Minneapolis. The Minnesota River runs along the northern border of the City. Savage's neighbors include Burnsville to the east, Credit River Township to the south, and Shakopee and Prior Lake to the west. Due to the City's location and appeal, it has become one of the fastest growing communities in the Twin Cities metro area.

Policies

The mission of the Utilities Services Division is to provide the Savage community with reliable water and sanitary sewer services now and into the future.

EXISTING WATER SUPPLY SYSTEM

Water Supply

The source of water for the City of Savage is groundwater aquifers. The City's water is supplied by a total of eight (8) active wells. The City used to have a backup well (Well No. 9). However, this well is now used for irrigation purposes and no longer for water supply. Well Nos. 3, 5, 6 and 7 are treated at WTP No. 2. Well Nos. 8, 9, 11, 12, and 14 are treated at WTP No. 3. The locations of these facilities are shown in FIGURE 8-1. The wells are between 152-1,029 feet deep and pump water from the Jordan, Prairie du Chien, Mt Simon/Hinckley, Tunnel City/Wonewoc, and glacial drift aquifers. Details for the existing wells are provided in Table 8-1.

TABLE 8-1: WELL LOG INFORMATION

Well No.	Unique Well Number	Year Installed	Well & Casing Depth (ft)	Well Diameter (in)	Capacity (gpm)	Geologic Unit	Status
3	151582	1985	393 / 305	20	1,200	Jordan	Active
5	453854	1989	152 / 132	20	450	Drift	Active
6	453857	1989	205 / 172	20	1,500	Prairie du Chien	Active
7	554226	1995	990 / 746	18	980	Mt. Simon	Active
8	582627	2000	1,029 / 787	18	1,500	Mt. Simon	Active
11	593637	2000	840 / 595	18	1,500	Mt. Simon/ Hinckley	Active
12	676443	2003	520 / 313	18	500	Tunnel City/ Wonewoc	Peak Use
14	731130	2007	994 / 755	18	1,500	Mt. Simon	Active

gpm = gallons per minute

The current total well pumping capacity is 9,130 gallons per minute (gpm), and the firm capacity (capacity with largest well out of service) is 7,630 gpm. Well No. 9 is no longer being used for water supply purposes due to concern for dewatering of the Tunnel City/Wonewoc aquifer over the past several years. Well No. 12 also pumps water from the Tunnel City/Wonewoc aquifer and therefore is only utilized during times of high water demand.

The Minnesota River flowing along the northeastern boundary of the City is the closest surface water source. The City does not have a DNR permit to withdraw water from the Minnesota River. Another surface water source is the Kraemer Quarry. The City of Savage has a partnership with the City of Burnsville to receive treated water from the Kraemer Quarry.

Water Treatment

The City of Savage has two water treatment plants (WTPs). WTP No. 2 treats water from Well Nos. 3, 5, 6 and 7. The plant has a treatment capacity of 4.2 million gallons per day (MGD). WTP No. 3 treats water from Well Nos. 8, 9, 11, 12, and 14. The plant has a treatment capacity of 4.2 MGD. The City of Savage has a combined treatment capacity of 8.4 MGD.

Both WTPs treat the "raw" water for removal of iron, manganese and radium. The treatment process includes the addition of chlorine for oxidation of iron and for disinfection, followed by the addition of potassium permanganate to oxidize the manganese. When combined, manganese sulfate and potassium permanganate are used to remove radium. During the filtration process, the water is filtered through dual media of greensand and anthracite coal. The water is then treated with fluoride to prevent tooth decay. The "finished" water is stored in the ground storage reservoir until it is pumped into the City's water distribution system. Each treatment plant has its own ground storage reservoir.

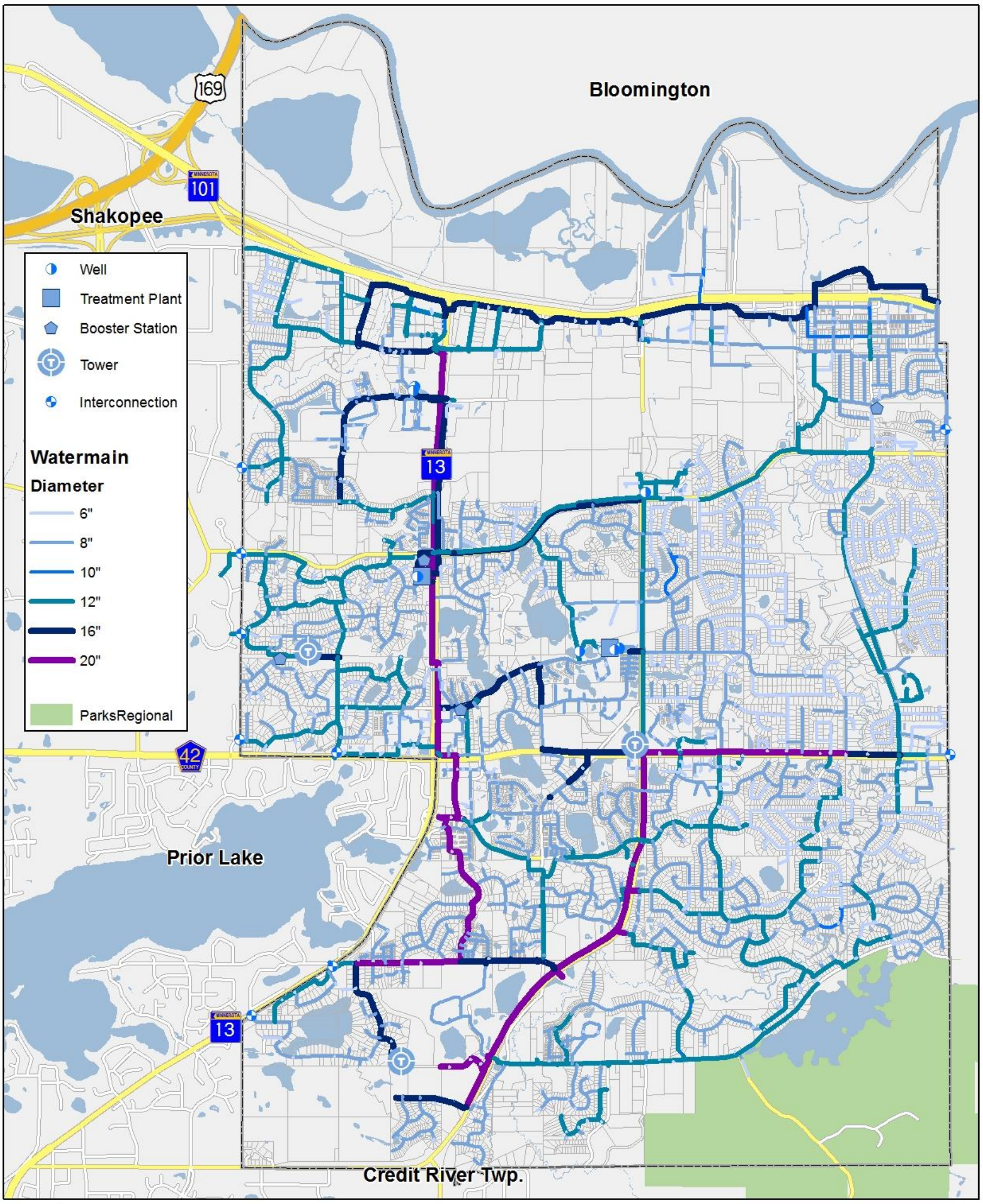
Water Storage

Municipal water systems are designed to provide sufficient reserve storage for emergency events, such as power outages, mechanical failure, and events where the supply is unable to meet the peak hourly demands, or the supply is lost altogether. Minimum storage requirements have been established by the "Ten States Standards", which state that, "in the event of a power failure or equipment malfunction, storage volume must be greater than or equal to the average daily consumption and should include a reasonable fire-fighting reserve."

The City's water distribution system has a total storage capacity of 9.0 million gallons. The average daily demand from 2010-2015 was 2.17 million gallons per day. There are a total of three elevated storage tanks in Savage: one with a capacity of 1.0 million gallons located at the intersection of CSAH 42 and CR 27, another with a capacity of

0.5 million gallons located near the intersection of Boone Avenue and 138th Street, and a third with a capacity of 1.0 million gallons located at 153rd Place. The City also has two ground storage reservoirs: one with a capacity of 5.0 million gallons located at WTP No. 3, and the other with a capacity of 1.5 million gallons located at WTP No. 2.

FIGURE 8-1: EXISTING WATER SUPPLY SYSTEM



EXISTING WATER DEMAND

Historical Water Use

The population of Savage has increased over the past ten years by about sixteen percent. The increase in population served is due mainly to new development. The historical average and peak day water demands are shown in Table 8-2.

TABLE 8-2: HISTORICAL WATER DEMANDS

Year	Population Served	Average Demand (MGD)	Average Demand (gpcd)	Peak Demand (MGD)	Peak Demand (gpcd)	Day of Peak Demand	Peak to Average Ratio
2005	25,000	2.70	108	9.57	383	7/15/05	3.5
2006	25,275	3.12	123	8.70	344	7/13/06	2.8
2007	25,485	3.35	131	10.1	396	6/14/07	3.0
2008	25,532	3.01	118	8.06	316	7/6/08	2.7
2009	26,852	2.62	98	6.29	234	6/3/09	2.4
2010	27,567	2.13	77	3.21	116	4/23/10	1.5
2011	26,911	2.19	81	5.52	205	7/21/11	2.5
2012	27,325	2.55	93	7.36	269	7/11/12	2.9
2013	27,794	2.27	82	6.49	234	8/27/13	2.9
2014	28,603	2.03	71	5.18	181	8/15/14	2.6
2015	29,047	1.91	66	4.65	160	7/22/15	2.4
2016	30,024	2.35	78	5.89	196	6/28/16	2.5
2017	30,285	2.51	83	6.33	209	6/16/17	2.5
2010-2015 Average			78	-	194	-	2.5

MGD = million gallons per day gpcd = gallons per capita per day

Variation in annual water demand can be attributed to changes in the climate; some years are drier resulting in a higher water demand, while years that are wetter typically have a lower water demand. Temperature can also play a role in water consumption.

The peak to average daily demand ratio varied from a high of 3.5 (2005) to a low of 1.5 (2010). On average from 2010-2015, the ratio was 2.5, which is within the DNR target of 2.6.

Water Sales

The City of Savage requires all housing and buildings connected to the City's water system to be metered. A comparison of water metered and sold to water pumped is provided in Table 8-3.

Table 8-3: Historical Water Use

Year	Population Served	Total Connections	Total Water Sold (MG)	Total Water Pumped (MG)	Percent Unaccounted (%)
2005	25,000	8,361	877	986	11
2006	25,275	8,613	1,059	1,137	7
2007	25,485	8,475	1,113	1,222	9
2008	25,532	8,584	987	1,098	10
2009	26,852	8,859	747	956	22
2010	27,567	8,922	709	777	9
2011	26,911	9,008	742	798	7
2012	27,325	9,201	911	929	2
2013	27,794	9,252	801	827	3
2014	28,603	9,393	728	742	2
2015	29,047	9,433	680	697	2
2016	30,024	9,549	879	856	-3
2017	30,285	9,631	934	915	-2
2010-2015 Average			762	795	4

MG = million gallons

In 2009, the City's water sales began to exceed the sum of the water pumped from the wells and the volume received through the Burnsville-Savage Interconnect. The City performed a detailed water audit to identify the cause of the problem. All well and water plant meters were found to be within calibration limits. Billing anomalies were suspected and investigated further. In 2015, the City began doing their own water billing. The City will continue to audit their water billing and usage each year to resolve the issue. The total volume of water sold for the years 2009 through 2015 was calculated as the total water pumped minus the annual volume of non-sale water as recorded by the City (per the City's Water Supply Plan). The total volume of water sold for the years 2016 and 2017 was not adjusted in this way.

The total water sold has shown a decreasing trend over the last decade, despite a population increase of approximately fifteen percent. The percent unaccounted water

has decreased and has been less than five percent each year since 2012. The average unaccounted water loss in the system from 2010-2015 was four percent.

Water Demand by Customer Category

Per capita water uses for residential areas are based on the total amount of water sold for residential use divided by the population for a specific year. The water sold to each customer group is monitored each year. The quantity of water sold is divided into categories including residential (single family homes, duplexes, and apartments), commercial (local businesses), industrial (manufacturing), and institutional (schools, hospitals, and nursing homes). The historical per capita water use for each customer group is listed in Table 8-4.

Per capita water uses for residential areas are based on the total amount of water sold for residential use divided by the population for a specific year. The water sold to each customer group is monitored each year. The quantity of water sold is divided into categories including residential (single family homes, duplexes, and apartments), commercial (local businesses), industrial (manufacturing), and institutional (schools, hospitals, and nursing homes). The historical per capita water use for each customer group is listed in Table 8-4.

TABLE 8-4: HISTORICAL WATER USE BY CUSTOMER CATEGORY

Year	Residential Water Sold (MG)	Residential Usage (gpcd)	Percent Residential (%)	C/I/I Water Sold (MG)	Percent C/I/I (%)	Other Water Usage (MG)	Percent Other (%)
2005	640	70	73	226	26	11	1
2006	728	79	69	263	25	68	6
2007	762	82	76	172	17	69	7
2008	832	89	77	154	14	89	8
2009	704	72	72	270	28	0	0
2010	607	60	73	226	27	0	0
2011	625	64	71	254	29	0	0
2012	715	72	71	292	29	0	0
2013	628	62	71	245	28	11	1
2014	604	58	72	225	27	9	1
2015	586	55	72	229	28	1	0
2016	616	56	70	256	29	7	1
2017	635	57	68	294	32	0	0
2010-2015 Average		62	72	-	28	-	0.4

The average residential per capita use from 2010-2015 was 62 gpcd, which is within the DNR target of 75 gpcd. About seventy-two percent of the annual water use is by residential customers. The C/I/I group percent has shown a slight increase over the past decade. From 2010-2015, the C/I/I sales were twenty-eight percent of total sales. It is important to note that in addition to commercial, industrial, and institutional; the C/I/I category also includes water sold to agricultural users. The City also has an "Other" category that averages less than one percent of total use. This includes uses by the City for hydrant flushing, water treatment plant (WTP) backwashing, and other minor operation and maintenance uses not considered billable.

Large Volume Customers

Large volume customers include any user that consumes more than five percent of the total water produced. The City of Savage currently does not have any one customer that consumes more than five percent of the total water produced. Table 8-5 summarizes the top ten water users in the Savage area, which together represent percent of the total water use in the City.

TABLE 8-5: LARGE VOLUME CUSTOMERS

Customer	Category	Water Volume (gallons per year)	Percent of Total Annual Use
Shakopee Public Utilities	Commercial	7,930,000	0.86%
Fabcon-00	Industrial	6,331,000	0.69%
Paradise Car Wash-00	Commercial	4,464,000	0.48%
Shakopee Public Utilities	Commercial	4,135,000	0.45%
Paradise Car Wash	Commercial	3,459,000	0.37%
Lifetime Fitness	Commercial	3,365,000	0.36%
Continental 298 Fund LLC	Commercial	2,954,000	0.32%
Somerset Hospitality	Commercial	2,792,000	0.30%
George Augustinack	Commercial	2,487,000	0.27%
Village Commons	Commercial	2,360,000	0.26%

Seasonal Water Demands

Seasonal water demands are different for the winter and summer months, as shown in Table 8-6. Summer months typically have a higher demand due to water uses such as irrigating lawns and washing cars. Note that since Savage also receives bulk water from Burnsville, the pumping volumes shown in Table 8-6 are not a complete representation of the water supplied to the system since it only includes pumping records for the

production wells within the City of Savage.

TABLE 8-6: MONTHLY PUMPING VOLUMES

Month	Water Pumped (MG)				
	2013	2014	2015	2016	2017
January	1,563,802	1,558,930	1,381,533	1,240,339	131,939
February	806,922	1,183,117	898,188	1,390,442	0
March	2,164,838	1,356,463	907,555	1,977,544	0
April	4,189,897	1,336,109	1,188,883	1,170,663	949,311
May	3,569,716	2,157,623	2,128,316	3,823,078	29,256,169
June	27,129,763	3,140,343	3,745,411	28,665,645	58,376,761
July	46,383,805	26,756,455	22,684,999	37,212,074	78,612,286
August	61,459,273	45,113,404	24,198,691	16,633,580	38,752,590
September	23,758,406	13,412,415	7,065,827	0	43,892,363
October	1,753,348	3,026,064	1,435,073	0	8,794,373
November	765,687	1,677,383	1,376,133	0	54,050
December	770,632	1,562,265	1,069,311	0	7,523
Total	174,316,089	102,280,571	68,079,920	92,113,365	258,827,365

The winter months are shown to have a lower water demand than the summer months. "Winter use" is defined as the average daily production for the months of November through March, and "summer use" is the average daily production for the months of July through September. January pumping data is used to represent the winter demands and July pumping data is used to represent the summer demands.

Resource Sustainability

Resource sustainability examines the use of water to provide for the City's present and future needs while sustaining social, economic and environmental quality. Monitoring is required by the DNR for production wells. Water levels should be taken a minimum of once a month at each production well. Compiled well monitoring data and well logs are available from the City's Engineering Department. Table 8-7 provides a list of the current monitoring wells.

TABLE 8-7: MONITORING WELLS

Well No.	Unique Well ID	Type of Well	Frequency of Measurement	Method of Measurement
3	151582	Production	Continuous	SCADA
5	453854	Production	Continuous	SCADA
6	453857	Production	Continuous	SCADA
7	554226	Production	Continuous	SCADA
8	582627	Production	Daily	SCADA
11	593637	Production	Continuous	SCADA
12	676443	Production	Continuous	SCADA
14	731130	Production	Continuous	SCADA

With the exception of the water supplied by the City of Burnsville, the City of Savage withdraws its entire water supply from wells. Within the City of Savage, there are three known natural resources that can be affected by the production wells pumping groundwater from the glacial drifts, Prairie du Chien, and Jordan aquifers. They include Boiling Springs, Eagle Creek and Savage Fen. The Savage Fen Wetland Complex is situated on approximately 640 acres located between the Minnesota River and the River bluffline, and between TH 13 and Quentin Avenue. Eagle Creek is a state-designated trout stream fed by Boiling Springs. Boiling Springs is influenced by groundwater pumping. Precautions are being taken to ensure the protection of these natural resources. The water being withdrawn from the Prairie du Chien and Jordan aquifers do have an impact on the Savage Fens; therefore, developing future wells in the above aquifers may not be a viable option.

The Mt. Simon-Hinckley aquifer should continue to be an adequate source of water for the foreseeable future. However, the Jordan Sandstone and drift aquifers have been found to be vulnerable to contamination due to the ability of surface water to infiltrate and recharge the aquifer. As part of the approved Wellhead Protection Plan, the City will concentrate their efforts on educating customers about groundwater protection through newsletters, newspaper articles, public service announcements, the City website, and educational mailings.

The City's wells are clustered in two separate well fields, with a treatment plant for each well field. It is unlikely that there would be a situation in which both well fields are affected at the same time. The City has a total of four booster stations. Two of the booster stations can pump to the high zone and two can pump to the middle zone.

Each booster station has a backup pump to ensure that the water can be supplied to customers on a continuous basis.

During situations of power loss to either WTP, a generator will automatically be activated. The Connelly Booster Station has a generator that will automatically activate during a power outage. There are also backup generators that can be used for Well Nos. 3, 5, 6, 7, 8, and 14. If Well No. 11 or 12 loses power, there are no backup generators available.

The Minnesota Department of Health requires that each supplier have either a Wellhead Protection (WHP) Plan or a Surface Water Protection (SWP) Plan or both to satisfy the criteria set forth in Minnesota Rules, parts 4720.5100 to 4720.5590. The Minnesota Department of Health defines Wellhead Protection (WHP) as a method of preventing well contamination by effectively managing potential contaminant sources in all or a portion of a well's recharge area. The WHP Plan for Savage has been approved by the MDH. Results of the assessment found all wells to be vulnerable to contamination that may occur at the land surface.

Water Demand Projections

The Metropolitan Council provides population projections for all communities in the Seven-County Metropolitan Area. These projections were used to project water demands in the City of Savage through the year 2040, as shown in Table 8-8. The total per capita water demand of 85 gpcd was selected based on water demand trends since the economic downturn in the late 2000s and anticipated growth patterns. The peak day water demand was calculated using a peaking factor of 2.8, a conservative value based on historical peaking factors since 2010.

TABLE 8-8: WATER DEMAND PROJECTIONS

Year	Population Served	Total Per Capita Water Demand (gpcd)	Average Day Demand (MGD)	Maximum Day Demand (MGD)
2018	31,017	85	2.64	7.4
2019	31,437	85	2.67	7.5
2020	33,400	85	2.84	7.9
2021	33,804	85	2.87	8.0
2022	34,179	85	2.91	8.1
2023	34,554	85	2.94	8.2
2024	34,929	85	2.97	8.3
2025	35,304	85	3.00	8.4
2030	37,400	85	3.44	9.6
2040	41,100	85	3.75	10.4

gpcd = gallons per capita per day MGD = million gallons per day

PROPOSED IMPROVEMENTS

Population is an important tool in estimating potential water use for the future using estimated per capita demands. Estimating population trends and projections depend on a variety of different variables including land use and economic trends. Due to the high variability of population trends it is difficult to project future populations with great accuracy because they are assumptions based on the past and present trends in population growth.

Ten States Standards recommends that groundwater source capacity should have a firm well capacity that equals or exceeds the design maximum day demand with the largest producing well out of service. The current well firm capacity of 7,630 gpm (10.98 MGD) satisfies the 2040 maximum day demand of 10.4 MGD. However, the City minimizes its use of Well No. 3 to protect the Savage Fen. Therefore, a more conservative firm pumping capacity without Well No. 3 would be 6,430 gpm (9.3 MGD). The City of Savage can receive up to 2.8 MGD through the Burnsville-Savage Interconnect. Therefore, even if Well No. 3 is not utilized to meet maximum day demands, the City can still meet the projected maximum day demands through 2040.

The City's existing treatment capacity is 8.4 MGD. Together with the 2.8 MGD of treated water that the City of Savage can receive through the Burnsville-Savage Interconnect, this capacity will satisfy the projected maximum day demand through the year 2040.

The City will need to further evaluate the need for additional wells and treatment as development continues in the southwestern corner of the City. A trunk water main extension is proposed along CR 27 and CR 44 to serve future development.

Emergency Planning and Response Procedures

Emergency plans are prepared to provide emergency response procedures and to identify actions needed to improve emergency preparedness. This plan details what to do in the event of a disruption, natural or manmade, what procedures to follow to restore water service to the city with minimal disruptions, and minimal potential health and safety risks. Section 1433(b) of the Safe Drinking Water Act requires community water suppliers serving over 3,300 people to prepare an Emergency Response Plan.

Emergency Telephone Lists

A list of all emergency contacts is available from the City's Engineering Department. The list includes all key utility and community personnel, contacts in surrounding communities, and contacts at the local, state, and federal emergency levels. Table 8-9 lists the key emergency response contacts for the City of Savage. The City's Emergency Response Plan was certified in January 2006.

Table 8-9: Emergency Response Contacts

Emergency Response Plan	Contact Person	Contact Number
Emergency Response Lead	City Engineer	(952) 224-3419
Alternate Emergency Response Lead	Utility Services Superintendent	(952) 224-3442

During emergencies, staff must collect and provide accurate information to residents. The communications should include the nature of the problem and the length for which the emergency is expected to last. Staff should be prepared to address any situation that arises in a timely manner as to avoid extended periods of loss of water service to the customers. There is a backup generator available to supply power during an emergency for the WTPs, selected booster stations and six of the eight wells.

Procedure for Augmenting Water Supplies

In the case of an emergency, additional water sources may be needed to augment or replace the existing sources.

Interconnections with Adjacent Communities

Savage has two interconnections with Burnsville, five interconnections with Prior Lake, and three interconnections with Shakopee. A minimum of twenty-four-hour notice is required before opening the Prior Lake and Shakopee interconnections. The City is exploring the possibility of constructing additional interconnections in the future, in particular with the City of Burnsville.

Surface Water Sources

The City of Savage does not have a DNR permit to withdraw water from any surface water sources. The Minnesota River is not a viable option as a direct water source for the City at this time due to the cost associated with construction of a new treatment plant to treat the surface water and the construction of water mains to receive and distribute the surface water, along with the reliability of adequate flow to meet the daily water demands for the City of Savage.

Alternative Sources of Water

Four of the City's eight wells are located in the same well field, and the other five are located in a second well field. Given the nature of the situation, wellhead protection measures need to be in place to ensure that groundwater sources are protected.

A select few commercial and industrial facilities have their own high capacity wells. These wells are not connected to the public system and do not receive treatment, so they are not an option during an emergency.

There are local gravel pits that can be used as a water supply to meet the City's daily water demands. The City has a partnership to receive water from the Kraemer Quarry via the City of Burnsville. The agreement between the two cities allows Savage to receive 300-730 million gallons on an annual basis through the interconnection with Burnsville.

Allocation and Demand Reduction Procedures

Allocation

During periods of limited water supplies, either during emergency situations or due to line breaks, power failures, sabotage, etc., public water suppliers are required by Minnesota Statutes 103G.261 to allocate water based on the priorities listed below.

1) Domestic water supply, livestock watering, and power production that meets contingency requirements.

2) Water uses involving consumption of less than 10,000 gallons per day.

3) Agricultural irrigation and processing of agricultural products.

4) Power production in excess of the use provided for in the contingency plan.

5) All other uses of more than 10,000 gallons per day.

6) Non-essential uses. These are defined by Minnesota Statutes 103G.291 as lawn sprinkling, vehicle washing, golf course and park irrigation, and other non-essential uses.

Within each of the water use priority categories, allocation should allow for equal distribution of the water supply. Allocation of water during times of restrictions should begin with the essential water uses. Allocations for non-essential uses will be determined by the City and include a total ban on outdoor water use, peak hour water restrictions, and odd/even numbered day water restrictions. Table 8-10 lists the priority ranking, average day demand and demand reduction potential for each customer category. The reduction potential for each customer category was calculated as the difference between non-winter (Apr.-Oct.) and winter (Nov.-Mar.) water use, based on 2017 pumping records.

TABLE 8-10: WATER USE PRIORITIES

Customer Category	Allocation Priority	Average Day Demand (GPD)	Demand Reduction Potential (GPD)
Residential	1	2,004,655	1,078,800
C/I/I	2	476,106	256,215
Non-Essential	3	25,058	13,485
Total		2,505,819	1,348,500

Demand Reduction

Short term water restrictions include power or equipment failure, or an unusual watermain break in the distribution system. Long term water restrictions are due to consumer demand that exceeds the City's ability to supply peak hour or peak day demands. Contamination of a well can also cause the water supply to be restricted.

The demand reduction potential in residential areas is based on demand during the

winter months when non-essential water uses such as lawn watering and car washing does not occur. The potential demand reduction in residential water consumption on a peak day is almost fifty percent if a total ban were to be placed on lawn watering and outdoor use.

Through its year-round watering restrictions, the City implements an odd/even numbered day lawn watering schedule. This method results in less reduction than is seen by placing a total ban on outdoor use. Maximum potential for demand reduction using the odd/even method is estimated to be approximately twelve percent. The City also implements a peak hour water ban. This method would result in a lower peak day demand by restricting non-essential water use such a lawn watering during the hours when peak water demand occurs (noon to 5pm).

Triggers for Allocation and Demand Reduction Actions

Demand reduction measures are to be used to ensure that the firm well capacity is not exceeded by high water demands.

TABLE 8-11: WATER DEMAND REDUCTION PROCEDURES

Condition	Trigger(s)	Actions
Stage 1 (Mild)	Year-Round	Voluntary reduction measures; Odd/even water sprinkling ban; 12:00 pm to 5:00 pm outdoor use ban
Stage 2 (Moderate-Severe)	*Production cannot meet demand *Stored water depleted within 24 hours *Serious malfunction of equipment or facilities	Suspend lawn watering, vehicle washing, and other nonessential uses; All commercial/industrial large water processes shall be shut down.
Critical Water Deficiency (M.S. 103G.291)	Executive Order by Governor	Stage 1: Restrict lawn watering, vehicle washing, golf course and park irrigation, and other non-essential uses Stage 2: Suspend lawn watering, vehicle washing, golf course and park irrigation, and other non-essential uses

Enforcement

Minnesota Statutes require public water supply authorities to adopt and enforce water

conservation restrictions during periods of critical water shortages. Odd/even, non-peak, and total sprinkler bans should be monitored by the City employees and if enforcement is needed the police department should provide assistance. Customers not complying with the water restrictions during periods of water shortages will be subject to the City's regulation which may include fines or, ultimately, discontinuance of water service.

Water Conservation Plan

The intention of the water conservation program is to develop a plan that reduces the demand for water, improves water use efficiency, and reduces the loss of water in the distribution system. Conservation can be utilized to reduce the peak water use and thereby reduce the need for additional water sources. Conservation programs have been found to be cost effective in comparison with the cost of developing new sources of water supply. Minnesota Statutes 103G.291 requires public water suppliers to implement demand reduction measures prior to seeking approvals to construct new wells or increases in authorized volumes of water.

Conservation Goals

Goals for various measures of water demand are discussed within this section. From 2010-2015, unaccounted for water in the City of Savage averaged four percent. The American Water Works Association (AWWA) recommends that not more than ten percent of the total water volume pumped should be unaccounted for. All water systems experience some water loss due to system leakage and other minor losses. The City of Savage is below the AWWA target of ten percent. The City should also continue to check for leaks in the system and repair them as soon as possible. Meters should also be checked and calibrated for accuracy.

The City's average residential per capita water demand from 2010-2015 was 62 gpcd. This residential demand is within the DNR's recommended target of 75 gpcd. The average total per capita water demand from 2010-2015 was 78 gpcd.

The peak day demand to average day demand ratio from 2010-2015 was 2.5, which is within the DNR target ratio of 2.6. Each year the City implements an odd/even day and peak hour watering restrictions. The City will continue educating their customers on water conservation methods.

Conservation Strategies

The Department of Natural Resources recommends seven measures for water conservation including: 1) Metering; 2) Water Audits, Leak Detection, and Repair; 3) Conservation-Oriented Water Rates; 4) Regulating; 5) Education and Information Programs; 6) Retrofitting Programs; and 7) Pressure Reduction. Each of the seven measures are discussed in detail below.

Metering

AWWA recommends that all water pumped from the wells, including all water distributed to customers, be metered by water utilities. To maintain an effective metering program, the City periodically conducts performance testing, repairs, and maintenance of all meters. The City requires all water users to have a meter. The meters are read monthly. Table 8-12 summarizes the City's meters.

TABLE 8-12: METERS

Category	Number of Connections	Number of Metered Connections	Metering Testing Schedule	Average age/meter Replacement schedule
Residential	9,206	9,206	As Needed	20 / 2018
Commercial	333	333	As Needed	20 / 2018
Irrigation	109	109	As Needed	20 / 2018
Institutional	35	35	As Needed	20 / 2018
Industrial	23	23	As Needed	20 / 2018
Other	37	37	As Needed	20 / 2018
Wells	9	9	As Needed	As Needed
WTP	2	2	As Needed	As Needed
Total	9,754	9,765		

Water Audits, Leak Detection, and Repairs

Unaccounted-for water is the volume of water that is lost between the water pumped from the wells and the water sold. Water audits are conducted monthly to identify, quantify, and verify the losses within the water system. Losses are typically due to leaks or breakage in the water main and other unmetered uses.

The City's unaccounted usage over the past decade is below the AWWA recommended unaccounted water use of ten percent. Areas with higher percentages of unaccounted for water should be the focus of leak detection efforts. Upon detection of leaks in the

system, repairs are made as soon as possible to avoid further water losses.

Conservation Water Rates

The City of Savage bills its residential customers monthly, using a conservation rate structure. Water rates are evaluated once a year along with other City fees. Additionally, rate studies are completed every three years. The City has an increasing block rate structure, which means that the rate per unit increases as water use increases. Rates are determined based on the cost of supplying, treating, and delivering water to customers. The current rates are listed in Table 8-13.

TABLE 8-13: 2018 WATER RATE SCHEDULE

Base Rate	
All Categories	$8.40
Step Rate (per 1,000 gallons)	
Up to 11,999 gallons	$3.38
12,000-15,999 gallons	$3.68
Over 16,000 gallons	$4.06

Regulations

Regulations in the plan should include both short-term reductions in demand and long-term improvements in water efficiencies. After 1994, all new homes and retrofits of existing homes are required to utilize water efficient fixtures. Use of low flow fixtures in residential houses can result in a reduction of water consumption of up to thirty-five percent.

Odd/even and peak hour water restrictions have been implemented by the City. The City will enforce the regulations as required to maintain system integrity. The restrictions on non-essential water use are in effect during the hours of noon to 5:00 p.m. The customers are asked to follow the requirements during times of water emergencies. In the case of a severe drought, in which the aquifer supply is depleted to unacceptable levels or at an unacceptable rate, the DNR may require the City to reduce water use even further.

Education and Informational Programs

Education is a vital component of a successful conservation program. The current education programs in place include annual Consumer Confidence Reports, newspaper articles, public service announcements, and billing inserts. The City also provides information to groups who tour City facilities and on the City website

(www.cityofsavage.com). A complete list of education programs is provided below.

Current Education Programs	Frequency
Billing inserts or tips printed on the actual bill	Annual
Consumer Confidence Reports	Annual
Local news papers	Annual
Community newsletters	Annual
Direct mailings (water audit/retrofit kits, showerheads, brochures)	As needed
Information at utility and public buildings	Ongoing
Public Service Announcements	As needed
Cable TV Programs	As needed
Demonstration projects (landscaping or plumbing)	As needed
K-12 Education programs (Project Wet, Drinking Water Institute)	As needed
School presentations	As needed
Events (children's water festivals, environmental fairs)	As needed
Community education	As needed
Water Week promotions	As needed
Information provided to groups that tour the WTP	Yes
Website (www.cityofsavage.com)	Ongoing Targeted efforts (large volume users, users with large increases)

Residents may reduce their water use by installing water efficient appliances, taking shorter showers, running dishwashers and washing machines only when they are full,

or installing water-efficient landscaping.

Retrofitting Programs

Replacement of inefficient plumbing fixtures and appliances can also reduce the per capita water use. Retrofit of existing buildings with water efficient plumbing fixtures will reduce water use and are part of a long-term plan. By replacing old existing fixtures one can reduce the average indoor water use by as much as thirty-five percent.