



**AGENDA ITEM EXECUTIVE SUMMARY**

Agenda Item number: 6.b

Title:

Recommendation to Approve the 2018 Water Utility Master Plan

Presenter:

Chris Adesso

Meeting: Government Services Committee

Date: January 28, 2019

Proposed Cost: n/a

Budgeted Amount: n/a

Not Budgeted:

**Executive Summary** *(if not budgeted please explain):*

The Environmental Services Division of the Public Works Department is responsible for operating the City’s Water Utility and providing safe, reliable and economical potable water to more than 19,000 customers. As a matter of prudent management of the utility, the Environmental Services Division in partnership with its consulting engineer Trotter & Associates has prepared a strategic 10 year master plan to guide the utility into the next decade.

At the August 2018 Government Services Committee meeting an overview of the entire Master Plan was presented to the Committee and a more detailed presentation of the “Water Supply Component” of the Master Plan was presented at the October Government Services Committee meeting. These presentations were intended to provide the committee members with manageable amounts of information and allow for questions and comments from the Committee as the plan was finalized; while outlining the roadmap for the strategic planning of the Water Utility for the next ten years.

Staff is seeking approval of the Master Plan to solidify it as a strategic planning document that can be used for programming capital projects, planning for future needs and to help insure both short-term and long-term goals of the utility are met. Approval of the Master Plan from the Committee does not constitute approval of any individual capital project or monetary expenditure, nor does it alleviate the requirement of City Council approval of future expenditures to execute any planned projects.

The Master Plan has been finalized and is available for consumption in its entirety on the City’s Website. For the convenience of the committee members an executive summary of the Master Plan has been provided in the packet for this agenda item. The topic of Utility Scale Water Softening has been ongoing over the last few months during the presentations of the Master Plan. As future plans are developed to meet the City’s water supply and treatment needs, water softening will likely be considered for each of those treatment alternatives. Utility scale softening should it be the desire of the City to provide, would be accomplished through the construction and up fit of treatment facilities over the course of the life of the Master Plan.

**Attachments** *(please list):*

\* 2018 Water Utility Master Plan Executive Summary

**Recommendation/Suggested Action** *(briefly explain):*

Recommendation to approve the 2018 Water Utility Master Plan

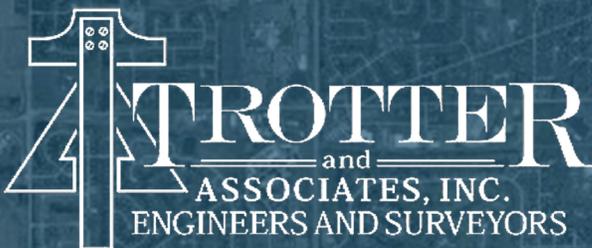


**City of St. Charles**

# **2018 Water Utility Master Plan**

*Continuity • Collaboration • Commitment*

**December, 2018**



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## EXECUTIVE SUMMARY



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## EXECUTIVE SUMMARY

### GENERAL BACKGROUND

The City of St. Charles was incorporated in 1874 and is located in Kane County, Illinois. St. Charles straddles the Fox River between South Elgin and Geneva. The City developed its first potable water supply in 1907. Since then, the City has been dedicated to providing a continuous supply of safe, reliable, and economical potable water to its more than 19,000 accounts. The clients who receive water from the City of St. Charles constitute residential, commercial, industrial, and institutional users. In total, these clients consume approximately 3.34 million gallons of water per day. The existing water facilities maintained by the City include seven wells, four treatment facilities, three elevated towers, several ground storage reservoirs, and approximately 240 miles of water main.

The City of St. Charles has an estimated population of 33,408 based on the 2010 Census and interpolated growth projections. The City Council has recently approved several new developments throughout the City limits that will increase the overall demand on the system. As a result, the City has been actively pursuing a strategic plan to address water quality and quantity through a 20-year planning horizon. In order to better sequence and develop capital projects, it is in the City's best interest to maintain an updated Water System Master Plan. The plan was developed as a collaborative effort with input from Public Works, Engineering, Finance, and Community Development Departments. The Water System Master Plan provides a roadmap for the water distribution system, supply, treatment, and storage improvements required to meet the City's short and long-term goals.

### MASTER PLANNING

A Water Master Plan Facility Plan is a management and planning document used to identify, evaluate, and plan required water distribution and other infrastructure improvements. It provides an assessment of the distribution, storage, and supply abilities to meet both current and future regulatory requirements and provides critical information for improvements to correct current or projected deficiencies.

Master plans are typically updated every five to ten years, or when significant changes in growth or regulatory requirements have occurred or are expected. The City of St. Charles most recent Water Master Plan was prepared in 2007 and is now more than ten years old. Since the 2007 update, the City has implemented a number of the recommendations including the installation of new and replaced water main, construction of the Red Gate water tower, and the construction of the Well #3/4 Treatment Facility among others. However, in an effort to be proactive the City is seeking to update the Master Plan to develop a single document which includes a Capital Improvements Plan to assist in budgeting for necessary improvements and to provide a guide for future improvements.

The ultimate goal of this plan is to establish the community's current and future water production and infrastructure needs and develop an implementation plan to meet those needs. This plan will provide the blueprint for future improvements, expansion phasing, and capital improvement projects.





## COMMUNITY NEEDS

The City of St. Charles has grown from a community of 17,492 in 1980 to 27,910 people in 2000 to an estimated 33,403 people in 2018, as determined with an annual growth projection of 1.0% from the 2016 American Community Survey. Historically, the City has had adequate capacity to serve its planning area under all circumstances. During extremely high water usages, the City has been required to supplement well supply from the ground storage reservoirs, however at no point was the system in jeopardy of not meeting demands.

Water usage has generally decreased over the past decade as a result of higher efficiency water fixtures, watering restrictions, and a public effort to reduce unnecessary water consumption. While the City should not depend on a decrease in demand, this trend is seen in most communities and represents a national shift rather than a local anomaly. It is unlikely that demand will return to levels seen in the early 2000's unless significant droughts or growth are experienced.

Section 2 of this Plan identifies population growth projections for five-year, 2030, and 2040 planning horizons. In order to estimate the future water demand that the City must be able to provide, four growth categories were developed and analyzed. These include:

- 2018 'Current' – This represents the existing average and maximum day demands on the system
- 2023 'Planned' – This includes developments which are in construction, planning, or RFP stages
- 2030 'Programmed' – Includes areas identified in the Land Use Plan as potential developments
- 2040 'Future' – Represents the estimated population at the end of this study's planning horizon

**Table 2-1: Future Water Demands**

	Current 2018	Planned 2023	Programmed 2030	Future 2040
<b>Current P.E.</b>	53,200	53,200	53,200	53,200
<b>Growth P.E.</b>	-	12,900	20,093	26,570
<b>Total P.E.</b>	53,200	66,100	73,594	80,000
<b>Average Day Demand "ADD" (MGD)</b>	4.00	5.00	5.50	6.00
<b>Maximum Day Demand "MDD" (MGD)</b>	9.74	12.10	13.50	14.60
<b>Water Production Capacity Req'd (MGD)</b>	<b>10.00</b>	<b>12.10</b>	<b>14.00</b>	<b>15.00</b>

As will be discussed in Section 2, the City has capacity to provide the average daily demand throughout the four planning horizons. However, the maximum day demand exceeds what is currently available due to the reduced capacity of the aging wells. Analysis of the existing wells and alternatives for additional water supply sources are reviewed in Section 5 and Section 6 of this report, respectively.



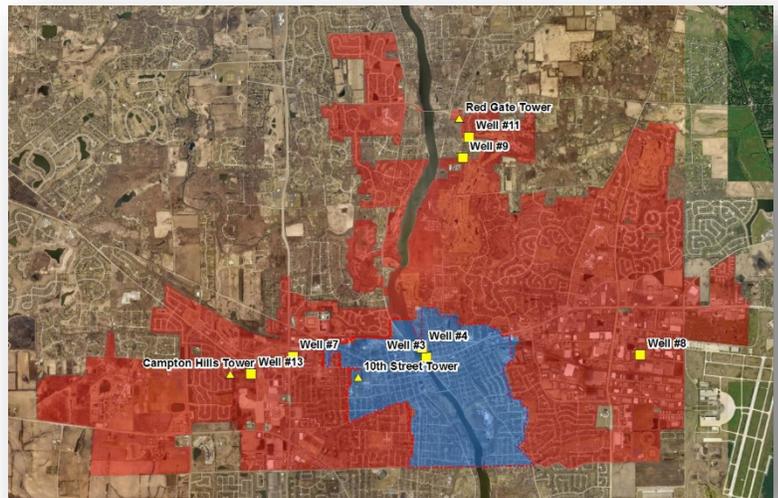


## WATER DISTRIBUTION SYSTEM EVALUATION

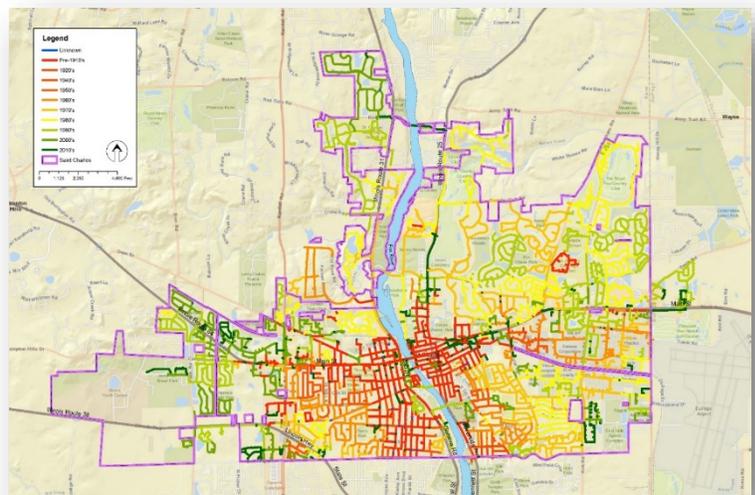
The City Water Department has adopted proactive water main maintenance, flushing, and rehabilitation programs to sustain the level of service provided to the community. The water main rehabilitation program is often coordinated with the City's Capital Improvement's Program for street rehabilitation and reconstruction to minimize costs. The City's water system has a large service area that is divided into two zones to maintain adequate water pressures across varying topographic regions, the Inner Service Area (shown in blue) and Outer Service Area (shown in red).

The City's water distribution system includes roughly 240 miles of water main, 2,900 fire hydrants, and 2,700 valves. For planning purposes the value of water main and other system components can be estimated to project a total system asset value. As calculated in Section 3, the existing City of St. Charles water distribution system value is estimated at approximately \$190 million including system valves and hydrants, prior to depreciation. The total replacement cost for the water system, estimated at approximately \$300 million, was calculated by adding 50% the unit asset value to account for surface restoration, contingencies, project management, design and administration. Based on straight-line depreciation and a seventy-five-year service life for this infrastructure, an average of \$4.50 Million would need to be budgeted annually in order to replace all of the existing distribution system by the year 2093. This budgetary amount would need to be increased by the Construction Cost Index (CCI) each year, which has averaged 2.92% over the decade.

This annual reinvestment should be prioritized based on a number of criteria including main diameter, age, break frequency, soil conditions, and the presence of lead services, among others. These criteria are discussed in Section 3 of this report, with recommended alternatives for rehabilitation of the distribution system in Section 4.



**City of St. Charles - Water Main Age**





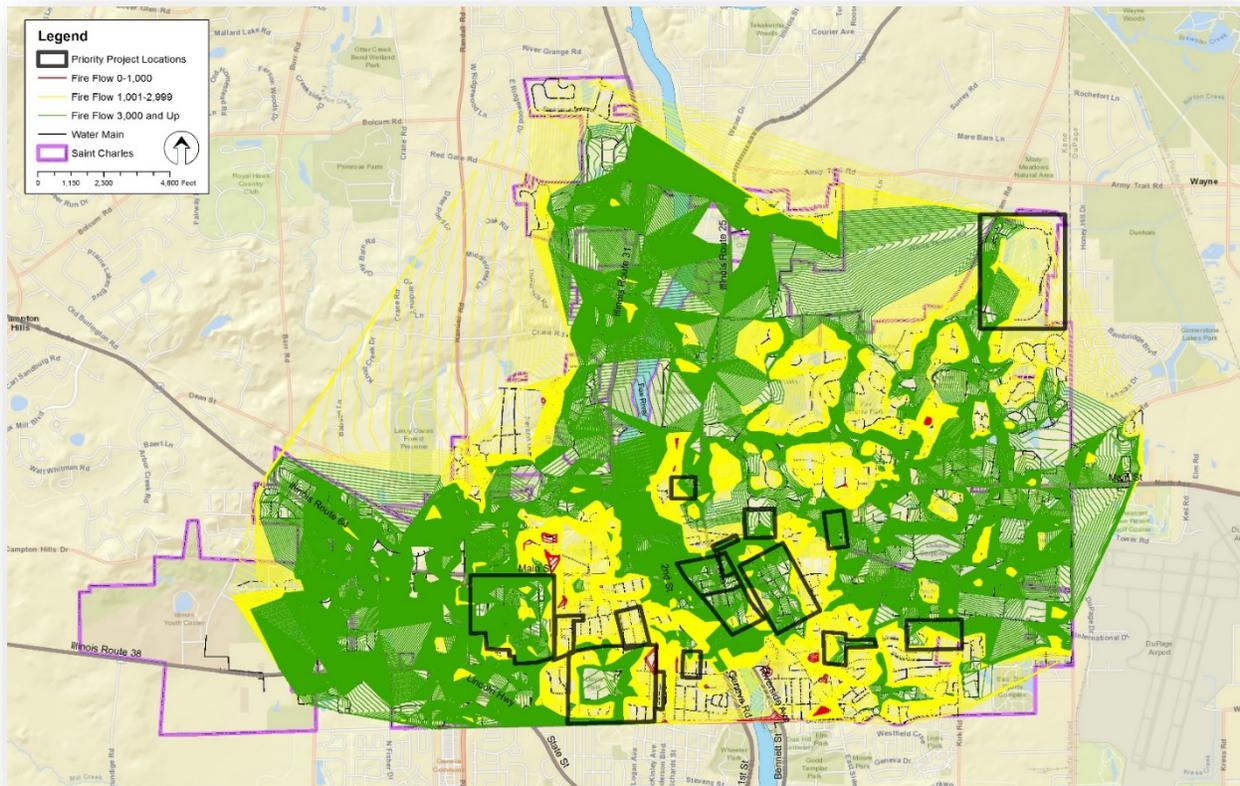
## DISTRIBUTION SYSTEM ALTERNATIVES

Through work sessions with City staff, a number of capital improvement projects were identified to rehabilitate and upgrade the distribution system. As will be discussed in Section 3, the water system has been constructed throughout the last century. As a result of the age of the system, many of the components are at or beyond their anticipated service life and will require rehabilitation or replacement.

Through review of water main age, size, material, break history, and available fire flows detailed in Section 3, 17 priority rehabilitation areas within the distribution system were identified. These areas may exhibit low available fire flow (AFF), a high frequency of main breaks, or a combination of issues. Each of these areas are discussed in further detail in the following pages, with prioritization of the improvements reviewed at the end of this section. The projects are numbered by orientation and do not represent prioritization. Full line item cost estimates for each project can be found in Appendix A.

- |   |   |
|---|---|
| A. Davis Elementary School  | I. Route 25 and North Avenue                |
| B. Munhall Elementary School  | J. Route 64 and 9 <sup>th</sup> Avenue      |
| C. Route 64 East  | K. Monroe west of 7 <sup>th</sup> Ave       |
| D. Lincoln Elementary School  | L. South Second west of 7 <sup>th</sup> Ave |
| E. 11 <sup>th</sup> and 12 <sup>th</sup> Street north of Prairie Street | M. Route 64 & Tyler Road                    |
| F. Prairie Street – 5 <sup>th</sup> to 8 <sup>th</sup>                  | N. South Avenue                             |
| G. 3 <sup>rd</sup> / 4 <sup>th</sup> Street Alley                       | O. Fairview Neighborhood                    |
| H. Horne & Ash Street   | P. Fox Ridge Elementary School              |
|   | Q. Royal Fox Subdivision                    |

### Available Fire Flows - Projects Completed





## WATER SUPPLY, TREATMENT & STORAGE FACILITIES

The City of St. Charles water supply and storage system consists of seven wells, three water treatment facilities, a 300,000-gallon spheroid water tower, a 1,500,000-gallon spheroid water tower, a 1,000,000-gallon Hydropillar® water tower, and several ground storage reservoirs with booster stations. As with most municipal water supplies, the existing infrastructure has been constructed over several decades and the components within the system vary in age. The City of St. Charles follows a rigorous maintenance program for the wells, towers and distribution system to ensure reliability of the infrastructure.

The City currently has an active booster station and ground storage reservoir capacity of 2.9 million gallons. These ground storage reservoirs are used in conjunction with the existing elevated water towers to meet the Maximum Hourly Demand and Fire Flow Demands placed on the system.

The City’s Wells and Water Towers have been strategically placed throughout the City’s service area, and source water is supplied by two distinct aquifers. Well #7, 9, 11 and 13 are supplied by a shallow sand and gravel aquifer commonly known as the St. Charles Aquifer. Wells #3, 4, and 8 are supplied by a deep aquifer known as the Galesville Aquifer. Presently, the City’s wells operate at 52.9% of the capacity that they were designed to produce. This lowered production is especially prevalent at Wells 7 and 11, with Well 7 not being used to pump any water and Well 9 operating at approximately 50% of design capacity.

**Well and Reservoir Design Capacities**

	System Served	Design Capacity (GPM)	Design Capacity (MGD)	Firm Capacity (GPM)	Firm Capacity (MGD)	Reservoir Capacity (gallons)
3	Inner	1,000	1.44	1,000	1.44	250,000
4	Inner	1,000	1.44	-	-	250,000
<b>Total</b>	<b>Inner</b>	<b>2,000</b>	<b>2.88</b>	<b>1,000</b>	<b>1.44</b>	<b>500,000</b>
7	Outer	1,750	2.52	1,750	2.52	175,000
8	Outer	1,200	1.73	1,200	1.73	2,000,000
9	Outer	2,150	3.10	-	-	0
11	Outer	1,900	2.74	1,900	2.74	236,500
13	Outer	1,500	2.16	1,500	2.16	0
<b>Total</b>	<b>Outer</b>	<b>8,500</b>	<b>12.25</b>	<b>6,350</b>	<b>9.15</b>	<b>2,411,500</b>

Production is set at current levels at each well for a specific reason – chlorination capacities, elevated iron levels, pump curve limitations, and physical age of the well pumps themselves. It should be noted that these “current” rates are designed to *produce the highest quality of water possible* by maximizing use of wells that produce the highest quality water. While Well #7 specifically has been removed from routine service, it could be brought back online during peak periods if necessary. These current rates and required future capacities are discussed in further detail in Section 6.





## WATER SUPPLY, TREATMENT & STORAGE ALTERNATIVES

While the City’s well sources have a design capacity in excess of 15 MGD and a firm capacity of 12 MGD, this has been reduced due to the age of the wells and treatment facilities. Specifically, Well #7 is run as infrequently as possible due to the age of the filtration facility and high iron concentrations in the source water. To meet maximum day demands the City can utilize this well, however it is in need of significant upgrades or replacement. Alternatives for rehabilitation or replacement of this treatment facility are reviewed in Section 6, but it is recommended that the City plan and budget for interconnection of Well #7 and Well #13, with common iron-removal treatment occurring at the Oak Street Facility.

As detailed in Section 2 – Community Needs, the City of St. Charles anticipates significant growth over the next five years. For planning purposes, this growth is anticipated to result in increased maximum day water usage on a linear basis. As a result, the current maximum day demand of 9.74 MGD may increase to 12.1 MGD in 2023 by the end of the 5-year planning horizon. Therefore, the City should continue reviewing alternatives for additional water supply and treatment, and must maintain all current facilities. This includes the short-term rehabilitation/interconnection of Well #7 as a priority project.

The table below lists each of the alternative supply sources, their associated capital cost, the treatment facility capital cost, and total project cost. Due to the significantly higher cost associated with either connection to DuPage Water Commission or conversion to surface water supply (Fox River), these alternatives have been omitted from further consideration.

**Table 6-4: Summary of Supply Alternative Costs**

Alternative	Supply Capital Cost	Treatment Capital Cost	Total Alternative Capital Cost
Alternative 3 - Well 10	\$3,640,000	\$7,470,000	\$11,110,000
Alternative 4 - Well 12	\$3,620,000	\$7,470,000	\$11,090,000
Alternative 5 - Well 14	\$3,950,000	\$7,470,000	\$11,420,000
Alternative 6 - Galesville Well @ 7/13	\$3,110,000	-	\$3,110,000
Alternative 7 - Galesville @ 9/11	\$3,190,000	-	\$3,190,000

Due to the relatively short-term requirement for additional supply, the City may elect to move forward with further investigation of groundwater alternatives. This would include investigating potential shallow well sites through boring of test holes and ultimately production evaluation with test wells. Once a potential site has been identified, it is recommended that two test holes be drilled to locate an adequate formation. Once located, a test well and several observation wells should be drilled to conduct a capacity evaluation. The test holes and test wells are anticipated to cost approximately \$200,000 in total and should be budgeted over the next two years.

If deep wells are going to be considered, alternative means of radium removal should be investigated as an alternative to blending. One option for radium removal would be pelletizing treatment, further discussed in Section 7. A pilot with this technology is estimated to cost approximately \$50,000 for a six month sidestream scale program. Similarly, it is recommended that this be budgeted for the short-term.





## WATER SOFTENING

As discussed in Section 5, the majority of the City’s existing water treatment facilities remain in good condition and should only require routine rehabilitation and maintenance over the planning period. In addition to maintaining excellent water quality, the City has identified implementing city-wide (utility-scale) water softening as a concept to be evaluated.

Hardness in water is the presence of dissolved magnesium and calcium ions. These ions combine most commonly with carbonate ions in water to create mineral deposits. Although water hardness is not regulated by the EPA in its Primary or Secondary Drinking Water Regulations, it constitutes a common challenge in providing quality drinking water. Hardness presents aesthetic concerns to consumers such as mineral deposits in piping, diminished soap effectiveness, and decreased lifespans of appliances.

Calcium and magnesium ions enter drinking water primarily through the dissolution of minerals in subterranean aquifers. As the City of St. Charles sources all of its drinking water from shallow and deep wells, high concentrations of hardness are to be expected. Tests have displayed that each of the seven wells currently used by the city provide water that is classified as either “Hard” or “Very Hard”.

**Table 6-2: Existing Water Supply Hardness**

Water Source	mg/L as CaCO <sub>3</sub>
Well 3	250
Well 4	240
Well 7	530
Well 8	260
Well 9	450
Well 11	530
Well 13	430
Hardness	mg/L as CaCO <sub>3</sub>
Soft	0 to 75
Moderately Hard	75 to 150
Hard	150 to 300
Very Hard	300 and above

Water softening in St. Charles is currently achieved primarily through household water softening systems. These systems are paid for and operated by residents and require regular replacement of a softener salt media. Implementation of city-wide softening would reduce reliance on these devices, and the shift away from household softening could garner public support for the project. At present, the high hardness entering homes can scale pipes before reaching household softeners or the softeners may not be maintained well enough to work efficiently. As such, the City receives a number of complaints from consumers regarding the hardness of their water.



The City currently operates ion-exchange processes at the combined Well #3/4 facility, as well as the Ohio Avenue/Well #8 facility. This process is utilized to remove radium present in the deep well water, but as by-product also removes hardness. As a result, water quality varies across the distribution system with some residents receiving softer water, and others harder water.

Viable alternatives for municipal water softening have developed rapidly over recent years, resulting in several potential technologies with different removal efficiencies and characteristics. Four potential alternatives that could be employed by the City of St. Charles are ion-exchange, lime softening, membrane softening, and pelletizing. Each of these technologies provide distinct benefits and draw backs, which will be reviewed in detail within Section 7. Alternatives and combinations of alternatives for each have been compiled as well.

The City has reviewed a number of alternative technologies to provide Utility-scale water softening. There are significant challenges associated with each technology, specifically relating to ion-exchange treatment. During previous planning efforts ion-exchange was identified as the preferable water softening technology, however in light of recent developments on chloride limitations in wastewater effluent this option will likely no longer be a viable standalone alternative.

The table below illustrates the capital cost associated with implementing water softening at each regional facility, as well as the total utility-scale capital cost. If the City elects to continue the water softening discussion, staff may elect to pilot test any of the alternatives to determine the efficiency utilizing City water sources. Further evaluations would also be warranted to investigate the feasibility of siting a regional Well #9/11 softening facility along Route 25 at the previously described location, as well as the viability of constructing a regional Well #7/13 softening facility adjacent to the existing Oak Street Filtration Facility.

<b>Utility Scale Softening Summary (20% Contingency)</b>			
<b>Softening Process</b>	<b>Well #7/13 Capital Cost</b>	<b>Well #9/11 Capital Cost</b>	<b>Total Capital Cost</b>
<b>Ion Exchange</b>	\$10,012,230	\$11,910,039	<b>\$21,922,269</b>
<b>Nanofiltration</b>	\$29,727,210	\$34,754,501	<b>\$64,481,711</b>
<b>Lime Softening</b>	\$33,249,600	\$42,403,079	<b>\$75,652,679</b>
<b>Pellet Softening</b>	\$16,040,450	\$30,362,830	<b>\$46,403,280</b>
<b>Pellet/IEX Softening</b>	\$20,429,057	\$33,726,663	<b>\$54,155,720</b>



## RECOMMENDATIONS AND SUMMARY

The City is responsible for providing safe and reliable water service for the communities both within the corporate boundary and in the neighboring areas. The preceding sections have described the Planning Area, the current and future capacity needs, the existing supply, storage, treatment, and distribution system infrastructure, and future improvements that should be budgeted within the duration of this Master Plan.

A significant amount of the water system equipment and distribution system has reached or has exceeded its respective service life. Diligent maintenance and operation have provided the City with exceptional equipment longevity; however, several major systems will require replacement within the next 10 years. Recommendations have been separated into two groups: annual equipment replacement and Capital Improvement Projects. Incorporating a number of items requiring replacement into a single capital project provides cost efficiencies in the form of scales of economy and consolidating contractor's costs.

The implementation schedule for capital improvements is driven by the urgency of rehabilitation and the benefit of upgrades to the system. The prioritization of large-scale capital improvements is discussed in Section 6 and smaller scale rehabilitations follow the replacement timeframe based on service life and installation year of equipment. The projects identified throughout Sections 4 and 6 are outlined in the table below. The annual expenditure included is approximately \$3.0-\$4.0M which can be increased or decreased according to the City's available funding.

### City of St. Charles - Water Master Plan 5 Year Capital Improvements Plan

Project Description		Fiscal Year Cash Flow (\$ in Millions, 2018)					Project Total
		2020	2021	2022	2023	2024	
S	AMI Meter Implementation	1.40	1.30	1.30			<b>4.00</b>
S	10th Street Tower Re-Coating & Repairs	0.50					<b>0.50</b>
S	Well #11 Chlorine Upgrades	0.50					<b>0.50</b>
S	Well #7/13 Interconnection - Phased	5.32					<b>5.32</b>
R	Well #8 & Ohio Avenue Rehabilitation	1.68					<b>1.68</b>
R	Well #9 Rehabilitation		0.75				<b>0.75</b>
R	Well #13 Rehabilitation			0.18			<b>0.18</b>
R	Well #3/4 Rehabilitation			0.89			<b>0.89</b>
S	Galesville Well at Oak Street				3.20		<b>3.20</b>
S	Galesville Well at Well #11					3.20	<b>3.20</b>
R	Well #11 Rehabilitation					0.60	<b>0.60</b>
							<b>0.00</b>
<b>Fiscal Year Total:</b>		<b>9.40</b>	<b>2.05</b>	<b>2.37</b>	<b>3.20</b>	<b>3.80</b>	<b>20.82</b>

S Water Supply/Storage  
 R Rehabilitation





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