SECONDARY WATER MASTER PLAN AND IMPACT FEE FACILITIES PLAN
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SYRACUSE CITY

SECONDARY WATER MASTER PLAN AND IMPACT FEE FACILITIES PLAN

January 2017

EXECUTIVE SUMMARY

This Water System Master Plan is a document to guide City officials and staff in making decisions relating to future issues with the City's Secondary water system. In the document, water resources supply, storage and distribution are reviewed for existing conditions and future conditions at build-out of the community. A summary of costs and projects are included in later chapters of the report.

1 - INTRODUCTION

Syracuse City is a growing community located in northern Davis County. With growth many challenges arise. One of these challenges is planning for secondary water impacts that the community will face in the future. This Secondary Water Master Plan and Impact Fee Facilities Plan will serve as a guide for community decisions to be made by the City council and staff. Guidance regarding supply and sources, storage and distribution improvements will be given to allow the City to make informed decisions regarding water resources into the future.

There was a Secondary Water System Capital Facility Plan done by Epic Engineering in February 2006 and a Secondary Water Distribution System Impact Fee Analysis done by Lewis, Young, Robertson and Burningham in July 2006.

Effective as of July 1, 2016 the secondary water impact fees and connection fees are as follows from the Consolidated Fee Schedule in Tables 1-1 and 1-2.

Table 1-1: Secondary Water Impact Fees[1]

Lot Size (sf)	Impact Fees (ea. Unit)
Residential	
4,000-7,000	$523.03
7,001-8,000	$760.31
8,001-9,000	$883.18
9,001-10,000	$1,008.44
10,001-11,000	$1,135.85
11,001-13,000	$1,330.48
13,001-15,000	$1,595.85
15,001-17,000	$1,867.01
17,001-19,000	$2,143.25
19,001-21,000	$2,423.98
21,001-23,000	$2,708.76
23,001-25,000	$2,997.23
25,001-27,000	$3,289.06
27,001-30,000	$3,658.21
30,001-33,000	$4,561.61
36,001-39,000	$5,021.48
39,001-42,000	$5,486.20
42,001-45,000	$5,955.43
45,001-48,000	$6,428.84
48,001-51,000	$6,906.17
51,001-54,000	$7,387.17
54,001-57,000	$7,871.64

57,001-60,000	$8,359.39
Open Land in a Commercial Subdivision	$0.17/sf of pervious area

1. See also Appendix A for the full fee schedule.

Table 1-2: Secondary Water Connection Fees[1]

Line Diameter (inch)	**Connection Fees (ea. Unit)**
¾	$300.00
1	$400.00
1 ½	$600.00
2	$800.00
3	$1,200.00
4	$1,600.00
6	$2,000.00
8	$2,400.00

1. See also Appendix A for the full fee schedule.

The deposit for water service is $75.00 per residential application and $100.00 per commercial/industrial/multi-family application.

Developers are required to bring 3 acre-feet per gross acre of secondary water for residential developments and 4 acre-feet per landscaped acre for commercial and industrial developments. (See ordinance in Appendix A).

The utility rates for secondary water service are as follows in Table 1-3:

Table 1-3: Secondary Water Utility Rates[1, 2]

Line Diameter (inch)	**Current Base Fee (ea. Unit)**
¾	$15.50/ month
1	$21.50/ month
1 ½	$58.00/ month
2	$103.11/ month
3	$184.50/ month
4	$412.44/ month
6	$928.00/ month
8	$1,649.78/ month
Open Land in a Residential Subdivision	$0.19/ sf of pervious area

1. The rate is based on ¾” line size flow for any service larger than 1”.
2. See also Appendix A for the full fee schedule.

2 – GROWTH AND PROJECTIONS

The 2014 population in Syracuse City, according to the U.S. Census Bureau, was 26,639 (U.S. Census Bureau, 2014). The growth rate from 2010 to 2014 was 9.3 percent (U.S. Census Bureau), which was a 2.3 percent annual rate of change. The growth rate from 2000 to 2010 was 149.73 percent, which was nearly a 15 percent annual rate of change. The future growth rate is anticipated to range from 4.7 percent in the early years to 2.1 percent as the City approaches build-out (Syracuse, 2014).

The persons per residential connection were established by dividing the population by the number of residential connections. The city provided the number of residential connections for 2014, 2015 and 2016. Based on the 2014 population and the growth rates determined by the increase in the number of residential connections, the population for 2015 and 2016. The people per residential connection is the population divided by the residential connections. For 2014-2016 the average persons per residential connection was 3.86, which was used to determine the future residential connections from the population (Syracuse, 2016). In 2014 there were 6,964 residential connections. The Culinary Water Master Plan and IFFP projected the number of ERCs.

It is estimated that, from the Table below (Table 2-1), future development will result in an additional 7,002 ERCs and 3,357 gross acres. This projection was done for just undeveloped areas and future annexation areas. No “in-fill” of established areas as neighborhoods mature was considered. The result was a conservatively high projected number of acres if development occurs in conformance to the land use plan. Most growth is planned to occur in either undeveloped agricultural areas (areas zoned A-1) or undeveloped residential areas (areas zoned R-1). Table 2-1 shows the estimated future ERCs and acreages based on developing currently undeveloped areas. It is expected that changes will occur over time to both the service boundaries and land densities (Syracuse City, 2014).

When the future estimated ERCs and acreages are added to the 7,730 existing ERCs and 6,422 existing gross acres (2016), the resulting number of ERCs and gross acres at build-out will be 14,732 ERCs and 9,779 gross acres. This number of ERCs includes new growth in undeveloped areas and undeveloped annexation areas. The estimates do not anticipate a high water use industry. Proposed development that would use significantly more water than typical residential development should be analyzed on a case by case basis.

Table 2-1: Estimated Future Build-out Gross and Irrigated Acres

Zone	Area (Gross Acres)[2]	Density (ERCs/Acre)[1]	ERCs
A-1	857.56	0.50	429
R-1	1,292.13	2.30	2,972
R-2	292.45	3.00	877
R-3	56.04	4.00	224
R-4	0.00	11.00	-

Zone	Area (Gross Acres)[2]	Density (ERCs/Acre)[1]	ERCs
PRD	87.84	6.00	527
General Commercial	445.44	3.50	1,559
Industrial	141.36	0.50	71
Institutional	16.96	0.50	8
Neighborhood Services	3.59	2.00	7
Professional Office	2.36	2.00	5
Research Park	161.17	2.00	322
TOTAL	**3,357**	**-**	**7,002**
Estimated Existing (2016)	6,422	-	7,730
Sum (estimated buildout)	**9,779**	-	**14,732**

1. The density (ERCs/acre) is from the December 24, 2015 General Plan Map.
2. The undeveloped areas within the City boundary were estimated by the City (Syracuse City, 2014). The undeveloped areas within the Planning Area and not within the City boundary were estimated by J-U-B Engineers as part of this project.

City projections based on the current General Plan Map indicate that a total of 3,357 additional acres will be developed within the city by build-out (see Table 2-1) (Syracuse, 2015). Information provided by the City (see Table 2-2) indicated that in 2014 there were 6,181 acres developed in the City. Therefore, build-out is expected to occur in approximately 2038 given the current planned annexation area and associated densities indicated in the General Plan Map dated December 24, 2015. More information on the projected population and equivalent residential connections (ERCs) growth is available in the Culinary Water Master Plan and Impact Fee Facilities Plan.

The resulting land development rate is 1.93% per year, which is calculated from the existing number of gross acres, the build-out ERCs and the year build-out occurs. The year build-out occurs is based on the ERC projections.

An analysis by the City of the portion of an acre that is typically irrigated indicated that it is 25%. Table 2-2 also shows the breakdown of gross acreage and irrigated acreage by type for the years 2014 through build-out.

Table 2-2: Gross Acres and Irrigated Acres

Year	Land Growth Rate[1]	Residential Gross Acres[2]	Non-Residential Gross Acres[2]	Agricultural Gross Acres[2]	Total Gross Acres[2]	% Irrigated[3]	Residential Irrigated Acres	Non-Residential Irrigated Acres	Agricultural Irrigated Acres	Total Irrigated Acres
2014	1.93%	2,910	936	2,335	6,181	25%	716	230	575	1,521
2015	1.93%	2,971	975	2,342	6,300	25%	731	240	576	1,550
2016	1.93%	3,033	1,016	2,348	**6,422**	25%	746	250	578	**1,580**
2017	1.93%	3,096	1,058	2,355	6,546	25%	762	260	579	1,610
2018	1.93%	3,161	1,102	2,362	6,672	25%	778	271	581	1,642
2019	1.93%	3,227	1,149	2,368	6,801	25%	794	283	583	1,673
2020	1.93%	3,294	1,197	2,375	6,932	25%	810	294	584	1,706
2021	1.93%	3,363	1,247	2,382	7,066	25%	827	307	586	1,738
2022	1.93%	3,433	1,299	2,388	7,202	25%	845	320	588	1,772
2023	1.93%	3,505	1,353	2,395	7,341	25%	862	333	589	1,806
2024	1.93%	3,578	1,410	2,402	7,483	25%	880	347	591	1,841
2025	1.93%	3,653	1,469	2,409	7,627	25%	899	361	593	1,877
2026	1.93%	3,729	1,530	2,415	**7,774**	25%	918	376	594	**1,913**
2027	1.93%	3,807	1,594	2,422	7,924	25%	937	392	596	1,950
2028	1.93%	3,887	1,661	2,429	8,077	25%	956	409	598	1,987
2029	1.93%	3,968	1,730	2,436	8,233	25%	976	426	599	2,026
2030	1.93%	4,051	1,802	2,443	8,392	25%	997	443	601	2,065
2031	1.93%	4,135	1,878	2,450	8,554	25%	1,017	462	603	2,105
2032	1.93%	4,221	1,956	2,457	8,719	25%	1,039	481	604	2,145
2033	1.93%	4,310	2,038	2,464	8,887	25%	1,060	501	606	2,187
2034	1.93%	4,400	2,123	2,470	9,059	25%	1,082	522	608	2,229
2035	1.93%	4,492	2,212	2,477	9,234	25%	1,105	544	610	2,272
2036	1.93%	4,585	2,305	2,484	9,412	25%	1,128	567	611	2,316
2037	1.93%	4,688	2,454	2,451	9,594	25%	1,154	604	603	2,360
2038	1.93%	4,779	2,501	2,498	**9,779**	25%	1,176	615	615	**2,406**

1. The land development growth rate is based on the City's General Plan Map and the City's projections of adding 3,357 acres by build-out.
2. The residential gross acreage in 2014 is based on 47.08% of the total (for zones R) and the build-out is based on 48.87% of the total (for zones R-1, R-2 and R-3). The non-residential gross acreage in 2014 is based on 15.14% of the total (for zones I&I, C, P & OS) and the build-out is based on 25.58% of the total (for zones PRD, C-2, GC, I&I, NS, PO, RP). The agricultural gross acreage in 2014 is based on 37.78% of the total and the build-out is based on 25.55% of the total. The City established that there were a total of 6,181 gross acres in 2014 and an additional 3,357 acres at build-out.
3. After analyzing the amount of non-irrigated versus irrigated acreage per acre the City determined this percentage was 25% irrigated per acre.

3 - EXISTING SYSTEM EVALUATION

Syracuse City owns and operates a secondary water system to provide irrigation for outdoor watering. All development within the city is required by ordinance to connect to the secondary water system for outdoor irrigation. All of the water storage and distribution facilities are owned and maintained by Syracuse City (Syracuse, 2014).

The current service area of the Syracuse City Secondary water system is the current Syracuse City boundary plus a small number of neighboring services in Davis County (Syracuse City, 2014). Appendix B contains a map, Figure 3-1, showing the existing service area and the existing water system.

3-1 Existing Demands and Level of Service

The existing demand was calculated to determine existing deficiencies in the City's water system. Then, the existing demand was input into the water model and various scenarios of flow conditions were evaluated. From these scenarios, areas of low pressure or flow (deficiencies) can be discovered.

The existing demands are a function of the existing gross acreage and irrigated acreage. Chapter 2 above provides more detail on the population, ERCs, gross acreage and irrigated acreage.

Water use at individual connections is not metered. Therefore, the amount of water that is lost to leaks or other demands is unknown.

For the model it was assumed that all of the existing connections had secondary water available for outdoor uses.

Several types of demand are used for calculating water usage, including the average annual, peak month, peak day and peak instantaneous demand. There are several methods of calculating these demands including those from the Utah State Administrative Code, Utah State University and based on observation.

3.1.1 Average Annual Demand

The State of Utah Administrative Code (UAC) publishes minimum requirements for the average annual outdoor demand per zone in UAC R309-510. Syracuse City is in Zone 4 and the average annual demand is 1.87 acre-feet per irrigated acre (UAC, 2016).

Utah State University published a report titled "Consumptive Use of Irrigated Crops in Utah" in 1998 that is often referred to by the Division of Water Resources and others in order to determine crop water requirements. Using data for the Riverdale, Utah site and using turf as the crop, the annual net irrigation requirements were found by summing the monthly net irrigation requirement. This was an average of 15.94 inches per year. Then, in order to determine the average annual irrigation water usage, the irrigation requirement was divided by the irrigation application efficiency. In order to closely approximate the observed values (at peak day in 2015) an application efficiency of 25% was used. This calculation is as follows: 15.94 inches/year / 25% application efficiency / 12 inches/foot = 5.3 acre-feet/irrigated acre (USU, 1998).

The 25% application efficiency used in the calculation above was used because of the seasonal effects of watering efficiency. For example, when secondary water is first turned on there are those in the system that do not adjust their sprinklers from the last summer. They will be using the same amount of water that is typically used in July or August in April which causes a lower efficiency than what is calculated in section 3.1.2 for peak day demand.

The final method uses observed flow data. The total annual amount of water and monthly maximum amount of water used were observed for both 2014 and 2015 by evaluating pumping data for the Bluff Road, Freeport Center and Jensen Park pump stations. The average annual observed values are based on the average of the total water supplied for 2014 and 2015 at all three pump stations. The City does not meter secondary water at individual connections. The water use is based on 213 days from April 1st to October 31st.

- Average Annual – State of Utah Minimum Requirement

1.87 AF/irrigated acre X 1,580 irr acre = 2,955 AF/year

- Average Annual – USU Minimum Requirement

5.3 AF/irrigated acre X 1,580 irr acre = 8,374 AF/year

- Average Annual –Observed

1.99 AF/irrigated acre X 1,580 irr acre = 3,141 AF/year

The observed values are approximately 106% of the State of Utah value and 38% of the USU values.

Not all of the water taken from a secondary water source reaches the root zone of the plants. Part of the water is lost during transport from the irrigation mechanism (flood, drip, sprinkler, and etc.) to the irrigated crop (turf or other plants). The remaining part is stored in the root zone and eventually used by the plants. In other words, only part of the water is used efficiently, the rest of the water is lost for the plants on the area that is to be irrigated (Food and Agriculture Organization, 2016). Additionally, water is lost to over-watering. Over-watering is probably the most significant cause of water loss in any irrigation system. No matter how the system is designed, if more water is applied than can be beneficially used by the crop, efficiency will suffer. Thus, proper irrigation scheduling is important if high efficiencies are to be achieved. The major losses associated with sprinkler irrigation are direct evaporation from wet soil surfaces, wind drift, evaporation losses from the spray, system drainage, application of water to pervious surfaces and leaks. Typical water application efficiencies are 60-90% for sprinkler irrigation. While irrigation application efficiencies should be in the 60-90% range, 50% was used to reflect the over-watering which is typical among the Syracuse City secondary water irrigation system users.

3.1.2 Peak Day Demand

The peak day demand is the highest demand the system will experience during a 24-hour period, however it is over a short period of time. The three methods noted above (UAC, USU and observed) were used to determine the peak day demand.

Guidelines established by the State of Utah estimate peak day demand at 3.96 gallons per minute per irrigated acre for zone 4 according to the UAC R309-510 (UAC, 2016).

The USU estimate is 6.44 gpm/ irrigated acre using a 50% irrigation efficiency (as described previously) (USU, 1998). The calculation is as follows for the peak monthly demand (July): (4.59+0.31 inches of water) x 1.08 / 31 days/month / 50% application efficiency / 12 months/year x 43,560 square feet/acre x 7.48 gallons/cubic foot / 24 hours/day / 60 minutes/hour= 6.44 gpm/irrigated acre.

The observed peak day demand is 6.48 gpm/irrigated acre. This is based on July 2016 measurements of the City's secondary metered water sources, which are the maximum pumped flow at the three pump stations plus the canal flow. The USU method using a 50% application efficiency closely approximates the observed peak day demand.

The methods for calculating peak day flows are compared below.

- <u>Peak Day – State of Utah Minimum Requirement</u>

3.96 gpm/irrigated acre X 1,580 irr acre = 6,257 gpm

- <u>Peak Day – USU Minimum Requirement</u>

6.44 gpm/irrigated acre X 1,580 irr acre = 10,175 gpm

- <u>Peak Day –Observed</u>

6.48 gpm/irrigated acre X 1,580 irr acre = 10,238 gpm

The observed value of 6.48 gpm/irrigated acre is more than 1.64 times the State value of 3.96 gpm/irrigated acre, while the USU value of 6.44 gpm/irrigated acre closely approximates the observed value. The USU method for estimating consumptive plant need will be used as the level of service to evaluate the existing infrastructure. The 6.44 gpm/irrigated acre is the value to calculate the existing demand and it has been used in the existing model to assess the existing infrastructure, including current source, storage and pipe sizes and service pressures.

3.1.3 Peak Instantaneous Demand

The peak instantaneous demand is the highest demand the system will experience during a 24-hour period, however it is over a very short period of time. The three methods noted above (UAC, USU and observed) were used to determine the peak instantaneous demand.

Guidelines established by the State of Utah estimate peak instantaneous demand at 7.92 gallons per minute per irrigated acre according to the UAC R309-510 (UAC, 2016).

The USU estimate is 12.23 gpm/irrigated acre using a 50% irrigation application efficiency (as described previously). The calculation is as follows for the peak instantaneous irrigation demand (July): 6.44 gpm/irrigated acre x 1.9=12.23 gpm/irrigated acre. The 1.9 peaking factor is based on typical irrigation demand patterns.

Flow records provided by the City were reviewed from July 2016 and verified the 1.9 peaking factor.

The peak instantaneous flows are compared below.

- <u>Peak Instantaneous – State of Utah Minimum Requirement</u>

7.92 gpm/irrigated acre X 1,580 irr acre = 12,514 gpm

- <u>Peak Instantaneous – USU Minimum Requirement</u>

12.23 gpm/irrigated acre X 1,580 irr acre = 19,323 gpm

The USU demand estimate with an irrigation application efficiency of 50% will be used as the level of service to evaluate the existing infrastructure. The 12.23 gpm/irrigated acre is the value to calculate the peak instantaneous existing demand. It is the existing level of service that has been used in the existing model to assess the existing infrastructure, including pipe sizes and service pressures.

Table 3-1 summarizes the existing demands/level of service for average annual, peak day and peak instantaneous demands from the three methods: State of Utah, Utah State University and observed.

Table 3-1: Summary of Demands/Level of Service

Description	gpm/ irr acre	gpm	af/yr/ irr acre	AF
Average Annual Demand				
Utah State University Minimum Requirement[1]	-	-	5.3	8,374
Peak Day Demand				
Utah State University Minimum Requirement[2]	6.44	10,175	-	-
Peak Instantaneous Demand				
Utah State University Minimum Requirement[1]	12.23	19,323	-	-

1. From USU's 1998 report, "Consumptive Use of Irrigated Crops in Utah" with an assumed irrigation application efficiency of 25% (USU, 1998).
2. From USU's 1998 report, "Consumptive Use of Irrigated Crops in Utah" with an assumed irrigation application efficiency of 50% (USU, 1998).

3-2 Existing Water Sources / Supply

This Master Plan and Impact Fee Facilities Plan does not discuss the condition of the City's water sources or supply. The City's system is relatively new.

3.2.1 Capacity

The majority of Syracuse's current water supply comes from the Davis and Weber Counties Canal Company and Weber Basin Water Conservancy District via the Layton Canal Company. In order to deliver the irrigation water to the city reservoirs, conveyances are shared with West Branch Irrigation Company as well as Clearfield Irrigation Company. Syracuse City also has shares in the Hooper Irrigation Company. The city has also contracted with the Weber Basin Water Conservancy District for additional irrigation water delivered on contract to Jensen Pond in the event that the city's demand exceeds their other allotments. The canal pump currently pumps about 850 gpm and the maximum is 1,800 gpm. The canal pump station includes only one pump on a VFD. The pump is outside and unprotected. The canal pump pumps from a ditch that has intermittent flow. The water source for the ditch is unknown. Table 3-2 lists the existing secondary water sources.

Table 3-2a: Existing Secondary Pump Stations

Pump Station Name	# of Pumps	Maximum Pumping Capacity (gpm)[1]
Syracuse City- Canal Pump	1	1,800
Syracuse City –Freeport Pump Station	4	7,800
Syracuse City-Jensen Pump Station	3	6,000
Syracuse City-Bluff Road Pump Station	3	5,500

1. Based on SCADA data from Syracuse City Mission website data.

Table 3-2b: Existing Water Supply

Source		Shares[2]	Amount (Ac-Ft/ Share)[2]	Maximum Supply (Ac-Ft)[2]	Maximum Supply (gpm)[1]
Syracuse Canal Pump				676	850
Davis and Weber Counties Canal Company	West Branch	669	6	4,014	5,046
	Clearfield Irr	165	6	990	1,245
Weber Basin Water Conservancy District	Layton Canal	1,158	1	1158	1,455
	Contract	1,113	1	1,113	1,399
Hooper Irr Company	Davis and Weber	18	3	54	68
Total				**7,329**	**9,213**

1. Based on water availability for 180 days of irrigation and 24 hours per day.
2. Based on information provided by the City.

3.2.2 Level of Service and Evaluation

Typically, a system's sources are designed for peak day demand and annual average demand. This is what has been used in the analysis of the Syracuse City's sources.

See Table 3-3 for a comparison of the 2016 demands and capacity of the available sources. Table 3-3 includes demands based on the State of Utah administrative code requirements, guidelines based on Utah State University's *Consumptive Use of Irrigated Crops in Utah* at 50% irrigation efficiency, and observation. The level of service is based on the USU demand estimates at 50% irrigation efficiency. The peak day supply is calculated as the average annual demand available for 180 days during the year. In actuality the City has sources that are able to provide more than that. It is difficult to discern how much that is because not all of the sources are accurately metered.

Essentially all of Syracuse City has secondary water available. Having secondary water available has a major beneficial impact on the amount of required culinary water infrastructure.

Table 3-3: Existing Water Sources/Supply: Demand and Capacity

Description	gpm	af/year	Is there sufficient capacity?[2]
Current Resources			
Total Current Supply	10,063	8,005	-
Average Annual Use			
USU Minimum Requirement – 5.3 AF/irrigated acre[1]	-	8,374	yes
Peak Day Demand			
USU Minimum Requirement – 6.44 gpm/irrigated acre[2]	10,175	-	yes

1. From USU's 1998 report, "Consumptive Use of Irrigated Crops in Utah" with an assumed irrigation application efficiency of 25% (USU, 1998).
2. From USU's 1998 report, "Consumptive Use of Irrigated Crops in Utah" with an assumed irrigation application efficiency of 50% (USU, 1998).

The existing supply, based on the numbers in Table 2-5, are sufficient to meet the demand based on the level of service determined by current use for peak day. There is sufficient capacity to meet the level of service for average annual conditions if the maximum supply is delivered. However, in recent years half of the supply has been delivered.

3-3 Existing Water Rights

3.3.1 Capacity

Water rights limit the amount of water the city has a right to use. Consequently, the City measures and records the amount of water diverted and reports that to the Division of Water Rights (Syracuse, 2014). Syracuse City has one approved water right for secondary water associated with a diversion from a drainage ditch that feeds the secondary water system at Freeport Reservoir. This water is referred to as the "canal pump" water. This one water right, which is a municipal right that could also be used for culinary water, is used to supplement water for the irrigation system. This water right is summarized in Tables 3-4 and 3-5. The status, status date and priority date are listed in Table 3-4 for the water right. The date of when the proof of use for each non-certificated water right is due is also listed in Table 3-4. Table 3-5 shows the amount of water associated with the water right. The water right allows for a total diversion flow rate of 5.0 cfs or 2,244 gpm. The diversion rate is equal to the depletion rate for this right because it was for municipal uses from the beginning. The annual volume associated with the right is 3,619.89 acre-feet. The annual volume is the flow rate assuming 365 days of use, 24 hours per day and 7 days per week. The water for this water right is diverted from a canal in Freeport Center at the City's Freeport Reservoir site. It has been essential for the city to utilize this water particularly in drought conditions when irrigation companies reduce the supply of water serving the reservoirs.

Syracuse City has made an application to attempt to secure additional water rights for irrigation. No decision on the application has been issued from the state engineer. At the time the application was made, the City was looking for ways to increase water supplies as demand on the supply grows in the future. The applications proposed to capture the shallow groundwater found through the City and utilize it in the secondary water system. These will need to be evaluated regarding their future need as well as the feasibility to divert the water and put it to use. If there is no intention or need for these rights in the future, then the applications may be withdrawn (Syracuse, 2014). Table 3-6 lists the unapproved applications.

Table 3-4: Existing Water Rights – Status[1]

Water Right #	Application	Status	Status Date	Priority Date	Proof Due
31-5207	A72447	APPL, approved	3/31/2000	6/16/2008	3/31/2024

1. Information on water rights is from the Utah Division of Water Rights website: https://www.waterrights.utah.gov/wrinfo/query.asp.

Table 3-5: Existing Water Rights – Quantity[1]

Water Right #	Flow (cfs)	Flow (gpm)	Flow (AF/yr)
31-5207	5.0	2,244	3,619.89
Syracuse Total Water Rights	**5.0**	**2,244**	**3,619.89**

1. Information on water rights is from the Utah Division of Water Rights website: https://www.waterrights.utah.gov/wrinfo/query.asp.

Table 3-6: Water Rights – Non-Appropriated Water Rights[1]

Water Right #	Proposed Points of Diversion	Status	Flow (cfs)	Flow (gpm)	Flow (AF/yr)
31-5227	Multiple 72 Sites	A74751	-	2,480	4,000
31-5229	Prestwick Subdivision 5 Sites	A74845	-	740	1,193
31-3070	1000 West Bluff Road	A27680	3.0	1,346	2,172

1. Information on water rights is from the Utah Division of Water Rights website: https://www.waterrights.utah.gov/wrinfo/query.asp.

3.3.2 Level of Service and Evaluation

Typically, a system's sources are designed for peak day demand. This is what has been used in the analysis of Syracuse City's sources.

See Table 3-7 for a comparison of the demands and capacity of the available sources. The level of service for both average annual and peak day conditions is based on the USU estimate with 50% irrigation efficiency.

Table 3-7: Existing Water Rights: Demand and Capacity

Description	cfs	gpm[2]	AF/yr	Is there sufficient capacity?
Current Resources				
Syracuse-approved	5.0	2,244	3,620	-
Other Sources	19.7	8,832	7,026	
Total Current Supply	**24.7**	**11,076**	**10,646**	
Average Annual Use				
USU Minimum Requirement – 4.4 AF/irrigated acre[1]	-	-	6,952	yes
Peak Day Demand				
USU Minimum Requirement – 6.44 gpm/irrigated acre[1]	22.7	10,175	-	yes

1. Rates based on the 1998 document by Utah State University titled, "Consumptive Use of Irrigated Crops in Utah." The irrigation efficiency is 50%.
2. This assumes water is delivered for 180 days, 24 hours per day for the other sources and 365 days per year, 7 days per week and 24 hours per day for the Syracuse water right.

The table indicates that there is sufficient capacity to meet the level of service determined by current use for the peak day diversion rate and there is sufficient capacity to meet the level of service for average annual conditions. The canal pump currently pumps about 850 gpm and its maximum capacity is 1,800 gpm. The water rights will allow a maximum pump output of 2,244 gpm. The City may want to have their approved water right certificated (31-5207) before the proofs are due.

3-4 Existing Water Storage

This Master Plan and Impact Fee Facilities Plan does not discuss the condition of the City's water storage facilities.

3.4.1 Capacity

Water storage provides a reserve to compensate for varying demand as a result of time of day and the season. The City may also elect to include a volume of water for emergency storage in the event of down time for some transmission lines or other critical system components. While secondary water is supplied to keep up with the peak day demand, the difference between the daily demand and hourly demand is supplied from the water stored.

Table 3-8 lists the City's existing storage reservoirs. These include 3 reservoirs—the Bluff Pond, the Freeport Reservoir and the Jensen Pond. The existing maximum volume of all storage reservoirs is 49 AF. The operating volume is the amount of water that is available to be used at the maximum drawdown level in the reservoir. The Jensen Pond is 24 feet deep, however, only 4 feet of depth can be used for the secondary water system due to the elevation of the pump station intake. The City also has a standpipe that is referred to as the Secondary Tank. The volume of the Secondary Tank is minimal at 1.0 AF (0.326 Mgal) and was not considered in the storage capacity calculations due to its minimal size. The elevation of the Secondary Tank is used to control pressure in the water system.

Table 3-8: Existing Water Storage

Location	Surface Area	Maximum Depth	Operating Depth	Storage Maximum Operating Volume		Elevation of Water Surface
	Acres	FT	FT	Mgal	AF	FT
Bluff Pond[1]	1.2	11	6	4.20	12.90	4262
Freeport Reservoir[2]	1.0	14	11	3.94	12.09	4368
Jensen Pond[3]	6	24	4	7.82	24.00	4245
Secondary Tank/Standpipe[4]	0.033	30	-	-	-	4470
Total				**15.96**	**49.00**	

1. The Bluff Pond pumps alarm at 5 ft and turn off at 3 ft as reported by the City.
2. The Freeport Reservoir pumps alarm at 6 ft and turn off at 3 ft as reported by the City.
3. The Jensen Pond pumps alarm at 16 ft and turn off at 15 ft as reported by the City.
4. The Secondary Tank is considered to be a stand pipe and its storage capacity is not included in the total due to its relatively small volume.

Storage can be divided into two categories.

- Equalization storage volume to satisfy peak hour demands. This is based on irrigation zones. According to the figure published by the USDA, titled "Irrigated Crop Consumptive Use Zones and Normal Annual Effective Precipitation," Syracuse City is in zone 4 (Soil Conservation Service, 1978). The minimum storage is calculated based on the zone and a gallon/irrigated acre rate published by the State of Utah in the Utah Administrative Code R309-510 (UAC, 2016).
- Emergency storage volume to meet emergency demands in the event of some type of system failure. This volume is determined by the City and has previously been set at 1 day of peak day demand. This would allow some needed water while the source is cut off.

Equalization Storage –State of Utah Minimum Requirement

- Outdoor Use for Zone 4: 2,848 gal/irr acre X 1,580 irr acres = 4.50 Mgallons
- Indoor use requirements and demands will be discussed in the Culinary Water Master Plan.

Emergency Storage-City Required

- 1 day of peak day storage: 1 x 6.44 gpm/irr acre X 1,580 irr acres = 10.99 Mgallons[1]

1. Syracuse currently restricts residential watering from 10 AM to 6 PM, but does allow larger users such as school and churches to water during the restricted time. For this reason, 18 hours of watering time is used for this calculation.

3.4.2 Level of Service and Evaluation

Typically, a system's storage is designed for equalization and emergency storage. This is what has been used in the analysis of the Syracuse City's storage reservoirs.

See Table 3-9 for a comparison of the demands and capacity of the available storage reservoirs. The level of service is based on the State's and City's minimum requirements.

Table 3-9: Existing Water Storage: Demand and Capacity

Description	Mgallons	AF	Is there sufficient capacity?
Current Capacity/ Resources			
Bluff Pond	4.2	12.9	
Freeport Reservoir	3.94	12.09	
Jensen Pond	7.82	24.00	-
Total Current Capacity/ Resources	**15.96**	**49.00**	
Current Demand			
Equalization: State of Utah – 2,848 gal/irr acre[1]	4.50	13.81	-
Emergency Storage: City Required – 1 day of Peak Day Storage[2]	10.99	33.73	-
Total Current Demand	**15.49**	**47.54**	**Yes**

1. From the Utah Administrative Code, R309-510-8 Storage Sizing: http://www.rules.utah.gov/publicat/code/r309/r309-510.htm. Zone 4.
2. 1 peak day assuming there are 18 hours of operation in a peak day

There is sufficient capacity to meet the level of service for secondary water storage based on the existing level of service.

3-5 Existing Water Distribution System

This Master Plan and Impact Fee Facilities Plan do not discuss the condition of the City's water distribution system.

3.5.1 Condition

The distribution system includes water lines varying in size from 3 to 24-inches. There is a total of 121 miles of pipelines in the City. Table 2-11 shows a breakdown of the distribution system pipelines by size and total length (in feet and miles) according to information provided by the City. The smaller pipelines and some larger ones (18-inch) were first put in in the 1980s, while the oldest larger diameter (20 and 24-inch) pipelines date to the early 2000s. The age of the pipelines is relatively young.

Table 3-10: Distribution System Breakdown[1]

Size (inch)	Length (LF)	Length (Miles)
3	40,269	7.63
4	33,348	6.32
6	132,838	25.16
8	287,075	54.37
10	40,282	7.63
12	53,252	10.09
16	20,672	3.92
18	22,524	4.27
20	9,187	1.74
24	10	0.002
Total	**639,496**	**121**

1. All information was provided by the City.

3.5.2 Modeling

The hydraulic model for Syracuse City was built in Innovyse's water modeling software called infowater. The model uses data for tanks, pipes, valves, and pumps to calculate pressures throughout the system. The demands were calculated and then loaded into the model (see section 3-1). Information about pipes, tanks, valves and pumps were provided by Syracuse City in GIS format and loaded into the model. The model was used to analyze peak day and peak instantaneous scenarios. These same scenarios were analyzed for existing conditions, future 2026, and buildout conditions. The pressures calculated in the model were then used to verify they met the minimum level of service of 45 psi as outlined by Syracuse City. The model was used to identify existing deficiencies as well as future deficiencies and solutions to fix the deficiencies.

3.5.3 Level of Service and Evaluation

The distribution system sizing should be based on the peak instantaneous demand. The USU estimate is 12.23 gpm/irrigated acre with an irrigation efficiency of 50%.

The distribution system existing level of service is based upon the peak instantaneous flow of 12.23 gpm/irrigated acre, which is the USU estimate. The City would also like their level of service to reflect a minimum pressure of 45 psi.

It is assumed that the minimum pipe size for all new developments is 8-inch diameter. Certain developments with large water users may require the installation of larger pipes. It is recommended that this aspect be considered on a case-by-case basis as new development is planned and reviewed.

Figure 3-2 (Appendix B) shows the peak instantaneous system pressure for the existing water system. There are multiple areas in the northeast area of the system where pressures are below 45 psi.

See Table 3-11 for a comparison of the demands and capacity of the distribution system.

Table 3-11: Existing Water Distribution System: Demand and Capacity

Description	Zone 1	Is there sufficient capacity?
Current Resources		
During Peak Instantaneous Demand	45	no

There is not sufficient capacity to meet the level of service for the secondary water distribution system. The pressures are below the level of service of 45 psi due to the difference in elevation between the Secondary Tank (standpipe) and the specific point/node in the City as well as pressure loss in pipelines. This existing deficiency will be discussed in Chapter 5.

4 – FUTURE SYSTEM EVALUATION

The future service area includes both the city boundary and the future annexation area (Syracuse, 2015). Syracuse City anticipates that the boundaries of the city will increase over time as demand for growth increases (Syracuse, 2014). The future service area is estimated based upon the land use classifications (density) and boundaries established by the City's General Plan. Much of the surrounding undeveloped land is unincorporated and is not adjacent to neighboring municipalities. Future demands on the system will occur in sections of the City already developed, in currently undeveloped areas of the city, and in the future annexation areas. Future demands on the water system have been estimated based upon the land use classifications established by the City's General Plan (Syracuse City, 2015). It is expected that changes will occur over time to both the service boundaries and land densities (Syracuse City, 2014). However, this analysis is based on what is currently adopted and master planned for future development (Syracuse City, 2015). As such, changes to this plan may be necessary as growth proceeds (Syracuse City, 2014). All areas of future demand were assumed to have secondary pressure irrigation available. Appendix B, Figure 4-1, contains a map showing the future service area and the proposed water system improvements to serve the future service area.

4-1 Future Demands and Level of Service

The future demand was calculated to determine deficiencies in the City's water system. Then, the future demand was input into the water model and various scenarios of flow conditions were evaluated. From these scenarios, areas of low pressure or flow (deficiencies) can be determined.

The future demands are a function of the existing gross acreage and irrigated acreage. Chapter 2 above provides more detail on the population, ERCs, gross acreage and irrigated acreage.

Water use at individual connections is not metered. Therefore, the amount of water that is lost to leaks or other demands is unknown.

For the model it was assumed that all of the connections had secondary water available for outdoor uses. For planning purposes, it is assumed that all new growth will use secondary water for irrigation.

The assumption has been made that future demand characteristics will be similar to current patterns for similar land uses. The existing level of service will be the same level of service for the future for the water sources, storage and distribution system. Table 4-1 summarizes the level of service and future demands.

Table 4-1 is a summary of the demands and level of service for the source, storage and distribution system.

Table 4-1: Summary of Level of Service and Demands

		Year 2016	Year 2026	Build-out/2038
	Required irrigated acre	**1,580 irr acres**	**1,913 irr acres**	**2,406 irr acres**
Water Source	9,274 gpd/irr acre -peak day	10,175 gpm	12,318 gpm	15,494 gpm
Water Rights	5.3 af-yr/irr acre -average annual	8,374 af/yr	10,138 af/yr	12,751 af/yr
Water Storage	12,122 gal/irr acre -peak day	15.49 Mgal	18.75 Mgal	23.59 Mgal
Water Distribution	Minimum pressure	45 psi	45 psi	45 psi

4-2 Future Water Sources / Supply and Water Rights

Based upon current growth rates for Syracuse and the USU Report's guidelines for supply, the existing sources are adequate for the average annual demand, but not adequate for the peak day demand. The main sources of supply will continue to be secondary water from Weber Basin Water Conservancy District and the Davis and Weber Canal Company.

The water requirement was analyzed in two different aspects. The first is on a flow rate or diversion basis. This diversion rate is the rate at which water must be supplied to meet the peak day demand (in gpm or cfs). The second approach looks at the volume of water needed for the annual projected use (in ac-ft/yr). Table 4-2 shows the peak day demand and Table 4-3 show the annual projected water use versus the water supply. Tables 4-4 and 4-5 show the peak day and average annual demands compared to the water rights diversion rate. In all of the tables the right hand column shows the excess capacity or deficiency for the system and the year that that occurs. It should be noted that the annual projected water volume in Table 4-3, is a yearly average. Demand will be slightly higher during peak events, and so a greater volume of water than the yearly average will be required.

Both the peak day and annual average demands were calculated based on the projected number of irrigated acres. Irrigated acres-based projections have been created to determine approximately when the existing sources and water rights diversion rate will be exceeded based upon both a peak day and an annual use or volume basis. See Table 2-2 for the projected number of irrigated acres and gross acres for each year. Total future water demand at build out was estimated to be 15,494 gpm for peak day in the year 2038.

In addition to the sources noted in Table 3-2, additional secondary water will be added to the system at a rate of 3 acre-feet/gross acre for residential developments and 4 acre-feet/irrigated acre for non-residential developments (See ordinance in Appendix A).

Table 4-2: Peak Day Source Water Supply Assessment for Planning Period

Year[3]	Peak Day Demand (gpm)[1,2]	Supply (gpm)								Excess Capacity (gpm)
		Syra-cuse	D&W-West Branch	D&W-Clearfield Irrigation	WBWCD-Contract	WBWCD-Layton Canal	Hooper Irrigation Co.	Water from Development Agreements-total[4]	Total Supply	
2016	10,175	850	5,046	1,244	1,456	1,399	68	0	10,063	-112
2017	10,372	850	5,046	1,244	1,456	1,399	68	291	10,354	-17
2018	10,572	850	5,046	1,244	1,456	1,399	68	590	10,653	81
2019	10,776	850	5,046	1,244	1,456	1,399	68	896	10,959	183
2020	10,984	850	5,046	1,244	1,456	1,399	68	1,209	11,273	289
2021	11,196	850	5,046	1,244	1,456	1,399	68	1,531	11,594	398
2022	11,412	850	5,046	1,244	1,456	1,399	68	1,860	11,923	512
2023	11,632	850	5,046	1,244	1,456	1,399	68	2,198	12,261	629
2024	11,856	850	5,046	1,244	1,456	1,399	68	2,544	12,607	751
2025	12,085	850	5,046	1,244	1,456	1,399	68	2,899	12,962	876
2026	12,318	850	5,046	1,244	1,456	1,399	68	3,262	13,325	1,007
2027	12,556	850	5,046	1,244	1,456	1,399	68	3,635	13,698	1,142
2028	12,798	850	5,046	1,244	1,456	1,399	68	4,017	14,080	1,282
2029	13,045	850	5,046	1,244	1,456	1,399	68	4,409	14,472	1,427
2030	13,297	850	5,046	1,244	1,456	1,399	68	4,811	14,874	1,577
2031	13,554	850	5,046	1,244	1,456	1,399	68	5,224	15,287	1,733
2032	13,815	850	5,046	1,244	1,456	1,399	68	5,646	15,709	1,894
2033	14,082	850	5,046	1,244	1,456	1,399	68	6,080	16,143	2,061
2034	14,354	850	5,046	1,244	1,456	1,399	68	6,525	16,588	2,234
2035	14,631	850	5,046	1,244	1,456	1,399	68	6,981	17,044	2,414
2036	14,913	850	5,046	1,244	1,456	1,399	68	7,449	17,512	2,599
2037	15,201	850	5,046	1,244	1,456	1,399	68	8,023	18,086	2,885
2038	15,494	850	5,046	1,244	1,456	1,399	68	8,423	18,486	2,992

1. The overall land growth rate, which the peak day demand is a function of, is 1.93% annual average—2.09% for residential, 4.18% for non-residential and 0.28% for agricultural. Analyzing the amount of irrigated acres on a typical property resulted in 25% of gross acreage is typically irrigated. See Table 2-2.
2. The peak day demand is based on the USU guideline of 6.44 gpm/irrigated acre at an irrigation application efficiency of 50%.
3. Build-out is assumed to occur in 2038. See Chapter 2 for more discussion on build-out.
4. Developers are required to provide 3 acre-feet of water per gross acre for residential developments and 4 acre-feet of water per irrigated acre for commercial and industrial developments (non-residential and non-agricultural). The number is the total amount added each year added to the amount from the prior year. See the City's ordinance in Appendix A.

Table 4-3: Annual Average Source Water Supply Assessment for Planning Period

Year[3]	Average Annual Demand (AF)[1,2]	Supply (AF)								Excess Capacity (AF)
		Syracuse	D&W-Weber Branch	D&W-Clearfield Irrigation	WBWCD-Contract	WBWCD-Layton Canal	Hooper Irrigation Co.	Water from Development Agreements-total[4]	Total Supply	
2016	8,374	676	4,014	990	1,158	1,113	54	0	8,005	-369
2017	8,536	676	4,014	990	1,158	1,113	54	232	8,237	-299
2018	8,700	676	4,014	990	1,158	1,113	54	469	8,475	-226
2019	8,868	676	4,014	990	1,158	1,113	54	713	8,718	-150
2020	9,039	676	4,014	990	1,158	1,113	54	962	8,967	-72
2021	9,214	676	4,014	990	1,158	1,113	54	1218	9,223	9
2022	9,392	676	4,014	990	1,158	1,113	54	1480	9,485	93
2023	9,573	676	4,014	990	1,158	1,113	54	1748	9,754	181
2024	9,758	676	4,014	990	1,158	1,113	54	2024	10,029	271
2025	9,946	676	4,014	990	1,158	1,113	54	2306	10,311	365
2026	10,138	676	4,014	990	1,158	1,113	54	2595	10,600	462
2027	10,333	676	4,014	990	1,158	1,113	54	2892	10,897	563
2028	10,533	676	4,014	990	1,158	1,113	54	3196	11,201	668
2029	10,736	676	4,014	990	1,158	1,113	54	3508	11,513	777
2030	10,943	676	4,014	990	1,158	1,113	54	3827	11,833	889
2031	11,154	676	4,014	990	1,158	1,113	54	4155	12,161	1,006
2032	11,370	676	4,014	990	1,158	1,113	54	4492	12,497	1,127

Year[3]	Average Annual Demand (AF)[1,2]	Supply (AF)								Excess Capacity (AF)
		Syracuse	D&W-Weber Branch	D&W-Clearfield Irrigation	WBWCD-Contract	WBWCD-Layton Canal	Hooper Irrigation Co.	Water from Development Agreements-total[4]	Total Supply	
2033	11,589	676	4,014	990	1,158	1,113	54	4837	12,842	1,253
2034	11,813	676	4,014	990	1,158	1,113	54	5191	13,196	1,383
2035	12,041	676	4,014	990	1,158	1,113	54	5554	13,559	1,518
2036	12,273	676	4,014	990	1,158	1,113	54	5926	13,931	1,658
2037	12,510	676	4,014	990	1,158	1,113	54	6382	14,387	1,877
2038	12,751	676	4,014	990	1,158	1,113	54	6700	14,705	1,954

1. The overall land growth rate, which the peak day demand is a function of, is 1.93% annual average—2.09% for residential, 4.18% for non-residential and 0.28% for agricultural. Analyzing the amount of irrigated acres on a typical property resulted in 25% of gross acreage is typically irrigated. See Table 2-2.
2. The average annual demand is based on the USU guideline of 5.3 AF/irrigated acre.
3. Build-out is assumed to occur in 2038. See Chapter 2 for more discussion on build-out.
4. Developers are required to provide 3 acre-feet of water per gross acre for residential developments and 4 acre-feet of water per irrigated acre for commercial and industrial developments (non-residential and non-agricultural). The number is the total amount added each year added to the amount from the prior year. See the City's ordinance in Appendix A.

Table 4-4: Peak Diversion Water Right Assessment for Planning Period

Year[3]	Demands		Supply (cfs)				Excess Capacity (cfs)
	Peak Day Demand (gpm)[1,2]	Peak Day Demand (cfs)	Syracuse Diversion Rate (cfs)[5]	Other Sources Diversion Rate (cfs)[5]	Water from Development Agreements-total (cfs)[4]	Total Right (cfs)	
2016	10,175	22.67	5.00	20.53	0.00	25.53	2.86
2017	10,372	23.11	5.00	20.53	0.65	26.18	3.07
2018	10,572	23.56	5.00	20.53	1.31	26.84	3.29
2019	10,776	24.01	5.00	20.53	2.00	27.52	3.51
2020	10,984	24.47	5.00	20.53	2.69	28.22	3.75
2021	11,196	24.95	5.00	20.53	3.41	28.94	3.99

Year[3]	Demands		Supply (cfs)				Excess Capacity (cfs)
	Peak Day Demand (gpm)[1,2]	Peak Day Demand (cfs)	Syracuse Diversion Rate (cfs)[5]	Other Sources Diversion Rate (cfs)[5]	Water from Development Agreements-total (cfs)[4]	Total Right (cfs)	
2022	11,412	25.43	5.00	20.53	4.14	29.67	4.25
2023	11,632	25.92	5.00	20.53	4.90	30.43	4.51
2024	11,856	26.42	5.00	20.53	5.67	31.20	4.78
2025	12,085	26.93	5.00	20.53	6.46	31.99	5.06
2026	12,318	27.45	5.00	20.53	7.27	32.80	5.35
2027	12,556	27.98	5.00	20.53	8.10	33.63	5.65
2028	12,798	28.52	5.00	20.53	8.95	34.48	5.96
2029	13,045	29.07	5.00	20.53	9.82	35.35	6.29
2030	13,297	29.63	5.00	20.53	10.72	36.25	6.62
2031	13,554	30.20	5.00	20.53	11.64	37.17	6.97
2032	13,815	30.78	5.00	20.53	12.58	38.11	7.33
2033	14,082	31.38	5.00	20.53	13.55	39.08	7.70
2034	14,354	31.98	5.00	20.53	14.54	40.07	8.08
2035	14,631	32.60	5.00	20.53	15.56	41.08	8.48
2036	14,913	33.23	5.00	20.53	16.60	42.13	8.90
2037	15,201	33.87	5.00	20.53	17.88	43.40	9.53
2038	15,494	34.52	5.00	20.53	18.77	44.30	9.77

1. The overall land growth rate, which the peak day demand is a function of, is 1.93% annual average—2.09% for residential, 4.18% for non-residential and 0.28% for agricultural. Analyzing the amount of irrigated acres on a typical property resulted in 25% of gross acreage is typically irrigated. See Table 2-2.
2. The peak day demand is based on the USU guideline of 6.44 gpm/irrigated acre at an irrigation application efficiency of 50%.
3. Build-out is assumed to occur in 2038. See Chapter 2 for more discussion on build-out.
4. Developers are required to provide 3 acre-feet of water per gross acre for residential developments and 4 acre-feet of water per irrigated acre for commercial and industrial developments (non-residential and non-agricultural). The number is the total amount added each year added to the amount from the prior year. See the City's ordinance in Appendix A.
5. See Chapter 3 for an assessment of the water rights and diversion rates.

Table 4-5: Annual Water Right Assessment for Planning Period

Year[3]	Average Annual Demand (AF/yr)[1,2]	Supply (AF/yr)				Excess Right (AF/yr)
		Syracuse Water Rights [5](AF/yr)	Other Sources[5] (AF/yr)	Water from Development Agreements-total[4] (AF/yr)	Total Right (AF/yr)	
2016	8,374	3620	7,329	0	10,949	2,575
2017	8,536	3620	7,329	232	11,181	2,645
2018	8,700	3620	7,329	469	11,418	2,718
2019	8,868	3620	7,329	713	11,662	2,793
2020	9,039	3620	7,329	962	11,911	2,872
2021	9,214	3620	7,329	1,218	12,167	2,953
2022	9,392	3620	7,329	1,480	12,429	3,037
2023	9,573	3620	7,329	1,748	12,697	3,124
2024	9,758	3620	7,329	2,024	12,972	3,215
2025	9,946	3620	7,329	2,306	13,255	3,309
2026	10,138	3620	7,329	2,595	13,544	3,406
2027	10,333	3620	7,329	2,892	13,841	3,507
2028	10,533	3620	7,329	3,196	14,145	3,612
2029	10,736	3620	7,329	3,508	14,456	3,720
2030	10,943	3620	7,329	3,827	14,776	3,833
2031	11,154	3620	7,329	4,155	15,104	3,950
2032	11,370	3620	7,329	4,492	15,441	4,071
2033	11,589	3620	7,329	4,837	15,786	4,196
2034	11,813	3620	7,329	5,191	16,139	4,327
2035	12,041	3620	7,329	5,554	16,502	4,462
2036	12,273	3620	7,329	5,926	16,875	4,602
2037	12,510	3620	7,329	6,382	17,331	4,821
2038	12,751	3620	7,329	6,700	17,649	4,898

1. The overall land growth rate, which the peak day demand is a function of, is 1.93% annual average—2.09% for residential, 4.18% for non-residential and 0.28% for agricultural. Analyzing the amount of irrigated acres on a typical property resulted in 25% of gross acreage is typically irrigated. See Table 2-2.
2. The average annual demand is based on the USU guideline of 5.3 AF/irrigated acre.
3. Build-out is assumed to occur in 2038. See Chapter 2 for more discussion on build-out.
4. Developers are required to provide 3 acre-feet of water per gross acre for residential developments and 4 acre-feet of water per irrigated acre for commercial and industrial developments (non-residential and non-agricultural). The number is the total amount added each year added to the amount from the prior year. See the City's ordinance in Appendix A.
5. See Chapter 2 for an assessment of the water rights and diversion rates.

Table 4-2 indicates that the City's secondary system sources are initially not keeping up with demand. The City is currently about 112 gpm short on peak day demand versus supply. As noted previously, the City feels like due to how they manage the supply (more from some sources during peak months and less during months of lower water use) that their actual supply can meet the existing demand.

As the years go by the deficiency will decrease as more water is added to the system from development agreements. The water is added at a rate of 3 acre-feet per gross acre for residential developments and 4 acre-feet per irrigated acre for non-residential/commercial/industrial developments (See the ordinance in Appendix A).

There is sufficient water supply and water rights capacity to meet the level of service for peak day and average annual conditions if the maximum supply is delivered. However, in recent years half of the supply has been delivered. A previous water rights investigation had noted that in 2013 only 49% of the allotted water was actually allocated to Syracuse (Syracuse, 2014). This included 75% from the Davis and Weber Counties Canal Company through both the Weber Branch and the Clearfield Irrigation Company, 64% from WBWCD through the Layton Canal and only 45% through WBWCD contract water.

The canal pump currently pumps about 850 gpm and its maximum is 1,800 gpm. The water rights will allow a maximum pump output of 2,244 gpm.

The City will want to have their approved water right certificated (31-5207) before the proofs are due.

4.2.1 Future Potential Sources – Water Reuse

While the amount of water available for secondary water on paper appears sufficient for the future. The City is concerned about the impact that a drought could have on the availability of its secondary water supplies. The City evaluated the cost to use treated wastewater from the North Davis Sewer District (NDSD) for 25% of its supply. This scenario would assume that there would be a drought reduction of 25% of its existing supplies, which occurred in 2011 and 2013. Wastewater production typically does not decrease during times of drought. This would allow the City to have a safety net for its secondary water supplies while still promoting conservation, but not requiring a curtailment of use.

North Davis Sewer District treats wastewater for Syracuse and surrounding communities. They are located approximately 830 feet to the west. NDSD operates a secondary treatment facility, which is suitable for discharging waste to the Great Salt Lake. NDSD discharges all of its treated effluent to the Great Salt Lake. In order to reuse the NDSD effluent for secondary water in Syracuse's secondary system a number of upgrades would need to occur in order to treat the effluent to what the Utah State Division of Water Quality (DWQ) (the regulatory authority) calls Type I water.

The sections below detail the key considerations for wastewater reuse.

Permitting and Regulatory requirements
Type I water is suitable for contact with humans. Type I reuse is governed by the Utah Administrative Codes R317-3 and R317-13. DWQ's regulatory requirements are as follows:

- Biochemical Oxygen Demand (BOD) of less than 10 mg/L based on weekly composite sampling.
- Turbidity of less than 2 NTU (daily arithmetic mean) and 5 NTU (maximum) measured continuously.
- E. coli of none detect (weekly median) and 9 organisms/100 mL (maximum) based on daily grab samples.
- Total Residual Chlorine of no less than 1.0 mg/L after 30 minutes' contact time at peak flow as measured continuously.
- pH between 6 and 9 as determined by daily grab samples or continuous monitoring.

In order to treat wastewater to Type I standards that meet the requirements noted above NDSD would need to add tertiary treatment for reuse. This would include filtration and disinfection. There are many types of filters available on the market including cloth filters, conventional media filters, continuous backwash filters and membranes. Typical disinfection is done using either chlorine or ultraviolet light (UV). "Much of the infrastructure to support chlorine disinfection is already present" (NDSD, 2007).

DWQ requires Utah Pollutant Discharge Elimination System (UPDES) permits for all discharge points from wastewater treatment plants. Currently, NDSD has an UPDES permit to discharge to the Great Salt Lake only. Syracuse would need to work with DWQ and NDSD to have DWQ issue an UPDES permit for reuse water being produced at NDSD. The outfall/point of compliance would likely be the point where the effluent leaves the reuse plant and is considered irrigation water.

In addition, a Reuse Project Plan is required.

Salinity
Salinity concentrations are an important consideration when considering reuse. While the secondary maximum contaminant level for drinking water for total dissolved solids (TDS), which is a measure of the salinity of a water, is 500 mg/L, in irrigation the aim is to provide water that has a TDS concentration below 750 mg/L.

The NDSD Water Reuse report indicated that the highest monthly average TDS concentration was 830 mg/L (NDSD, 2007). This value is acceptable. Good drainage is suggested.

Public perception
While public perception of reuse projects has been an issue across the country in the past, today there are more and more projects popping up even in Utah. In November 2013 the first water reclamation facility producing Type I water went online in Santaquin, Utah. In the

summer of 2014 the City reused over 80 million gallons of Type I reclaimed water in the City's pressurized irrigation system.

Water quantity

If the City were to receive 25% of its supply from reuse water that would be the amounts shown in Table 4-6. The section on Water rights, below, notes that the City is limited to using 2,193 gpm due to their available water rights for culinary water.

Table 4-6: Peak Day Source Water Reuse Supply Assessment for Planning Period

Year[3]	Peak Day Demand (gpm)[1,2]	Potential Water Reuse Supply (gpm)[4]	Potential Water Reuse Supply (mgd)[4]
2016	10,175	2,544	3.66
2017	10,372	2,593	3.73
2018	10,572	2,643	3.81
2019	10,776	2,694	3.88
2020	10,984	2,746	3.95
2021	11,196	2,799	4.03
2022	11,412	2,853	4.11
2023	11,632	2,908	4.19
2024	11,856	2,964	4.27
2025	12,085	3,021	4.35
2026	12,318	3,080	4.43
2027	12,556	3,139	4.52
2028	12,798	3,200	4.61
2029	13,045	3,261	4.70
2030	13,297	3,324	4.79
2031	13,554	3,388	4.88
2032	13,815	3,454	4.97
2033	14,082	3,520	5.07
2034	14,354	3,588	5.17
2035	14,631	3,658	5.27
2036	14,913	3,728	5.37
2037	15,201	3,800	5.47
2038	15,494	3,874	5.58

1. The overall land growth rate, which the peak day demand is a function of, is 1.93% annual average—2.09% for residential, 4.18% for non-residential and 0.28% for agricultural. Analyzing the amount of irrigated acres on a typical property resulted in 25% of gross acreage is typically irrigated. See Table 2-2.
2. The peak day demand is based on the USU guideline of 6.44 gpm/irrigated acre at an irrigation application efficiency of 50%.
3. Build-out is assumed to occur in 2038. See Chapter 2 for more discussion on build-out.
4. The water reuse supply is projected to be 25% of the peak day demand.

Water quality
The Type I water reuse water quality requirements are summarized in the following table.

Table 4-7: Type I Water Reuse Requirements

Type I Water Reuse Requirements[1]					
Parameter	**Max Monthly Avg**	**Max Weekly Avg**	**Min Daily**	**Daily Avg**	**Max Daily**
Turbidity (NTU)	NA	NA	NA	2	5
BOD_5 (mg/L)	10	NA	NA	NA	NA
E-Coli (No./100mL)	NA	ND	NA	NA	9
pH	NA	NA	6	NA	9
Total Residual Chlorine (mg/L)	NA	NA	1.0	NA	NA

NA-Not applicable; ND-Non detect
1. From the Utah Administrative Code R317-3-11.

The UPDES permit available for NDSD on DWQ's website expired in 2013, so there is likely a more up-to-date permit available. However, the permit available online is likely similar to their current UPDES permit. Their discharge point is listed as "through a 54-inch diameter gravity flow concrete pipe leading from the chlorine contact basin to an unnamed irrigation return drainage ditch and hence to the Great Salt Lake." Their secondary treatment limits are as follows in Table 4-8.

In NDSD's 2007 report they note potential concerns with the use of reuse water in Freeport Reservoir including "eutrophication of the water body, ammonia toxicity and endocrine disruption for fish or other aquatic biota." The report continues, "the reuse water would have higher nutrient concentrations than the current canal water. This would be beneficial for lawn and golf course irrigation by the city, but may potentially cause eutrophication in the pond. It should be noted that if the Layton canal is used to transport reuse water to other users excluding the Syracuse City pond, the reuse water can be put into the canal downstream of the Syracuse City diversion, so there would be no effect on the existing water quality used by the City in their pond."

Table 4-8: NDSD Effluent Limitations

NDSD Effluent Limitations[1]				
Parameter	**Max Monthly Avg**	**Max Weekly Avg**	**Min Daily**	**Max Daily**
BOD5, mg/L; BOD5 Min % Removal	25; 85	35; NA	NA; NA	NA; NA
TSS, mg/L; TSS Min % Removal	25; 85	35; NA	NA; NA	NA; NA

NDSD Effluent Limitations[1]				
Parameter	**Max Monthly Avg**	**Max Weekly Avg**	**Min Daily**	**Max Daily**
E-Coli (No./100mL)	126	157	NA	NA
pH	NA	NA	6.5	9.0
Total Residual Chlorine (mg/L)	NA	NA	NA	2.5
WET, Acute Biomonitoring	NA	NA	NA	Pass/Fail
Oil & Grease, mg/L	NA	NA	NA	10

NA-Not applicable; ND-Non detect

1. North Davis Sewer District UPDES permit limits.

In comparing the effluent limits in Tables 3-3b and c it is clear that the current NDSD treatment strategy is not sufficient to meet strict Type I reuse requirements.

Water rights

In 1995 the Utah State Legislature passed the Conservation and Use of Sewage Effluent Act, which sets forth basic guidelines regarding administration of water rights for water reuse projects. The act also authorized the State Engineer to make rules regarding the notification process for water reuse projects.

In relation to the City, the law states that they "may contract with the person responsible for administration of a regional Publicly-Owned Treatment Works (POTW) to act as its agent for the purpose of using sewage effluent discharge from the regional POTW." The city must have valid water rights for the water produced at the POTW—the water that is sent to NDSD by Syracuse. According to the act, the City may use the treated effluent for "a beneficial use consistent with, and without enlargement of, those water rights." The City must file a notification with the State Engineer prior to using the water.

The City has 4.887 cfs and 3,521 acre-feet of year of water rights associated with their culinary water system, which is 2,193 gpm.

Budgetary Cost Estimates

The capital expenditure for filtration, disinfection, and pumping equipment at NDSD to produce Type I water would be approximately $12.52M in capital costs to complete the requirements for reuse of the NDSD effluent. This assumes a separate building needs to be constructed for the filtration and disinfection equipment, and pipelines and a pump station would also be required. Costs are based on providing infrastructure with a capacity for 5.5 MGD of reuse water (approximately 25% of peak day demand at build-out). The capital costs assume that there are no costs for purchasing land or easements, that these are all donated by NDSD or the City. As a comparison, in the Water Reuse Feasibility Study completed in 2007 the price for reusing 8.4 cfs was estimated as $309-538/acre-foot (NDSD, 2007). In the Market Re-evaluation study of 2011 these costs were increased to $328-562/acre-foot (NDSD, 2011).

Annual costs would be approximately $0.976M, resulting in a 25-year life cycle cost of $24.40M. The life cycle and annual cost estimates assume that there are no grants or cash-on-hand and that the loan rate for the remainder of the project cost is 3%. The cost of an acre-foot of water over the 25-year period would be $321.

4-3 Future Water Storage

Along with the existing storage assumptions discussed in the previous section, future storage requirements are determined based on the assumptions listed below:

- Secondary water will be available in newly developed areas.
- Most of the new development will be residential areas, so the typical residential demand currently experienced for a connection with secondary water has been applied for undeveloped areas.
- The level of service is based on the State minimum guidelines.

The State of Utah has minimum guidelines for establishing equalization storage volumes. Typically, cities determine necessary emergency storage. The level of service for storage is based on 2,848 gallons/irrigated acre for equalization and 1 day of peak day flow for emergency storage.

Table 4-9 shows the storage assessment. The available storage includes the city's three reservoirs (4.2 MG Bluff Pond, 3.94 MG Freeport Reservoir and 7.82 MG Jensen Pond).

Table 4-9: Storage Assessment for Planning Period

Year[3]	Storage Needs (Million Gallons)			Storage Available (Million Gallons)				Excess Storage (Mgal)
	EQ[2]	Emer-gency[2]	Total Storage Needs	Bluff Pond	Freeport Reservoir	Jensen Pond	Total	
2016	4.50	10.99	15.49	4.20	3.94	7.82	15.96	0.47
2017	4.59	11.20	15.79	4.20	3.94	7.82	15.96	0.17
2018	4.68	11.42	16.09	4.20	3.94	7.82	15.96	-0.13
2019	4.77	11.64	16.40	4.20	3.94	7.82	15.96	-0.44
2020	4.86	11.86	16.72	4.20	3.94	7.82	15.96	-0.76
2021	4.95	12.09	17.04	4.20	3.94	7.82	15.96	-1.08
2022	5.05	12.32	17.37	4.20	3.94	7.82	15.96	-1.41
2023	5.14	12.56	17.71	4.20	3.94	7.82	15.96	-1.75
2024	5.24	12.80	18.05	4.20	3.94	7.82	15.96	-2.09
2025	5.34	13.05	18.40	4.20	3.94	7.82	15.96	-2.44
2026	5.45	13.30	18.75	4.20	3.94	7.82	15.96	-2.79
2027	5.55	13.56	19.11	4.20	3.94	7.82	15.96	-3.15
2028	5.66	13.82	19.48	4.20	3.94	7.82	15.96	-3.52
2029	5.77	14.09	19.86	4.20	3.94	7.82	15.96	-3.90
2030	5.88	14.36	20.24	4.20	3.94	7.82	15.96	-4.28
2031	5.99	14.64	20.63	4.20	3.94	7.82	15.96	-4.67
2032	6.11	14.92	21.03	4.20	3.94	7.82	15.96	-5.07
2033	6.23	15.21	21.44	4.20	3.94	7.82	15.96	-5.48
2034	6.35	15.50	21.85	4.20	3.94	7.82	15.96	-5.89
2035	6.47	15.80	22.27	4.20	3.94	7.82	15.96	-6.31
2036	6.60	16.11	22.70	4.20	3.94	7.82	15.96	-6.74
2037	6.72	16.42	23.14	4.20	3.94	7.82	15.96	-7.18
2038	6.85	16.73	23.59	4.20	3.94	7.82	15.96	-7.63

1. The overall land growth rate, which the peak day demand is a function of, is 1.93% annual average—2.09% for residential, 4.18% for non-residential and 0.28% for agricultural. Analyzing the amount of irrigated acres on a typical property resulted in 25% of gross acreage is typically irrigated. See Table 2-2.
2. The storage requirements are based on the State minimum guidelines of 2,848 gal/irrigated acre for equalization and the emergency storage is based on 1 day of peak day demand, which is based on the USU guideline of 6.44 gpm/irrigated acre at an irrigation application efficiency of 50%.
3. Build-out is assumed to occur in 2038. See Chapter 2 for more discussion on build-out.

The storage assessment is indicating that there is a small excess storage capacity. By build-out the storage deficiency is expected to be close to 7.6 M gallons (23.3AC-FT).

4-4 Future Water Distribution System

Areas of future development have been modeled based on projected demands and assumed pipe locations. It is anticipated that 8-inch waterlines will be installed to serve future developments unless otherwise noted. A summary of the model results using the level of service based on peak instantaneous demands established in section 3.1.3 is included in Appendix C. The Table in Appendix C compares the pressure for a particular node at the 2016, 2026 and 2038 peak instantaneous demands. Model runs for the existing condition include all improvements listed under “Existing Deficiencies”, while model runs for the future condition include all improvements listed under “Future Deficiencies and Existing Deficiencies,” which includes the 2026 (10 year) and 2038 (build-out) conditions. See Figure 4-2 in Appendix B that shows the peak instantaneous system pressure for the proposed water system.

5 - SYSTEM DEFICIENCIES AND RESERVE CAPACITY

There is a deficiency with the existing system with a shortfall of the source/supply based on the level of service. As developers bring more water with each new development this deficiency will continue to diminish. There are no deficiencies in the existing system based on the City's level of service for water rights and water storage.

Future deficiencies are defined as those improvements required to maintain established levels of service at build-out. Of course the difficulty lies in determining the timing of needed improvements. Typically, the improvements are needed some time prior to build-out. Both the peak day and average annual source/supply and water right diversion rate are sufficient in the future as is the distribution system, once the existing deficiencies are addressed. The water storage has excess capacity of 0.47 MG and a future deficiency of 7.63 MG as build-out approaches.

Syracuse has experienced remarkable growth since 2000, but there are still sections of undeveloped land in the City. The construction sequence of the future deficiency projects will depend upon where development occurs. The model makes assumptions on where growth will occur based on discussions with the city. Development trends and rates will have an impact on where improvements are needed and when.

5-1 Water Sources / Supply and Water Rights

The capacity of the water sources are 850 gpm (676 acre-feet) from the canal pump (Syracuse water rights), 8,832 gpm (7,026 acre-feet) from the Davis and Weber Canal Company (Weber Branch and Clearfield Irrigation Company) and the Weber Basin Water Conservancy District (contract and Layton Canal). Also, additional water will come from development agreements added at a rate of 3 acre-feet per gross for residential developments and four acre-feet per irrigated for non-residential developments (See the ordinance in Appendix A). Initially the peak day supply is deficient through year 2020. As stated earlier the peak day and average annual supply have a reserve capacity through build-out. See Tables 5-1 and 5-2 for more analysis on the excess capacity or deficiency of the source.

Table 5-1: Peak Day Water Sources Excess Capacity/Deficiency

Year	Gross Acres	Irrigated Acres	Demand (gpm)	Excess Capacity/ Deficiency (gpm)	Excess Capacity/ Deficiency (%)
Capacity[1]	-[1]	-[1]	-[1]	-	-
2016	6,422	1,580	10,175	-112	-1%
2026	7,774	1,913	12,318	1,007	8%
Build-out/2038	9,779	2,406	15,494	2,991	16%

1. As long as the City continues to require water from development agreements added at a rate of three acre-feet per gross for residential developments and four acre-feet per irrigated for non-residential developments and this number exceeds the actual use supply will outpace the demand (See the ordinance in Appendix A).

Table 5-2: Average Annual Water Sources Excess Capacity/Deficiency

Year	Gross Acres	Irrigated Acres	Demand (AF)	Excess Capacity/ Deficiency (AF)	Excess Capacity/ Deficiency (%)
Capacity[1]	-[1]	-[1]	-[1]	-	-
2016	6,422	1,580	8,374	-369	-5%
2026	7,774	1,913	10,138	462	4%
Build-out/2038	9,779	2,406	12,751	1,954	13%

1. As long as the City continues to require water from development agreements added at a rate of three acre-feet per gross for residential developments and four acre-feet per irrigated for non-residential developments and this number exceeds the actual use supply will outpace the demand (See the ordinance in Appendix A).

The total water rights peak day and average annual diversion rates have reserve capacity through build-out. See Tables 5-3 and 5-4. As long as additional water from development agreements added at a rate of 3 acre-feet per gross for residential developments and four acre-feet per irrigated for non-residential developments there will be sufficient water rights to meet the demand because water is being added at a greater rate that it is being used (See ordinance in Appendix A).

Table 5-3: Peak Day Water Rights Excess Capacity/Deficiency

Year	Gross Acres	Irrigated Acres	Demand (gpm)	Excess Capacity/ Deficiency (gpm)	Excess Capacity/ Deficiency (%)
Capacity[1]	-[1]	-[1]	-[1]	-	-
2016	6,422	1,580	10,175	1,283	11%
2026	7,774	1,913	12,318	2,401	16%
Build-out/2038	9,779	2,406	15,494	4385	22%

1. As long as the City continues to require water from development agreements added at a rate of three acre-feet per gross for residential developments and four acre-feet per irrigated for non-residential developments and this number exceeds the actual use supply will outpace the demand (See the ordinance in Appendix A).

Table 5-4: Average Annual Water Rights Excess Capacity/Deficiency

Year	Gross Acres	Irrigated Acres	Demand (AF)	Excess Capacity/ Deficiency (AF)	Excess Capacity/ Deficiency (%)
Capacity[1]	-[1]	-[1]	-[1]	-	-
2016	6,422	1,580	8,374	2,575	24%
2026	7,774	1,913	10,138	3,406	25%
Build-out/2038	9,779	2,406	12,751	4,898	28%

1. As long as the City continues to require water from development agreements added at a rate of three acre-feet per gross for residential developments and four acre-feet per irrigated for non-residential developments and this number exceeds the actual use supply will outpace the demand (See the ordinance in Appendix A).

5-2 Water Storage

The capacity of the water storage reservoirs is 15.96 Mgal. See Table 5-5.

Table 5-5: Water Storage Excess Capacity/Deficiency

Year	Gross Acres	Irrigated Acres	Demand (Mgal)	Excess Capacity/ Deficiency (Mgal)	Excess Capacity/ Deficiency (%)
Capacity	6,874	1,691	20.50	-	-
2016	6,422	1,580	15.49	0.47	3
2026	7,774	1,913	18.75	-2.79	-17
Build-out/2038	9,779	2,406	23.59	-7.63	-48%

5-3 Water Distribution

An analysis was done to determine the excess capacity in the transmission and distribution lines. The existing peak instantaneous flow rate in the pipeline was compared to the maximum permissible flow in the pipeline. The maximum permissible velocity was established to be 5 feet/second for the purposes of this analysis (AWWA, 2005). So, the resulting diameter at 5 feet/second was compared to the actual diameter of the pipeline. The result is the size differential. Then, a “diameter difference” was assigned for every 2-inch difference based on the following intervals: greater than 10-inch equals 5 diameter, greater than 8-inch equals 4 diameter, greater than 6-inch equals 3 diameter, greater than 3-inch equals 2 diameter and greater than 2-inch equals 1 diameter. For example, a “five diameter” difference means that there are five pipe sizes between the actual and the minimum required diameter (calculated at 5 feet per second)—that is 16-inch, 14-inch, 12-inch, 10-inch and 8-inch. The “diameter difference” indicates the excess capacity in the pipeline.

Table 5-6 shows the excess capacity in the waterlines organized by the diameter larger than required for the year 2016.

Table 5-6: Distribution Excess Capacity-Year 2016

Diameter Difference	Diameter of Pipelines Affected (inches)	Number of Pipelines	Length of Pipelines (feet)	% of the Total Length
Five	12, 16, 18	24	13,392	2.17
Four	10,12,16,18	29	13,817	2.24
Three	8,10,12,16,18,20	420	155,596	25.19
Two	4,6,8,10,12,16,18	765	302,625	48.99
One	4,6,8,10,12,16,18	144	63,132	10.22
No Excess	3,4,6,8,10,12,16,18,20	158	69,171	11.20

1. The “diameter difference” was assigned for every 2-inch difference based on the following intervals: greater than 10-inch equals 5 diameter, greater than 8-inch equals 4 diameter, greater than 6-inch equals 3 diameter and greater than 3-inch equals two diameter and greater than 2-inch equals one diameter. For example, a

"five diameter" difference means that there are five pipe sizes between the actual and the minimum required diameter (calculated at 5 feet per second)—that is 16-inch, 14-inch, 12-inch, 10-inch and 8-inch.

5-4 Cost of Excess Capacity

The cost of the excess capacity for 2016 is not included. The City did not have the data (years of installation and year of installation construction costs) of the costs for the source, water rights, storage and distribution.

6 - PROJECTS TO ADDRESS DEFICIENCIES

6-1 Projects to Address Existing System Deficiencies

Figure 6-1 shows projects to address existing deficiencies (Appendix B).

6.1.1 Water Sources / Supply and Water Rights

No projects are required to increase the water source. Although, the City has a potential shortfall until the year 2020 in its water supply.

Due to the need of providing irrigation water for subdivision development, the developer shall continue to be required to convey to Syracuse City water rights that have been customarily used on the property to be developed that are useable by and acceptable to Syracuse City to provide a minimum of three acre-feet of water per gross acre for residential developments and four acre-feet of water per irrigated acre for non-residential developments annually during normal water years, for each acre or part thereof within the subdivision. In the event there are no owner water rights on the property to be developed, the developer shall obtain and convey water rights acceptable and useable by Syracuse City (See the ordinance in Appendix A).

The non-certificated water right 31-5207 must be extended beyond the 50-year approval date. This water will be needed as future development occurs. As the water demands increase in the future, the city may choose to provide proof of beneficial use of the water and request that the water become certificated.

Syracuse City has made application to attempt to secure additional water rights for irrigation. No decision on the application has been issued from the state engineer. At the time the city was looking for ways to increase water supplies as demand on the supply grows in the future. The applications proposed to capture the shallow groundwater found through the city and utilize it in the secondary water system. These will need to be evaluated regarding their future need as well as the feasibility to divert the water and put it to use. If there is no intention or need for these rights in the future, then the applications may be withdrawn (Syracuse, 2014).

6.1.2 Water Storage

There are no existing deficiencies for water storage.

6.1.3 Water Distribution System

There is a large portion of Syracuse that doesn't meet the established level of service of 45 psi during peak instantaneous demand. To alleviate this existing deficiency, it is proposed that the existing 1 MG culinary water tank be converted to a secondary tank. This will allow the city to maintain a higher operating water level within the tank. This will keep pressures in the system above 45 psi. Even after tying in the new water tank, sections of Marilyn Acres still do not meet the minimum level of service of 45 psi. It is recommended that an additional loop be added to this system. Figure 6-1 is included in Appendix B to show the existing deficiency projects.

6-2 Projects to Address Future System Deficiencies and Growth

Figure 6-2 shows projects to address future deficiencies (Appendix B).

6.2.1 Water Source and Water Rights

No projects are required.

6.2.2 Water Storage

The City will need to add a 1,500 gpm pump by 2019 to the Jensen reservoir pump station, where there is a slot for an additional pump.

By 2018, it is proposed that the Bluff reservoir be expanded to add storage to the water system. The reservoir will be expanded by installing vertical walls and deepening the reservoir by 4 feet. This will add an additional 6.94 ac-ft (2.3 Mgal) of storage to the secondary system. It is also proposed that the Bluff pump station be moved closer to the reservoir and by 2022 be expanded by 1,500 gpm.

By 2025 an additional turnout will be needed for Jensen Pond.

By 2025, it is proposed that a new reservoir be constructed to add 16.36 ac-ft (5.33 Mgal) of storage. It is also proposed that a pump station be constructed to initially pump 3000 gpm. By 2032, an additional 2,000 gpm capacity will be added to the new pump station and by 2036 an additional 1,500 gpm capacity will be added to the new pump station.

6.2.3 Water Distribution System

When the Bluff reservoir is expanded and the new reservoir and pump station are constructed the existing piping near the reservoirs will need to be upsized. This masterplan has budgeted for 1,100 feet of 20-inch pipe, 11,550 feet of 18-inch pipe and 2,500 feet of 16-inch pipe.

Development is typically required to provide and install water distribution facilities consisting of mostly 8-inch diameter pipelines. There are also improvements that will be the responsibility of Syracuse City. Pipelines that are assumed to be the responsibility of development are shown on the map (Figure 6-2, Appendix B) and do not have cost estimates included in the report. They are only shown schematically on the map (Figure 6-2, Appendix B) to represent locations to loop the existing system.

7 – PRIORITIZED IMPROVEMENTS COSTS AND SCHEDULE

7-1 Summary of Costs

Detailed cost estimates for the above improvements are included in Appendix D. All cost estimates are calculated based on 2017 dollars. Locations of these projects are shown on the figures in Appendix B, Figures 6-1 and 6-2.

A prioritization of projects to address existing deficiencies is summarized as follows in Table 7-1.

Table 7-1: Projects to Address Existing Deficiencies

1	Certificate the Existing Water Right 31-5207	$15,000
2	1,425 LF of 8”; Loop into Marilyn Acres	$132,000
3	Conversion of 1 MG Culinary Water Tank and New 2 MG Culinary Water Tank	$1,354,000
	TOTAL – PROJECTS TO ADDRESS EXISTING DEFICIENCIES	**$1,501,000**

A tentative prioritization of projects to address future deficiencies is summarized based upon expected growth patterns in Table 7-2.

Table 7-2: Projects to Address Future Deficiencies

1	Install additional Jensen Pond pump (1,500 gpm)	$100,000
2	Install additional turnout into Jensen Pond	$80,000
3	Expand Bluff Reservoir (additional 6.94 ac-ft)	$2,262,000
4	Install additional pumps (1,500 gpm)and new pump station building at Bluff Reservoir	$1,000,000
5	Install new reservoir (16.36 AC-FT)	$3,120,000
6	Install new pump station (3,000 gpm)	$1,036,000
7	Install additional pumps at new pump station (2,000 gpm)	$157,000
8	Install additional pumps at new pump station (1,500 gpm)	$92,000
9	Upsize pipeline for new reservoir	$1,130,000
10	Upsize pipeline for Bluff reservoir expansion	$2,160,000
11	Install 250 LF of 8” pipeline along 1000 West from Antelope to 1650 South	$55,000
	TOTAL – PROJECTS TO ADDRESS FUTURE DEFICIENCIES	**$11,192,000**

Costs to correct existing deficiencies and future deficiencies, or in other words to provide capacity for growth to the build out condition, are as follows:

Projects to Address Existing Deficiencies: **$1,501,000**

Projects to Address Future Deficiencies: **$11,192,000**

These summaries of cost represent approximate costs in 2017 dollars and are a budgetary level estimate. These costs do not represent all improvements or additions that will be made to the system. There will be many other facilities that will be installed as part of future development. The costs identified above are only for those improvements needed to meet minimum standards, or levels of service, at build-out. Other installed facilities will consist of lines to provide service to specific parcels.

7-2 Improvements Schedule

Table 7-3 includes a schedule of all of the project improvements noted in the existing system and future system evaluation.

Table 7-3. Project Improvements Schedule

Type of Project		Year Needed By	What Is Needed
Water Source/Supply	Peak Hour	2019	Install additional pump at Jensen Pond pump station (1,500 gpm).
		2022	Install additional pump at Bluff Pond pump station (1,500 gpm).
		2025	Install new turnout to Jensen Pond
		2025	Install pumps at new pump station (3,000 gpm).
		2032	Install Additional Pumps at new pump station (2,000 gpm).
		2036	Install Additional Pumps at new pump station (1,500 gpm).
Water Rights	Peak Day/ Average Annual	2024	Certificate WR #31-5207.
Water Storage	Peak Day	2017	Convert Ex. Culinary Tank (1 Mgal) to secondary system.
		2018	6.94 AF Expansion of Bluff Pond
		2025	Install new reservoir – 16.36 AF (10.13 Mgal)

Type of Project		**Year Needed By**	**What Is Needed**
Water Distribution	Peak Hour	2022	Upsize pipe line for Bluff reservoir and pump expansion
		2022	Upsize pipeline for new reservoir and pump Station.
		2030	Connect pipeline along 1000 West from Antelope to the North

8 – CONCLUSIONS AND RECOMMENDATIONS

Currently Syracuse is adequately supplying water to its citizens with very few problems. As the community grows, however, the existing system will have shortfalls in specific areas. The first of these will be water storage. Additional storage will be needed to address water storage deficiencies. At the build out condition there will a be a storage deficiency.

With continued effort the distribution system will be adequate to handle the growth expected in the community with the recommendations in the report. If Syracuse City continues with a proactive approach to water planning as they have done with this master plan, future challenges can be minimized and project costs reduced.

9 - REFERENCES

American Water Works Association (AWWA), Computer Modeling of Water Distribution Systems, Manual of Water Supply Practices M32, Second Edition, 2005.

Center for Irrigation Technology Irrigation Notes, California State University-Fresno, Irrigation Systems and Water Application Efficiencies, January 1988, http://cwi.csufresno.edu/wateright/880104.asp.

Food and Agriculture Organization, accessed August 1, 2016 http://www.fao.org/docrep/t7202e/t7202e08.htm.

North Davis Sewer District, Draft Water Reuse for Sod Irrigation Feasibility Memo, dated November 8, 2006.

North Davis Sewer District, Market Re-Evaluation of Upstream Users, Wetland Use Alternative, & Potential Water Rights Transfers, dated October 2011.

North Davis Sewer District, Water Reuse Feasibility Study, completed in 2007.

Syracuse City, General Plan Map, dated December 24, 2015.

Syracuse City, personal communication regarding the number of connections, November 2016.

Syracuse City, Water Rights Forty-Year Plan, March 2014.

USDA- Soil Conservation Service, “Irrigated Crop Consumptive Use Zones and Normal Annual Effective Precipitation,” Syracuse City is in zone 4, 1978

U.S. Census Bureau, Syracuse City population estimate, 2014.

Utah Division of Water Rights, website: <https://www.waterrights.utah.gov/wrinfo/query.asp>, accessed October 26, 2016.

Utah State Administrative Code, UAC R309-510, <http://www.rules.utah.gov/publicat/code/r309/r309-510.htm>, accessed October 25, 2016.

Utah State University, “Consumptive Use of Irrigated Crops in Utah,” Riverdale site, page 308, 1998.

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D