PREPARED FOR:

OREM

PREPARED BY:

BOWEN COLLINS & ASSOCIATES

WATER MASTER PLAN

MAY 2021

WATER
MASTER PLAN

May 2021

PROFESSIONAL ENGINEER
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STATE OF UTAH

Prepared for:

OREM

Prepared by:

BOWEN COLLINS
& ASSOCIATES

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CHAPTER 1
INTRODUCTION

INTRODUCTION

In 2016, the City of Orem prepared master plans for their water, sewer, and storm drain systems. Each plan included identification of a detailed capital facility plan (projects needed to maintain quality service to residents) along with a financial implementation plan (needed rates and impact fees to complete the identified projects). The Water Master Plan was ultimately finalized and adopted in February of 2016. Since the completion of the previous master plan study, a number of changes have occurred that may affect the City's master plan and warrant additional consideration. Changes that need to be evaluated and addressed include:

- **Land Use Changes –** Since the preparation of the last master plan, several areas included as part of the City's service area have had land use planning changes that may affect future growth projections. This includes:
  - **Southwest Annexation Area –** The "Southwest Annexation Area" (the area roughly between 2000 South and 1400 South west of I-15) was officially annexed into the City in 2015. Land use plans have evolved in the area since its annexation with the most recent land use plan adopted in August of 2020. The land use plan better refined what areas will develop as residential or nonresidential and included changes in development around the announced Orem Temple site.
  - **Mountainland Association of Governments Updated Projections –** The Mountainland Association of Governments released revised growth projections for areas in the City in coordination with the Governor's Office of Management and Budget. In most cases, these projections are not significantly different than what was projected in the last master plan. However, there are a few areas of additional growth that have been identified and incorporated as part of the City's projections of residential and nonresidential populations.
  - **Other City Planning Changes –** In addition to the growth identified by the Mountainland Association of Governments projections, the City's planning department has also provided input on potential changes to the City's general plan and zoning where future growth may occur. This includes significant redevelopment potential along State Street, University Parkway, and a few other areas of the City. The changes have been incorporated as part of this master plan update.
- **Vineyard City Water Supply –** At the time the previous master plan was prepared, the City of Orem had a contractual obligation to supply water to Vineyard City utilizing City of Orem transmission lines. Since that time, Vineyard City has chosen to pursue a contract directly with the Central Utah Water Conservancy District (CUWCD) for all of its water supplies. Once this change in wholesale water supply agreement is finalized, it will significantly reduce the City's future supply obligations. Since the Vineyard demand was located on the far west side of the City's system, removal of this demand will have a significant effect on the City's conveyance needs across the system.
- **Conservation –** The State of Utah recently adopted new conservation goals for growth through the year 2065. In addition, the City of Orem has demonstrated some significant reductions in water use through conservation over the last 5 years such that projections of demand through 2065 have been significantly reduced.

- **Future Storage Reservoir Location** – One major conclusion of the previous water master plan was that the City needed to construct a significant amount of new storage. The City has historically relied on some of the City's storage requirements using storage at the Don A. Christiansen Regional Water Treatment Plant owned and operated by CUWCD. As demands from other entities increase on the treatment plant, available storage at the plant is expected to decrease, leaving Orem without sufficient storage to meet its needs. One of the first recommendations of the last master plan was to conduct a study to identify where land could be obtained to construct this future storage. That study is now complete and has identified Community Park as the preferred location for up to 10 million gallons of future storage. With this storage location selected, this master plan can now be updated to optimize system improvements to take advantage of the proposed new storage.
- **Financial Conditions** – The financial implementation plan ultimately adopted by the City of Orem Council included a 7-year rate increase plan and used pay-as-you-go financing to minimize interest costs to the City. While this was a prudent decision at the time, a few changes in financial conditions have resulted in a desire to reconsider this approach. First, construction inflation over the last five years has been notably higher than historic averages. Second, bond interest rates have dropped to historically low levels. The combination of these two factors means that it may be more cost effective for the City to bond for some needed projects now rather than continue with the pay-as-you-go approach.

This water master plan report identifies recommended improvements that resolve existing and projected future deficiencies in the water system throughout the City's service area based on the changes discussed above. The results of this study will be incorporated into a financial implementation plan to establish impact fees and water user rates for the City.

SCOPE OF SERVICES

The general scope of this project involved a thorough analysis of the City's water production and distribution system and its ability to meet the present and future water needs of its residents. As part of the Water Master Plan, BC&A completed the following tasks.

Task 1: Collected information as needed to develop the water master plan based on the City's general plan and existing facilities.

Task 2: Updated population projections and estimated water demand to evaluate future growth needs. This included removal of Vineyard demand and adjustments in future growth for changes in the Southwest Annexation area and other areas of the City.

Task 3: Evaluated City of Orem source and storage requirements for existing and future development conditions.

Task 4: Updated and calibrated a hydraulic computer model of the City of Orem distribution system to evaluate existing and projected future system deficiencies. This included developing and calibrating the model using data from the City's existing GIS database and historical water use data on water system performance and pressures.

Task 5: Identified existing operating deficiencies.

Task 6: Identified projected future operating deficiencies.

Task 7: Evaluated alternative improvements for resolving deficiencies identified in Tasks 5 and 6.

Task 8: Developed a water system capital facilities plan identifying a plan for budgeting and planning system improvements.

Task 9: Documented results of the previous tasks in a report with additional memoranda as needed. As part of the master plan, BC&A made presentations to the City's Public Works Advisory Commission and City Council as requested during the project.

In addition to the tasks completed as part of the master plan, BC&A also provided support for a water right impact fee analysis and a water rate analysis produced by another City consultant (Lewis Young Robertson & Burningham) as part of a separate report.

ACKNOWLEDGMENTS

The BC&A team wishes to thank the following individuals from the City of Orem for their cooperation and assistance in working with us in preparing this report:

Chris Tschirki	Public Works Director
Neal Winterton	Water Resources Division Manager
Lane Gray	Water Section Manager
Quinn Fenton	Water Supply Supervisor
Tyler Peay	Water Utility Supervisor
Drew Hoffman	Water Engineering Specialist

PROJECT STAFF

The project work was performed by the BC&A's team members listed below. Team member's roles on the project are also listed. The project was completed in BC&A's Draper, Utah office. Questions may be addressed to Keith Larson, Project Manager at (801) 495-2224.

Mike Collins	Principle in Charge
Keith Larson	Project Manager
Andrew McKinnon	Project Engineer
Marilyn Rice	Staff Engineer
Mike Hilbert	Clerical

CHAPTER 2
EXISTING SYSTEM FEATURES

INTRODUCTION

As part of this Master Plan, BC&A has assembled an inventory of existing infrastructure within the water distribution system. The purpose of this chapter is to present a summary of the inventory of the City of Orem's existing water distribution system and provide a quick reference for City personnel regarding components of the system.

SERVICE AREA

The City of Orem provides water for residents within its corporate boundaries as shown in Figure 2-1. Its service area is approximately 20 square miles and is bordered by the following: The Wasatch Mountain Range to the east, Utah Lake and Vineyard to the west, Lindon City to the north, and Provo City to the south and east. In 2020, this equated to an approximate City of Orem service population of 98,625 permanent residents. In addition to permanent residents, the City also serves the Utah Valley University student and faculty population along with many other commercial, industrial, and institutional entities. The east side of the City is largely residential and is mostly built out. The west side of the City is mostly commercial/industrial, with some large areas still available for future development.

Southwest Annexation Area

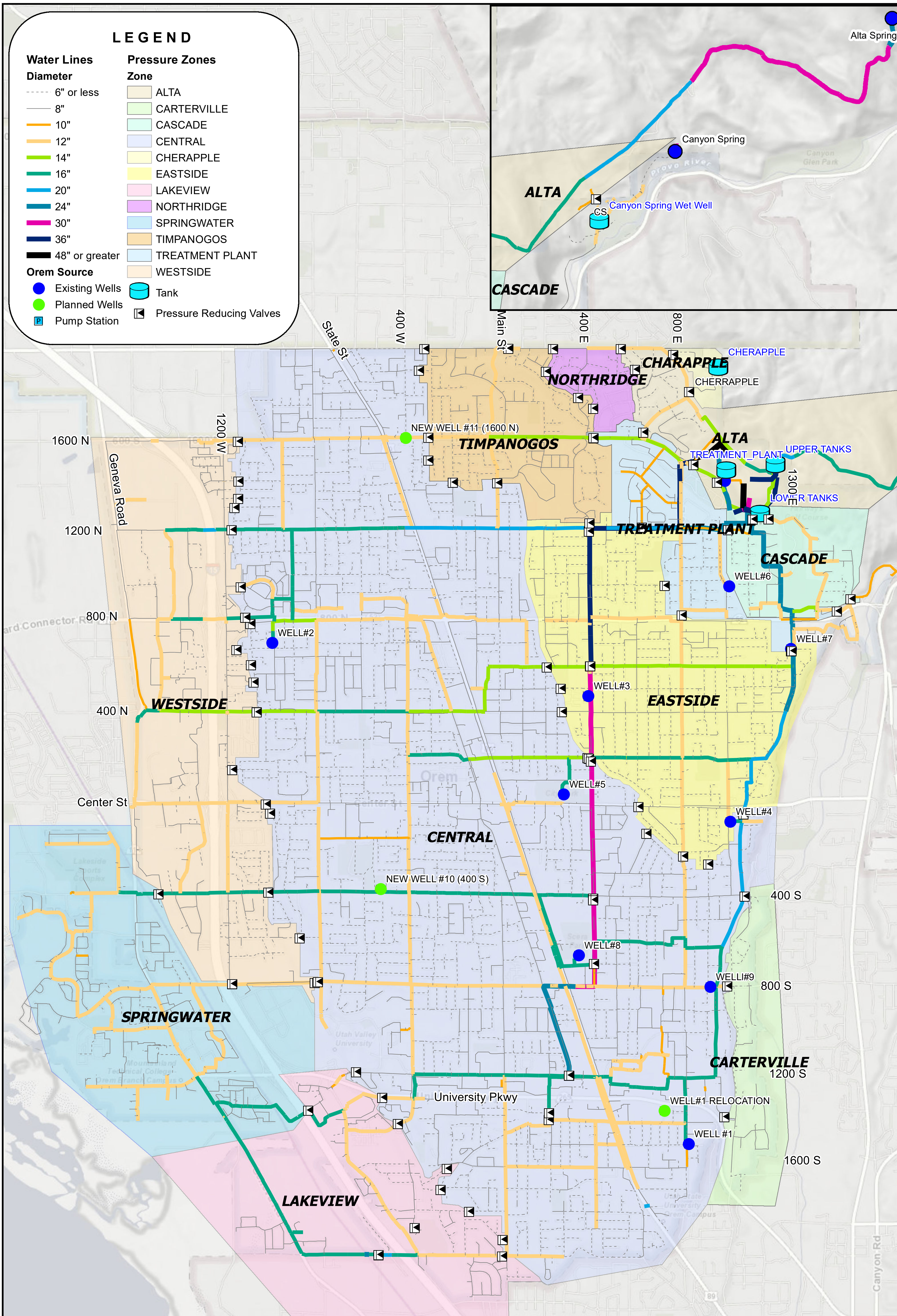
In 2015, the City annexed an area commonly referred to as the "Southwest Annex". This area includes the area between 2000 South and 1400 South, west of I-15. For the purpose of this study, this area is still often referred to as the "Southwest Annex" because of its history. However, it may also be referred to as the "Southwest Area".

Vineyard City

Vineyard City has agreements with the City of Orem to purchase water conveyed through the City of Orem for its use. Vineyard City is currently in the process of negotiating agreements with the Central Utah Water Conservancy District to purchase water. Bowen Collins produced this plan with the expectation that all Vineyard demands will switch to direct wholesale from Central Utah Water Conservancy District in the next three years, thus eliminating Vineyard demands from future planning needs for the City of Orem.

TOPOGRAPHY

The City of Orem water system service area is approximately 20 square miles and is bordered by the following: The Wasatch Mountain Range to the east, Utah Lake and Vineyard to the west, Lindon City to the north, and Provo City to the south and southeast. The topography of the City generally slopes from northeast to southwest with the City's primary source of water (Don A. Christiansen Regional Water Treatment Plant) located at the northeast corner of the City. Most of the City's storage reservoirs are located on the east edge of the City to provide adequate pressure with lower pressure zones served through pressure regulating stations. Figure 2-2 shows a basic hydraulic schematic of how the City's distribution system functions.



BOWEN COLLINS & ASSOCIATES

OREM CITY

WATER MASTER PLAN

OREM CITY WATER SYSTEM

NORTH:

NORTH

SCALE:

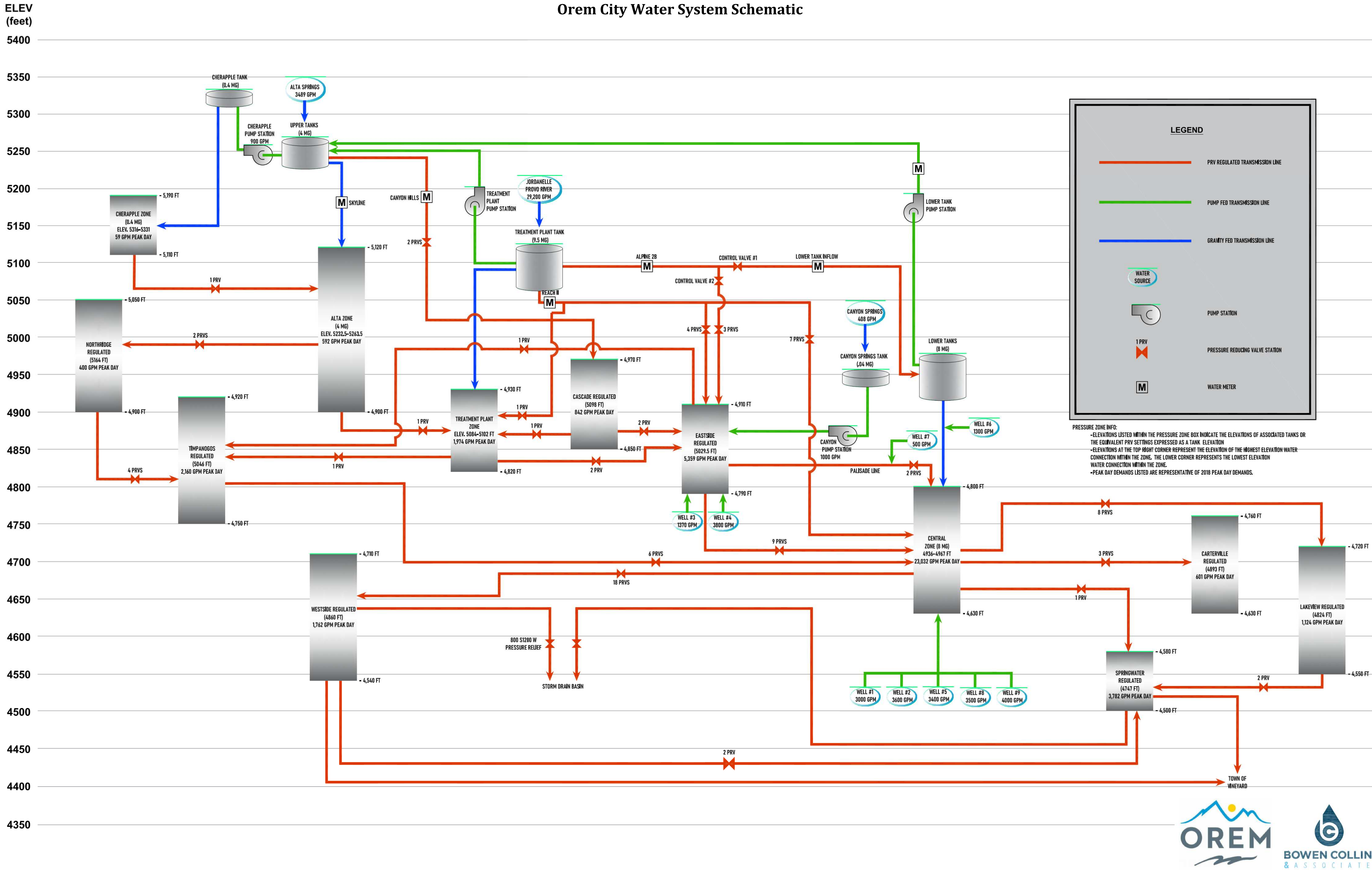
0 1,250 2,500 Feet

FIGURE NO.

2-1

P:\Orem City\2020 Master Plan Assistance\4.0 GIS\Water\Water-Figure 2-1 - Existing Facilities.mxd amckinnon 4/20/2021

Figure 2-2
Orem City Water System Schematic



SUPPLY SOURCES

The City of Orem has nine wells in its water supply system along with two spring sources. The City is also supplied with treated surface water from water rights to natural runoff in the Provo River and reservoir storage in Deer Creek Reservoir and Jordanelle Reservoir. The City has agreements with the Metropolitan Water District of Orem to purchase additional water as needed. Facilities associated with supply are summarized in the following sections. A detailed discussion of each source and its yield can be found in Chapter 4 – Supply Evaluation.

WELLS

The City of Orem currently operates nine wells, the locations of which are shown in Figure 2-1. The majority of wells are located on the east side of the City and provide flow to the Central, Eastside, and Treatment Plant pressure zones. Table 2-1 summarizes the characteristics of each well source.

Table 2-1
Existing Wells and Springs

Name	Address	Size (inches)	Zone	Capacity (mgd)[1]	Capacity (gpm)
Well #1	1450 S 800 E	14	Central	4.63	3,217
Well #2	710 N 980 W	12	Central	5.29	3,674
Well #3	479 N 400 E	10	Eastside	2.04	1,413
Well #4	65 S 1000 E	14	Eastside/Central	5.51	3,823
Well #5	56 N State St.	14	Central	5.14	3,570
Well #6	950 N 1000 E	12	Central	1.58	1,100
Well #7	665 N Palisade Dr.	8	Eastside	0.94	655
Well #8	701 S State St.	12	Central	5.44	3,778
Well #9	800 S 900 E	14	Central	5.96	4,141
			Subtotal Wells	**36.53**	**25,371**
Alta Springs				2.9	2,000
Canyon Springs				0.7	500
			Subtotal Springs	**3.6**	**2,500**
			Total	**40.13**	**27,871**

[1] Based on maximum production from data for years 2013-2019

SPRINGS

The City of Orem operates two spring sources located in Provo Canyon: Alta Spring and Canyon Spring. Alta Springs is located about 3 miles northeast from the mouth of the canyon. Approximately 18,000 feet of pipe connect the spring to two tanks situated on the east bench of the City... Canyon spring is located closer to the City near Mount Timpanogos Park. A small tank and booster pump operate in conjunction with Canyon spring, providing additional supply to the Eastside pressure zone. From 2010 to 2020, the Alta Springs production average was 2,683 acre-ft and the Canyon Springs production average was 568 acre-ft per year.

DON A. CHRISTIANSEN REGIONAL WATER TREATMENT PLANT

The Don A. Christiansen Regional Water Treatment Plant (DACRWTP), formerly known as the Utah Valley Water Treatment Plant, is owned and operated by the Central Utah Water Conservancy District (CUWCD) and is located at approximately 900 South Cascade Drive on the City of Orem's east bench. The DACRWTP treats water for many Utah County cities, as well as Jordan Valley Water

Conservancy District in Salt Lake County, and has an existing capacity of approximately 100 mgd. The plant is a direct filtration water plant, which means water passes through filters to remove sediment and potentially harmful pathogens. The plant also includes sedimentation basins and ozone and chlorine disinfection. The City of Orem is currently working with CUWCD to formalize an agreement regarding capacity at the plant. Based on historic practices, this master plan assumes that the city currently has 42 mgd (29,170 gpm) of available supply from the plant.

STORAGE FACILITIES

Figure 2-1 indicates the location of storage facilities for the City of Orem, and Table 2-2 summarizes the characteristics of each storage facility.

Table 2-2
System Storage

Tank Name	Volume (million gallons)	Dimensions	Bottom Elevation (ft)	Overflow Elevation (ft)	Source	Description
Upper Tank 1	2.0	100' Diameter	5,232.5	5,263.5	Alta Springs/WTP/Wells	Buried Concrete Circular
Upper Tank 2	2.0	100' Diameter	5,232.5	5,263.5	Alta Springs/WTP/Wells	Buried Concrete Circular
Canyon Springs	0.05	30' Diameter	4,928	4,938	Canyon Springs	Buried Concrete Circular
Lower Tank 1	5.0	160' Diameter	4,936	4,967	WTP/Wells	Steel Tank
Lower Tank 2	3.0	125' Diameter	4,936	4,967	WTP/Wells	Steel Tank
Cherapple	0.4	75' Diameter	5,315.8	5,330.8	Alta Springs/WTP/Wells	Buried Concrete Circular
DACRWTP*	9.5	325' Diameter*	5,084	5,102	WTP	Buried Concrete Circular
Total	21.95					

*The DACRWTP has a total storage capacity of 37 MG. Only 9.5 MG of the storage at the treatment plant is available to the City of Orem. Remaining storage is dedicated to CUWCD operations and/or for other municipalities.

It will be noted that there is a large amount of storage located at the DACRWTP (37 million gallons). Of this total, the City of Orem has rights to only 9.5 million gallons of capacity. In the past, because Orem has been the plant's largest customer, the City enjoyed access to nearly all of the storage at the treatment plant. However, as new customers are added at the plant, it is expected that the availability of storage to the City will decrease until it reaches its contractual level of 9.5 million gallons.

PUMPING FACILITIES

Since the majority of the sources and storage for the water system reside at a high elevation on the east side of Orem, the water distribution system requires a minimal number of booster stations, which are summarized in Table 2-3. The location of each booster pump facility is shown in Figure 2-1. The Canyon Spring Booster Station draws water from the Canyon Spring Tank to provide additional supply to the Eastside pressure zone. The Cherapple Booster Station pumps water from the Alta pressure zone up to the Cherapple tank. Booster stations located at the DACRWTP and

Lower tanks are designed to supply flow to the upper tanks in the case that demand in the Alta, Cherapple, and Northridge pressure zones exceeds the capacity of Alta Springs (see Figure 2-2).

Table 2-3
City of Orem Booster Pump Stations

Name	Address	Zone From	Zone To	Design Capacity (gpm)
Canyon Springs	Mt. Timpanogos Park	Canyon Springs	Eastside	900
Cherapple	1945 Skyline Dr.	Alta	Cherapple	300
Lower Tank	1200 E 1300 N	Central	Alta	2,000
Treatment Plant[2]	Cascade Dr.	Treatment Plant	Alta	--[1]
		Total		--[1]

[1] – Data unavailable
[2] – Owned by CUWCD, not the City of Orem

DISTRIBUTION PIPING

Table 2-4 lists the reported pipe diameters and corresponding lengths in the City of Orem distribution system. Pipe materials include PVC, ductile iron, cast iron, and steel. Location and sizing of distribution pipes are shown in Figure 2-1.

Table 2-4
Water Distribution Pipe

Diameter (inch)	Length (ft)	Length (mi)	Percentage
Unknown	14,169	2.68	0.75%
4	58,341	11.05	3.08%
6	721,765	136.70	38.13%
8	635,230	120.31	33.55%
10	23,488	4.45	1.24%
12	240,665	45.58	12.71%
14	37,971	7.19	2.01%
16	88,707	16.80	4.69%
20	22,265	4.22	1.18%
24	16,999	3.22	0.90%
30	18,747	3.55	0.99%
36	12,537	2.37	0.66%
48	192	0.04	0.01%
60	2,043	0.39	0.11%
Total	**1,893,119**	**358.5**	**100%**

PRESSURE ZONES

The City of Orem water distribution system is divided into 12 major pressure zones as shown in Figure 2-1. Table 2-5 lists the approximate hydraulic grade setting for each pressure zone along with the approximate service percentage of the zone.

Table 2-5
Pressure Zones

Pressure Zone	Approximate Static Hydraulic Grade Line (ft)	Service Elevations (ft)	Existing Peak Day Demand (gpm)[1]	Existing Percentage of Demand	2065 Peak Day Demand (gpm)[1]	Percentage of 2065 Demand
Cherapple	5,316 – 5,331	5110-5190	59	0.14%	69	0.12%
Alta	5,232.5 – 5,263.5	5120-4900	592	1.42%	685	1.23%
Northridge	5,164	4900-5050	400	0.96%	400	0.72%
Timpanogos	5,046	4750-4912	2,160	5.18%	2,195	3.96%
Treatment Plant	5,084 – 5,102	4820-4930	1,974	4.73%	1,989	3.59%
Cascade	5,098	4850-4961	842	2.02%	848	1.53%
Eastside	5,030	4790-4910	5,359	12.84%	5,739	10.35%
Central	4,936 – 4,967	4630-4800	23,032	55.18%	32,675	58.94%
Carterville	4,893	4630-4760	601	1.44%	623	1.12%
Lakeview	4,824	4550-4720	1,124	2.69%	1,287	2.32%
Westside	4,860	4540-4710	1,762	4.22%	2,615	4.72%
Springwater	4,747	4500-4580	3,782	9.06%	4,501	8.12%
Southwest Annex[2]	4,747	4500-4580	16	0.04%	1,782	3.21%
Lower Tanks			34	0.08%	34	0.06%
Total			41,738	100.00%	55,440	100.00%

1 – Development of peak day demand estimates is discussed in Chapter 3.
2 – Note that the Southwest Annexation area will likely all fall within the Springwater pressure zone. It has been separated here for information purposes.

CHAPTER 3
FUTURE GROWTH AND DEMAND PROJECTIONS

INTRODUCTION

Before attempting to hydraulically model and evaluate the City's water distribution facilities, one must first have an accurate understanding of water demands. This includes an estimate of both the quantity and distribution of existing and future demands. The purpose of this chapter is to summarize the results, assumptions, and process of calculating both existing and future water production requirements. Production requirements are evaluated in terms of annual and peak day production.

WATER DEMAND

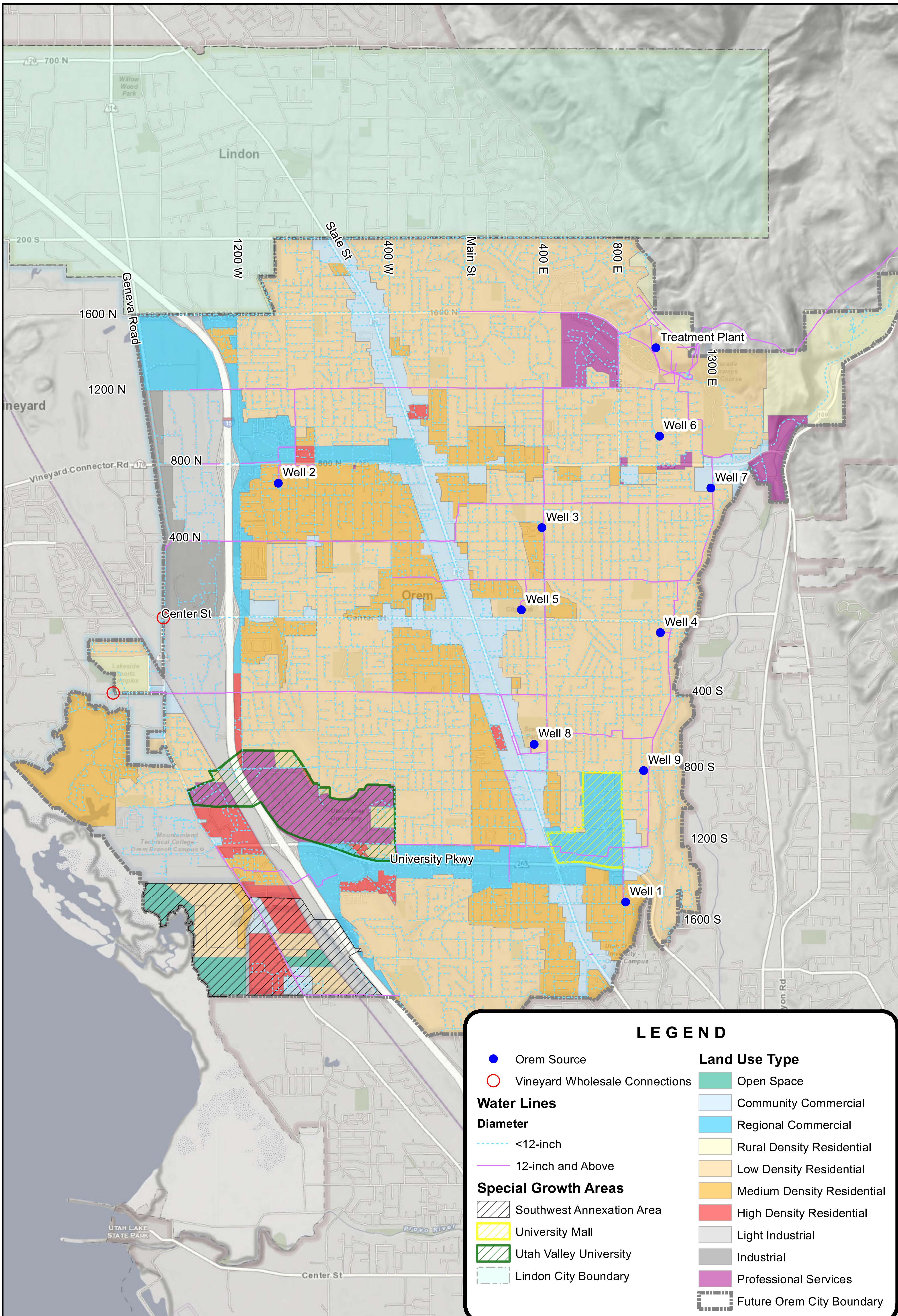
There are several methods that can be used to estimate water demands. This study develops water production requirements based on three factors: residential population, nonresidential population or employment population, and student population. The methodology of this study can be summarized as follows:

1. Define the service area.
2. Divide the service area into a number of smaller sub-areas using geographical information system (GIS) mapping. Traffic analysis zones developed by MAG were the primary unit for subdividing the City.
3. Project residential population for each sub-area based on existing and projected patterns of development.
4. Project non-residents for each sub-area based on existing and projected patterns of development.
5. Adjust projections as required to accommodate areas of special growth consideration including Utah Valley University, University Place Redevelopment, the Southwest Annexation Area, and other areas identified by City planning personnel.
6. Estimate the water production requirements from each factor (residential and nonresidential) based on a statistical analysis of existing levels of development and historic water use.
7. Convert projections of residential and nonresidential development to future water demands based on their historic contributions.

Each step of this process is summarized in the sections below.

STUDY AREA

The study area for this analysis is generally the same as the City's municipal boundary as shown in Figure 3-1 with two current wholesale connections to the Vineyard City at 400 South and Center Street.



BOWEN COLLINS & ASSOCIATES

OREM CITY
WATER MASTER PLAN

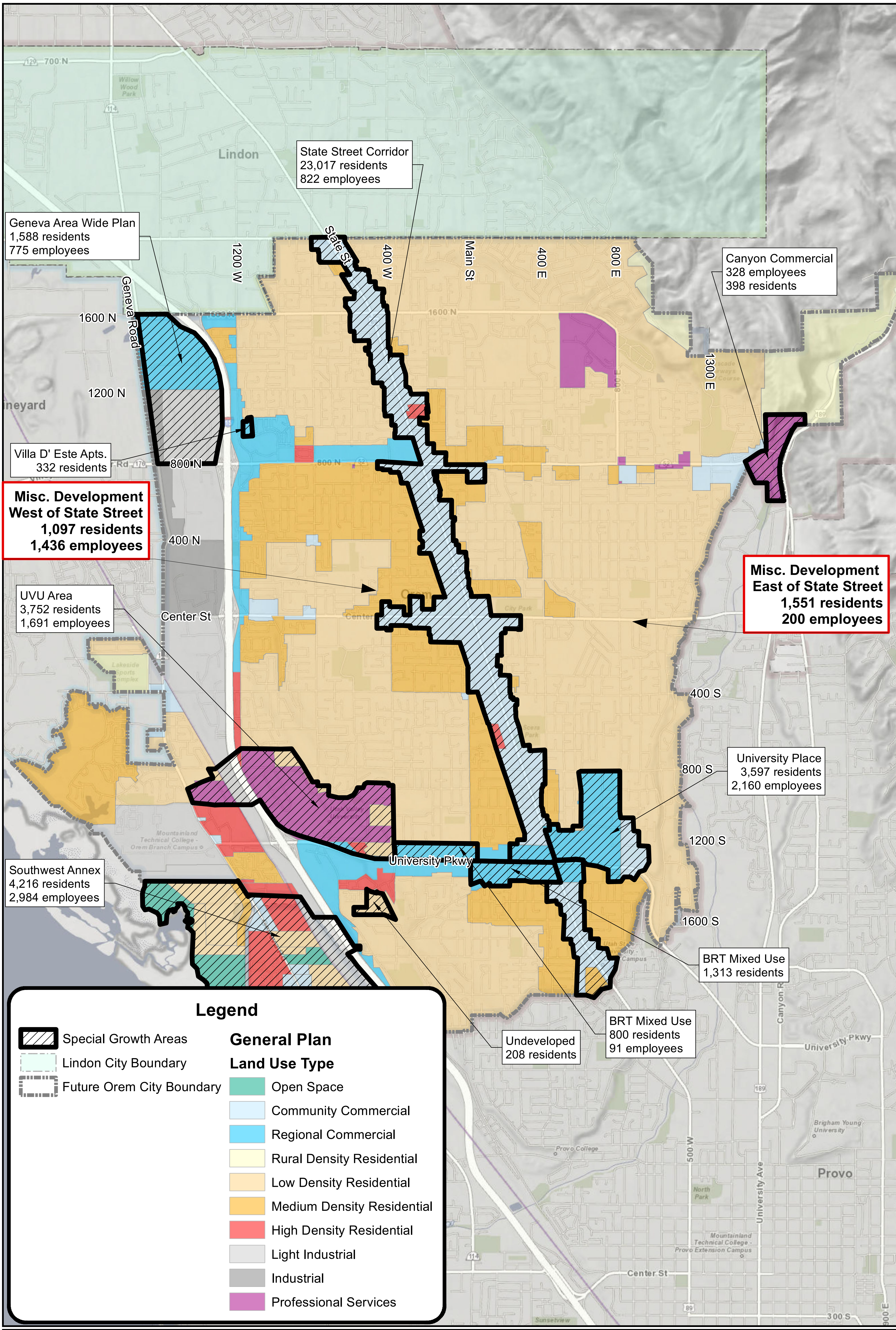
OREM CITY GENERAL PLAN & SPECIAL GROWTH AREAS

NORTH:

SCALE: 0 1,500 3,000 Feet

FIGURE NO. 3-1

P:\Orem City\2020 Master Plan Assistance\4.0 GIS\Water\Water-Figure 3-1 - general plan.mxd mrice 3/31/2021



BOWEN COLLINS & ASSOCIATES

OREM CITY
WATER MASTER PLAN

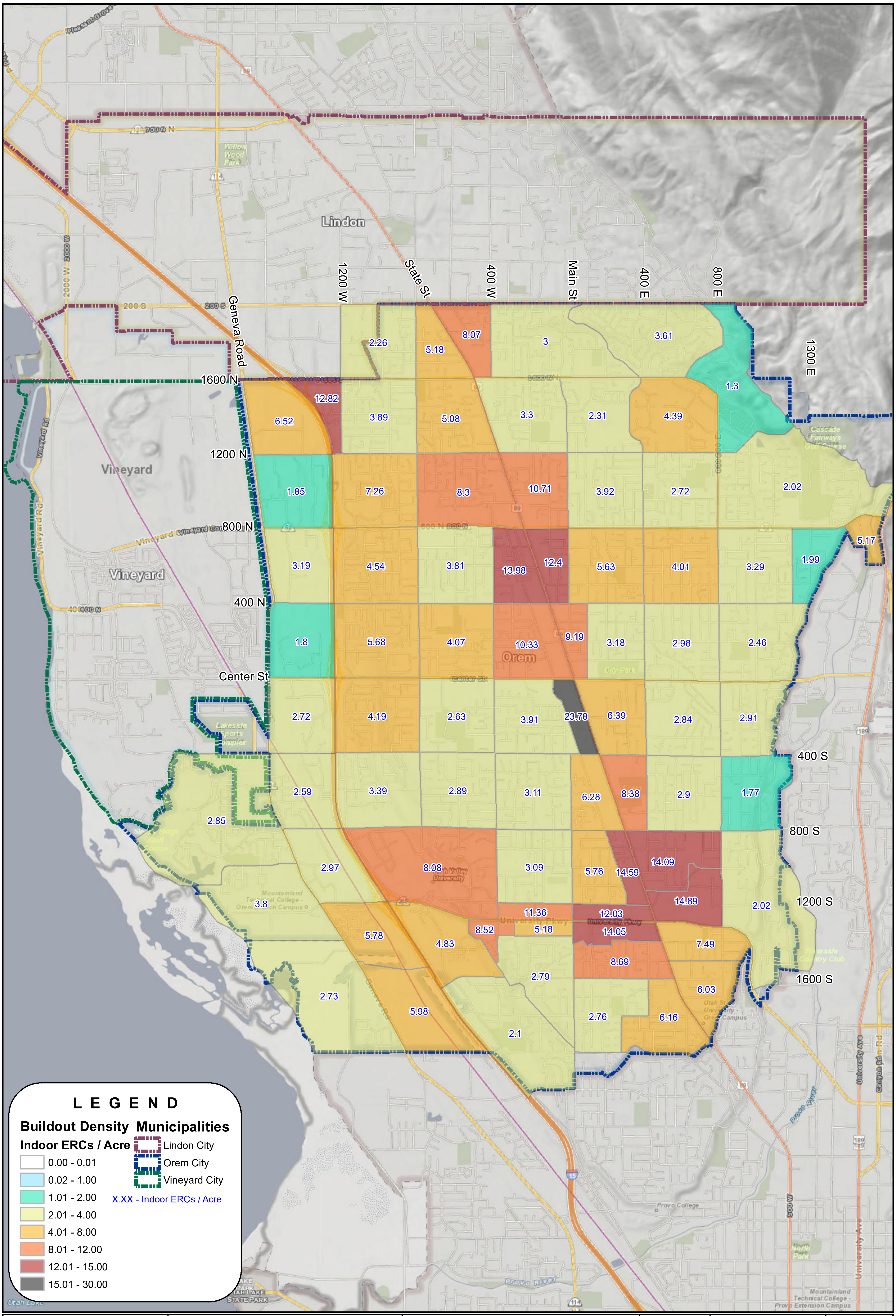
FOCUSED GROWTH PLANS INCLUDING REDEVELOPMENT

NORTH:

SCALE: 0 1,500 3,000 Feet

FIGURE NO. 3-2

P:\Orem City\2020 Master Plan Assistance\4.0 GIS\Water\Water-Figure 3-2 - Development Density.mxd mrice 3/30/2021



BOWEN COLLINS & ASSOCIATES

OREM CITY
WATER MASTER PLAN

BUILDOUT ERC DENSITY

NORTH:

SCALE: 0 1,500 3,000 Feet

FIGURE NO. 3-3

P:\Orem City\2020 Master Plan Assistance\4.0 GIS\Water\Water-Figure 3-3 - TAZ Density Final.mxd amckinnon 12/21/2020

It is anticipated that Vineyard City will shortly switch to buying wholesale water directly from the Central Utah Water Conservancy District instead of Orem. Otherwise, the City's water service area is expected to remain unchanged.

TRAFFIC ANALYSIS ZONES

Division of the service area into smaller sub-areas is important for two reasons. First, it increases the accuracy of the population and flow projections by examining land use and development patterns at a smaller scale. Second, it yields projections that are distributed spatially across the service area, an important requirement for water system modeling efforts.

For this study, sub-areas were defined based on Traffic Analysis Zones (TAZ). A TAZ is the smallest geographic unit used for residential and nonresidential population projections developed by the Mountainland Association of Governments (MAG). Nonresidential population data includes employees, retail, industrial, and other non-residents. TAZ boundaries are established on an arbitrary basis by MAG for travel demand modeling.

TAZ boundaries were used for this analysis because population projections have already been developed from census data and planning data for TAZ areas by the MAG. The projections are provided for every year starting in 2015 and continuing to 2050. TAZ boundaries were also used because they are small enough to give an adequate distribution of flow across the service area for use in modeling[1].

CITY OF OREM RESIDENTIAL AND NONRESIDENTIAL POPULATIONS

Residential and nonresidential projections for Orem were developed for two periods: Present to 2050, and 2050 to 2065. The methodology varies slightly for each period. The sections that follow describe in greater detail how the projections for each of these situations were developed.

City of Orem Projections from Present to 2050

The population projections from present to 2050 were taken directly from the MAG Population Projection Report, 2015 Baseline (2019 Update). This was done for both residential and nonresidential (employment) populations. The MAG projections were used to estimate both the total magnitude of growth and where the growth will occur in the City.

The only exception to this is the Southwest Annexation Area. The City has more detailed information on the planned development in this area than would have been available to those preparing the MAG projections. In this area, an equivalent residential population was developed based on data provided by the Development Services Department. Based on the planning data, it was assumed that this area would be built out by the year 2030.

[1] The TAZ boundaries used in this analysis are shown later in this report as part of Figure 3-3. As can be seen in the figure, TAZ boundaries are not always consistent with the City's service area boundaries. If a TAZ was only partially in the study area boundary, then the percentage inside the boundary was determined. MAG projections were multiplied by this percentage to determine the portion of the TAZ projection within the study area boundary.

City of Orem Projections from 2050 to Buildout - Residential

The detailed MAG projections only extend to 2050. Because this does not cover the full planning window of this water master plan, growth beyond the year 2050 needed to be examined and incorporated into this study. A buildout estimate of growth was developed for each area of the City by augmenting the MAG projections with information from the City's Development Services Department. Figure 3-2 shows areas of expected development and redevelopment as identified by the City's Development Services Department. This includes focused growth plans in several areas of the City including:

- State Street Corridor
- Utah Valley University
- Bus Rapid Transit Area along University Parkway (UVX)
- University Place
- Canyon Commercial (mouth of Provo Canyon)
- Geneva Areawide Plan (between I-15 and Geneva Road)
- Various small properties elsewhere in the City

The projected buildout densities in these areas were compared to the estimated 2050 MAG projections. Where the City planning data suggested higher densities than identified by MAG, additional growth was added between 2050 and 2065 to match the City projections. Therefore, full development of the City at current planned densities is shown at 2065. Final densities at full development by TAZ are shown in Figure 3-3.

Projections for UVU – Nonresidential

Because Utah Valley University (UVU) makes up a significant portion of City-wide water demand, and has a significant potential for growth, projections for UVU were treated separately from other nonresidential projections. Based on UVU's 2010 Master Building Plan, the square footage of buildings on the UVU campus is estimated to approximately double from 2010 to buildout to accommodate future student populations in the City of Orem. As a result, water production for the campus will also likely double in the future. Projections for UVU assume funding for expansion projects on campus will be uniform through 2060 so that a student population of approximately 53,000 students is reached in 2060. It should be noted that the student population has been used to project water growth for UVU rather than building square footage because an accurate estimate of the existing building square footage was not available during this study. With either approach, the estimated water is anticipated to double within the planning window.

The results of the residential and nonresidential projections described above are summarized in Tables 3-1.

Table 3-1
City of Orem Population Projections

Year	Orem Residential Population*	Orem Nonresidential Population*	UVU Student Population
2020	98,625	65,373	39,931
2030	109,374	74,042	42,749
2040	122,441	73,564	45,568
2050	133,429	73,605	48,386
2060	137,734	77,827	51,205
2065	139,887	79,939	52,614

*Population data projections based on data from MAG.

HISTORICAL WATER USE

In order to predict future water production requirements for the City of Orem, historical water use data was used to determine per capita demands. Table 3-2 contains the historical production data provided by the City of Orem from the period of 2009 to 2019. This table includes:

- **Annual Production and Annual Sales** – Annual production is the actual quantity of water which the City distributed into the system, while annual sales refers the quantity that was actually billed to customers. The difference between production and sales is described as system loss. System loss can be attributed to two primary factors: leaks and unmetered water. Unmetered water typically makes up the majority of system losses, and includes unmetered connections, inaccurate meter reads, system maintenance, water for construction, firefighting, incidental line breaks, or theft. In general, the City appears to be experiencing substantial system losses, at least in recent years. Ideally, system loss would be less than 6 percent.

- **Average Day Production and Sales –** Average day production refers to the total volume of production divided by the numbers of days in the year, generally presented in terms of a volumetric flow rate (million gallons per day or gallons per minute). Average day production is useful for estimating future production demands of the system by expressing the production in terms of a per capita demand.

- **Peak Day Production –** For the purposes of planning and computer modeling, it is important to not only estimate the average daily production requirements for the system, but also the production required during the peak water use day of the year (the day with the highest demands on the system). Modeling peak day demands provides useful information regarding system capacity and potential deficiencies.

Table 3-2
Historic Water Production from 2009 - 2019

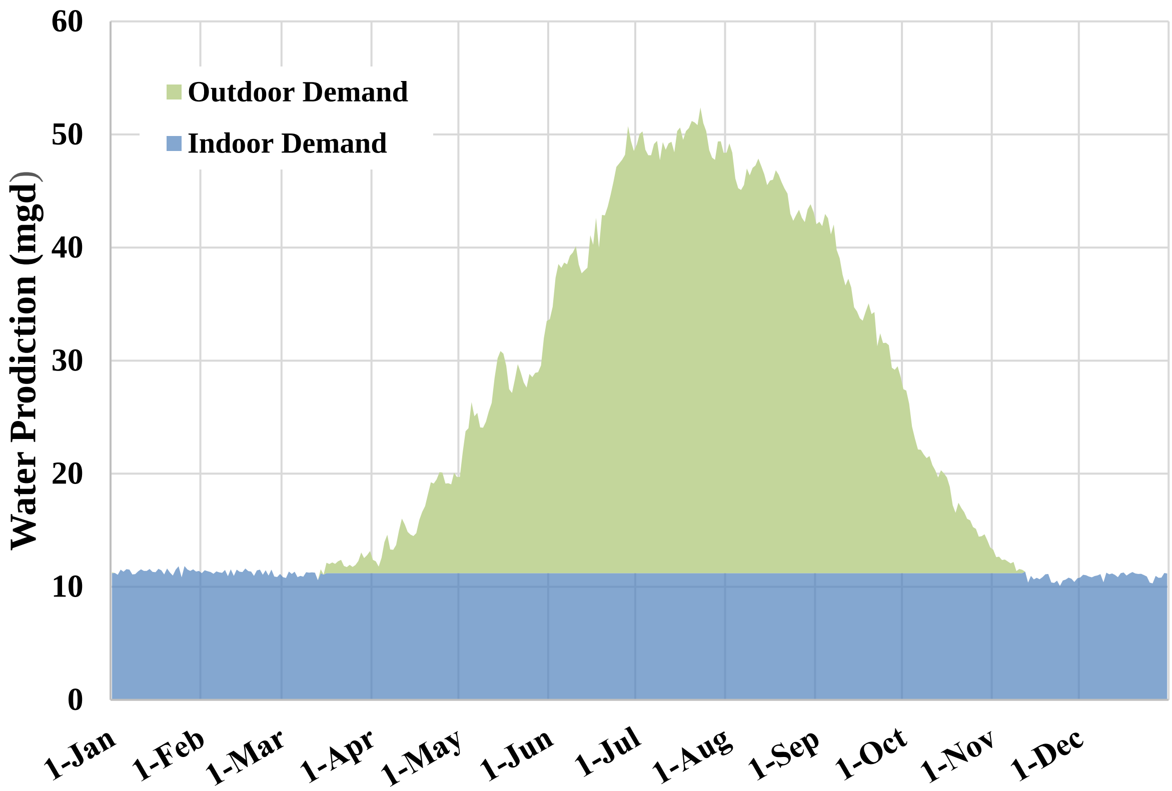
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average
Annual Production (acre-ft)	26,023	27,043	24,974	30,260	27,768	27,718	26,535	28,732	27,145	28,581	25,946	27,339
Annual Sales (acre-ft)*	22,373	20,072	19,613	24,183	22,397	23,394	22,030	20,126	24,606	23,306	22,459	22,233
System % Loss*	14%	26%	21%	20%	19%	16%	17%	30%	9%	18%	13%	19%
Residential Population Served	87,497	88,328	89,167	90,006	90,845	91,685	92,593	94,827	95,916	97,231	98,053	92,377
Nonresidential Population Served	57,605	58,152	58,704	59,257	59,809	60,362	60,914	62,374	63,150	64,118	64,741	60,835
Average Day Production (mgd)	23.23	24.14	22.29	27.01	24.79	24.75	23.69	25.65	24.23	25.52	23.16	24.41
Average Day Production (gpcd)	265.51	273.33	250.04	300.14	272.87	269.89	255.84	270.49	252.65	262.42	236.23	264.20
Peak Day	July 20th	July 21st	July 22nd	June 25th	July 3rd	July 7th	June 29th	July 15th	June 28th	July 10th	July 22nd	N/A
Peak Day Production (mgd)	54.91	56.34	51.51	61.51	56.43	54.55	52.17	54.70	60.24	61.24	56.70	56.39
Peak Day Production (gpcd)	627.51	637.86	577.65	683.37	621.18	594.96	563.89	577.37	628.96	631.19	579.63	611.23
Peak Day Peaking Factor	2.36	2.33	2.31	2.28	2.28	2.20	2.20	2.13	2.49	2.40	2.45	2.31

*Estimated based on total water sale revenue and the associated number of water connections and water rates for each year

Seasonal Water Use

Water use in a water system varies significantly as a function of time. Demands change throughout the day as well as through different times of the year. While indoor water use patterns tend to remain relatively constant throughout the year, seasonal effects have a large impact on outdoor water use. Figure 3-4 shows the typical water use pattern over the period of 2009 to 2019. This typical pattern will be used for representing seasonal demand fluctuations for future demand and supply evaluation.

Figure 3-4
City of Orem Seasonal Demand



Water Conservation

The State of Utah recently released regional conservation goals that identify area specific conservation targets (Utah's Regional M&I Water Conservation Goals, November 2019). Table 3-3 lists the conservation goals for the Salt Lake and Provo Regions.

Table 3-3
Regional Conservation Goals from 2015 Baseline Use

Year	Salt Lake Region	Provo Region (including Utah County)
2030	11%	20%
2040	15%	27%
2065	19%	32%

The Provo Region's conservation goal is significantly more aggressive than the Salt Lake Region despite having nearly identical climate and seasonal conditions. This is primarily because the Provo Region (including Utah County) has a much higher percentage of undeveloped land compared to the Salt Lake Region. As a result, significant savings on a per capita basis are expected through the development of new properties with smaller lot sizes and reduced turf grass coverage. Even though the City of Orem is in the Provo Region, the land use availability within the City of Orem is much more similar to the Salt Lake Region. There is limited undeveloped land and most growth will occur through redevelopment of already developed areas. Orem is also different from most Utah County cities with regards to a secondary system. Where many Utah County cities can achieve major water savings simply by adding secondary water meters, this opportunity is not available to Orem. These several issues results in a lower potential for conservation within the City of Orem compared to surrounding cities in Utah County. Thus, for the purpose of this study, the City of Orem will adopt an individual conservation goal that matches the Salt Lake Region to more realistically represent the development conditions and conservation potential in the City of Orem. While lower than the Provo Region goal, this still represents a significant reduction in water use by residents of the City and will require a concerted effort to achieve.

FUTURE PRODUCTION REQUIREMENTS

Future production requirements for the water system were estimated by multiplying per capita demands by the population projections. Table 3-4 shows the projected production requirements for the water system through buildout. Note that Table 3-4 presents projections of water production for two different water use scenarios:

- **Without Conservation –** The first set of projections in Table 3-4 are based on per capita water use as measured in the year 2015. Per capita demand for 2015 was chosen because it was the adopted year for the baseline of the State of Utah's conservation goal.
- **With State Conservation Goal –** As part of its overall supply plan (and consistent with the State of Utah's conservation goal), the City is encouraging conservation to reduce per capita water use in its service area as defined by Table 3-3. This projection represents projected demands if the City achieves this goal.

Table 3-4
Projected Water Production Requirements Through Buildout

	2025	2035	2045	2055	2065
Average Annual Production without Conservation (acre-ft)	29,461	32,839	37,107	38,883	40,118
Average Annual Production with Conservation (acre-ft)	27,301	28,570	31,244	32,118	32,496
Peak Day Demand (mgd)	63.9	70.0	76.2	79.2	82.1

Figure 3-5 provides a visual representation of the projected annual water demand for the City through buildout.

Figure 3-5
Projected Annual Production Requirements
With and Without Conservation

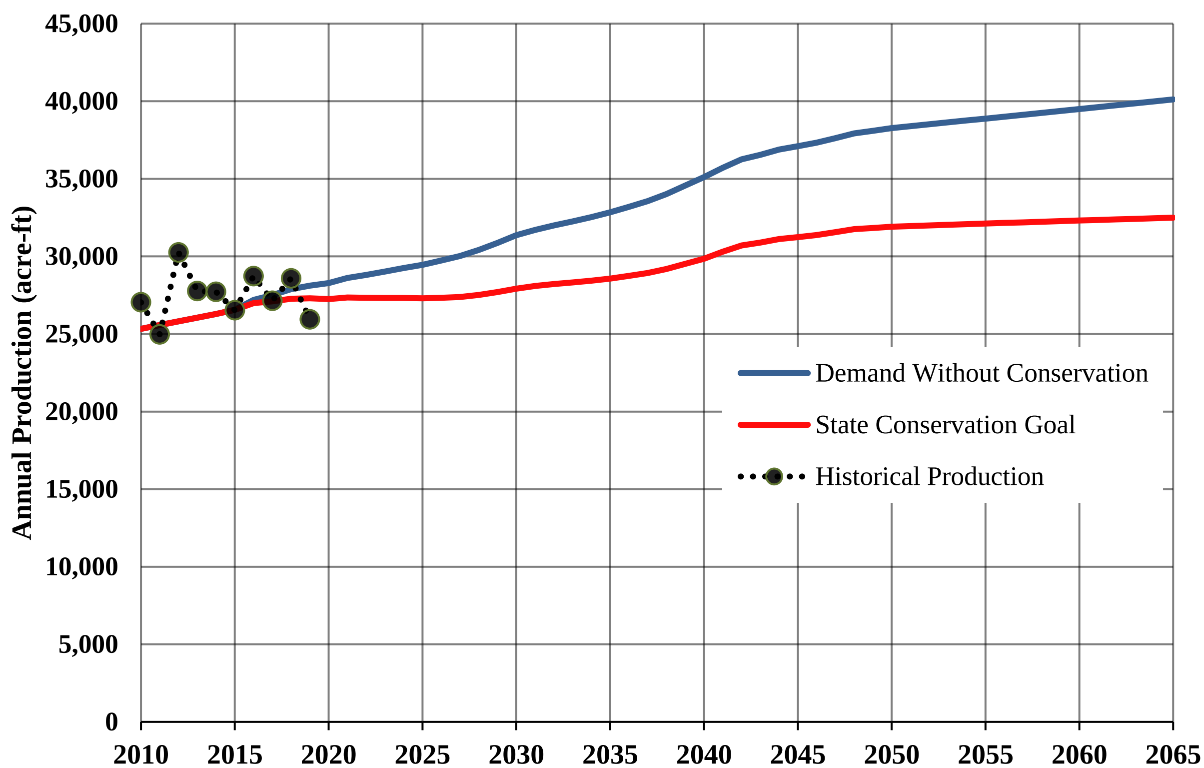


Figure 3-5 indicates that annual demand in the City has remained relatively flat or steady since 2010 even as the City's population has grown by about 10 percent. This means that the City has likely made commendable progress toward its conservation goals over the last 10 years. However, if additional conservation is desired to meet City and State of Utah long-term goals, the City will likely need to place continued emphasis on conservation moving forward.

PEAK DAY PRODUCTION

For planning and modeling purposes, it is valuable to not only have an estimate of average production requirements for the system, but also to estimate peak day demands. From 2009 to 2019, the highest peak day demand was 61.51 MGD observed in 2012. More recently, peak day demands have trended a little lower, with 2018 having the highest observed peak day demand in the last 5 years at 59.3 MGD. For planning purposes, this has been used as the basis for future peak demand projections.

For 2018, meter data acquired from the City was used to estimate the percentage of water use attributed to residents, non-residents, and parks. These estimates show that Orem residents account for approximately 67% of water use, with non-residents and parks at 28% and 3%, respectively. Based on these values, residential and nonresidential peak day per capita demands were calculated. These demands are summarized in Table 3-5.

Table 3-5
2018 Peak Day Water Use by User Type

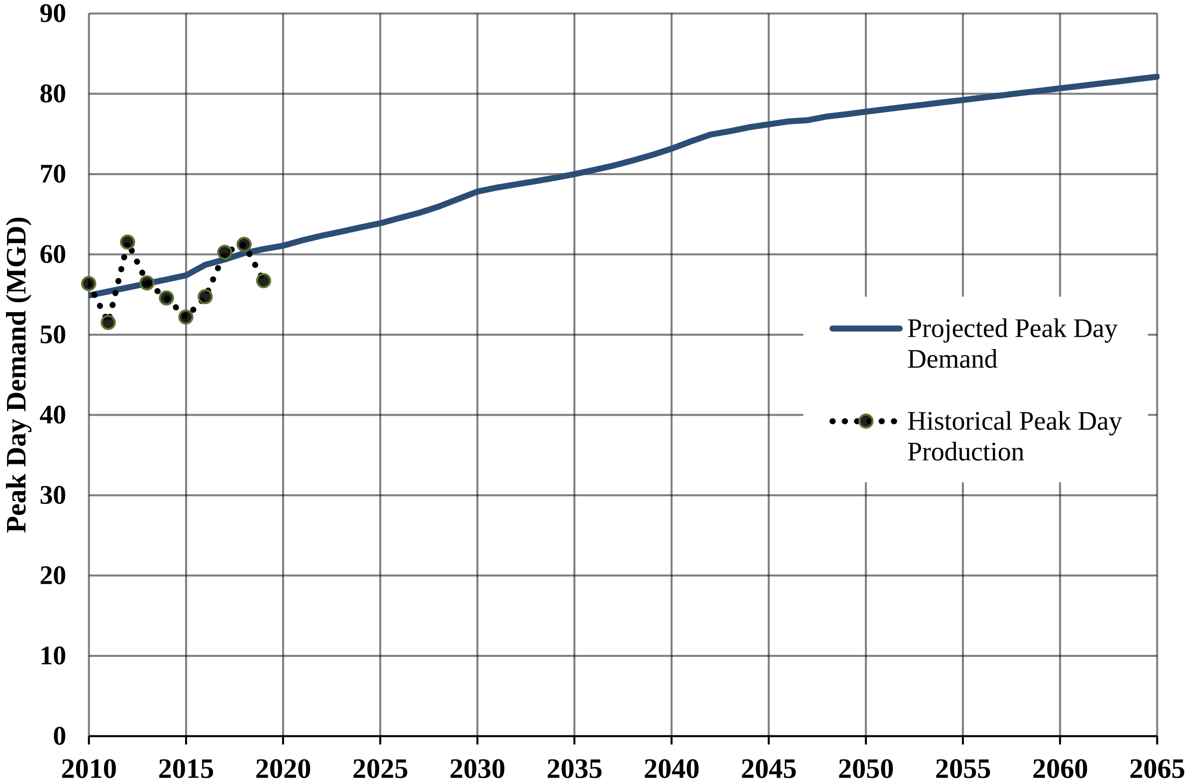
Component	Total Peak Day Demand (gallons/day)	2018 Population Estimate	Per Capita Peak Day Demand (gallons/cap/day)
Residential Population	39,821,485	95,123	419
Nonresidential Population	16,615,713	64,022	260
Parks	2,820,000		
Total	**59,257,198**		

Using the per capita demand estimates shown in Table 3-5, future demands were estimated using the population projections for future growth leading up to the buildout population in 2065. The results are shown in Table 3-6 and Figure 3-6. Peak day demands for parks were assumed to be constant through 2065.

Table 3-6
Projected Peak Day Water Use

Year	Orem Residential Population	Orem Nonresidential Population	Total Peak Day Demand (gallons/day)
2025	102,727	69,513	63,865,730
2035	114,506	74,131	69,995,163
2045	129,387	74,007	76,192,665
2055	135,582	75,716	79,229,436
2065	139,887	79,939	82,127,778

Figure 3-6
Projected Peak Day Demand



It will be noted that, unlike annual demands, no reduction in projected peak day demands have been shown in association with conservation. Past studies have shown that most initial conservation activities are focused on reducing outdoor use by adjusting watering schedules to better match evapotranspiration. Correspondingly, most of the conservation observed in the state in recent years has been achieved through the reduction of outdoor water use in the spring and fall. In the heat of the summer, initial conservation efforts have been inconsistent in reducing demands. As a result, peak day demands have been less affected by conservation than annual water use. While more aggressive future conservation efforts may do better at reducing peak demands, this master plan will conservatively base all peak day demand projections on recent historical use without reductions associated with conservation. The City recently began installation of a new automatic metering infrastructure (AMI) system that will have the capability to monitor water use on a daily or even hourly basis. When the system is fully installed with associated meters, , the City will be able more accurately measure the distribution of peak day and peak hour demands and how conservation affects those scenarios respectively.

CHAPTER 4
WATER SUPPLY EVALUATION

INTRODUCTION

The purpose of this chapter is to evaluate the adequacy of the City of Orem's sources to meet projected future production requirements. This evaluation considers supply capacity in terms of reliable annual yield, peak day production, and seasonal availability. This includes consideration of the water sources that the City of Orem is currently utilizing, as well as additional sources which the City has already planned to develop (i.e. Jordanelle (CUP) Project water).

It should be noted that this chapter will focus exclusively on the adequacy of City sources to meet projected annual and peak day demand requirements for the City. In addition to making sure it has enough water, it is also important for the City to consider how it uses this water throughout the year. Optimizing the use of existing sources was addressed in the 2016 Water Master Plan. As the City's water source portfolio has generally not changed since that time, that analysis has not been updated as part of this plan.

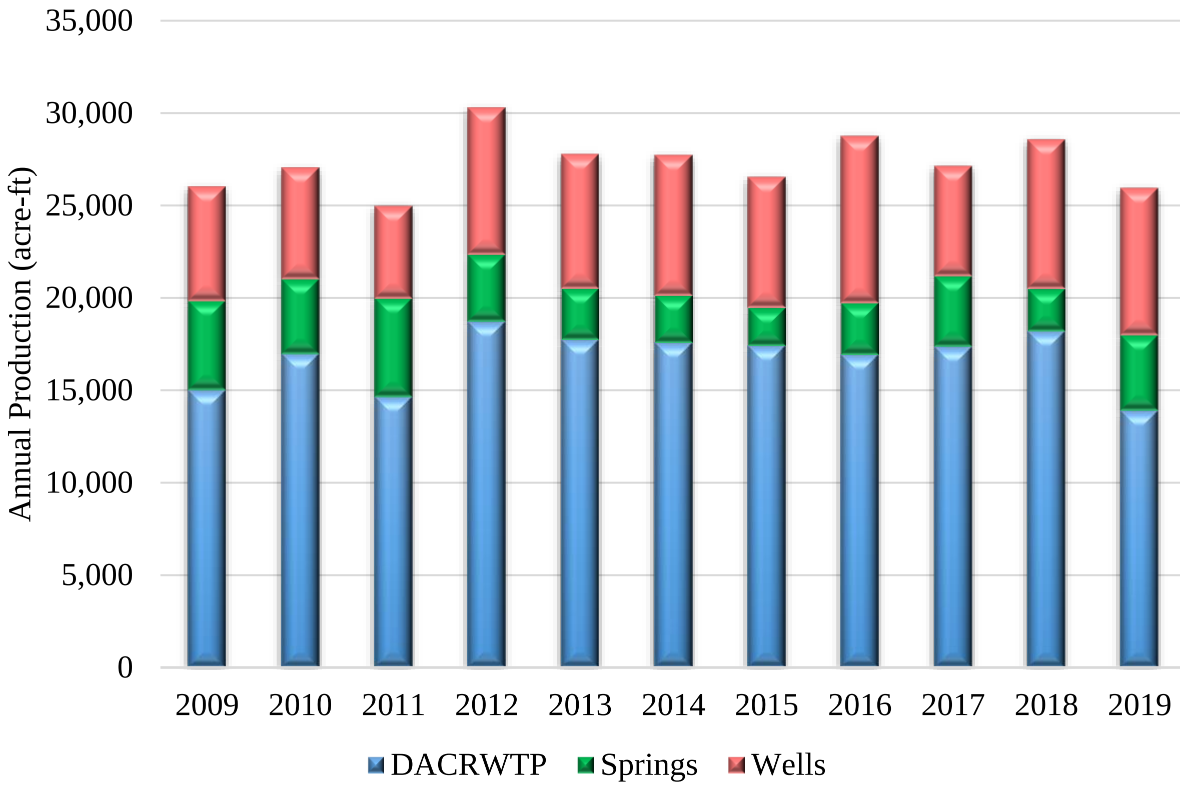
HISTORIC SOURCE UTILIZATION

The City of Orem obtains its water from a combination of municipal sources including two springs in Provo Canyon, nine City wells, and surface water treated at the Don A. Christiansen Regional Water Treatment Plant (DACRWTP). Surface water at the DACRWTP is a combination of reservoir storage and natural river flow. Historic use of these sources since 2009 is summarized in Table 4-1 and Figure 4-1.

Table 4-1
Historical Source Utilization (acre-ft)

Source	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Springs	4,839	4,045	5,333	3,621	2,778	2,564	2,073	2,794	3,807	2,287	4,084
Wells	6,169	6,023	4,992	7,950	7,245	7,574	7,045	9,037	5,958	8,076	7,960
DACRWTP	15,013	16,974	14,647	18,719	17,743	17,578	17,416	16,939	17,372	18,216	13,901
Total	**26,021**	**27,041**	**24,972**	**30,290**	**27,766**	**27,716**	**26,533**	**28,770**	**27,137**	**28,579**	**25,945**

Figure 4-1
Historical Sorce Utilization



ANNUAL SOURCE CAPACITY

Utah Administrative Code R309-510-7 requires that municipal water sources physically and legally meet water demands under two separate conditions. First, source capacity must be adequate to provide one year's supply of water, which is the average annual production requirement. Second, source capacity must be adequate to meet peak day production requirements. The following sections discuss the average annual production capacity of each of Orem's sources. Included in this discussion is the consideration of how the yield of each source might vary during different climatic conditions (dry and average water years). For purposes of evaluating source production capacity, the City of Orem sources have been grouped into three categories; springs, wells, and surface water treated at the DACRWTP.

Springs

A portion of the City of Orem's municipal water originates from Alta Springs and Canyon Springs located in Provo Canyon. Springs are an ideal choice for culinary water due to their low cost of production and high quality of water. Alta Springs is located at a high elevation and supplies water to the Upper Tanks without any required pumping, while Canyon Springs requires a booster station to supply flow to the system. The springs produce very clean water and do not require treatment, except for the addition of chlorine.

The spring yield varies seasonally, and the production is dependent on soil moisture and yearly snowpack, in addition to other hydrologic factors. Yields under varying climate conditions were determined by looking at past extremes in available historical water production records and discussions with City personnel. Dry year production for spring sources has been estimated based on metered production during the dry water year of 2013. Average year spring production is estimated based on average metered production during the period of 1981-2006 (from the City of Orem Water Supply and Demand Model, 2006)[1].

The average water yield of developed the City of Orem springs is 3,838 acre-ft. Reliable yield during dry years is estimated to be 2,958 acre-ft per year. Table 4-2 summarizes the contribution from each spring source using historical data.

Table 4-2
Source Summary of Existing Springs

Source	Average Yearly Yield (acre-ft)	Dry Year Yield (acre-ft)	Dry Year Yield Percentage
Alta Spring	3,012	2,321	77%
Canyon Spring	826	637	77%
Total	**3,838**	**2,958**	**77%**

Wells

The City of Orem has a total of 9 municipal groundwater wells which operate under several different water rights. The wells vary in capacity as summarized in Table 2-1 of Chapter 2. As of 2006, the City of Orem's water right allows for a maximum sustained pumping rate of 21.6 mgd (33.5 cfs), with a maximum allowable yearly removal of 18,306 acre-ft. Over the past 5 years, the maximum annual volume of groundwater removed via wells was 9,037 acre-feet, leaving approximately half of the water right remaining. Although the City's "paper" water rights designate the City has a right to 18,306 acre-feet, the volume which could actually be extracted annually without negatively impacting the aquifer(s) is likely less. For this analysis, it has been assumed that the available yield for City of Orem wells will be the same in both dry and average years.

Don A. Christiansen Regional Water Treatment Plant

The majority of water used by the City of Orem is treated surface water from the DACRWTP. Water treated at this location can come from either Provo River direct flow rights or from storage rights in several different mountain reservoirs in the Provo River Drainage via the Metropolitan Water District of Orem.

[1] It will be noted that actual water used from City of Orem springs has trended lower in recent years than the reported average for 1981 to 2006. The City of Orem personnel have indicated that this lower use in recent years is the result of factors other than available yield and that the longer-term averages should be used for planning purposes.

Surface Water Storage. The Metropolitan Water District of Orem, through various canal companies, currently maintains the rights to a total of 13,861 acre-ft per year of surface water from mountain storage reservoirs. The breakdown of reservoir surface water storage is shown in Table 4-3.

Table 4-3
Summary of Surface Water Storage Reservoirs

Reservoir Name	Description*	Storage Quantity (acre-ft)
Jordanelle/Deer Creek	Upper Lakes	920
Jordanelle	Bonneville (CUP) Project	7,520
Deer Creek	DC Project Issue 1	1,300
Deer Creek	DC Project Issue 2	200
Deer Creek	DC Project Issue 3	754
Deer Creek	Dixon Irrigation Co.	300
Deer Creek	Provo Bench Canal Co.	948
Deer Creek	PRWUCO	3,246
	Total	**14,188**

*Source: City of Orem Water Supply and Demand Model, 2006

Provo River Direct Flow Rights. As of 2006, the City of Orem maintains a 'Class A' Provo River direct flow right of 35.01 mgd (54.168 cfs) during the period of April 20th to October 15th. However, this allotment decreases to 84% of the original value on June 21th each year (down to 24.4 mgd/45.5 cfs), with another reduction on July 21th which further reduces the right to 79% of the original value (27.7 mgd/42.8 cfs). In average water years, the total yield is approximately 16,812 acre-ft, with a peak day demand production of 27.64 mgd (42.8 cfs). During dry years, water yields from the Provo River can be significantly reduced. In the City's 2006 Supply and Demand model, it was estimated that dry year yields could be as little as 20 percent of average year flows. Total yield during a dry year (assuming 20 percent of average year yield) is estimated to be 3,706 acre-ft with an approximate peak day production of 5.53 mgd (8.56 cfs).

Total Supply

Table 4-4 summarizes the amount of water available to the City of Orem currently and in 2065. Estimated usable yield is provided for both average and dry years.

Table 4-4
Current Usable Yield of Existing City of Orem Culinary Water Sources

Water Source	Usable Yield in Average Year (acre-ft)	Usable Yield in Dry Year (acre-ft)
Springs	3,837	2,958
Wells	18,306	18,306
Provo River Rights	16,812	3,706
Deer Creek Storage	6,700	6,700*
Jordanelle / Deer Creek Storage	1,161	1,161*
CUP Water	7,520	7,520*
Total	**54,336**	**40,351**

* – Multiple year drought could affect the value for storage

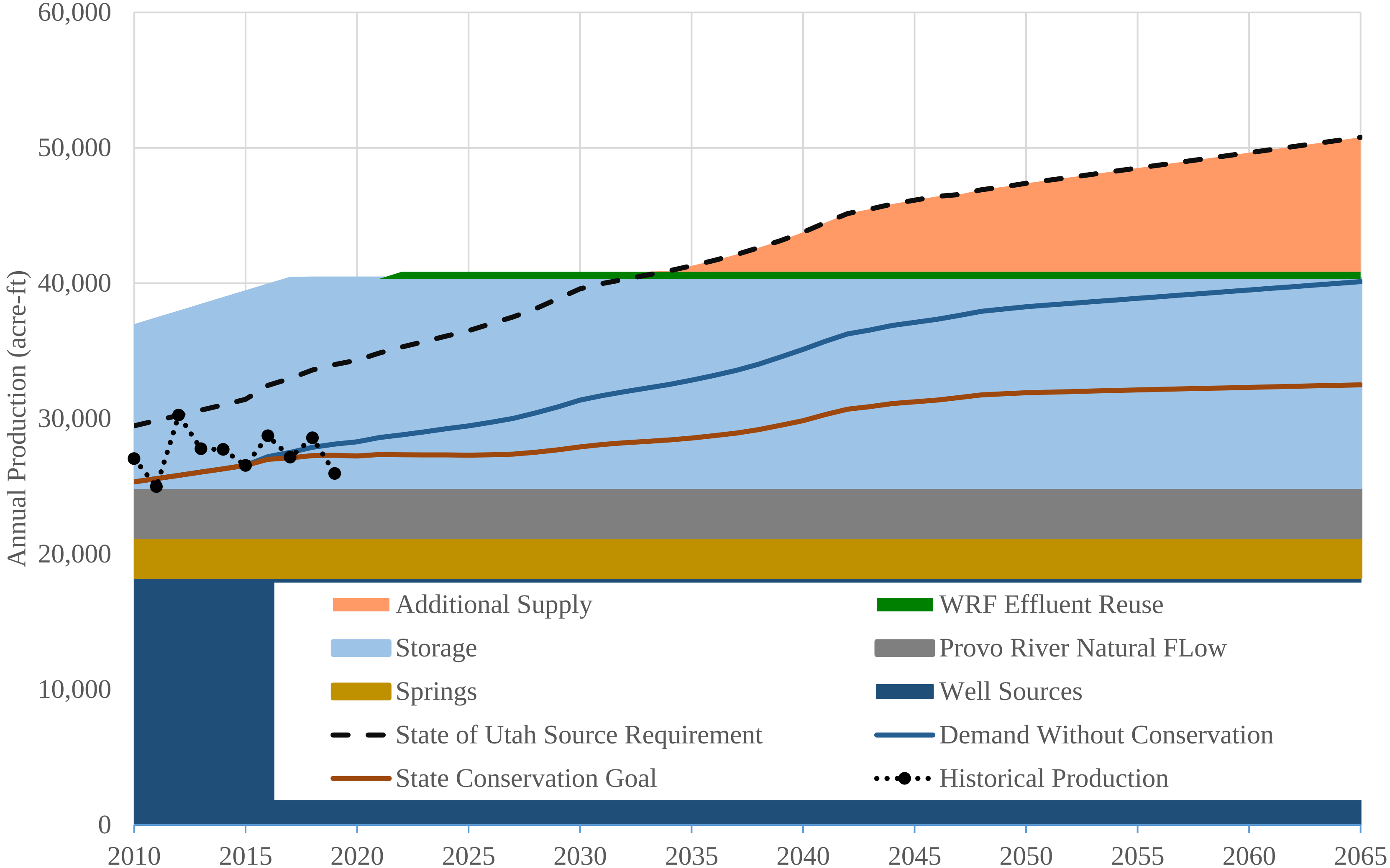
Comparison of Annual Source Yield to Projected Demand Requirements

Figure 4-2 compares the available annual water supply for the City with the predicted annual system demand through buildout. Annual source yield in the figure is presented in terms of dry year yield in order to provide the City with a conservative comparison of supply and demand. Included in the figure are three sets of demand projections:

1. Required production without conservation – This projection is based on per capita water use measured in 2015.
2. Required production with conservation – In this projection, per capita water use has been reduced to meet the City's conservation goal as described in Chapter 3.
3. State of Utah System Specific Source Sizing Requirement – In addition to the City's projections of required demand, the State of Utah also estimates required source sizing based on recent demands. The source requirement uses the last three years of data and includes a variability factor. This variability factor is intended to represent a safety factor to account for annual fluctuations in both demand and supply availability. As currently calculated, this should be considered a conservative projection of required supply for planning purposes.

As shown in Figure 4-2, the City is projected to have more than enough annual water supply if the City meets its water conservation goals. Without conservation and no variability factor, the City also shows enough supply to meet demands, but just barely. Projected supply needs as required by the State of Utah current source sizing requirement results in a projected annual supply deficit by the year 2033 and a need to acquire an additional 10,450 acre-feet worth of supply at buildout.

Figure 4-2
Projected Annual Production Requirements



Note: Well capacity based on maximum water rights. Storage and natural flow based on City of Orem Supply Report (2006), Spring capacity based on dry year yield (2013)

It should be noted that the conclusions above are based on a number of assumptions relative to future yields associated with each source. Any changes to the yields assumed here will require reconsideration of City water needs. Of specific concern are annual groundwater yields. While the City has water rights to the volume of water shown, the amount of water that is physically available or restrictions associated with State of Utah groundwater management efforts could result in actual yields that are less than the amounts shown. It is recommended that the City continue to monitor production from its several sources and revisit projected yields periodically. Studying groundwater recharge (aquifer storage and recovery) would be beneficial for the City.

Additional Sources

Based on the current State of Utah source size requirement, the City of Orem will need to secure up to 10,450 acre-ft of additional source to meet future demands. However, it should be noted that the source sizing requirement is based on recent water use patterns without any consideration of future conservation. As a result, it likely represents a conservative estimate of future water needs. Thus, it is recommended that the City monitor demands and conservation progress for several more years before investing significantly in new sources. However, if reductions in water use associated with conservation are less than expected, or if existing source yields are restricted for any reason, the City will want to be prepared to pursue additional sources to meet annual demands. If this becomes necessary, the most likely sources of future water for the City of Orem based on current information are as follows:

- **Wastewater Reuse** – One source the City can add to its water portfolio is effluent reuse from the Water Reclamation Facility (WRF). The City previously identified reuse water as a valuable source to develop in the City. Projected yield associated with this source is 516 acre-ft. This additional supply will likely be developed in the near term for water conveyance benefits, even if it is not yet needed to provide annual supply volume.
- **Additional Surface Water Supply** – Any additional source capacity needed beyond existing supplies and reuse would most likely need to come from additional surface water sources. This would likely come in the form of additional Provo River water purchased from existing irrigation shareholders. This water could then be treated at the DACRWTP.

Table 4-5 lists the estimated additional source yield required to meet future annual production requirements if the City does not reduce its per capita water use through conservation.

Table 4-5
Future Annual Source Yield

Source	Additional Source Yield for Annual Demands (acre-feet/year)
Reuse	516*
Additional supply	9,934**
Total	**10,450****

*Based on recommended reuse system to Sleepy Ridge Golf Course and Lakeside Sports complex. See WRF Reuse Evaluation memo in Appendix C of the 2016 Water System Master Plan. The City's water right quantity for reuse is 9,634 acre-ft
**Additional annual supply needed only if the City doesn't achieve its conservation goals

PEAK DAY PRODUCTION CAPACITY

To this point in the report, only the annual yield of each source has been considered. The following sections discuss the peak production capacity of each of Orem's sources.

Springs

Since peak production requirements have historically occurred in July, peak day spring production is estimated based on historical data from this month. Peak day production during average years is estimated based on historical spring production data from 1981-2006, while the peak day production capacity during dry years is estimated from metered data for the dry year of 2013, both evaluated for the month of July. Peak day capacity of the City's spring sources is summarized in Table 4-6.

Table 4-6
Source Summary of Existing Springs

Source	Average Water Year Peak Day Yield (mgd)	Dry Water Year Peak Day Yield (mgd)	Dry Water Year Peak Day Yield Percentage
Alta Spring	4.43	2.46	56%
Canyon Spring	0.73	0.68	93%
Total	**5.16**	**3.14**	**61%**

Wells

As mentioned in the discussion of annual source production, the City has a total of 9 municipal groundwater wells with varying capacity. Peak day capacity for each well was estimated based on actual well production data from 2011 to 2019. It is recommended that the assumed reliable peak production of the wells be reduced for planning purposes to account for potential problems that may arise regarding water quality, pump maintenance at individual wells, or lower aquifer levels during dry periods. This considered, the reliable peak day capacity for each well is estimated as 80% of the recorded maximum daily flow during the year of 2018. Table 4-7 presents the location, size, pressure zone, and estimated reliable peak day capacity of each well.

Table 4-7
Existing Wells Reliable Peak Capacity

Name	Address	Size (inches)	Zone	Peak Capacity (mgd)	80% Planning Capacity (mgd)
Well #1	1450 S 800 E	14	Central	4.63	3.71
Well #2	710 N 980 W	12	Central	5.29	4.23
Well #3	479 N 400 E	10	Eastside	2.04	1.63
Well #4	65 S 1000 E	14	Eastside/Central	5.51	4.40
Well #5	56 N State St.	14	Central	5.14	4.11
Well #6	950 N 1000 E	12	Central	1.58	1.27
Well #7	665 N Palisade Dr.	8	Eastside	0.94	0.75
Well #8	701 S State St.	12	Central	5.44	4.35
Well #9	800 S 900 E	14	Central	5.96	4.77
			Total	**36.53**	**29.23**

As shown in Table 4-7, the reliable peak day capacity from Orem's wells is approximately 29 mgd (54 cfs).

Surface Water Treated at the DACRWTP

Water treated at the DACRWTP is a combination of direct flow from the Provo River and surface water stored in Deer Creek and Jordanelle Reservoir. As has been discussed previously, the City of Orem has historically been the primary water user at the plant. As a result, it has always had adequate treatment capacity to meet its needs. As additional users begin to take more water from the plant, it seems prudent for the City to formalize its use of peak day production capacity at the plant. This needs to be negotiated between Orem and CUWCD. For the purposes of this analysis, the City of Orem's portion of the plant capacity has been assumed to be 42 mgd.

Total Peak Day Capacity

Projected peak day production capacities for each of the City of Orem's current sources are summarized in Table 4-8.

Table 4-8
Peak Day Production Capacity of Current City of Orem

Source	Peak Production during Average Year (mgd)	Peak Production during Dry Year (mgd)
Springs	5.16	3.14
Wells	29.23	29.23
DACRWTP	42	42
Total	**76.39**	**74.37**

Comparison of Peak Source Production to Projected Demand Requirements

Figure 4-3 compares the projected peak day demand requirement for the City of Orem distribution system through buildout against the available peak day capacity of Orem's current sources. Since dry year conditions are of the greatest concern, only the estimated reliable production during a dry year is shown. As with the projected annual demands, the figure includes both projected demands (as calculated in Chapter 3) and required source capacity based on the State of Utah System Specific Source Sizing Requirement.

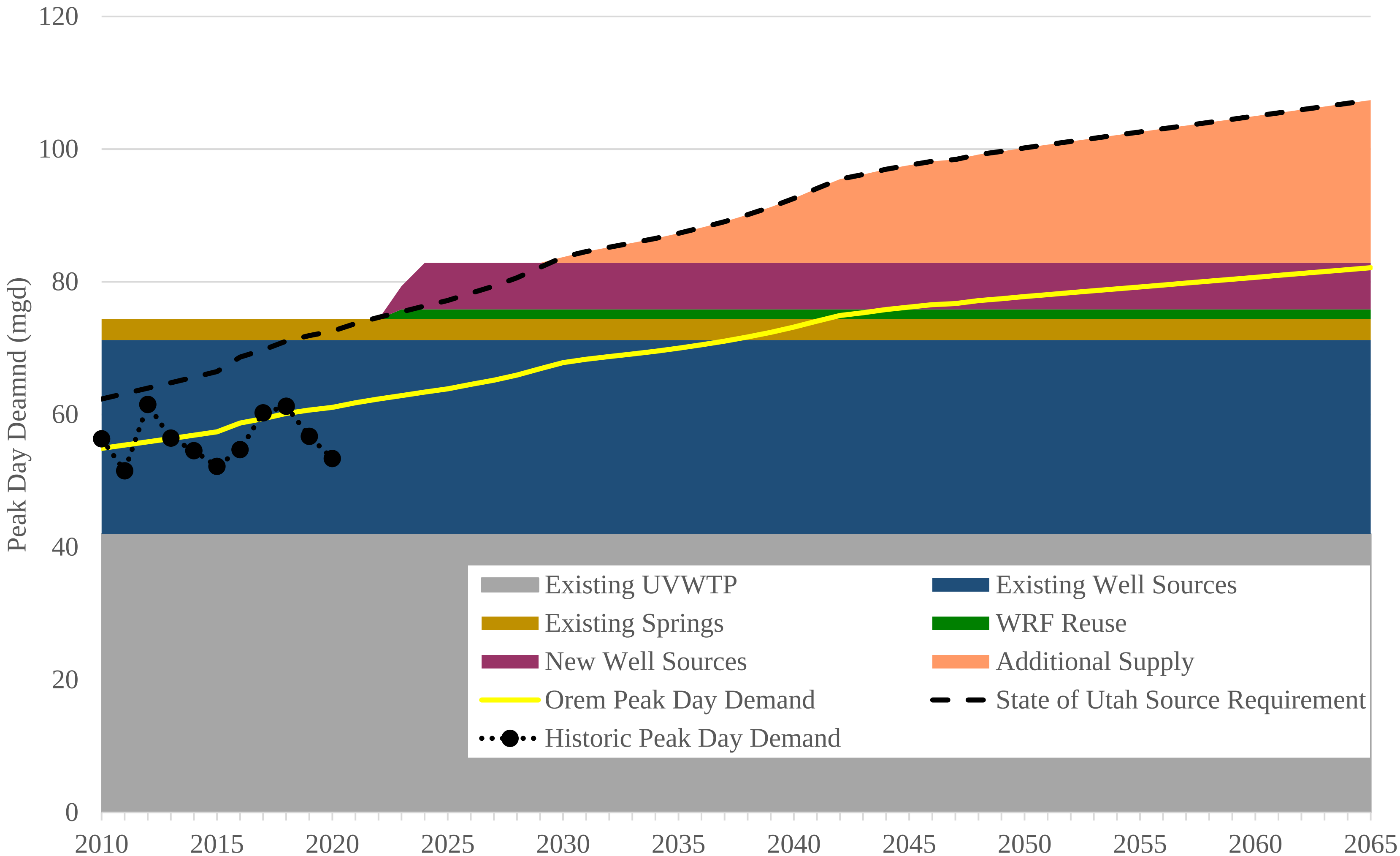
Additional Sources

If Orem continues to grow as projected in Chapter 3 of this report, peak day demand on the system will exceed the peak day capacity of the City's existing sources by about 2043. However, with the more aggressive safety factor included in the State of Utah Sizing Requirement, additional peaking capacity is projected to be needed much earlier (2023 based on current projections). The City has already planned on adding the following sources:

- **Two New Wells (400 South and 1600 North)** – Each of these wells are expected to have a capacity of between 3,000 and 4,000 gpm. For planning purposes, if it is conservatively assumed that each well yields 3,000 gpm, this will add 6,000 gpm (8.63 mgd) of total capacity. Following the same logic for well capacity as discussed for existing wells, 80 percent of this value can be considered additional reliable capacity. This equates to 4,800 gpm or approximately 7 mgd
- **Reuse –** The City is also currently in the process of adding reuse capacity to the system. It is expected that this will increase reliable peak day production capacity by 1.5 mgd.

As shown in Figure 4-3, the addition of these two sources will provide the City with enough capacity to meet projected demands through buildout if future demands are consistent with observed peak demands in 2018. However, based on the State of Utah source sizing requirement, there will still eventually be a deficit in peak day supply without additional sources. As was discussed relative to annual demands, the current State of Utah source sizing requirement is a conservative estimate of future water needs. Thus, it is recommended that the City monitor demands and conservation progress for several more years before investing significantly in new sources. However, if the City ultimately still needs additional peak day source capacity, the City will most likely need to secure additional capacity at the DACRWTP or in additional groundwater wells. A summary of the additional source capacity requirement is shown in Table 4-9.

Figure 4-3
Projected Peak Day Demand
And Available Supplies



Notes: Existing Well capacity based on 80% of max 2018 production, Spring capacity on dry year yield (2013), Existing UVWTP Capacity based on available data (42 mgd)

Table 4-9
Future Peak Day Source Capacity

Source	Additional Source Capacity for Peak Day Demands (mgd)
Wells	7
Reuse	1.48*
DACRWTP	23.0
Total	**30.48**

*Based on recommended reuse system to Sleepy Ridge Golf Course and Lakeside Sports complex.

SOURCE RECOMMENDATIONS

While the actual necessity of additional source capacity to meet average annual demands is uncertain, additional peak day source capacity will almost certainly be required in the coming years. Based on these conclusions, BC&A would recommend the following actions:

1. **Proceed with Reuse Water Projects.** The City has been looking at this project closely for several years. It is recommended that the City proceed forward with the construction of the identified reuse projects to take advantage of this water resource and help address water conveyance issues in the southwest corner of the City.
2. **Construct a New Well near Community Park –** As part of overall storage and conveyance needs, a new well is an essential part of proposed improvements. The City has plans for a new well on 400 South in the vicinity of Community Park (see Chapters 5, 6. And 7). This will be a priority location for a new well. As part of developing a new well, the City will need to capture and convey stormwater from existing sumps in the future well's wellhead protection zone. These projects are described further in the Storm Water Master Plan, but are included in the Water Master Plan budget because they would not be required without the new well.
3. **Construct a New Well at Approximately 1600 North 400 West–** The City has tentatively identified a well site near 1600 North at 400 West that may be suitable as the site of a second new well. It is recommended that a well be constructed in the area in 2022 or 2023. As part of developing a new well, the City will need to capture and convey stormwater from existing sumps in the new well's wellhead protection zone. These projects are described further in the Storm Water Master Plan, but are included in the Water Master Plan budget because they would not be required without the new well.
    - In addition to these improvements, Well No. 1 will be reconstructed in Hillcrest Park. This improvement will be discussed further in Chapter 7.
4. **Monitor Demands to Assess Future Supply Needs –** Beyond the improvements identified above, the City of Orem may need additional water depending on how it grows and what level of conservation is achieved by City residents. It is recommended that the City keep its options open for further supply development but hold off on any major investments in additional new sources as it continues to monitor demands (both annual and peak).

Recommended source projects and their associated costs are summarized in Table 4-10.

Table 4-10
Recommended Well Improvements

Project	Project Number	Project Year	Estimated Cost (2020 Dollars)[1,2]
Reuse Water Project	RW1	2022	$2,800,000
400 South Well	W1A	2022	$2,500,000
400 South Well – Wellhead Protection Storm Drain Improvements[3]	W1B	2022	$2,290,000
1600 North Well	W2A	2024	$3,000,000
1600 North Well - Wellhead Protection Storm Drain Improvements[4]	W2B	2024	$824,600
Total			**$11,414,000**

[1] Does not include the potential cost of land acquisition
[2] Does include 15% engineering, legal, and administrative costs
[3] This includes projects WPZ6A and WPZ6B from the City of Orem's 2020 Strom Water Master Plan
[4] This includes projects WPZ1 and DB_WPZ2 from the City of Orem's 2020 Strom Water Master Plan

CHAPTER 5
STORAGE CAPACITY EVALUATION

The purpose of this chapter is to evaluate the City of Orem's water storage capacity. This chapter provides an overview of State rules and regulations pertaining to public water system storage facilities. As part of this evaluation, the size and location of existing storage reservoirs was analyzed to determine if the City has sufficient storage to adequately meet peak demands and to provide emergency and fire flow storage. This analysis will first examine recommended storage levels based on observed system demands. It will then compare this recommended level of storage to State of Utah requirements based on new system specific sizing standards.

STORAGE EVALUATION CRITERIA

In a water distribution system, three types of storage are recommended:

- Equalization storage
- Fire flow storage
- Emergency storage

Each of these storage components is discussed below.

EQUALIZATION STORAGE

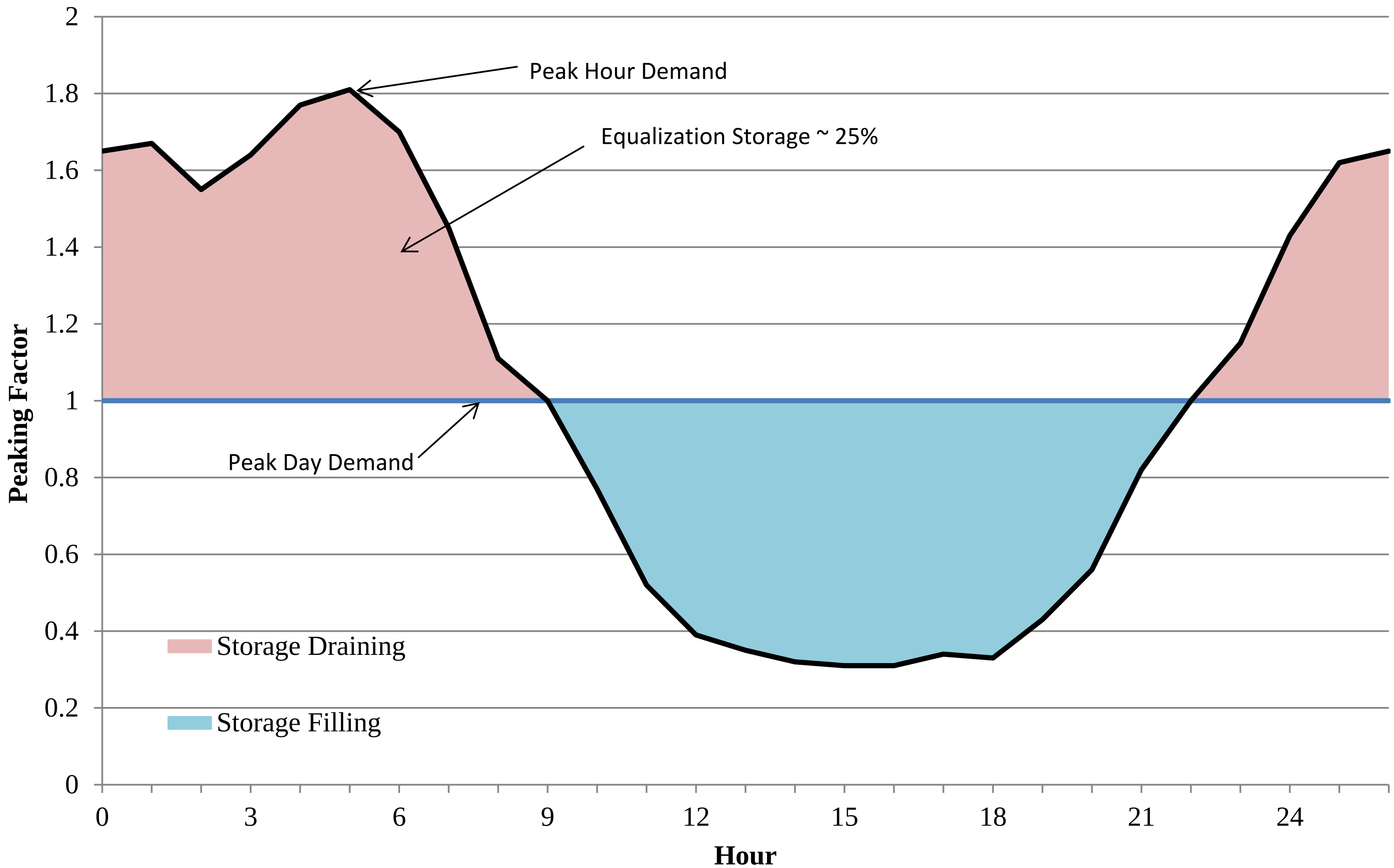
Equalization storage is the storage needed to accommodate fluctuations in demand throughout the day. This storage allows water supply to be delivered at a more constant rate while peaks and valleys in demand are met from storage.

Because the City of Orem has a good database of water use records, BC&A prepared a City specific calculation of equalization storage for the master plan. Figure 5-1 shows the dominant demand pattern for the City of Orem based on measured flows through the Alpine IIB and Reach II flow meters during the peak day of demand (July 2020). As can be seen in the figure, water demands peak in the early morning hours when most people are irrigating their lawns. Demand then drops off significantly during the day as water use is primarily limited to smaller indoor uses.

While demands vary significantly during the day, the same is not true for most supplies. It is usually most economical to size sources, major conveyance pipelines, and pump stations to produce water at a relatively constant rate. This is especially true for major surface water treatment facilities that have a difficult time changing production rates rapidly. As a result, most systems are designed to supply water at a relatively constant rate throughout the day. Storage is then used to satisfy any demands above the rate of supply.

Figure 5-1 shows the difference between demand and supply throughout a peak day of demand. During the hours of greatest demand, water from storage is used to meet demand that exceed supply (as shown in red). During periods of lower demand, supply continues at its steady pace to refill storage reservoirs in preparation for peak demands the next day (as shown in blue). Based on the measured flows and as shown in the figure, the required equalization storage for the City was calculated to be approximately 25 percent of average peak day demands.

Figure 5-1
City of Orem Diurnal Pattern



FIRE FLOW STORAGE

Fire flow storage requirements are defined in Utah State code as follows:

"(3) Fire Flow Storage.

(a) Fire flow storage shall be provided if fire flow is required by the local fire code official or if fire hydrants intended for fire flow are installed.

(b) Water systems shall consult with the local fire code official regarding needed fire flows in the area under consideration. The fire flow information shall be provided to the Division during the plan review process.

(c) When direction from the local fire code official is not available, the water system shall use Appendix B of the International Fire Code, 2015 edition, for guidance. Unless otherwise approved by the local fire code official, the fire flow and fire flow duration shall not be less than 1,000 gallons per minute for 60 minutes."

As stated in the code, the primary authority responsible for establishing needed fire flows and fire flow storage is the local fire code official. As established by the City of Orem's fire marshal in a recent ISO survey, the maximum fire flow requirements vary by development type and ranges from 1,500 gpm in predominantly residential areas to 4,000 gpm in commercial areas. For the purposes of the master plan, fire flows in residential areas have been established at 2,000 gpm for 2 hours, while commercial areas require 4,000 gpm for 4 hours. Although not specifically outlined in the code, State Division of Drinking Water officials have historically allowed for fire flow for individual water pressure zones to come from storage within the zone itself or from storage in higher zones in the system. This is a positive for Orem because it means that the City does not have to build fire flow storage in every zone (e.g. fire suppression storage in the Cherappple Pressure Zone can also be counted as available fire suppression storage for all the regulated zones below Cherapple). For the system as a whole, the required fire flow volume is equal to the largest single fire flow demand. In the case of the City of Orem, this is 4,000 gpm for 4 hours (960,000 gallons).

EMERGENCY STORAGE

Emergency storage is the volume of water required to meet water demand during an emergency. No specific requirement is given for emergency storage in state code. The determination of required emergency storage is left largely to the entity designing and operating the water system.

In the City of Orem, the most common water supply emergencies relative to storage analysis are power outages. During power outages, water supplies are unable to produce needed water. In the event of an extended citywide outage, all wells and the treatment plant would not be able to operate. While some water delivery during a power outage can be accomplished through auxiliary power to selected water system facilities, it is also wise to include some additional emergency water at storage reservoirs. This also gives system operators the benefit of a little extra buffer for system operations. The City of Orem's water supply is also heavily dependent on water from the DACRWTP. If the treatment plant were to go offline unexpectedly, it would be difficult for Orem to meet city-wide demands. In the short-term, Orem could satisfy critical indoor demands with its wells and spring water under this type of scenario. However, in the long-term for larger demand periods, this would create a major problem for water deliveries to the City.

Based on conversations with City personnel and common practice in the industry, it is recommended that all zones include emergency storage adequate to supply the system during a 6-hour power outage during peak day demands. This equates to a recommended emergency storage volume of 25 percent of peak day demand.

RECOMMENDED STORAGE BASED ON OBSERVED WATER USE PATTERNS

Based on the analysis above, the volume of recommended storage is:

- Equalization Storage = 25 percent peak day demand
- Emergency Storage = 25 percent peak day demand
- Fire Flow = 960,000 gallons

Thus, the total recommended storage required for the City of Orem based on observed water use patterns is equal to 50 percent of peak day demand plus fire flow or approximately 30.5 million gallons plus 960,000 gallons (31.5 million gallons total) for 2020.

DIVISION OF DRINKING WATER STORAGE REQUIREMENT

In 2018, the Utah Legislature made modifications to the Utah Safe Drinking Water Act (Utah Code 19-4). The modifications require the Division of Drinking Water (DDW) to use waters supplier data to establish system individualized source and storage sizing requirements for each water system. As part of the above-mentioned modifications, DDW can set the system specific sizing requirements based on either the data submitted by the water systems to DDW or an engineering study submitted by the water system directly to DDW. The DDW calculated storage requirement for the City of Orem for 2020 is 970 gallons per day per equivalent residential connection (ERC) plus fire flow. For the year 2020, this equates to a combined equalization/emergency storage of 30.6 million gallons plus 960,000 gallons fire storage (total of 31.6 million gallons).

Based on the very close agreement of the calculated storage recommendation based on observed water use patterns and the DDW storage requirement, the City will adopt the slightly more conservative DDW storage requirement (970 gallons/ERC) for the purpose of this study.

TOTAL EXISTING AND FUTURE STORAGE REQUIREMENTS

The evaluation of City water storage facilities for existing and future conditions is shown in Tables 5-1 and 5-2. As can be seen in the tables, the analysis indicates there is an existing storage shortage of almost 10 million gallons. By 2065, the shortage increases to approximately 21.2 million gallons. These tables assume that Vineyard City eventually transitions to using CUWCD delivered water such that the City of Orem does not provide any supply or storage for Vineyard City. Note that storage at Canyon Springs (50,000 gal) has been included in the WTP storage because it flows to the same tank service area.

Table 5-1
2020 Storage Facilities Evaluation

Tank service Area	Peak Day Summer Demand (gpm)	Equalization / Emergency Storage Requirement (gallons)	Fire Flow Storage (gallons)	Total Storage Required	Available Storage	Equalization Storage Surplus by Service area (deficit) (gallons)	Total Storage Surplus by Service Area (deficit) (gallons)	Storage Surplus Total (deficit) (gallons)
Cherapple	60	43,178	240,000	283,178	400,000	378,457	116,822	116,822
Upper Tanks	4,061	2,930,324	-	2,930,324	4,000,000	2,537,951	1,069,676	1,186,497
WTP	7,455	5,379,216	720,000	6,099,216	9,550,000	6,866,108	3,450,784	4,637,281
Lower Tanks	30,856	22,263,391	-	22,263,391	8,000,000	(3,108,040)	(14,263,391)	(9,626,110)
Total	**42,432**	**30,616,110**	**960,000**	**31,576,110**	**21,950,000**			**(9,626,110)**

Table 5-2
2065 Storage Facilities Evaluation

Tank service Area	Peak Day Summer Demand (gpm)	Equalization / Emergency Storage Requirement (gallons)	Fire Flow Storage (gallons)	Total Storage Required	Available Storage	Equalization Storage Surplus by Service area (deficit) (gallons)	Total Storage Surplus by Service Area (deficit) (gallons)	Storage Surplus Total (deficit) (gallons)
Cherapple	73	52,364	240,000	292,364	400,000	373,873	107,636	107,636
Upper Tanks	4,350	3,138,709	-	3,138,709	4,000,000	2,433,981	861,291	968,927
WTP	8,144	5,875,942	720,000	6,595,942	9,550,000	6,618,272	2,954,058	3,922,985
Lower Tanks	45,861	33,090,551	-	33,090,551	8,000,000	(8,510,115)	(25,090,551)	(21,167,566)
Total	**58,428**	**42,157,566**	**960,000**	**43,117,566**	**21,950,000**			**(21,167,566)**

[1]Does not include peak day summer demands for Town of Vineyard; the City of Orem will not provide storage to Town of Vineyard.

Up to this point, these deficiencies have likely not caused any significant operational issues due to the fact that Orem currently has access to storage not owned by the City at the DACRWTP. However, as demands increase in the City and storage from the plant is allocated to additional entities, this buffer will shrink and storage will become much more important for satisfying peaks in demand. The City completed a storage tank evaluation and location study in early 2017 to assist in identifying potential sites to construct additional storage in the City. The City has selected the two best tank sites based on the results of that study.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be made regarding storage in the City of Orem water distribution system:

1. Total Storage – The City of Orem's water system currently has a total of 21.95 million gallons of storage. Based on the criteria established previously, the water system currently has a deficiency of 9.6 million gallons of storage. By 2065, the system will have a storage deficiency of 21.2 million gallons if additional storage facilities are not constructed.
2. Storage deficiencies in the system affect the Lower Tanks, which provide storage to the Central pressure zone and zones below the Central zone. These zones represent the majority of the City of Orem's service area. Up to this point, these deficiencies have likely not caused any operational issues since current source capacities exceed peak system demands and also because Orem currently has access to unused storage in the DACRWTP. However, as demands increase in the City and storage from the plant is allocated to additional entities, this buffer will shrink, and storage will become much more important for satisfying peaks in demand.

Based on these conclusions, BC&A would recommend the following actions:

1. **Construct a New 10 Million Gallon Storage Reservoir –** To remediate the current storage deficiency in the water system, BC&A recommends that the City construct a new 10 million gallon storage facility. The proposed location for a new storage reservoir is near Community Park as identified in the City's recent tank siting study. The tank at this site will fill during low demand periods during the day, and a booster station will pump from the tank into the system to help mitigate drops in pressure during periods of high demand. As part of this improvement, the City will need to construct a new well at the site (to serve as the primary supply to the tank and minimize the amount of water that must be bled down from the system).
2. **Consider Options for Future Storage Requirements –** While a new 10 MG water storage facility will help alleviate the existing storage deficiencies in the system, the City will still face an additional 12 million gallon storage deficit between now and projected buildout in 2065. While additional storage improvements will likely not be included in the 10-year capital facilities plan, the City should begin to consider options to meet future storage needs. This may include negotiating with CUWCD or adjacent property owners near the Site 5 storage location to obtain property rights to construct new storage or could include acquiring additional storage capacity at the DACRWTP.

Table 5-3 displays the timing and estimated cost of the recommended storage improvements for the City.

Table 5-3
Recommended Storage Tank Improvements

Project	Project Number	Project Year	Estimated Cost (2020 Dollars)
10 Million Gallon Storage Facility	ST1	2022	$13,800,000
12 Million Gallon Storage Facility	ST2	2035	$16,560,000
Total			**$30,360,000**

*Does not include the potential cost of land acquisition,
**Does include 15% engineering, legal, and administrative costs

CHAPTER 6
HYDRAULIC MODELING

INTRODUCTION

A critical component in evaluating the performance of the City of Orem water system is the development of a hydraulic computer model. A hydraulic model was developed using Innovyze's InfoWater software. The purpose of this chapter is to present a summary of the methodology used to develop this model.

WATER SYSTEM MODEL

A hydraulic computer model is a digital representation of physical features and characteristics of the water system, including pipes, valves, storage tanks and pumps. Key physical components of a water system are represented by a set of user-defined parameters that represent the characteristics of the system. The computer model utilizes the digital representation of physical system characteristics to mathematically simulate operating conditions of a water distribution system. Computer model output includes pressures at each node, flow rate for each pipe in the water system, and water surface levels in storage tanks. There are several well-known computer programs for modeling water distribution systems. InfoWater 12.4 developed by Innovyze was used for this Master Plan. This program uses the EPANET computing engine.

The City's existing water system hydraulic model was updated by Bowen, Collins & Associates for this study using available GIS data in conjunction with historic demand and production data provided by City of Orem personnel. The model was set up to run both steady state and extended period simulations. The steady state simulation is primarily intended to identify pressure and pipe deficiencies in the distribution system, such as undersized water lines. The extended period simulation is for tracking dynamic, time-dependent variables, such as water quality components or the depth of water in a storage tank throughout the course of a day.

GIS DATA

The GIS data used to update the water system model included:

- Pipeline locations, diameters, and lengths
- Water system valves, pumps, and water tanks
- Elevation contours

CALIBRATION

Calibration is the task of adjusting hydraulic model parameters so that model output results correlate with actual observed conditions in the water system. Model calibration was achieved by checking model pressure outputs against field measured pressure readings at a number of PRV's throughout the system as well as through communication with City personnel. A few assumptions regarding the calibration of the model are listed below:

- **Pipe Roughness –** Pipe roughness in the distribution system varies between 110 and 130 with an average of approximately 115.
- **Pipe Size Data –** Pipe diameters and locations in the model were determined based on the available GIS data from the City. The diameters assigned in the City's existing model were checked against updated GIS information and updated or revised where necessary.
- **Pipe Depth –** Junction elevations in the model were extracted from a Digital Elevation Model which represents the elevation of the ground surface throughout the City. In reality, pipes sit 4 to 5 feet below the ground surface, but the relative model elevations are the same.
- **Pump Curves –** Model pump curves remained the same as they were input into the City's existing model.

MODEL DEMANDS AND DEMAND DISTRIBUTION

A key component in hydraulic modeling is the development of system demands. There are two components to consider when developing the demands for the model: total system demands and distribution of demands. Total system demands are discussed in Chapter 3 of this report. For modeling purposes, the demand scenarios of most concern are those that represent the highest flow demands on the system. These scenarios are peak hour demand and peak day demand with a simultaneous fire flow event. A peak hour to peak day factor of 1.8 was used in the model simulations. This value was calculated using flow meter data for the peak week of demand. Total model flows for peak day and peak hour demands are summarized in Table 6-1.

Table 6-1
Projected Peak Demands

Year	Peak Day Demand (mgd)	Peak Hour Demand (mgd)
2020*	61.1	109.9
2025	63.9	115.0
2035	70.0	126.0
2045	76.2	137.1
2055	79.2	142.6
2065	82.1	147.8

*Estimated peak day demand assuming similar weather conditions to 2018.

The distribution of system demands was accomplished with the aid of meter data provided by the City. Metered water usage data from July of 2020 which contained metered flows and geospatial references were imported into the model and assigned to a model junction based on the geographic coordinate. Demands were factored up to match the highest historic peak day demand over the last 5 years (July 2018). Meter data for municipal meters was then assigned to the model based on the service area of each meter. Since not all meters had a corresponding geospatial location and meters do not account for system losses, model demands were then scaled to appropriately match the total peak day demand for the system. Demand distribution for future system model scenarios, such as the buildout demand scenario, were developed using the MAG TAZ growth projections across the City as discussed in Chapter 3.

CHAPTER 7
DISTRIBUTION SYSTEM EVALUATION

The purpose of this chapter is to document the results of the hydraulic modeling evaluation of the City of Orem distribution system.

MODEL SCENARIOS

As discussed in Chapter 6, the City of Orem model includes a series of steady state flow simulations. These simulations provide snapshots of the system under steady state conditions. The steady state conditions that were modeled represent the most extreme demand conditions that the system will experience including peak hour demands and peak day demands with fire flow. The following is a description of each model scenario simulated in the hydraulic model:

1. **Existing Peak Day Demand –**This scenario represents the average demands on the system during the peak usage day for existing conditions (2020).
2. **Existing Peak Hour Demands** – The purpose of this scenario is to identify existing deficiencies under peak hour demand conditions. For this simulation, a peak hour factor of 1.8 was used based on flow meter data provided by the City.
3. **Existing Peak Day Demand with Fire Flow** – This scenario identifies potential deficiencies in the system under existing peak day demand conditions with fire flow demands.
4. **Existing Winter Demand Set** – This scenario identified locations with potentially high system pressures during low demands when pipe friction losses are minimal. Winter demands were developed by multiplying summer demands by approximately 0.05 to represent winter nighttime demands.
5. **2065 Peak Day Demand** – This scenario represents the average demands on the system at buildout (2065) during the projected peak usage day during the year.
6. **2065 Peak Hour Demand** – The purpose of this scenario is to identify potential deficiencies under peak hour demand conditions in the year 2065. This scenario was developed by applying a 1.8 peaking factor to the 2065 peak day demand.
7. **2065 Peak Day Demand with Fire Flow** – This scenario was used to identify potential fire flow deficiencies at buildout. Since fire flow deficiencies are usually the result of locally undersized pipes, buildout fire flow deficiencies closely match existing fire flow deficiencies.
8. **2030 Peak Hour Demand** – This scenario was developed in order to aid in the timing of future system improvements between the current system and the system at buildout.

Source Failure Scenarios

Along with the model scenarios outlined above, additional model scenarios were simulated to determine the ability of the system to deliver water to customers during a source failure. The following source failure scenarios were evaluated:

DACRWTP Failure – The most impactful source failure scenario for the City of Orem involves the complete shutdown of the DACRWTP. Under such a scenario, the system would not be capable of supplying peak day demands once emergency storage has been depleted. In the case of a treatment plant failure, well and spring water would become the primary sources for the City. Under this scenario, sources would only have the capacity to satisfy indoor (winter) demands. From a distribution standpoint, spring flow would be utilized in the upper zones (Alta, Cherapple, Northridge, Timpanogos, Cascade, and Treatment Plant) while well flow would satisfy remaining demands.

Individual Well Failure –The hydraulic model was used to evaluate the system pressures with each well turned off one by one. This is done to verify that there are no portions of the system that are dependent on the operation of a particular well to provide adequate pressure during peak demands.

EVALUATION CRITERIA

The performance of the system was evaluated using the following criteria:

- **Pressure within the system during peak demands** - The State of Utah requires that a public water system maintain a minimum pressure standard of 30 psi during peak hour demands and 40 psi during peak day demands. City of Orem personnel have indicated its design criteria is to keep pressures above 50 psi during peak hour demands with a maximum pressure of 150 psi for static demand conditions. For most parts of the City, the City tries to maintain pressures between 60 psi and 120 psi.
- **Pressure within the system during peak day demands with fire flow –** The State of Utah requires that a public water system be capable of conveying the required fire flow with a residual pressure of 20 psi. Any node in a residential area incapable of supplying 1,500 gpm with a 20 psi residual was identified as deficient. Commercial areas were evaluated with a fire flow of up to 4,000 gpm with a 20 psi residual pressure (including areas around University Place).
- **Maximum pipe velocities –** While high instantaneous velocities in a pipeline are not generally as much of a concern to the system as low pressures, they can cause damage to pipes and potentially lead to pipe failure. High velocities alone do not generally require improvements to eliminate the velocity issues, but indicate areas where additional conveyance improvements will have the most benefit. Pipelines with velocities above 7 ft/sec indicated areas where additional conveyance improvements would be beneficial. Any pipeline which displayed a maximum velocity greater than 10 ft/sec was flagged as a deficient pipe.

SYSTEM EVALUATION RESULTS

Existing System with Current Development Conditions

The hydraulic computer model was used to simulate system conditions for the Exisitng Winter (Static), Existing Peak Day, Existing Peak Hour, and Existing Fire Flow (with PDD) demand scenarios. Model results for critical model scenarios under existing demands are included in the following figures:

1. Figure 7-1 shows pressures for the Existing Winter Demand Scenario
2. Figure 7-2 shows pressures for the Existing Peak Hour Demand Scenario
3. Figure 7-3 the available fire flow in conjunction with Existing Peak Day Demands

From these figures, the following observations can be made:

- As shown in Figure 7-1, the majority of the system pressures under a winter demand scenario range from 50 to 120 psi. However, a limited number of locations in the system, namely at the lower end of the Alta, Timpanogos, and Westside pressures zones, display relatively high pressures above 120 psi. These are locations that the City should be aware of in case maintenance is needed, but do not require any specific remedies.
- As can be seen in Figure 7-2, all areas of the City's system currently meet State of Utah guidelines for pressure, but there are many areas in the Central pressure zone that fall below the City's preferred criteria of 50 psi during peak hour demands, with some areas in the Central pressure zone dropping below 40 psi.
- Figure 7-3 indicates the results of the fire flow simulation during peak day demands. As shown in the figure, there are a number of model junctions with available fire flow less than the recommended 1,500 gpm. The deficient nodes are generally a result of either undersized water lines or long dead ends. Many of these deficiencies can be remedied by upsizing or looping existing waterlines.

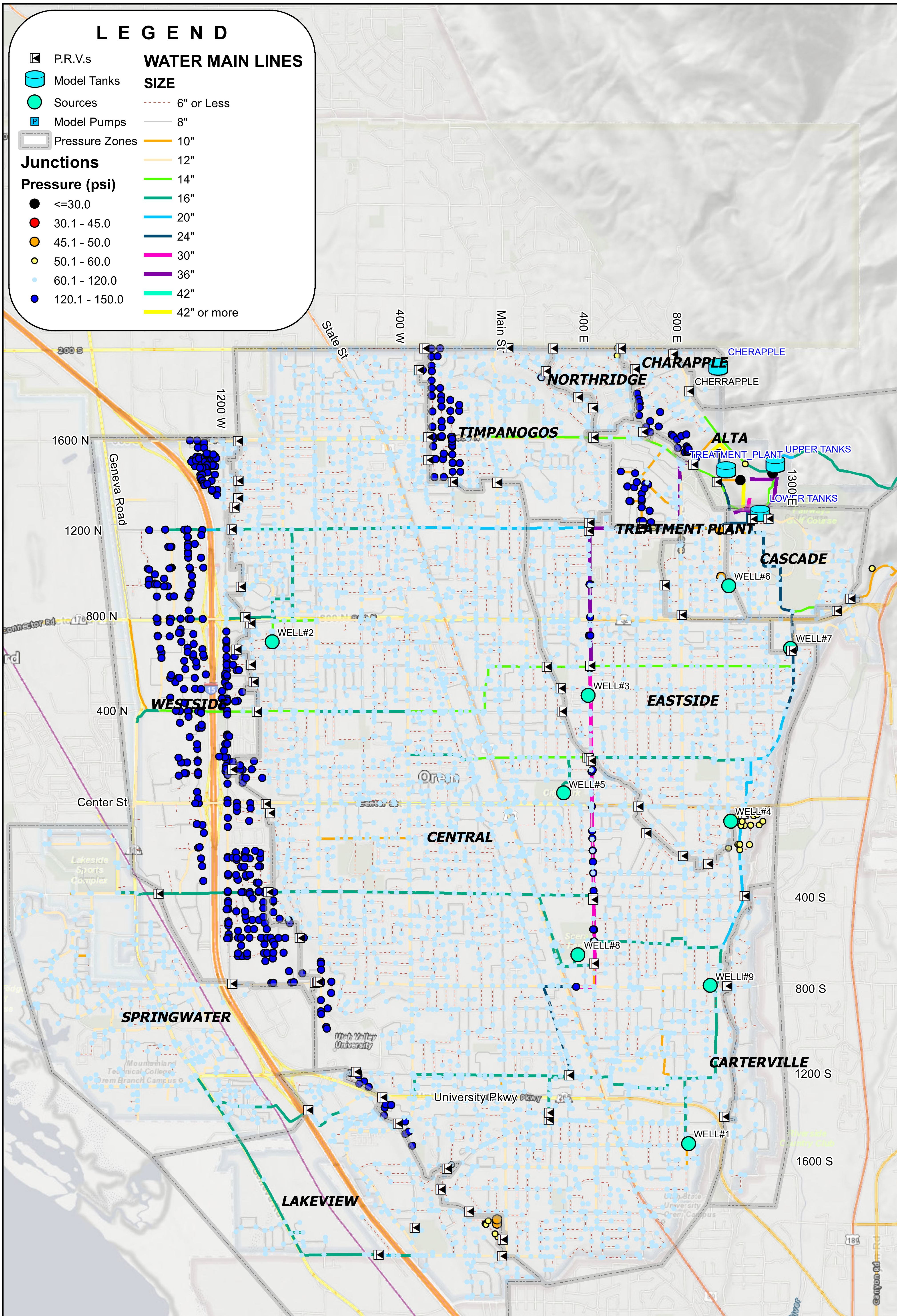
Existing System with Buildout Development Conditions

Model results for critical model scenarios under buildout demands are included in the following figures:

1. Figure 7-4 shows pressures for the 2065 Peak Hour Demand scenario without improvements.
2. Figure 7-5 shows pressures for the 2065 Peak Hour Demand scenario with improvements.

From these figures, the following observations can be made:

- With the existing infrastructure in the model, buildout peak hour demands drop pressures significantly throughout the system as shown in Figure 7-4. Velocities through system pipes also exceed 10 ft/sec in many locations.



OREM CITY
WATER MASTER PLAN

STATIC DEMAND PRESSURES FOR EXISTING CONDITIONS

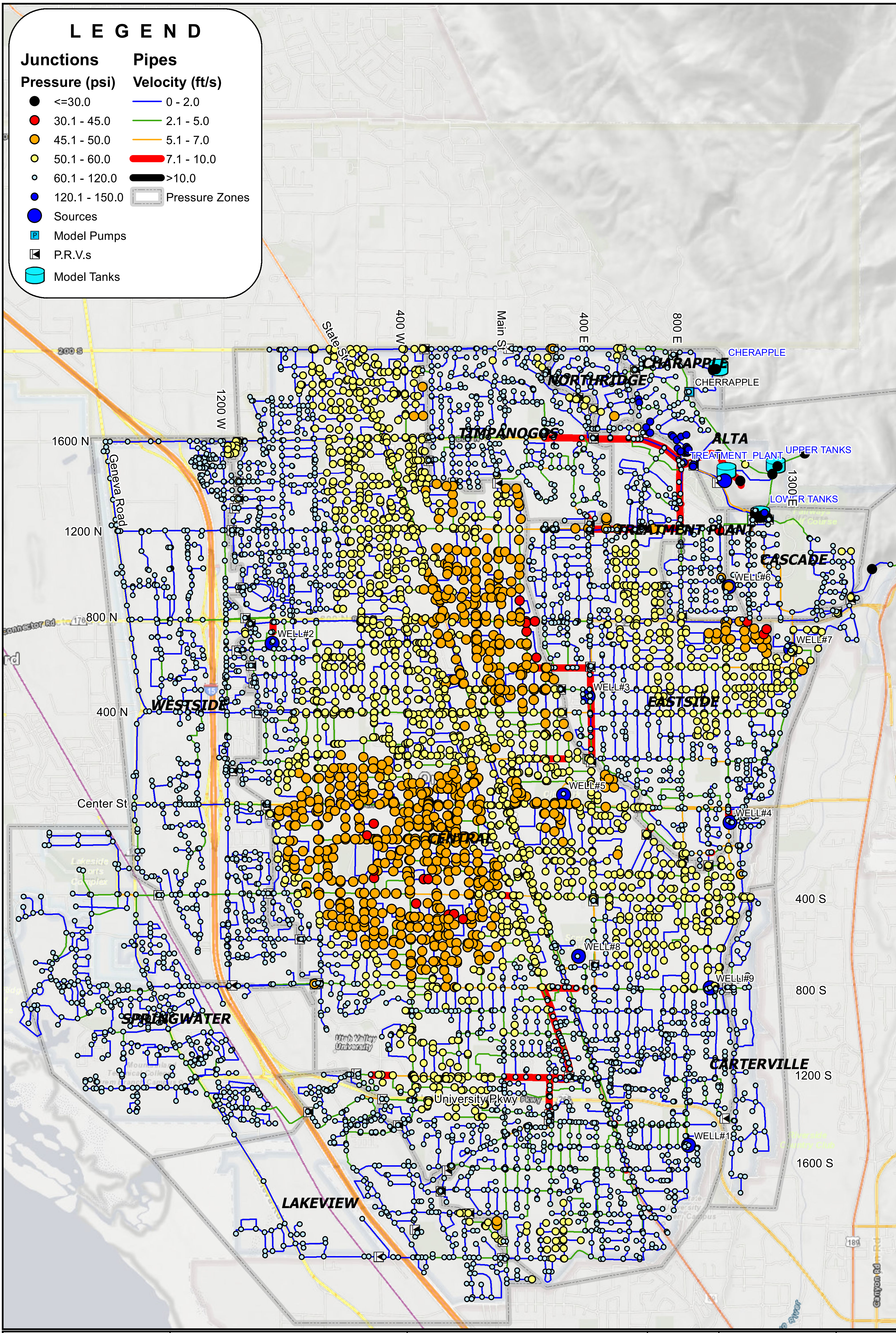
NORTH: NORTH

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 7-1

BOWEN COLLINS & ASSOCIATES

P:\Orem City\2020 Master Plan Assistance\4.0 GIS\Water\Water-Figure 7-1-Static Demand.mxd mrice 3/31/2021



BOWEN COLLINS & ASSOCIATES

OREM CITY
WATER MASTER PLAN

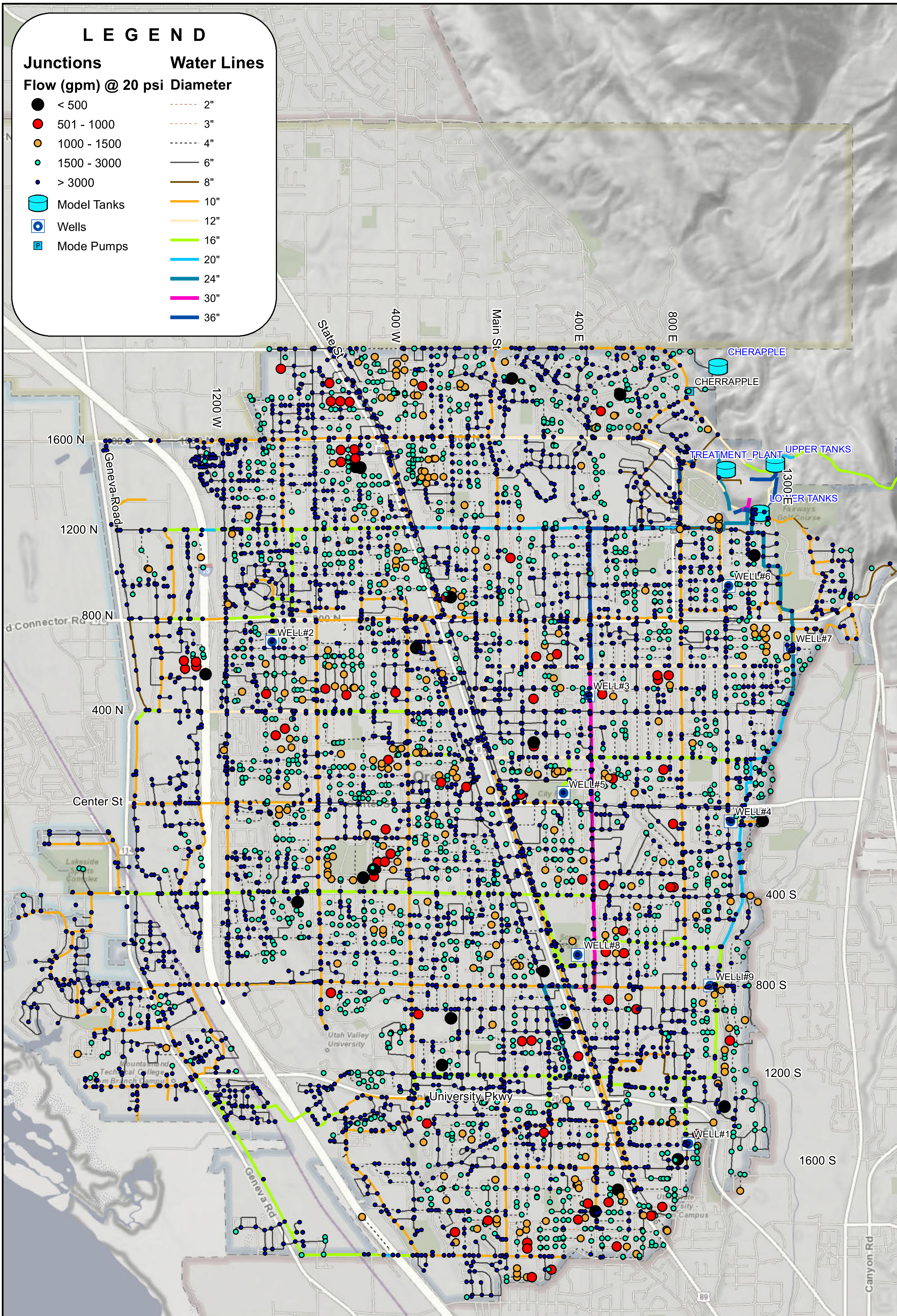
PEAK HOUR DEMAND
FOR 2020 CONDITIONS
SYSTEM PRESSURE

NORTH:

SCALE:
0 1,250 2,500
Feet

FIGURE NO.
7-2

P:\Orem City\2020 Master Plan Assistance\4.0 GIS\Water\Water-Figure 7-2-Ex PHD_2020Update.mxd mrice 3/31/2021



BOWEN COLLINS & ASSOCIATES

OREM CITY
WATER MASTER PLAN

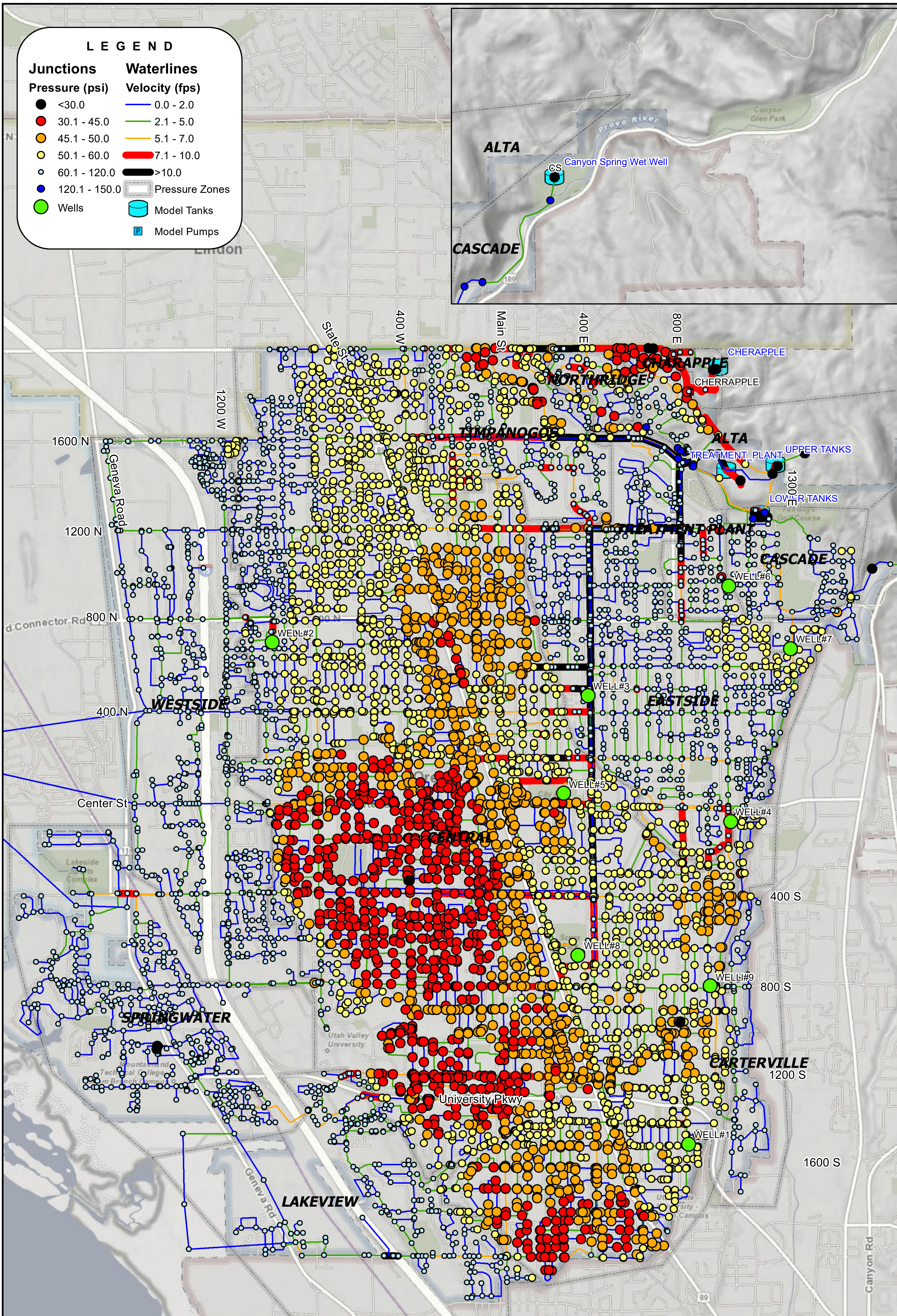
PEAK DAY DEMAND
AVAILABLE FIRE FLOW
FOR EXISTING CONDITIONS

NORTH:

SCALE:
0 1,250 2,500 Feet

FIGURE NO.
7-3

P:\Orem City\2020 Master Plan Assistance\4.0 GIS\Water\Water-Figure 7-3 - Available FF_2020Update.mxd mrice 3/31/2021



BOWEN COLLINS & ASSOCIATES

OREM CITY
WATER MASTER PLAN

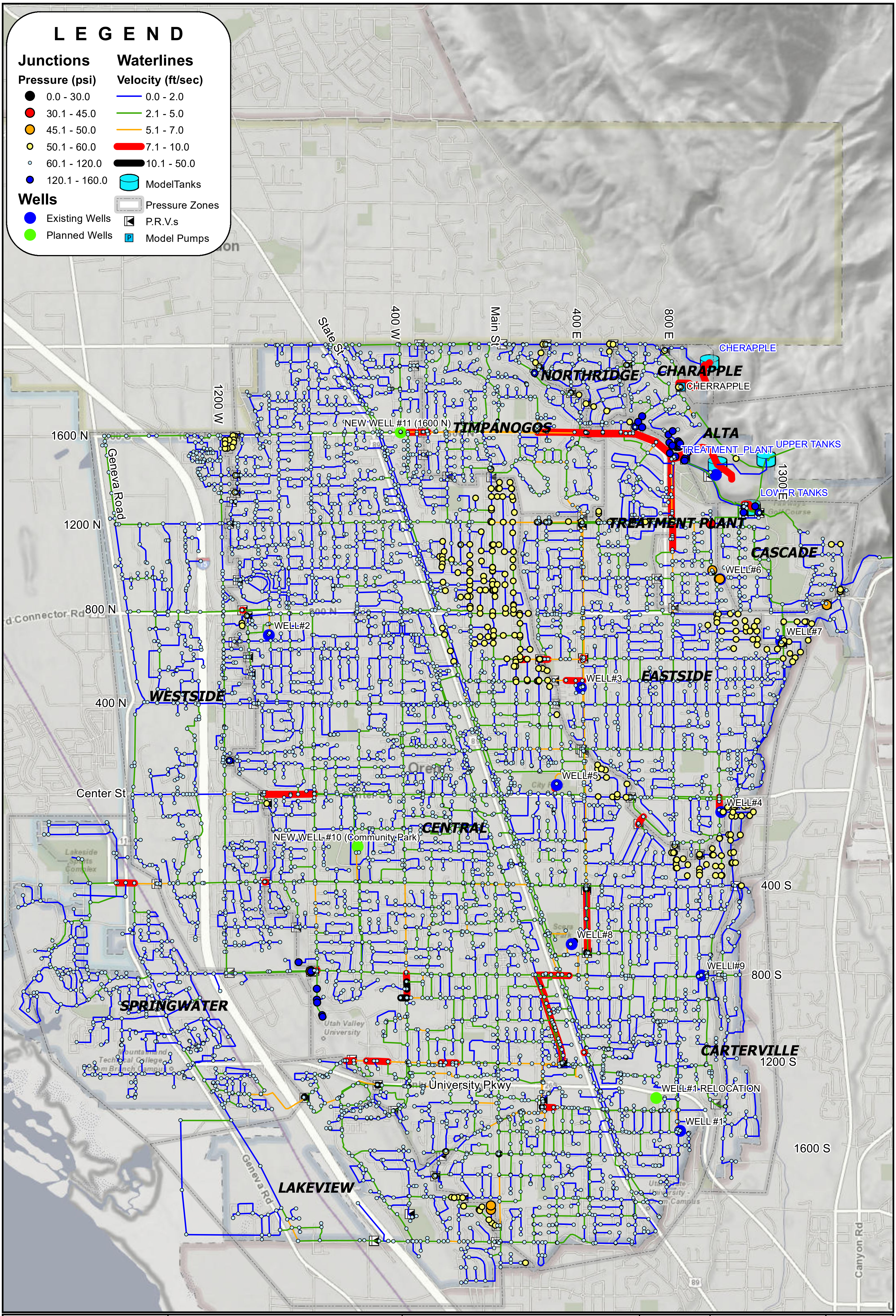
PEAK HOUR DEMAND
FOR FUTURE CONDITIONS
PRESSURE & VELOCITY

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 7-4

P:\Orem City\2020 Master Plan Assistance\4.0 GIS\Water\Water-Figure 7-4- BoPHD-Pressure No Improvements_2020Update.mxd mrice 3/31/2021



BOWEN COLLINS & ASSOCIATES

OREM CITY
WATER MASTER PLAN

PEAK HOUR DEMAND
FOR FUTURE CONDITIONS
WITH IMPROVEMENTS

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO.
7-5

P:\Orem City\2020 Master Plan Assistance\4.0 GIS\Water\Water-Figure 7-5- BoPHD-Pressure with Improvements_2020Update.mxd mrice 3/31/2021

- In order to remedy deficiencies in the system, new pipes were added to the buildout model until pressures across the system were at or above the City evaluation criteria as shown in Figure 7-5. Recommended improvements to satisfy the City's evaluation criteria are discussed below

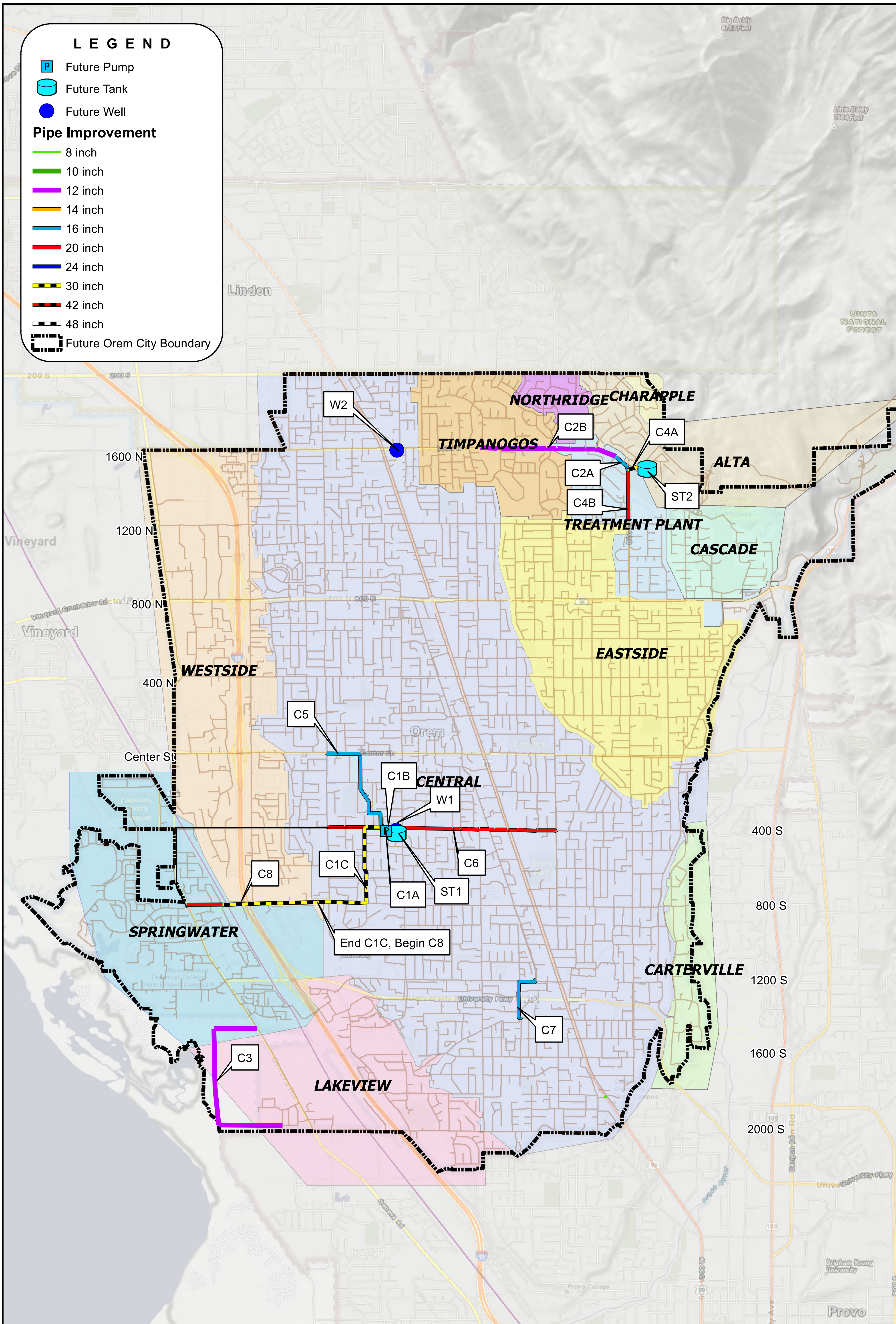
RECOMMENDED DISTRIBUTION SYSTEM IMPROVEMENTS

Based on the results of the computer model evaluation and input from City personnel, several system improvements have been identified through buildout. Once these improvements are completed, the City of Orem transmission and distribution system will be capable of meeting the performance criteria outlined previously. It should be noted that the buildout model demand inputs take into account a reduction in demand at the Sleepy Ridge Golf Course and Lakeside Sports Complex as a result of the City's plan to begin using reuse water from the City's Water Reclamation Facility to irrigate open spaces. This is an essential project to the long-term conveyance plan of the City. If reuse does not occur for any reason, the modeling results and subsequent improvements identified in this master plan will need to be re-evaluated.

Major Conveyance Improvements

As the City of Orem continues to grow, improvements will need to be made to the water conveyance system to keep up with increasing demands. Figure 7-6 shows the location and size of proposed projects, and Table 7-1 provides an overall summary of the projects. The conveyance improvements generally fall into one of two categories:

- **Conveyance from East to West –** Since the majority of the east side of the City has already reached or is approaching buildout development conditions, new development is mostly occurring in the western region of the City. However, the bulk of Orem's sources and storage are located in the northeast region of the City. The City will need to add major conveyance improvements from its storage facilities to improve delivery to other parts of the City's distribution system.
- **Distribution on New 400 South Storage Water –** As discussed in Chapter 5, a new storage reservoir is planned for 400 South. This will provide significant benefit to the City by adding a new source in an area with both existing and projected future pressure problems. The reservoir will be constructed near some existing transmission lines but, to take advantage of the full storage facility, additional transmission lines will be needed to convey water to the reservoir during low demands and away from the reservoir during peak hour conditions.



BOWEN COLLINS & ASSOCIATES

OREM CITY
WATER MASTER PLAN

BUILD-OUT WATER SYSTEM IMPROVEMENTS

NORTH: NORTH

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 7-6

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Table 7-1
Major Conveyance System Improvements Summary

Project Identifier	Project Description	Length (ft)	Diameter (in)	Estimated Project Year	Construction Cost Estimate* (2020 Dollars)
C1A	400 South Pump Station Phase 1	N/A	N/A	2022	**$5,203,000**
C1B	New pipes connecting well, tank and pumpstation to system**	2,933	20, 30	2022	**$1,161,000**
C1C	400 South - Phase 1 Gravity Line to Springwater Pressure Zone	5,130	30	2022	**$3,556,000**
C2A	Replace existing 12" pipe	715	16	2027	**$246,000**
C2B	Parallel existing 12"	4,820	12	2027	**$1,484,000**
C3	Southwest Annex pipelines	7,218	12	2025	**$2,222,000**
C4A	Parallel existing pipes	452	30	2035	**$243,000**
C4B	Parallel existing pipes	1,736	20	2035	**$663,000**
C5	400 South N-S Transmission Line (New/Replace 6”)	5,643	16	2040	**$1,935,000**
C6	400 South E-W Transmission Line (Parallel)	8,206	20	2040	**$3,134,000**
C7	Parallel existing pipes	1,962	16	2045	**$673,000**
C8	Major Conveyance Pipes to Springwater Pressure Zone	4,658	20, 30	2040	**$3,089,000**
				TOTAL	**$23,006,000**

*Includes 15% engineering, legal and administrative costs
** Higher contingency cost due to uncertainty of length

The following is a description of each recommended major conveyance improvement.

C1. Pump Station at 400 South The site of the new 10 MG storage tank that will be constructed at 400 South in the vicinity of Community Park in the Central Pressure Zone. A pump station is needed at this site to allow the proposed 10 MG storage reservoir near Community Park to support water demands in the Central Pressure Zone. This will require the construction of a new pump station with a capacity of 10,500 gpm.

C1B. 400 South Transmission Lines. New 30" and 20" diameter pipes will be needed as the discharge line from the new pump station to connect into the existing and future transmission lines in and around 400 South. New 30" will connect the new tank to the new pump station which will then connect to existing and new transmission lines that run east and west from the pump station. The new transmission pipes that run east and west will be 20-inch to provide sufficient capacity out of the pump station and into the distribution system. The first phase of the 20-inch transmission lines will be to provide additional capacity between 400 West and 800 West. This will allow the new pump station to support pressures in the Central pressure zone during high demand periods.

C1C. Phase 1 Gravity Line to Springwater Pressure Zone. To address inadequate pressures in the western part of the city, a new 30" gravity line is recommended to serve future Springwater demand. This section of the gravity pipeline would connect from the new 400 South 10 MG storage reservoir to below the pressure reducing valve at the top of the Springwater Pressure Zone near 800 South 820 West. This pipeline will begin relatively deep because it needs to come from the bottom of the new 10 MG tank at 400 South, making it more costly to construct. It should be possible to keep the pipe relatively flat so that normal depths are achieved by the time it connects to below the PRV at 820 West. Once this connection is made, the new 400 South 10 MG Tank will be able to support some of the Springwater pressure zone demands by gravity. It will not be possible to support all of the demands in the Springwater pressure zone until Project C8 is completed.

C2A. 1600 North Replacement Transmission Line. The pipe section along 1600 North from 800 East to Technology Way is recommended to be upsized from a 12" pipe to a 16". This will reduce velocities and pressure losses such that existing low pressures in the Timpanogos, Northridge, and Central Pressure Zone will be increased to meet City design criteria.

C2B. 1600 North Parallel Transmission Line. A parallel 12" pipe is recommended along 1600 North from Technology Way to Nighthawk St. This will reduce velocities and pressure losses such that existing low pressures in the Timpanogos, Northridge, and Central Pressure Zone will be increased to meet City design criteria.

C3. Southwest Annex Buildout Pipes. As the Southwest Annex builds out, 12-inch pipe is recommended at the western edge to meet peak demands and expected fire flow requirements for industrial development. The size of this pipe may be reevaluated as development in the area occurs. It is anticipated that this project will be developer funded.

C4A Cascade Dr. Parallel Transmission Line. In order to take advantage of future storage, a 30-inch line paralleling existing lines along Cascade Dr. connecting the new tank into the existing system is recommended. Velocities in existing transmission lines are around 15 ft/sec which exceeds the City's design criteria of 10 ft/sec and can cause excessive pressure loss and damage seals on isolation valves.

C4B. 800 East Parallel Transmission Line. A continuation of Project C4A, Project C4B will extend the parallel waterline further south with a 20-inch pipe. This reach of pipe will resolve high velocities and support effective use of storage.

C5 400 South N-S Transmission Line. Buildout model simulations indicate future pressure deficiencies in the Central pressure zone due to inadequate transmission line capacity. A 16-inch pipe is recommended from 400 South, heading north and south away from 400 South towards 400 North 800 West and 400 South 600 West. This project helps take advantage of the new storage facility in 400 South.

C6 400 South E-W Transmission Line. An east-west transmission line improvement is needed near 400 South to improve the ability to deliver water to the new storage facility during low demands and the ability to move water away from the storage facility during peak demands. A new 20-inch parallel pipe is recommended parallel to the existing 16-inch along 400 S from 800 West to 400 East.

C7 200 E Parallel Transmission Line. To meet the anticipated demands from future redevelopment near University Place, it is recommended that additional capacity be added to the existing 16-inch waterline by adding a new 16-inch waterline parallel to the existing line. The proposed water line will start along the 1200 South, heading west, then south crossing University Parkway at 200 and tying into the existing line at 200 East 1400 South.

C8 Major Conveyance Pipes to Springwater Pressure Zone. This project includes the remaining pipelines along 800 South that will be required for the new 400 South 10 MG tank to support all the demands in the Springwater Pressure Zone. Additional 30-inch and 20-inch diameter pipes will extend earlier phases of piping connecting to the Springwater Pressure Zone. These improvements will allow 10 MG storage reservoir at 400 South to support all the demands in the Springwater Pressure Zone such that any PRVs from the Central or Westside Pressure Zones to the Springwater Pressure Zone could be turned down as fire flow support only. This section of piping crosses I-15, the Lake Bottom Canal, and Union Pacific rail lines which increases construction costs.

Note that many of the projects are shown as parallel pipelines. Because replacing large transmission lines can be difficult and expensive, the majority of major conveyance improvements involve the installation of parallel water lines to meet the required capacity. During the design process, the alignments for proposed projects should be evaluated to determine the best route to provide conveyance to intended destinations. Factors that may affect alignments include traffic, existing utility congestion, right-of-way width, easements, and other special considerations. In some cases, a parallel pipeline may not be the best option and the City may end up replacing an existing pipeline at a larger diameter.

Improvements to Increase Fire Flows

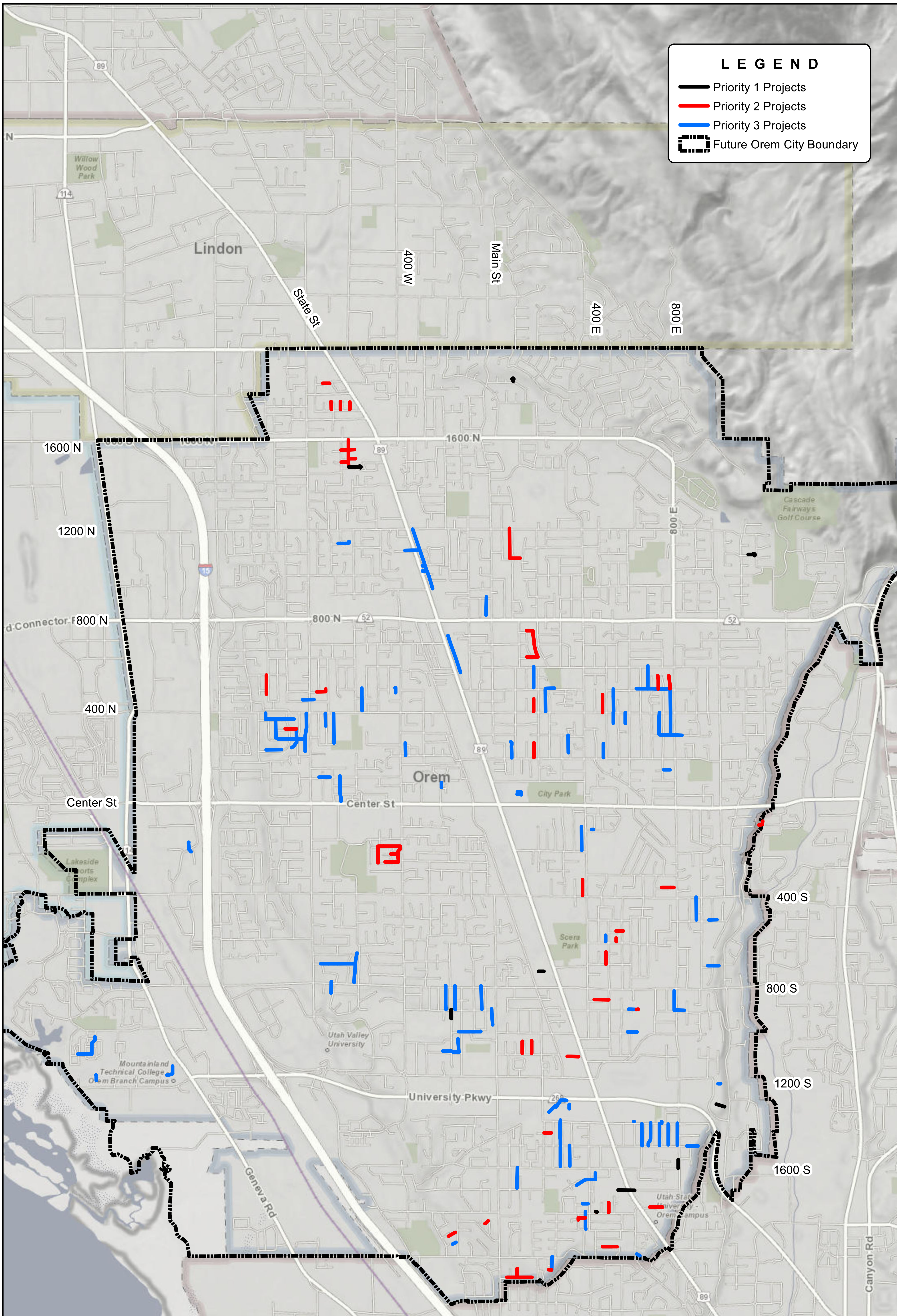
Figure 7-7 shows pipelines that should be upsized to a minimum diameter of 8" to increase fire flows to required levels. Fire flow projects are summarized in Table 7-2. Projects are prioritized into 3 different categories based on the severity of the deficiency.

- Priority 1 – These projects primarily resolve fire flow deficiencies where current available flow is less than 500 gpm. This includes areas with undersized pipes or inadequate looping.

- Priority 2 – These projects primarily resolve fire flow deficiencies where current available flow is less than 1,000 gpm.
- Priority 3 – Priority 3A and 3B projects include all other fire flow deficiencies where current available flows are less than 1,500 gpm. Phase A projects are generally considered to be higher priority than Phase B projects, but the exact timing of these projects is flexible. The City can complete phase these projects in any order desired to reduce overall construction costs (e.g. match timing of projects with road reconstruction activities, etc.).

Additional Improvement Projects

In addition to the capacity related system improvements identified through system modeling, the City has provided a list of condition related maintenance and renewal improvements that need to be completed. A majority of these projects are major conveyance improvements, such as new pipelines, pipeline replacements, PRV replacements, and security upgrades. The redrilling of Well 1 in Hillcrest Park has also been included in this these maintenance related projects as a source improvemet. A summary of these projects is listed in Table 7-3. It is recommended that all projects contained in this list be included in the 10-year capital facilities plan in order to prevent existing system deficiencies from becoming more serious. The 10-year capital facilities plan is discussed in Chapter 8 of this report.



BOWEN COLLINS & ASSOCIATES

OREM CITY

WATER MASTER PLAN

PROPOSED IMPROVEMENTS FOR FIRE FLOW

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 7-7

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Table 7-2
Summary of Recommended Fire Flow Improvements

Project Identifier	Project Description	Estimated Project Year	Construction Cost Estimate* (2020 Dollars)
FF1	Priority 1 - Replace 2,264 feet of undersized waterlines (8 inch)	2024	**$422,000**
FF2	Priority 2 - Replace 16,804 feet of undersized waterlines (8 inch)	2025-2029	**$3,126,000**
FF3A	Priority 3 (Phase 1) - Replace 21,286 feet of undersized waterlines (8 inch)	2030-2040	**$3,960,000**
FF3B	Priority 3 (Phase 2) - Replace 21,286 feet of undersized waterlines (8 inch)	2040+	**$3,960,000**
		TOTAL	**$11,468,000**

*Does include 15% engineering, legal and administrative costs

Table 7-3
Summary of Condition Related Improvement Projects Identified by the City of Orem

Priority Rank	Project	Project Description	Length (Feet)	Diameter (in)	Construction Cost Estimate* (2020 Cost)
Major Conveyance Improvements					
1	Replace Water Line	Main Street, 1880 North to 2000 North & 1850 North, Main Street to 165 East	3,435	8 & 12	**$640,000**
2	Replace PRVs	Reach II PRV's 1200 N. 400 E.	NA	N/A	**$192,000**
3	Security System	Install security system at all water sources.	NA	N/A	**$45,000**
4	Meter Replacement	Upgrade all 3" and larger meters as needed (Commercial and City owned)	NA	N/A	**$1,022,000**
5	Replace Water Line	Replace with new 8" main line on 800 East, 1600 South to 1700 South. Master Plan project.	670	8	**$125,000**
6	Replace Water Line	Replace Alta Springs water line from Johnson's Hole turnout to old head house.	8,400	16	**$1,917,000**
7	Replace Water Line	Replace water line on 600 East, 200 North to 400 North.	1,350	8	**$252,000**
8	Replace Water Line	Replace main line on State Street, 1600 North to 2000 North on the Westside. Master Plan project.	3,040	8	**$566,000**
9	Replace Water Line	Replace main line on State Street, 100 North to 1200 North on the Westside. Master Plan project.	5,000	8	**$931,000**
10	Replace Water Line	Replace with 12" main line on 1600 North, 1330 West to 1430 West.	1,240	8	**$231,000**
11	Replace Water Line	Replace main line on Geneva Road, 1000 North to 800 North. Master Plan project.	2,640	8	**$492,000**
12	Replace Water Line	Replace water line on 1500 South, State to 400 E	670	12	**$137,000**
13	Replace Water Line	Replace old cast main line on 200 North, Palisade Drive to 400 West.	10,565	16	**$2,411,000**
14	Replace Water Line	Replace water line on State Street, 800 North to 2000 North on the eastside. Master Plan project.	8,300	12	**$1,689,000**
15	Replace Water Line	Replace shot coat steel main line on State Street, 1120 South to 1400 South on the eastside.	1,400	12	**$285,000**
			SUBTOTAL		**$10,935,000**
Source Improvements					
R2	Replace Well 1	Redrill Well 1 in Hillcrest Park. Master Plan Project.	N/A	N/A	$3,000,000
			TOTAL		**$13,935,000**

*Includes 15% for engineering, legal and administrative costs

CHAPTER 8
CAPITAL IMPROVEMENT PLAN

In coordination with City of Orem personnel, a capital facilities plan has been developed to serve as a guideline for the budgeting and implementation of recommended system improvements over the next 10 years. The purpose of this chapter is to present recommendations regarding levels of funding for system maintenance, renewal, and capital improvement projects.

RECOMMENDED CAPITAL IMPROVEMENT BUDGET

Before establishing a 10-year capital improvement plan, it is necessary to determine how much funding should be set aside each year for capital improvements. One of the best ways to identify a recommended level of funding is to consider system service life. As with all utilities, each component of a water system has a finite service life. If adequate funds are not set aside for regular system renewal, the transmission and distribution system will fall into a state of disrepair and be incapable of providing the level of service that City of Orem customers expect.

To determine the target level of yearly spending on the system, the replacement value of the current system was evaluated. The total cost to replace all pipes, pump stations, and wells in the City would be approximately $380,000,000. Based on the assumption that most water system components have an average service life of 50 to 70 years, the City should plan to spend about 1.5 to 2 percent of the total system value per year in order to prevent utilities from falling into disrepair. Based on this assumption, it is recommended that the City plan to spend between $5.4 and 7.6 million per year for the water system. In addition to the water system improvements, the City has an annual budget item assigned for fleet replacement and repair, which is approximately $300,000 per year. This considered, the recommended level of investment for capital improvements in the water fund is between $5,700,000 and $7,900,000 (2020 dollars).

Since the completion of the 2016 master plan, the City has ramped up investment in its water system. Whereas the city historically had averaged less than $2 million per year invested in its water system, capital funding is now close to $6 million per year. This places the City within the range of recommended system funding but toward its lower end. Correspondingly, it is recommended that the City maintain at or near its current level with small increases moving forward to account for inflation and system growth.

CAPITAL IMPROVEMENT PLAN SUMMARY

The recommended capital improvements for Orem's water system are summarized in Table 8-1. Included in the table is a summary of each project along with the estimated construction cost. The table includes improvements to the conveyance system, storage facilities, a new water reuse system, development of new groundwater sources, automated metering infrastructure, and other improvements. Not included in the table is routine rehabilitation and replacement of system components that will also need to be accounted for in future budgets.

Table 8-1
City of Orem Water System Capital Improvement Projects

Project type	Project Identifier	Project Description	Estimated Project Year	Estimated Cost (2020 Dollars)
Major Conveyance	C1A	400 South Pump Station	2022	$4,600,000
Major Conveyance	C1B	New pipes connecting well, tank and pumpstation to system	2022	$1,161,000
Major Conveyance	C1C	Phase 1 Gravity Line to Springwater Pressure Zone	2022	$3,556,000
Major Conveyance	C2A	Replace existing 12" pipe	2027	$246,000
Major Conveyance	C2B	Parallel existing 12"	2027	$1,484,000
Major Conveyance	C3*	Southwest Annex pipelines	2025	$0
Major Conveyance	C4A	Parallel existing pipes	2035	$243,000
Major Conveyance	C4B	Parallel existing pipes	2035	$663,000
Major Conveyance	C5	400 South N-S Transmission Line	2040	$1,935,000
Major Conveyance	C6	400 South E-W Transmission Line	2040	$3,134,000
Major Conveyance	C7	Parallel existing pipes	2045	$673,000
Major Conveyance	C8	Major Conveyance Pipes to Springwater Pressure Zone	2040	$3,089,000
Fire Flow	FF1	Replace 2,264 feet of undersized waterlines (8 inch)	2024	$422,000
Fire Flow	FF2	Replace 16,804 feet of undersized waterlines (8 inch)	2025-2029	$3,126,000
Fire Flow	FF3A	Replace 21,286 feet of undersized waterlines (8 inch)	2030-2040	$3,960,000
Fire Flow	FF3B	Replace 21,286 feet of undersized waterlines (8 inch)	2040+	$3,960,000
Storage	ST1	10-million-gallon storage facility	2022	$13,800,000
Storage	ST2	12-million-gallon storage reservoir	2035	$16,560,000
Reuse Water	RW1	Water Reuse Project	2022	$2,793,780
Wells	W1	400 South Well	2022	$4,790,000
Wells	W2	1600 North Well	2022	$3,824,600
Automated Metering	AMI	Install new automated meter infrastructure	2021-2024	$5,000,000
Misc. Replacement	R1	Miscellaneous Replacements/Improvements Identified from Previous Plans	2021-2029	$10,907,000
Well Replacement	R2	Redrill Well #1 in Hillcrest Park.	2023	$3,000,000
			TOTAL	**$92,955,380**

*C-3 to be paid for by developer, not included in total. Expected costs at $2.2M

10-YEAR CAPITAL IMPROVEMENTS SCHEDULE

While Table 8-1 displays all projects needed to serve the system through buildout, of particular interest is the development of a project schedule over the next 10 years. Based on the City's identified project needs and recommended level of capital investment, BC&A has created a recommended capital improvement plan covering the next 10 years based on system needs and input from City staff. This plan is shown in Figures 8-1 detailed in Table 8-2.

As shown in the figure, the proposed improvement plan includes a number of years in which the proposed capital expenditures are significantly higher than average expenditures over the planning window. During these years, it is expected that the additional capital expenditures will be met through a combination of bond proceeds and cash reserves of the City. While the final plan for bonding will be developed as part of the rate study, there are projects worth approximately $35 million in 2022 and $2 million in 2027 that may be considered as multigenerational projects that would be appropriate for bond funding. This figure does not show bond payments as an expense as the final bonding plan will be developed as part of a future rate study.

To facilitate understanding of the proposed plan, system improvement projects have been grouped into the following major budget categories:

- **Major Conveyance –** This item includes large diameter pipelines intended to bring flow from the northeast end of the City south and west to areas of high demand and help relieve pressure deficiencies under existing conditions or that may occur as a result of growth within the next 10-years. Because these improvements are driven by projected growth, there is little flexibility in when they can be completed
- **Storage –**Storage projects include the cost of adding water storage in the City to alleviate equalization deficiencies. The City currently has a storage deficiency of almost 10 million gallons that must be addressed in the near future. The proposed 400 South Tank is important because it helps address existing pressure problems in the Central pressure zone. For these reasons, storage has been worked into the improvement plan as soon as possible.
- **WRF Reuse –** This item includes the cost to install facilities to implement reuse of effluent water from the City's water reclamation facility for irrigation purposes. This project is a high priority because it will allow the City to postpone many other costlier conveyance projects.
- **Wells –** Well projects include the installation of new wells to expand the City's peak day supply. These well improvements are also an important part of City plans to alleviate pressure deficiencies. The 400 South Well is needed to support the new 400 South Tank and correspondingly must be completed as soon as possible. Because these improvements are essential to the overall City conveyance strategy, they have been planned for completion in the near future.
- **Fire Flow –** Fire flow projects included in the 10-year plan include areas of the City with the most severe fire flow deficiencies (Priority 1 and Priority 2 deficiencies). While it would be ideal to eliminate all fire flow deficiencies over the next 10 years, consideration must also be given to available budget, roadway disruption, other pavement infrastructure management issues and other system priorities. Under the current plan, the most urgent fire flow improvements would be completed within this planning window, with the remaining improvements completed thereafter as quickly as budget allows.
- **AMI –** The AMI item includes the cost to install new water meters in the City to more accurately account for water used and to improve operation efficiencies through smart meter

technology. Because of the nature of this project, it is expected that it will be completed in phases over a period of several years.

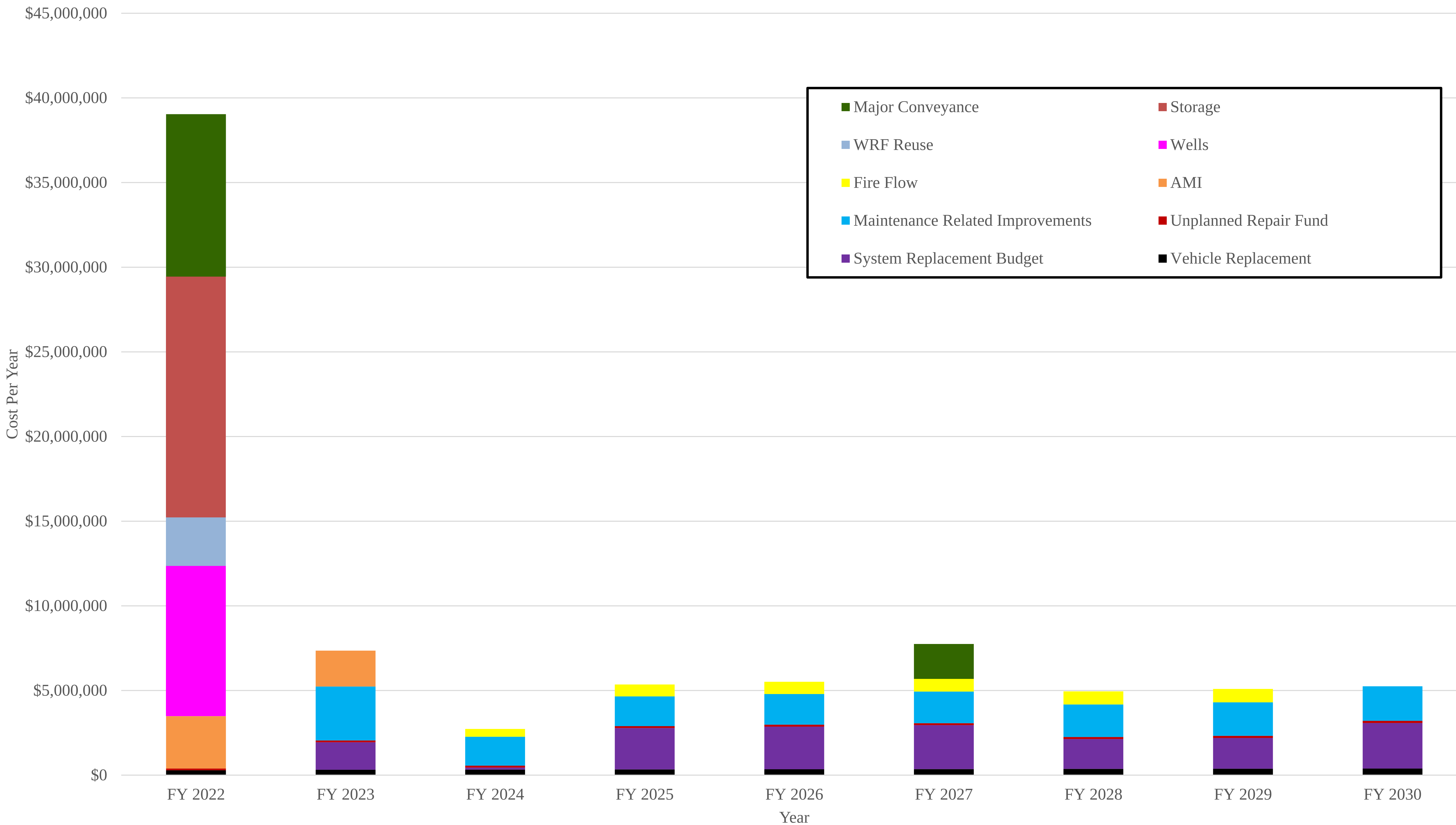
- **Maintenance Related Replacement –** This budget item includes those specific maintenance related projects already identified by City personnel. This consists of both conveyance and source related projects, including the planned replacement of Well #1. These projects have been incorporated into the plan as budget allows.
- **System Replacement –** While the specific projects identified above have received the most attention in this report, it is important not to fall behind on the routine rehabilitation and replacement of aging infrastructure. Failing to fund this category will result in higher costs in the long run as infrastructure ages and begins to fail. This budget item has been included to maintain system investment at the sustainable level identified at the beginning of this chapter. This can include pipes, wells, tanks, pumps, motors, valves, hydrants, etc.
- **Unplanned Repairs** – This budget category includes funds which should be reserved in order to cover the potential cost of unexpected system failures, such as pipe breaks. This is a relatively small portion of the budget.
- **Fleet Replacement** – City personnel have developed a schedule for vehicle replacement based on approximate use, depreciation, and reliability. These costs are expected to remain relatively constant as the City replaces vehicles at regular intervals.

Ultimately, this improvement plan may need to be altered slightly depending on the final bonding and rate plan selected by the City. However, it is strongly recommended that the City maintain the recommended funding levels and follow the overall principles contained in this plan. Failure to do so will result in decreased level of service for City residents and businesses.

Table 8-2
10-Year Capital Improvement Plan

Project Identifier	Project Description	Estimated Total Cost (2020 Dollars)	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
C1A	400 South Pump Station	$4,600,000	$4,738,000								
C1B	New pipe connecting well, tank and pump station to system	$1,161,000	$1,195,830								
C1C	Phase 1 Gravity Line to Spring water Pressure Zone	$3,556,000	$3,662,680								
C2A	Replace existing 12" pipe	$246,000						$293,737			
C2B	Parallel existing 12"	$1,484,000						$1,771,974			
C3	Southwest Annex Pipes (Developer funded)	$2,222,000									
ST1	10 Million Gallon Tank in 400 South	$13,800,000	$14,214,000								
RW	Reuse Project	$2,793,780	$2,877,593								
W1	400 South Well	$4,790,000	$4,933,700								
W2	1600 North Well	$3,824,600	$3,939,338								
FF1	Replace 2,264 feet of existing 2- and 4-inch pipe with 8-inch pipe	$422,000			$461,131						
FF2	Replace 16,804 feet of existing 4-inch pipe with 8-inch pipe	$3,126,000				$703,668	$724,778	$746,521	$768,917	$791,985	
AMI	Install new automated meter infrastructure	$5,000,000	$3,090,000	$2,121,800							
R1	Maintenance related replacement/improvement projects	$10,935,000		$1,607,277		$1,811,251	$1,810,952	$1,865,280	$1,921,239	$1,978,876	$2,038,242
R2	Well #1 replacement in Hillcrest Park	$3,000,000		$3,182,700							
System Replacement	Replace system where needed	$13,084,278	$0	$1,624,241	$122,593	$2,443,983	$2,517,303	$2,592,822	$1,763,452	$1,816,355	$2,686,590
Repairs	Unplanned repair fund	$900,000	$103,000	$106,090	$109,273	$112,551	$115,927	$119,405	$122,987	$126,677	$130,477
Fleet Replacement	Fleet maintenance and replacement	$2,677,670	$286,000	$318,270	$327,818	$337,653	$347,782	$358,216	$368,962	$380,031	$391,432
	TOTAL	**$77,622,328**	**$39,040,141**	**$7,353,101**	**$2,727,811**	**$5,356,060**	**$5,516,742**	**$7,747,955**	**$4,945,557**	**$5,093,924**	**$5,246,741**

Figure 8-1
City of Orem Water Capital Improvement Plan - 2020 Update



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