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PRESSURIZED IRRIGATION MASTER PLAN AND CAPITAL FACILITY PLAN

(HAL Project No.: 416.02.100)

July 2020

HANSEN ALLEN & LUCE inc
ENGINEERS

PAYSON CITY

PRESSURIZED IRRIGATION WATER MASTER PLAN

(HAL Project No.: 416.02.100)

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ABBREVIATIONS AND UNITS

ac	acre [area]
ac-ft	acre-foot (1 ac-ft = 325,851 gal) [volume]
CIP	Capital Improvement Plan
CFP	Capital Facilities Plan
CUWCD	Central Utah Water Conservancy District
CWP	Central Water Project
DBP	disinfection byproduct
EPA	U.S. Environmental Protection Agency
EPANET	EPA hydraulic network modeling software
ERC	Equivalent Residential Connection
ft	foot [length]
ft/s	feet per second [velocity]
gal	gallon [volume]
gpd	gallons per day [flow rate]
gpm	gallons per minute [flow rate]
HAL	Hansen, Allen & Luce, Inc.
hp	horsepower [power]
hr	hour [time]
IFA	Impact Fee Analysis
IFFP	Impact Fee Facilities Plan
in.	inch [length]
irr-ac	irrigated acres
kgal	thousand gallons [volume]
kW	kilowatt [power]
kWh	kilowatt hour [energy]
MG	million gallons [volume]
mg/L	milligram per liter [concentration]
µg/L	microgram per liter [concentration]
mi	mile [length]
PRV	Pressure Reducing Valve
psi	pounds per square inch [pressure]
s	second [time]
SCADA	Supervisory Control And Data Acquisition
THM	trihalomethane
UV	ultraviolet radiation (disinfection method)
wsfu	water supply fixture unit
yr	year[time]

CHAPTER 1 INTRODUCTION

PURPOSE AND SCOPE

The purpose of this master plan is to provide direction to the City of Payson to help it construct and maintain an efficient and effective pressurized irrigation water system for its customers at the most reasonable cost. Recommendations are based on demand data, growth projections, standards outlined by the Utah Administrative Code, and standard engineering practices. The planning horizon for the master plan is the year 2050.

The master plan is a study of the City's pressurized irrigation water system and customer water use. The following topics are addressed herein: growth projections, source requirements, storage requirements, and distribution system requirements. Operational parameters for the City's pressurized irrigation water system were reviewed and optimized based on stability, ease of use, and cost. Based on this study, needed capital improvements have been identified and conceptual-level cost estimates for the recommended improvements have been provided.

The results of the study are limited by the accuracy of growth projections, data provided by the City, and other assumptions used in preparing the study. It is expected that the City will review and update this master plan every 5–10 years as new information about development, system performance, or water use becomes available.

BACKGROUND

Payson City is located in southern Utah County, Utah. While it has roots in agriculture, Payson's economy has diversified to include other industries such as healthcare, industrial manufacturing, food service, and retail sales. Payson grew at a slow pace from its inception in 1850 until about 1970, when growth began to accelerate. Growth has become even more rapid in recent years as the population in Utah County has expanded, and areas further north have built out or become more expensive. The City has a current estimated population of 23,207 (Fregonese 2019). See Figure 1-1. At the end of 2018, the City provided pressurized irrigation water service to about 4,672 connections.

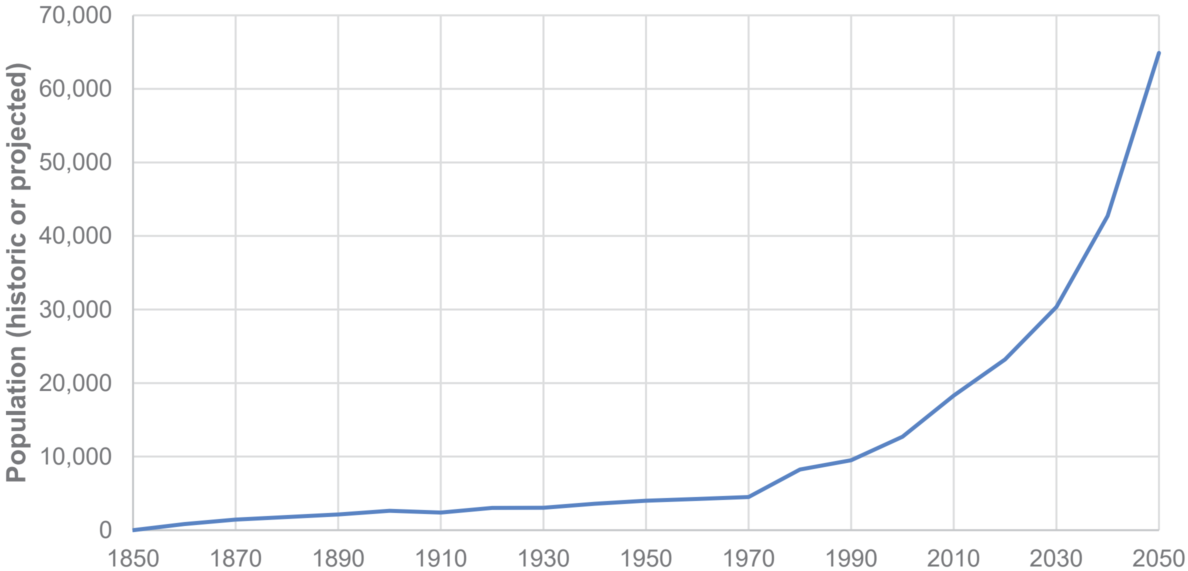


Figure 1-1: Payson Historic and Projected Population
(U.S. Census Bureau 2018, Fregonese 2019)

The existing pressurized irrigation water system includes water sources from Spring Lake, Payson Canyon, and the Strawberry High Line Canal; two storage ponds; two pressure zones; two pump stations; and about 85 miles of pipe with diameters of 4 to 24 inches. See Figure 1-2. The City recognizes that its continued growth necessitates proactively planning additional pressurized irrigation water facilities to maintain the current level of service for outdoor water use.

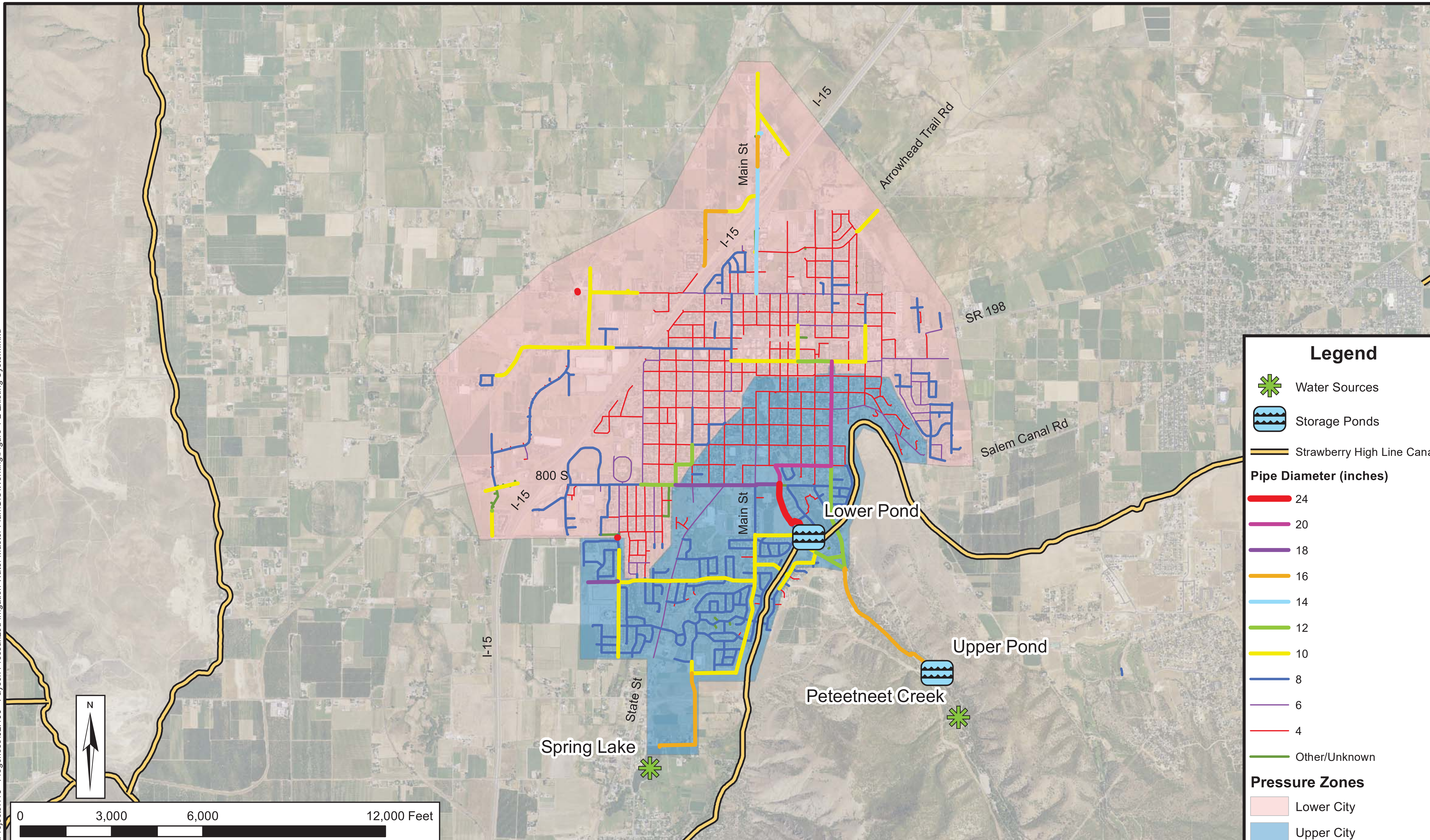
In November 2014, the City prepared a Capital Facilities Plan, Impact Fee Facilities Plan, and Impact Fee Analysis for its drinking and pressurized irrigation water systems (Horrocks 2014). This master plan builds on those studies and extends the planning period to approximately 2050 for the purpose of providing a basic full system layout design to guide new development.

MASTER PLANNING METHODOLOGY

Pressurized irrigation water systems consist of water sources, storage facilities, distribution pipes, pump stations, and other components. Design and operation of the individual components must be coordinated so that they operate efficiently under a range of demands and conditions. The system must be capable of responding to daily and seasonal variations in demand while simultaneously providing sufficient capacity for unexpectedly high flows and other emergency situations.

Identifying present and future water system needs is essential in the management and planning of a water system. For this study, existing water demands are based on an analysis of the City's water use over the past several years. The report addresses sources, storage, distribution, minimum pressures, hydraulic modeling, capital improvements, funding, and other topics pertinent to the Payson City pressurized irrigation water system.

A computer model of the City's pressurized irrigation water system was prepared to simulate the performance of facilities under existing and future conditions. System improvement recommendations were prepared from the analysis and are presented in this report.



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PAYSON CITY

EXISTING PRESSURIZED IRRIGATION SYSTEM

FIGURE 1-2

LEVEL OF SERVICE

This master plan is based on a defined level of service. The level of service for a water system describes how much water will be delivered through the system, and at what pressure. In turn, this dictates the design of the system – the more water that must be delivered (as specified by the level of service), the larger and more expensive the system components must be.

To establish a level of service for a water system, common practice is to evaluate water use data for several previous years to determine current usage, and then plan to deliver this amount plus some extra, to account for emergencies or unusually high flows. However, this is not the most environmentally or financially responsible approach if current water use is wasteful or excessive.

A review of water use data from 2016 – 2018 revealed that pressurized irrigation water usage in Payson is substantially higher than is necessary to keep turf grass alive and healthy. This is almost certainly due to the billing practices used by Payson City. Because customers are not metered for pressurized irrigation water use, and pay a flat monthly fee for service, they have no financial incentive to conserve water.

It would not be financially responsible of the City to create a master plan which encourages or promotes wasteful water use. Doing so would require the City to construct more and/or larger facilities, and construct them sooner, than it otherwise would if customers simply watered responsibly. This would come at great cost.

Rather than promote wasteful water use, Payson City has instead opted to take measures to reduce water use in their city to more responsible levels. In 2019, Payson City accepted bids to install meters on all customer connections in the pressurized irrigation water system. Work on meter installation is expected to begin in 2020. Beginning in 2021, the City also plans to bill customers according to an aggressive tiered rate schedule that promotes conservation. These measures will motivate customers to water responsibly. These measures will also allow for the design of a responsible water system – one that is appropriately sized, without excessive costs.

To that end, the City has defined a level of service for water use that is responsible and achievable, without being excessive. Table 1-1 shows the defined level of service for water supply compared to current water use.

Table 1-1
Future Water Supply Level of Service Compared to Current Use

Condition	Peak Day Demand	Average Yearly Demand	Equalization Storage
Current Use	8.7 gpm/irr-ac	4.2 ac-ft/irr-ac	9,396 gal/irr-ac
Level of Service	6.0 gpm/irr-ac	3.2 ac-ft/irr-ac	6,480 gal/irr-ac
Demand Reduction	**31%**	**24%**	**31%**

Because full implementation of meters will take several years, the evaluation of existing conditions in this master plan considers current use. However, future projected water use is evaluated at the level of service.

DESIGN AND PERFORMANCE CRITERIA

Summaries of the key design criteria and demand requirements for the pressurized irrigation water system are included in Table 1-2. They are based upon existing conditions, future land use plans, and the level of service. The design criteria were used in evaluating system performance and in recommending future improvements. Criteria development is described in later chapters.

Table 1-2
Key System Design Criteria

	Criteria	Existing Requirements	Estimated Future Requirements
Irrigated Acreage	Existing and Planned Irrigated acreage	845 irr-ac	1,970 irr-ac
Source			
Peak Day Demand	Level of Service	7,350 gpm	11,820 gpm
Average Yearly Demand	Level of Service	3,549 acre-ft	6,304 acre-ft
Storage	Level of Service	24.4 ac-ft	39.2 ac-ft
Distribution			
Peak Instantaneous	2 × Peak Day Demand	14,700 gpm	23,640 gpm
Max. Operating Pressure	City Preference	115 psi	115 psi
Min. Operating Pressure	City Preference	30 psi	30 psi

CHAPTER 2 IRRIGATED ACREAGE

EXISTING IRRIGATED ACREAGE

Outdoor water demands are based on irrigated acreage (irr-ac). Existing irrigated acreage was estimated using aerial imagery. Table 2-1 provides a breakdown of the existing irrigated acreage by pressure zone.

Table 2-1
Existing Irrigated Acreage by Zone

Zone	Irrigated Acreage
Upper City	398
Lower City	447
Total	**845**

FUTURE IRRIGATED ACREAGE

Projections of future irrigated acreage are based on the future land use plans. For each planned type of land use in the Payson City General Plan, an irrigation factor was determined based on analysis of aerial imagery in Payson. In cases where planned land use types do not yet exist in Payson, similar areas in surrounding communities were assumed to be representative of future development in Payson. Table 2-2 presents the irrigation factors used for each land use type.

Table 2-2
Irrigation Factors by Land Use Type

Land Use	Irrigation Factor
Commercial	11%
High Density Residential	28%
Industrial	17%
Low Density Residential	35%
Medium Density Residential	30%
Mixed Use Center	28%
Mixed Use Neighborhood	24%
Office Flex	17%
Parks/Open Space	85%
Public Facilities	14%
Rural Residential	14%
Transit-Oriented Development	20%

Based on the future land use plan and the irrigation factors shown in Table 2-2, total 2050 irrigated acreage was calculated for each pressure zone as shown in Table 2-3.

Table 2-3
Future Irrigated Acreage by Zone

Zone	Irrigated Acreage
Upper City	780
Lower City	935
Arrowhead	255
Total	**1,970**

GROWTH PROJECTIONS

The development of impact fees requires growth projections over the next ten years. In addition to impact fee projects this report will also highlight anticipated projects 10-20 years out in the "Capital Facilities Plan" section of this report. Growth projections for Payson were made as part of the City's strategic, general, and master planning efforts by Fregonese Associates, Inc. Growth projections are shown in Table 2-4.

Table 2-4
Growth Projections

Year	Total Projected ERCs	Total Projected Irrigated Acres
2019	10,433	845
2029	12,759	1,028
2039	16,766	1,304
2050	23,195	1,970

CHAPTER 3 WATER SOURCES

EXISTING WATER SOURCES

Three surface water sources (Table 3-1 and System Map in Appendix A) currently supply the City's pressurized irrigation water. The sources have a total production capacity of 8,884 gpm or 4,650 ac-ft/yr.

Table 3-1
Existing Pressurized Irrigation Water Sources

Source	Flow Capacity (gpm)	Flow Capacity (cfs)	Annual Capacity[1] (ac-ft)
Strawberry High Line Canal	6,284	14.0	3,790
Spring Lake	1,700	1.6	323
Payson Canyon	900	2.0	537
Total	**8,884**	**17.6**	**4,650**

1. Based on Water Rights or Physical capacity, whichever is limiting

The following are brief summaries of each source:

- The turnout from the Strawberry High Line Canal can physically deliver up to 8,530 gpm (19 cfs) if necessary, although it is more typically operated at 6,283 gpm (14 cfs) or less. The City owns 3,790 ac-ft in canal company shares, and this number is expected to grow as developers bring Strawberry water to the City.
- Using input from City Personnel, the reliable supply of water from Payson Canyon was determined to be 900 gpm (2.0 cfs). If necessary, the City can draw upon storage in the Payson Lakes to temporarily increase this flow.
- The City has pumped a peak supply of approximately 700 gpm from Spring Lake during the past several years, but has plans to rebuild the pump station to increase capacity to 1,700 gpm.

Payson also has the ability to use reclaimed water from the Payson City Wastewater Treatment Plant. There is capacity in the system for up to 2 cfs of reclaimed water. However, Nebo Power Plant has first rights to reclaimed water, so it was not included in the above totals as a reliable supply.

EXISTING WATER SOURCE REQUIREMENTS

Existing Peak Day Demand

Peak day demand is the water demand on the day of the year with the highest water use. It is used to determine required source capacity under existing and future conditions.

The City currently does not meter pressurized irrigation connections, except for connections installed within the last few years. Accordingly, peak day demand was estimated on a system-wide basis by considering existing irrigated acreage and source flow into the system on the peak day. Peak day demand for current conditions was estimated at 8.7 gpm/irr-ac. Table 3-2 shows the existing pressurized irrigation water demands in each pressure zone.

Table 3-2
Existing Pressurized Irrigation
Water Peak Day Demand

Pressure Zone	Irrigated Acreage	Existing Demand (gpm)
Upper City	398	3,460
Lower City	447	3,890
Totals	**845**	**7,350**

Existing Average Yearly Demand

Average yearly demand is the volume of water used during an entire year, and is used to ensure the sources have enough volume to meet annual demands under existing and future conditions. Average yearly demand was determined based on existing irrigated acreage and annual usage data. At the current level of use, demand is about 4.2 ac-ft/irr-ac.

Based on the existing 845 irrigated acres, Payson's average yearly pressurized irrigation water demand is 3,549 ac-ft.

FUTURE WATER SOURCE REQUIREMENTS

As with existing water source requirements, future water source requirements were evaluated on two criteria. First, sufficient water source capacity is needed to meet peak day flow. Second, the water sources must also be capable of supplying the average yearly demand.

Future Level of Service

Several municipalities in Utah have seen substantial reductions in water use after installing customer meters on their secondary water connections, and billing for water use using an aggressive, tiered rate schedule. These municipalities have found that investing in meters to control water use is less expensive in the long run than sizing a system for excessive, wasteful use.

Payson solicited bids for installation of secondary water meters in Fall of 2019, with plans to begin work to install meters in 2020. Implementation of meters is expected to result in substantial water conservation, and as such, it is not appropriate to design a future system based on current water demands, which are substantially higher than what is actually needed to keep turf grass alive.

Considering future water conservation, this master plan uses a revised future level of service. It is based on water use levels achieved by other municipalities after metering secondary water use. Table 3-3 compares the existing and future level of service requirements for Payson City.

Table 3-3
Existing and Future Level of Service

Parameter	Existing	Future
Peak Day Source	8.7 gpm/irr-ac	6.0 gpm/irr-ac
Average Yearly Source	4.2 ac-ft/irr-ac	3.2 ac-ft/irr-ac

The amount of irrigated acreage associated with each residential connection will depend on lot size. Estimated annual water use per lot size is included in Appendix B.

Future Peak Day Demand

Following the methodology described for existing conditions and calculating 1,970 irr-ac at year 2050, the peak day demand is projected to be 11,820 gpm based on the City's future level of service. See Table 3-4.

Table 3-4
Future Pressurized Irrigation Water Demand

Pressure Zone	Irrigated Acreage	Future demand (gpm)
Upper City	780	4,680
Lower City	935	5,610
Arrowhead	255	1,530
Total	**1,970**	**11,820**

Future Average Yearly Demand

Estimating 1,970 irr-ac at year 2050, and applying the future level of service of 3.2 ac-ft/irr-ac the average yearly demand per the City's level of service is projected to be 6,304 ac-ft in year 2050.

WATER SOURCE RECOMMENDATIONS

Tables 3-5 and 3-6 show a comparison of demands and sources.

Table 3-5
Existing Pressurized Irrigation Water Demand and Source Capacity

Parameter	Peak Day (gpm)	Average Yearly (ac-ft)
Demand	7,352	3,549
Capacity	8,884	4,650
Surplus (+) or Deficit (−)	**+1,533**	**+1,101**

Table 3-6
Future Pressurized irrigation Water Demand and Source Capacity

Parameter	Peak Day (gpm)	Average Yearly (ac-ft)
Demand	11,820	6,304
Capacity	8,884	4,650
Surplus (+) or Deficit (−)	**-2,936**	**-1,654**

Based on the future level of service and current development plans, additional source capacity is needed to support the growth of the pressurized irrigation water system through 2050.

It is recommended that the City maintain its current wells and canal diversions and develop additional pressurized irrigation water sources totaling 3,000 gpm and 1,700 ac-ft/yr. The next sections cover recommended source options. The City may also reconsider its level of service and landscaping/irrigation policies to reduce future demand.

Groundwater

Groundwater is the least expensive drinking water source for Payson City. For that reason, it is recommended that the City reserve groundwater in the area for drinking water supply. Nonetheless, groundwater can be an appropriate temporary or backup supply to the pressurized irrigation system.

The City is currently in the process of converting the 800 South well for use in the pressurized irrigation system, which will help to supply the pressurized irrigation system until further surface water sources can be developed. Besides the 800 South well, it is anticipated that there will be no further need to use groundwater to supply the pressurized irrigation water system.

Canal Companies

It is recommended that the City continue to acquire shares in canal companies as land develops, according to Payson City Title 10.6.

ULS Pipeline

Central Utah Water Conservancy District (CUWCD) is in the process of constructing the Spanish Fork – Santaquin Utah Lake System pipeline, more commonly known as the ULS pipeline. Service from the pipeline is expected to be available to Payson City sometime within the next 10 years. Payson City has agreements with CUWCD to eventually use 5,123.96 acre-feet of water per year from the ULS pipeline, which is sufficient to meet the needs of the City through 2050 when considering other available sources. The City may wish to consider leasing a portion of its ULS water to other municipalities during times when it has excess water available.

CHAPTER 4 WATER STORAGE

EXISTING WATER STORAGE

The City's existing pressurized irrigation water system includes two irrigation ponds with a total capacity of 35 ac-ft. See Table 4-1.

Table 4-1
Existing Storage Capacity

Pond	Zone	Capacity (ac-ft)
Upper Pond	Upper	10
Lower Pond	Lower	25
Total		**35**

EXISTING WATER STORAGE REQUIREMENTS

The purpose of storage within the pressurized irrigation water system is to provide equalization storage for those periods where demand exceeds the source supply. Equalization storage requirements were based on irrigated acreage and the level of service determined based on analysis of water usage data. A level of service of 9,396 gallons (0.0288 ac-ft) per irrigated acre was selected for the Payson P.I. system. Therefore, under existing conditions, with 845 irrigated acres, the required storage is 24.4 ac-ft. A breakdown of the required equalization storage by pressure zone is shown in Table 4-2.

Table 4-2
Existing Storage Requirements

Zone	Irrigated Acreage	Storage Requirement (ac-ft)	Existing Capacity (ac-ft)	Deficiency (-) or Surplus (+), (ac-ft)
Upper City	398	11.5	10.0	-1.5*
Lower City	447	12.9	25.0	+12.1
Total	**845**	**24.4**	**35.0**	**+10.6**

* Pump Stations makes up for this deficiency

Despite a shortage of storage in the Upper City Zone, the Upper Pond does not run empty because of supplemental supply from the booster pump stations at Spring Lake and the Lower Pond during periods of peak demand.

FUTURE WATER STORAGE REQUIREMENTS

Table 4-3 presents the future irrigation storage requirements based on HAL's analysis of developed and developable area in each pressure zone. Considering future conservation efforts, the future level of service for water storage is 6,480 gal/irr-ac.

Table 4-3
Future Storage Requirements

Zone	Irrigated Acreage	Storage Required (ac-ft)	Existing Capacity (ac-ft)	Deficiency (ac-ft)
Upper City	780	15.5	10.0	-5.5
Lower City	935	18.6	25.0	+6.4
Arrowhead	255	5.1	0.0	-5.1
Total	**1,970**	**39.2**	**35.0**	**-4.2**

WATER STORAGE RECOMMENDATIONS

The Upper City pressure zone currently has insufficient storage capacity for peak day conditions. The pump station from the lower pond is currently being used to compensate for this deficiency, and the 800 South well will soon be used to compensate as well.

Installing customer meters in the pressurized irrigation system is anticipated to be the most effective way to address this deficit in the near-term. Meters will be used to decrease water use and extend the life of existing pressurized irrigation infrastructure. In the long term, another storage pond will be necessary in the Upper City pressure zone.

The Arrowhead zone can be supplied using capacity in the Lower City zone, and will not need a storage facility of its own.

Although capacity is expected to remain in the Lower City zone through year 2050, it is sometimes more practical to construct a new transmission pond at a convenient location (often near a source) than it is to construct large transmission mains connecting existing storage to distant sources or areas of the system. Two additional ponds are proposed in the lower zone, in order to minimize construction costs and provide redundancy and operational flexibility to the system. Capacity in these ponds will be useful well beyond the 2050 planning horizon of this report.

CHAPTER 5 WATER DISTRIBUTION

PEAK WATER DISTRIBUTION SYSTEM DEMANDS

Payson's pressurized irrigation water distribution system consists of all pipelines, valves, fittings, and other appurtenances used to convey water from sources and storage ponds to water users. The existing water system contains approximately 85 miles of pipe with diameters of 4 to 24 inches. Two pressure zones comprise the current system (Figure 1-1).

Existing Peak Instantaneous Demand

Peak instantaneous demand was calculated based on irrigated acreage and the level of service defined by analysis of usage data. The selected level of service for current usage was 17.4 gpm per irrigated acre; therefore, the total peak instantaneous demand was 14,703 gpm under existing conditions.

Future Peak Instantaneous Demand

Future peak instantaneous demand was calculated based on a future level of service of 12.0 gpm/irr-ac. The total future irrigated acreage that is planned is 1,970 acres. Therefore, the future peak instantaneous demand was calculated as 23,640 gpm.

HYDRAULIC MODEL

Development

A computer model of the City's pressurized irrigation water distribution system was developed to analyze the performance of the existing and future distribution system and to prepare solutions for existing facilities not meeting the distribution system requirements. The model was developed with the software EPANET 2.0, published by the U.S. Environmental Protection Agency (EPA 2014; Rossman 2000). EPANET simulates the hydraulic behavior of pipe networks. Sources, pipes, ponds, valves, controls, and other data used to develop the model were obtained from GIS data of the city's pressurized irrigation water system and other updated information supplied by the City.

HAL developed models for two phases of pressurized irrigation water system development. The first phase was a model representing the existing system (existing model). This model was used to calibrate the model and identify deficiencies in the existing system. The second phase was a model representing future conditions and the improvements necessary to accommodate growth (future model).

Model Components

The two basic elements of the model are pipes and nodes. A pipe is described by its inside diameter, length, minor friction loss factors, and a roughness value associated with friction head losses. A pipe can contain elbows, bends, valves, pumps, and other operational elements. Nodes are the endpoints of a pipe and can be categorized as junction nodes or boundary nodes. A junction node is a point where two or more pipes meet, where a change in pipe diameter occurs, or where flow is added (source) or removed (demand). A boundary node is a point where the hydraulic grade is known (a reservoir, pond, or PRV). Other components include ponds, reservoirs, pumps, valves, and controls.

The model is not an exact replica of the actual water system. Pipeline locations used in the model are approximate and not every pipeline may be included in the model, although efforts were made to make the model as complete and accurate as possible. Moreover, it is not necessary to include all of the distribution system pipes in the model to accurately simulate its performance.

Pipe Network

The pipe network layout originated from GIS data provided by the City. HAL verified its accuracy by reviewing maps and drawings provided by the City, as well as a model prepared for the previous capital facility plan. Elevation information was obtained from LIDAR data collected by the state of Utah. Hazen-Williams roughness coefficients for pipes in this model ranged from 130 - 150, which is typical for these pipe materials in EPANET (Rossman 2000, 31).

Water Demands

Water demands were allocated in the model based on analysis of aerial imagery. Irrigated areas across the City were identified and used to compute area-specific peak day water demands, which were then allocated to the closest model node. Future demand was assigned to nodes in the future model which best represented the location of anticipated development.

The pattern of water demand over a 24 hour period is called the diurnal curve or daily demand curve. SCADA data was insufficient to characterize a diurnal curve for the Payson pressurized irrigation system, so a diurnal curve based on other systems in Utah was used in the model. The diurnal curve used has a peaking factor of 2.1 (the ratio of peak instantaneous demand to peak day average demand). The diurnal curve used in this study is presented in Figure 5-1. The diurnal curve was input into the model to simulate changes in the water system throughout the day.

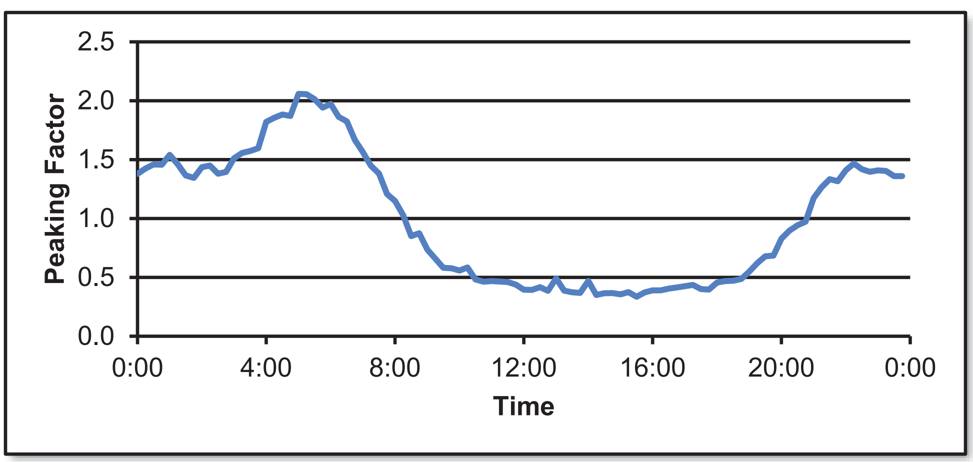


Figure 5-1: Diurnal Curve used for Analysis

In summary, the spatial distribution of demands followed the distribution of irrigated acreage in the City; the flow and volume of demands followed the level of service described in Chapter 3; and the temporal pattern of demand followed a diurnal curve consistent with many communities similar to Payson.

Water Sources and Storage Ponds

Reservoirs were used to represent source flow from canals and Payson Canyon. Pond location, height, diameter, and volume are represented in the model. The extended-period model predicts water levels in the ponds as they fill from sources and as they empty to meet demand in the system.

ANALYSIS METHODOLOGY

HAL used the extended-period model to analyze the performance of the water system with current and projected future demands. An extended-period model represents system behavior over a period of time: ponds filling and draining, pumps turning on or off, pressures fluctuating, and flows shifting in response to demands. The model was used to analyze conditions, controls, operation, performance, and energy efficiency. Recommendations for existing and future conditions were checked with the extended-period model to confirm adequacy.

The two extreme operating conditions analyzed with the model were static conditions and peak instantaneous conditions. Each of these conditions is a worst-case situation so the performance of the distribution system may be analyzed for compliance with City requirements. Each operating condition is discussed in more detail below.

Static Conditions

Low-flow or static conditions are usually the worst case for high pressures in a pressurized irrigation water distribution system. Before the evening irrigation period begins, storage is typically nearly full, and movement of water through the system is minimal. Under these conditions, the system approaches a static condition where water pressures are dictated only by elevation differences and pressure-regulating devices. This high-pressure condition was simulated with the model to analyze the system's existing and future conformance to pressure requirements.

Peak Instantaneous Demand Conditions

Peak instantaneous demand conditions are the worst-case for low pressures in a pressurized irrigation water distribution system. The pressurized irrigation water system reaches peak instantaneous demand conditions when irrigation is the highest, such as hot summer days or holidays. The high demand causes high velocities and increased pressure losses in the distribution pipes, resulting in reduced pressure.

CHAPTER 6 CAPITAL FACILITY PLAN

GENERAL

The purpose of this section is to identify the pressurized irrigation facilities that are required to meet the demands placed on the system by future development for the IFFP 10-year planning period and the CFP 20-year planning period. Proposed facility capacities were sized to adequately meet the 20-year growth projections and were compared to current master planned facilities. A detailed design analysis will be required before construction of the facilities to ensure that the location and sizing is appropriate for the actual growth that has taken place since this CFP was developed.

METHODOLOGY

Future water demands were based on the growth projections converted into irrigated acreage projections. The demands were added incrementally by year to the facility analysis. A 20-year solution was identified for the year a facility reaches capacity. A hydraulic model was developed for the purpose of assessing the system operation and capacity with future demands added to the system. The model was used to identify problem areas in the system and to identify the most efficient way to make improvements to transmission pipelines, sources, pumps, and storage facilities.

The future system was evaluated in the same manner as the existing system, by modeling (1) peak instantaneous demands and (2) peak day demands.

FUTURE WATER SOURCE

Future growth projections require the City to provide additional pressurized irrigation water sources. The CFP analysis utilized the future level of service requiring that the system's water sources are capable of meeting a peak day demand of 6.0 gpm per irrigated acre.

The following are source projects selected to meet the source requirements for future growth:

- Main Street Source – ULS turnout on main street to provide source to both the upper and lower zones.
- South City Source – ULS turnout in the vicinity of Spring Lake to provide source to both the upper and lower zones.

FUTURE PRESSURIZED IRRIGATION WATER STORAGE

Based upon the future level of service, the water system must provide 6,480 gallons of storage per irrigated acre. The future 20-year irrigated acreage projection requires two storage facilities to supply storage to future pressure zones. The following storage facilities are anticipated to meet future demands:

- A 6.0 ac-ft pond to serve the southern end of the Lower City Zone
- A 6.0 ac-ft pond to serve the southern end of the Upper City Zone

FUTURE ZONE PUMPING

Zone pumping is not expected to be needed when the ULS pipeline becomes operational. The ULS pipeline has sufficient pressure to supply all pressure zones.

FUTURE TRANSMISSION PIPING

Future transmission lines need to be constructed to allow for future growth in the undeveloped areas of the City. The model was used to determine the most efficient way to keep pressures and pressure swings within the criteria limits with added future demands. The level of service selected for pipelines was a peak instantaneous demand of 12.0 gpm per irrigated acre. Pipelines are considered at capacity when velocities cannot increase without causing pressures or pressure swings outside of the level of service. This generally occurs when a pipe reaches about 5 fps at peak instantaneous demand when considering the system as a whole under peak demand conditions. The majority of the waterline projects are required to connect sources to storage ponds and to connect the existing and future areas of the system. These transmission lines are described below and shown on Figure 6-1:

- Arrowhead line – 16-inch line to provide conveyance from the Lower Pond to the Arrowhead zone
- 800 South well line – 16-inch line to provide conveyance from the 800 South well to the Upper zone
- Main Street ULS line – 24-inch line from the Main Street ULS turnout to existing distribution mains in Canyon Road.
- Eastern Upper zone lines – 12-inch and 10-inch lines to provide transmission conveyance to the east side of Rocky Ridge
- Eastern Lower zone lines – 12-inch lines to provide transmission conveyance to the eastern areas of the Lower Zone
- Western Lower Zone line – 12-inch transmission in 1130 South and underneath I-15 to provide transmission to the western areas of the Lower zone
- Southern Upper Zone lines – 24-inch, 16-inch, and 12-inch lines to provide conveyance from the southern ULS turnout to a future storage facility for the Upper Zone
- Southern Lower Zone lines – 16-inch, 12-inch, and 10-inch transmission lines for areas south of the 800 S interstate exit on both sides of I-15, and to connect to a future storage facility for the Lower Zone

FUTURE WATER RIGHTS

It is anticipated that water rights acquired through the City’s water transfer ordinance (Payson City Title 10.6), together with water from the ULS pipeline, will be sufficient to meet demands through the 20-year planning window.

MASTER PLANNING

Throughout the master planning process, the three main components of the City’s water system (source, storage, and distribution) were analyzed to determine the system’s ability to meet existing demands and also the anticipated future demands. Each of the system deficiencies identified in the master planning process and described previously in this report were presented to City staff. Possible solutions were discussed for each of the identified system deficiencies as well as possible solutions for maintenance and other system needs not identified in the system analysis.

After the workshop, HAL studied the feasibility of the solution alternatives and developed conceptual costs.

One important method of paying for system improvements is through impact fees. Impact fees are collected from new development and should only be used to pay for system improvements related to new development. For this reason it is important to identify which projects are related to resolving existing deficiencies, and which projects are related to providing anticipated future capacity for new development.

PRECISION OF COST ESTIMATES

When considering cost estimates, there are several levels or degrees of precision, depending on the purpose of the estimate and the percentage of detailed design that has been completed. The following levels of precision are typical:

Type of Estimate	Precision
Master Planning	±50%
Preliminary Design	±30%
Final Design or Bid	±10%

For example, at the master planning level (or conceptual or feasibility design level), if a project is estimated to cost $1,000,000, then the precision or reliability of the cost estimate would typically be expected to range between approximately $500,000 and $1,500,000. While this may seem very imprecise, the purpose of master planning is to develop general sizing, location, cost, and scheduling information on a number of individual projects that may be designed and constructed over a period of many years. Master planning also typically includes the selection of common design criteria to help ensure uniformity and compatibility among future individual projects. Details such as the exact capacity of individual projects, the level of redundancy, the location of facilities, the alignment and depth of pipelines, the extent of utility conflicts, the cost of land and easements, the construction methodology, the types of equipment and material to be used, the time of construction, interest and inflation rates, permitting requirements, etc., are typically developed during the more detailed levels of design.

At the preliminary design level, some of the aforementioned information will have been developed. Major design decisions such as the size of facilities, selection of facility sites, pipeline alignments and depths, and the selection of the types of equipment and material to be used during construction will typically have been made. At this level of design the precision of the cost estimate for a $1,000,000 project would typically be expected to range between approximately $700,000 and $1,300,000.

After the project has been completely designed, and is ready to bid, all design plans and technical specifications will have been completed and nearly all of the significant details about the project should be known. At this level of design, the precision of the cost estimate for the same $1,000,000 project would typically be expected to range between approximately $900,000 and $1,100,000.

SYSTEM IMPROVEMENT PROJECTS

As discussed in previous chapters, source, storage and distribution system capacity expansion will be needed to meet the demands of future growth. Project descriptions for water system improvements are presented in Chapters 3, 4 and 5 with the location of each project shown in the Master Plan Map. Each recommendation includes a conceptual cost estimate for construction and year needed.

Unit costs for the construction cost estimates are based on conceptual level engineering. Sources used to estimate construction costs include:

1. "Means Heavy Construction Cost Data," 2019
2. Price quotes from equipment suppliers
3. Recent construction bids for similar work

All costs are presented in 2019 dollars. Recent price and economic trends indicate that future costs are difficult to predict with certainty. Engineering cost estimates provided in this study should be regarded as conceptual level for use as a planning guide. Only during final design can a definitive and more accurate estimate be provided for each project.

A cost estimate calculation for each project is provided in Appendix D and Table 6-1. Table 6-1 provides a cost summary for the recommended system improvements through year 2039. These projects are shown on Figure 6-1.

Table 6-1
Recommended 20-Year Projects

TYPE & YEAR	MAP ID	RECOMMENDED PROJECT	Existing Deficiency Cost	New Growth Cost
Water Conservation Project **0-10 Years**	N/A	Install meters at customer connections.	$4,320,000	$0
Transmission Growth Project **0-10 Years**	1	Install or upsize 9,900 feet of 16-inch pipe to serve the Arrowhead Zone.	$0	$1,072,000
Source Growth Project **0-10 Years**	2	Install 7,800 feet of 16-inch pipe to connect the 800 S. Well to the Upper City pressure zone. Equip well 8 with a new motor and VFD controls.	$0	$1,467,000
Transmission Growth Project **0-10 Years**	3	Upsize 4,300 feet of pipe in 100 S. to 12-inch to provide transmission capacity to the eastern area of the Lower City pressure zone.	$0	$134,000
Transmission Growth Project **0-10 Years**	4	Install 1,200 feet of 12-inch pipe in 600 E. and 4000 feet of 10-inch pipe in 400 S. and Goosenest Drive to provide transmission capacity to the eastern area of the Upper City Pressure zone.	$0	$862,000
Transmission Growth Project **0-10 Years**	5	Install 2,500 feet of 12-inch pipe in 1130 S. Bore under I-15 to connect the distribution system on the eastern and western sides of I-15.	$0	$735,000
Source and Storage Growth Project **10-20 Years**	6	Install a turnout from the ULS pipeline and construct an upper zone pond on the southern end of the City. Install 1,100 feet of 16-inch pipe in 12240 S to connect the system to the ULS turnout. Install 2400 feet of 24-inch pipe to connect the storage pond to the system.	$0	$2,518,000

TYPE & YEAR	MAP ID	RECOMMENDED PROJECT	Existing Deficiency Cost	New Growth Cost
Source Growth Project **10-20 Years**	7	Install a turnout from the ULS pipeline and install 2,000 feet of 24-inch pipe to connect the turnout to distribution piping in the Upper City and Lower City pressure zones. Install PRV stations to regulate flow into each pressure zone.	$0	$607,000
Storage and Transmission Growth Project **10-20 Years**	8	Construct a storage pond on the southern end of the City in the Lower City pressure zone and construct or upsize 6,400 feet of 16-inch pipe, 9,600 feet of 12-inch pipe, and 6,700 feet of 10-inch pipe to connect the storage facility to the existing system and provide service to the area of the City south of the 800 S freeway interchange.	$0	$3,388,000
Transmission Growth Project **10-20 Years**	9	Construct four connections from the pipe constructed in Project 2 to existing distribution piping to switch the pipe to the Lower City pressure zone.	$0	$72,000
TOTAL			$4,320,000	$10,855,000

FUNDING OPTIONS

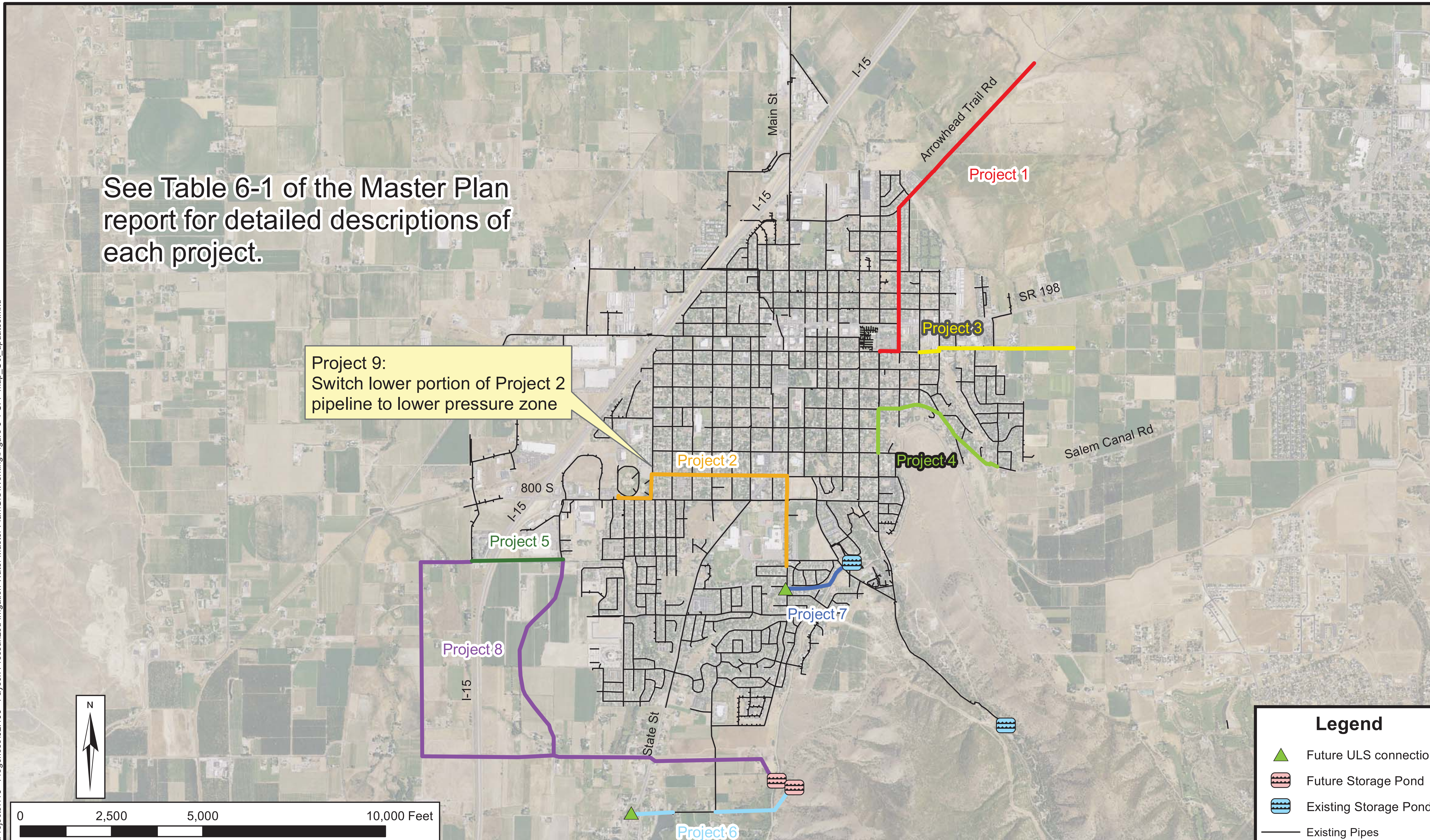
Funding options for the recommended projects, in addition to water use fees, include: general obligation bonds, revenue bonds, State/Federal grants and loans, and impact fees. In reality, the City may need to consider a combination of these funding options. The following discussion describes each of these options.

General Obligation Bonds

This form of debt enables the City to issue general obligation bonds for capital improvements and replacement. General Obligation (G.O.) bonds would be used for items not typically financed through the Water Revenue Bonds (for example, the purchase of water source to ensure a sufficient water supply for the City in the future). G.O. bonds are debt instruments backed by the full faith and credit of the City which would be secured by an unconditional pledge of the City to levy assessments, charges or ad valorem taxes necessary to retire the bonds. G.O. bonds are the lowest-cost form of debt financing available to local governments and can be combined with other revenue sources such as specific fees, or special assessment charges to form a dual security through the City's revenue generating authority. These bonds are supported by the City as a whole, so the amount of debt issued for the water system is limited to a fixed percentage of the real market value for taxable property within the City.

Revenue Bonds

This form of debt financing is also available to the City for utility related capital improvements. Unlike G.O. bonds, revenue bonds are not backed by the City as a whole, but constitute a lien against the water service charge revenues of a Water Utility. Revenue bonds present a greater risk to the investor than do G.O. bonds, since repayment of debt depends on an adequate revenue stream, legally defensible rate structure, and sound fiscal management by the issuing jurisdiction.



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PAYSON CITY PRESSURIZED IRRIGATION SYSTEM	CAPITAL FACILITY PLAN PROJECTS	FIGURE 6-1

Due to this increased risk, revenue bonds generally require a higher interest rate than G.O. bonds, although currently interest rates are quite low. This type of debt also has very specific coverage requirements in the form of a reserve fund specifying an amount, usually expressed in terms of average or maximum debt service due in any future year. This debt service is required to be held as a cash reserve for annual debt service payment to the benefit of bondholders. Typically, voter approval is not required when issuing revenue bonds.

State or Federal Grants and Loans

Historically, both local and county governments have experienced significant infrastructure funding support from state and federal government agencies in the form of block grants, direct grants in aid, interagency loans, and general revenue sharing. Federal expenditure pressures and virtual elimination of federal revenue sharing dollars are clear indicators that local government may be left to its own devices regarding infrastructure finance in general. However, state or federal grants and loans should be further investigated as a possible funding source for needed water system improvements.

It is also important to assess likely trends regarding state or federal assistance in infrastructure financing. Future trends indicate that grants will be replaced by loans through a public works revolving fund. Local governments can expect to access these revolving funds or public works trust funds by demonstrating both the need for and the ability to repay the borrowed monies, with interest. As with the revenue bonds discussed earlier, the ability of infrastructure programs to wisely manage their own finances will be a key element in evaluating whether many pressurized irrigation funding sources, such as federal/state loans, will be available to the City.

Impact Fees

The Utah Impact Fees Act, codified in Title 11, Chapter 36a, of the Utah Code, authorizes municipalities to collect impact fees to fund public facilities. An impact fee is “a payment of money imposed upon new development activity . . . to mitigate the impact of the new development on public infrastructure” (Subsection 11-36a-102(8)). Impact fees enable local governments to finance infrastructure improvements without burdening existing development with costs that are exclusively attributable to growth.

Impact fees can be applied to water-related facilities under the Utah Impact Fees Act. The Act is designed to provide a logical and clear framework for establishing new development assessments. It is also designed to establish the basis for the fee calculation which the City must follow in order to comply with the statute. The fundamental objective for the fee structure is the imposition on new development of only those costs associated with providing or expanding water infrastructure to meet the capacity needs created by that specific new development. Impact fees cannot be applied retroactively.

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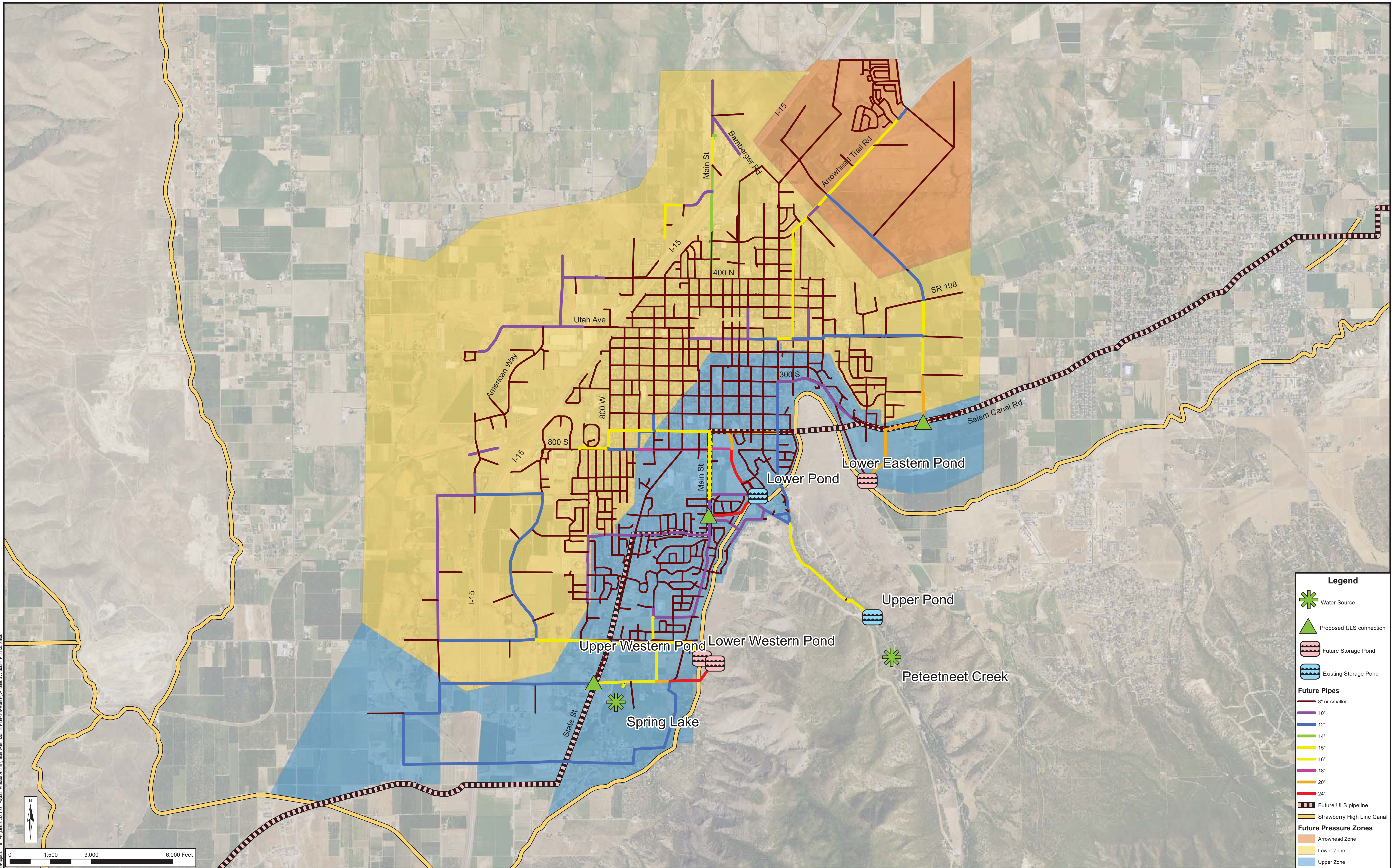
APPENDIX A

Pressurized Irrigation
Master Plan System Map



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PAYSON CITY PRESSURIZED IRRIGATION SYSTEM

MASTER FACILITIES PLAN MAP

APPENDIX A

APPENDIX B
Water System Data and Calculations

Payson City
2019 P.I. System Master Plan
Existing and Build-Out Requirements
09/13/2019 RJG

Lower City Zone	Existing				10-year				20-year				2050			
	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)
Unit Req.	N/A	8.50	4.2	0.029	N/A	6.00	3.2	0.020	N/A	6.00	3.2	0.020	N/A	6.00	3.20	0.020
Total Demand	447	3,800	1,877	12.9	489	2,936	1,566	9.7	709	4,251	2,267	14.1	935	5,611	2,992	18.6
Total Capacity		6,284	3,790	25.00		6,284	3,790	25.00		6,284	3,790	25.00		6,284	3,790	25.00
Surplus/Deficit		2,485	1,913	12.1		3,348	2,224	15.3		2,033	1,523	10.9		673	798	6.4

Upper City Zone	Existing				10-year				20-year				2050			
	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)
Unit Req.	N/A	8.50	4.2	0.029	N/A	6.00	3.2	0.020	N/A	6.00	3.2	0.020	N/A	6.00	3.20	0.020
Total Demand	398	3,383	1,672	11.5	450	2,699	1,439	8.9	491	2,948	1,572	9.8	780	4,678	2,495	15.5
Total Capacity		1,600	860	10.00		1,600	860	10.00		1,600	860	10.00		1,600	860	10.00
Surplus/Deficit		-1,783	-812	-1.5		-1,099	-579	1.1		-1,348	-712	0.2		-3,078	-1,635	-5.5

Arrowhead Zone	Existing				10-year				20-year				2050			
	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)
Unit Req.	N/A	8.50	4.2	0.029	N/A	6.00	3.2	0.020	N/A	6.00	3.2	0.020	N/A	6.00	3.20	0.020
Total Demand	0	0	0	0.0	89	535	285	1.8	104	626	334	2.1	254	1,526	814	5.1
Total Capacity		0	0	0.00		0	0	0.00		0	0	0.00		0	0	0.00
Surplus/Deficit		0	0	0.0		-535	-285	-1.8		-626	-334	-2.1		-1,526	-814	-5.1

SUMMARY	Existing				10-year				20-year				2050			
	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)	Service (irr-ac)	Peak Day Source (gpm/irr-ac)	Avg. Yearly Source (ac-ft/irr-ac)	Storage (ac-ft)
Unit Req.	N/A	8.50	4.2	0.029	N/A	6.00	3.2	0.020	N/A	6.00	3.2	0.020	N/A	6.00	3.2	0.020
Total Demand	845	7,183	3,549	24.4	1,028	6,170	3,291	20.4	1,304	7,825	4,173	25.9	1,969	11,815	6,301	39.2
Total Capacity		7,884	4,650	35.0		7,884	4,650	35.0		7,884	4,650	35.0		7,884	4,650	35.0
Surplus/Deficit		702	1,101	10.6		1,714	1,359	14.6		59	477	9.1		-3,931	-1,651	-4.2

Typical Water Demand for Various Lot Sizes

Unmetered Peak Day Demand:	8.7	gpm/irr-ac
Unmetered Average Yearly Demand:	4.2	ac-ft/irr-ac
Metered Peak Day Demand:	6	gpm/irr-ac
Metered Average Yearly Demand:	3.2	ac-ft/irr-ac

				Unmetered use		Metered use	
Lot size (sq ft)	Lot size (ac)	Typical % Irrigated	Typical Irrigated Acreage	Peak Day (gpm)	Average Yearly (ac-ft)	Peak Day (gpm)	Average Yearly (ac-ft)
5000	0.11	25%	0.03	0.25	0.12	0.17	0.09
6000	0.14	30%	0.04	0.36	0.17	0.25	0.13
7000	0.16	35%	0.06	0.49	0.24	0.34	0.18
8000	0.18	40%	0.07	0.64	0.31	0.44	0.24
9000	0.21	45%	0.09	0.81	0.39	0.56	0.30
10000	0.23	45%	0.10	0.90	0.43	0.62	0.33
11000	0.25	45%	0.11	0.99	0.48	0.68	0.36
12000	0.28	45%	0.12	1.08	0.52	0.74	0.40
13000	0.30	45%	0.13	1.17	0.56	0.81	0.43
14000	0.32	45%	0.14	1.26	0.61	0.87	0.46
15000	0.34	50%	0.17	1.50	0.72	1.03	0.55
16000	0.37	50%	0.18	1.60	0.77	1.10	0.59
17000	0.39	50%	0.20	1.70	0.82	1.17	0.62
18000	0.41	50%	0.21	1.80	0.87	1.24	0.66
19000	0.44	50%	0.22	1.90	0.92	1.31	0.70
20000	0.46	55%	0.25	2.20	1.06	1.52	0.81
21000	0.48	55%	0.27	2.31	1.11	1.59	0.85
22000	0.51	60%	0.30	2.64	1.27	1.82	0.97
23000	0.53	60%	0.32	2.76	1.33	1.90	1.01
24000	0.55	60%	0.33	2.88	1.39	1.98	1.06
25000	0.57	60%	0.34	3.00	1.45	2.07	1.10
26000	0.60	60%	0.36	3.12	1.50	2.15	1.15
27000	0.62	60%	0.37	3.24	1.56	2.23	1.19
28000	0.64	60%	0.39	3.36	1.62	2.31	1.23
29000	0.67	60%	0.40	3.48	1.68	2.40	1.28
30000	0.69	60%	0.41	3.60	1.74	2.48	1.32
31000	0.71	60%	0.43	3.71	1.79	2.56	1.37
32000	0.73	60%	0.44	3.83	1.85	2.64	1.41
33000	0.76	65%	0.49	4.28	2.07	2.95	1.58
34000	0.78	65%	0.51	4.41	2.13	3.04	1.62
35000	0.80	65%	0.52	4.54	2.19	3.13	1.67
36000	0.83	65%	0.54	4.67	2.26	3.22	1.72
37000	0.85	65%	0.55	4.80	2.32	3.31	1.77
38000	0.87	65%	0.57	4.93	2.38	3.40	1.81
39000	0.90	65%	0.58	5.06	2.44	3.49	1.86
40000	0.92	65%	0.60	5.19	2.51	3.58	1.91
41000	0.94	65%	0.61	5.32	2.57	3.67	1.96
42000	0.96	65%	0.63	5.45	2.63	3.76	2.01
43000	0.99	65%	0.64	5.58	2.69	3.85	2.05
44000	1.01	65%	0.66	5.71	2.76	3.94	2.10

APPENDIX C
Computer Model Output
(See disk)

APPENDIX D

Cost Estimate Calculations

Payson City Capital Facility Plan
Pressurized Irrigation Recommended Improvements
Preliminary Engineer's Cost Estimates

	Item	Unit	Unit Price	Quantity	Cost	Contingency/ Eng/Admin
PI Met.	***System Metering***					
	PI Customer Meter	EA	$ 800	4500	$ 3,600,000	$ 720,000
					Total to System Metering	**$ 4,320,000**
PI 1.	***Arrowhead Transmission Project***					
	Pipe constructed 2019	LS	$ 789,813	1	$ 789,813	$ -
	16" pipe (developer portion)	LF	$ 109	4700	$ 512,300	$ 102,460
	16" pipe - City upsize	LF	$ 50	4700	$ 235,000	$ 47,000
					Total to Arrowhead Transmission Project	**$ 1,687,000**
					City Portion of Costs	**$ 1,072,000**
PI 2.	***Rec Zone waterline and well work***					
	Water Line	LS	$ 1,046,962	1	$ 1,046,962	$ -
	Well Upgrades	LS	$ 420,380	1	$ 420,380	$ -
					Total to Rec Zone waterline and well work	**$ 1,467,000**
PI 3.	***Eastern Lower Zone Transmission***					
	12" Transmission Line (developer portion)	LF	$ 119	4300	$ 511,700	$ 102,340
	12" Transmission Line (city upsize)	LF	$ 26	4300	$ 111,800	$ 22,360
					Total to Eastern Lower Zone Transmission	**$ 748,000**
					City Portion of Costs	**$ 134,000**
PI 4.	***Eastern Upper Zone Transmission***					
	12" Transmission Line	LF	$ 145	1200	$ 174,000	$ 34,800
	10" Transmission Line	LF	$ 136	4000	$ 544,000	$ 108,800
					Total to Eastern Upper Zone Transmission	**$ 862,000**
PI 5.	***1130 S Western City Transmission***					
	12" Transmission Line	LF	$ 145	2500	$ 362,500	$ 72,500
	Bore under I-15	LS	$ 250,000	1	$ 250,000	$ 50,000
					Total to 1130 S Western City Transmission	**$ 735,000**
PI 6.	***Southern Upper Zone Expansion***					
	Storage Pond	LS	$ 1,300,000	1	$ 1,300,000	$ 260,000
	Land	AC	$ 100,000	1	$ 100,000	$ 20,000
	24" Transmission Line	LF	$ 218	2400	$ 523,200	$ 104,640
	16" Transmission Line	LF	$ 159	1100	$ 174,900	$ 34,980
					Total to Southern Upper Zone Expansion	**$ 2,518,000**
PI 7.	***Main Street ULS source***					
	24" Transmission Line	LF	$ 218	2000	$ 436,000	$ 87,200
	Pipe connection and PRV station	LS	$ 35,000	2	$ 70,000	$ 14,000
					Total to Main Street ULS source	**$ 607,000**
PI 8.	***Southern Lower Zone Expansion***					
	Storage Pond	LS	$ 1,300,000	1	$ 1,300,000	$ 260,000
	Land	AC	$ 100,000	1	$ 100,000	$ 20,000
	16" Transmission Line	LF	$ 159	6400	$ 1,017,600	$ 203,520
	12" Transmission Line - Developer	LF	$ 109	9600	$ 1,046,400	$ 209,280
	12" Transmission Line - City Upsize	LF	$ 29	9600	$ 278,400	$ 55,680
	10" Transmission Line - Developer	LF	$ 109	9600	$ 1,046,400	$ 209,280
	10" Transmission Line - City Upsize	LF	$ 19	6700	$ 127,300	$ 25,460
					Total to Southern Lower Zone Expansion	**$ 5,899,000**
					City Portion of Costs	**$ 3,388,000**
PI 9.	***Lower Zone Transmission***					
	Pipeline connections	LS	$ 15,000	4	$ 60,000	$ 12,000
					Total to Lower Zone Transmission	**$ 72,000**

Total for Improvements $ 18,915,000
Total Costs to City $ 15,175,000