MAPLETON

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WATER SYSTEMS MASTER PLAN

A MASTER PLAN AND CAPITAL IMPROVEMENT PLAN FOR THE DRINKING WATER SYSTEM AND PRESSURIZED IRRIGATION SYSTEM OF MAPLETON CITY

(HAL Project No.: 437.15.100)

HANSEN ALLEN & LUCE inc
ENGINEERS

August 2024

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August 2024

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GLOSSARY OF TECHNICAL TERMS

Average Daily Flow: The yearly demand volume averaged over a calendar year and expressed in a flow rate.

Average Yearly Demand: The volume of water used during an entire year.

Buildout: When the development density reaches maximum allowed by the City's current general plan and zoning ordinances.

Demand: Required water flow rate or volume.

Distribution System: The network of pipes, valves and appurtenances contained within a water system.

Drinking Water: Water of sufficient quality for human consumption. Also referred to as Culinary or Potable water.

Equivalent Residential Connection: A measure used in comparing water demand from non-residential connections to residential connections (for this study, one ERC is defined as the average indoor water demand of an average residence in Mapleton).

Fire Flow Requirements: The rate of water delivery required to extinguish a particular fire. Usually it is given in rate of flow (gallons per minute) for a specific period of time (hours).

Head: A measure of the pressure in a distribution system that is exerted by the water. Head represents the height of the free water surface (or pressure reduction valve setting) above any point in the hydraulic system.

Head loss: The amount of pressure lost in a distribution system under dynamic conditions due to the wall roughness and other physical characteristics of pipes in the system.

Peak Day: The day(s) of the year in which a maximum amount of water is used in a 24-hour period.

Peak Day Demand (PDD): The average daily flow required to meet the needs imposed on a water system during the peak day(s) of the year.

Peak Instantaneous Demand (PID): The flow required to meet the needs imposed on a water system during maximum flow on a peak day.

Pressure Reducing Valve (PRV): A valve used to reduce excessive pressure in a water distribution system.

Pressure Zone: The area within a distribution system in which water pressure is maintained within specified limits.

Service Area: Typically, the area within the boundaries of the entity or entities that participate in the ownership, planning, design, construction, operation and maintenance of a water system.

Static Pressure: The pressure exerted by water within the pipelines and other water system appurtenances when water is not flowing through the system, i.e., during periods of little or no water use.

Storage Reservoir: A facility used to store, contain and protect water until it is needed by the customers of a water system. Also referred to as a Storage Tank.

Transmission Pipeline: A pipeline that transfers water from a source to a reservoir or from a reservoir to a distribution system.

Water Conservation: Planned management of water to prevent waste.

ABBREVIATIONS AND UNITS

ac	acre [area]
ac-ft	acre-foot (1 ac-ft = 325,851 gal) [volume]
CIP/CFP	Capital Improvement Plan/Capital Facilities Plan
CUWCD	Central Utah Water Conservancy District
DIP	Ductile Iron Pipe
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]
IFC	International Fire Code
in.	inch [length]
irr-ac	irrigated acre
kgal	thousand gallons [volume]
MG	million gallons [volume]
MGD	million gallons per day [flow rate]
mi	mile [length]
PDD	peak day demand
PI	pressurized irrigation
PID	peak instantaneous demand
psi	pounds per square inch [pressure]
s	second [time]
SCADA	Supervisory Control and Data Acquisition
VFD	variable frequency drive (pump operation type)
yr	year[time]

EXECUTIVE SUMMARY

PURPOSE OF STUDY

The purpose of this study is to provide Mapleton City with guidance in operating, maintaining, planning, and growing their drinking water and pressurized irrigation systems, to help provide efficient and reliable service to customers, both now and in the future, at the lowest reasonable cost.

PLANNING HORIZON

The ultimate planning horizon for this study is when the development density reaches maximum allowed by the City's current general plan and zoning ordinances, referred to as buildout in this report.

COMPONENTS OF A WATER DISTRIBUTION SYSTEM

The following three components of a water distribution system were analyzed to determine the capacity and ability of the water system to meet existing and future water demands:

1. Source – the water used to supply the system
2. Storage – a location to store water for purposes of meeting demand peaks and maintaining reserves for emergency and firefighting purposes
3. Distribution – pipelines used to deliver water from sources or storage locations to the customer

Each of these components must have enough capacity and capability to serve existing and future customers. To ensure adequate capacity, this study proposes a level of service as a design standard for new development (as discussed in the following section).

METHODS

Water usage and water system data were used to develop a responsible level of service for each component (source, storage, distribution) of the water system. The level of service was used to evaluate the existing system, identify existing deficiencies, and develop a computer model of the existing system.

The land use element of the general plan, population projections, development concept plans, and the proposed level of service were used to forecast the locations and magnitudes of future water demands in the City. Computer modeling and other tools were used to determine the infrastructure necessary to best meet these demands.

LEVEL OF SERVICE

The level of service is the standard to which the drinking water system is designed. To set the level of service, three years of historical data (both water billing data and water production data, as documented by the City) were analyzed. For the drinking water system, the average volume of water used indoors by the average residence in Mapleton is determined. This volume of water is called an Equivalent Residential Connection (ERC). For the pressurized irrigation system, the average volume of water used per irrigated acre (irr-ac) is determined. The average volume of water for both indoor and outdoor usage are used to set levels of service for the drinking water system and pressurized irrigation system respectively.

The previous master plan used statewide minimum sizing standards for source and storage requirements. Sufficient data has been collected since the previous master plan to establish system specific source and storage requirements. This master plan uses the past three years of water usage data to determine these requirements.

Table ES-1 shows the levels of service set during this study. Pressure requirements are expressed in units of pounds per square inch (psi). Other requirements are expressed in units of demand (gallons per minute [gpm]) or volume (gallons [gal] or acre-feet [ac-ft]) or volume per unit (ac-ft per ERC or ac-ft per irrigated acre [irr-ac]).

Table ES-1
Level of Service Parameters

Parameter	Proposed Level of Service	
	Drinking Water System (Indoor Use)	Pressurized Irrigation System (Outdoor Use)
Minimum System Pressure[1]	30 psi (peak instantaneous) 40 psi (peak day)	30 psi (peak instantaneous) 40 psi (peak day)
Peak Day Demand	500 gpd/ERC	6.6 gpm/irr-ac
Average Yearly Demand	0.35 ac-ft/ERC	3.2 ac-ft/irr-ac
Storage	500 gal/ERC	7,200 gal/irr-ac
Allowable Lot Area Irrigated[2]	50%	50%

1. Pressure requirements for the drinking water system are as stated in Utah Code R309-105-9(2). Consistent with the rule, the Mapleton City requirement for drinking water connections prior to 2007 is 20 psi under all demand conditions.
2. Lot area is the area shown on a typical plat for each lot and excludes roadways/public right of ways.

These level of service parameters were used to quantify system demand and compare it to system capacity. This allowed the project team to identify vulnerabilities in the water system and make plans for future growth.

DISTRIBUTION SYSTEM VULNERABILITIES

The existing system was analyzed to identify vulnerabilities and areas which need improvements to support future growth. Table ES-2 contains a summary of system vulnerabilities. Further information about these vulnerabilities is described in subsequent sections.

Recommended solutions to these vulnerabilities are shown in Table ES-3 and described in further detail in Chapter 7.

Table ES-2
System Vulnerabilities

	ID	Description	Notes
Drinking Water	DW-V1	System Performance	System contains approximately 8 miles of undersized pipes (4-inch or 6-inch diameter) (see Figure 1-1).
	DW-V2	System Source	System will approach source capacity as the City develops (see Chapter 3).
	DW-V3	Aging Infrastructure	Some drinking water infrastructure is reaching the end of its projected useful life and is increasingly at risk for failure (see Table 7-3).
	DW-V4	Non-Revenue Water	Based on recent historical data, Mapleton City does not bill for approximately 25% of drinking water produced. Non-revenue water can be caused by leakage, inaccurate meters, theft, and other causes. Non-revenue water leads to increased production requirements and lost potential revenue (see Chapter 3).
	DW-V5	System Efficiency	System has lower energy efficiency if not properly managed (see Chapter 6).
Pressurized Irrigation	PI-V1	System Performance	System has high pressure fluctuations (see Chapter 6).
	PI-V2	System Source	System will require additional turnouts to meet future demands (see Chapter 3).
	PI-V3	Non-Revenue Water	Based on recent historical data, Mapleton City does not bill for approximately 10% of pressurized irrigation water received. Non-revenue water can be caused by leakage, inaccurate meters, theft, and other causes. Non-revenue water leads to increased production requirements and lost potential revenue (see Chapter 3).
	PI-V4	System Efficiency	System has lower energy efficiency if not properly managed (see Chapter 6).

Table ES-3
Proposed Solutions to System Vulnerabilities

Description	Notes	Vulnerabilities Addressed
New Wells and Turnouts	Construct new wells and connect new turnouts to provide additional sources to the systems. Add a system to provide water to the pressurized irrigation system from the drinking water system (see Chapter 7).	DW-V2, PI-V2
Ongoing Infrastructure Replacement	Replace aging and undersized pipes with new pipes to maintain system performance and increase distribution (see Chapter 7).	DW-V1, DW-V3
Recommended Projects	Construct recommended projects to meet growing demand and maintain system performance (see Chapter 7).	DW-V2, PI-V1, PI-V2
Water Audit	Perform an AWWA Water Audit to evaluate non-revenue water in the system to determine methods to reduce it (see Chapter 3).	DW-V4, PI-V3
Leak Detection Study	Commission a leak detection and repair study to identify pipes at risk of failure and reduce non-revenue water (see Chapter 3).	DW-V4, PI-V3
System Operation	Operate the system within designed parameters to conserve energy (see Chapter 6).	DW-V5, PI-V4

GENERAL RECOMMENDATIONS

The following subsections contain general recommendations for Mapleton City to follow to provide continued water service into the future.

General Source Recommendations

The following are recommended actions for Mapleton City to take to provide adequate source capacity into the future:

- Drill an additional well to provide additional source to the drinking water system.
- Construct additional turnouts from CUWCD's Mapleton Springville Pipeline to the pressurized irrigation system.
- Strategically pursue system interconnections with Springville and/or Spanish Fork as opportunities arise.
- Continue to maintain existing wells and implement improvements for water quality and capacity.

General Storage Recommendations

The City has adequate storage in both the drinking water system and the pressurized irrigation system to meet the storage requirements at buildout. The following are recommended actions for Mapleton to take to provide adequate storage capacity into the future:

- Continue to maintain existing storage facilities.
- Periodically test tanks for leaks.
- Periodically clean tanks.
- Consider decommissioning the Westwood Tank.
- When the Lower Storage tank reaches the end of its useful life, consider demolishing existing tanks at this site and replacing them with a larger tank to provide additional storage at the correct elevation for drinking water system Zone 1.

General Distribution Recommendations

The following are recommended actions for Mapleton City to take to provide adequate distribution capacity into the future:

- Construct recommended distribution system projects to provide capacity for growth.
- Proactively replace aging pipes.
- Perform a water audit to identify methods to reduce non-revenue water.
- Commission a leak detection and repair study to reduce non-revenue water.

CAPITAL IMPROVEMENT PLAN

Projects necessary to support growth through the buildout condition are identified and described in Chapter 7. Conceptual-level cost estimates were prepared for each project. These projects are required due to future development throughout the city. Projects attributable to new growth are eligible to be repaid with impact fees. Table ES-4 lists recommended system operations and maintenance projects along with the estimated costs. Table ES-5 lists major capital projects that are necessitated due to system growth.

Table ES-4
Operations and Maintenance Projects

	Type	Map ID	Recommended Project	Cost
Drinking Water	Maintenance	DW-OM-01	Identify and implement a solution to mitigate manganese in Westwood Well.	$100,000
	Maintenance	DW-OM-02	Redevelop Seal Well.	$3,380,000
	Maintenance	DW-OM-03	Decommission Westwood Tank.	$100,000
	Maintenance	DW-OM-04	Replace all existing 4-inch and 6-inch pipes in the drinking water system with 8-inch pipes.	$14,310,000
	Maintenance	DW-OM-05	Replace the ductile iron pipe in 1600 West from Maple Street to 2600 South with a 12-inch PVC waterline.	$3,420,000
	Maintenance	DW-OM-06	Replace the ductile iron pipe in 1600 South from 800 West to 1600 West with an 8-inch PVC waterline.	$850,000
	Maintenance	DW-OM-07	Replace the ductile iron pipe in Monta Vista Drive from 800 West to 2000 South with an 8-inch PVC waterline.	$630,000
	System Optimization	DW-OM-08	Install an altitude valve on Crowd Canyon Tank.	$100,000
	Total Cost – Drinking Water			**$23,000,000**
Pressurized Irrigation	Meet LOS	PI-OM-01	Reduce pressure swings due to flushing the PI Pond Pumps.	$20,000
	Total Cost – Pressurized Irrigation			**$20,000**
Drinking Water and Pressurized Irrigation Total Cost				**$23,020,000**

Table ES-5
System Growth-Related Projects

	Type	Map ID	Recommended Project	Cost
Drinking Water	Source	DW-FS-01	Locate and drill a new well.	$4,100,000
	Meet LOS	DW-FT-01	Incorporate the Clegg Canyon and Quiet Meadows pressure zones into Zone 2.	$20,000
	Meet LOS	DW-FT-02	Change the pressure zone of the Horizon Heights Subdivision from Zone 1 to Zone 2.	$20,000
	Transmission	DW-FT-03	Install an 8-inch water line to create a second path of water from Zone 2 into Horizon Heights.	$490,000
	Meet LOS	DW-FT-04	Change the pressure zone of Overlook Ridge Drive from Zone 1 to Zone 2.	$10,000
	Total Cost – Drinking Water			**$4,600,000**

Table ES-5 – Continued
System Growth-Related Projects

	Type	Map ID	Recommended Project	Cost
Pressurized Irrigation	Source	PI-FS-01	Install two pumps capable of pumping to Zone 3 and Zone 2 in the PI Pond Pump Station.	$320,000
	Source	PI-FS-02	Connect additional turnouts from the Mapleton Springville Pipeline to the pressurized irrigation system.	$410,000
	Source	PI-FS-03	Install an air gap connection between Crowd Canyon Tank and the pressurized irrigation system to provide backup source to the PI system.	$100,000
	Transmission	PI-FT-01	Install a 12-inch transmission waterline on Main Street from the Main Street Turnout to 1600 South.	$850,000
	Transmission	PI-FT-02	Install a 20-inch transmission line from Harmony Ridge to the PI Pond. Install a PRV and bypass vault near The Preserve and at the north end of the PI Pond.	$9,140,000
	Transmission	PI-FT-03	Install a 20-inch transmission line from Dogwood turnout to the Main Street transmission line. Install a Zone 1 PSV into the PI Pond.	$3,640,000
	Transmission	PI-FT-04	Install a 12” transmission waterline on 1600 South from Main Street to 1300 West.	$1,740,000
	Transmission	PI-FT-05	Install a 12” transmission waterline from the PI Pond to the north end of Zone 2.	$2,070,000
	Transmission	PI-FT-06	Install a 16-inch transmission line from the Bench Pipeline to Twin Hollow/Main Street to provide Zone 2 water to the south end of Zone 2.	$1,610,000
	Transmission	PI-FT-07	Install a 12-inch transmission waterline on Highway 89 between Mapleton Village Drive and Sugar Maple Drive (Mapleton Heights).	$570,000
	Meet LOS	PI-FT-08	Change the pressure zone of 1200 East from Zone 1 to Zone 2.	$10,000
	Meet LOS	PI-FT-09	Change the pressure zone of the Horizon Heights Subdivision from Zone 1 to Zone 2. Install one valve.	$10,000
	Meet LOS	PI-FT-10	Install a Zone 1 8-inch line through Horizon Heights along 800 West from Union Bench Drive to Overlook Ridge Drive.	$750,000
	Meet LOS	PI-FT-11	Change the pressure zone of Overlook Ridge Drive from Zone 1 to Zone 2. Install one valve.	$10,000
	Meet LOS	PI-FT-12	Connect all existing customers to the pressurized irrigation system.	$16,490,000
	Total Cost – Pressurized Irrigation			**$37,700,000**
Drinking Water and Pressurized Irrigation Total Cost				**$42,300,000**

CONCLUSIONS

Key conclusions from the master plan are as follows:

- There is an immediate need for extensive development of the pressurized irrigation system.
- The drinking water system is well developed and provides adequate pressure and fire flow capacity according to the City's LOS and applicable state codes. Old and undersized pipes should be proactively replaced.
- A new well should be added to the drinking water system and existing wells should be regularly maintained.
- There is an opportunity for energy savings through proper operation of the City's drinking water and pressurized irrigation systems.
- Some of the City's water infrastructure is approaching the end of its service life. Proactive infrastructure replacement is recommended. The City's infrastructure maintenance and replacement plan should be periodically re-evaluated to account for changes in construction costs and new information.
- There appears to be opportunity to save money and conserve water by locating and repairing leaks.

CHAPTER 1 INTRODUCTION

PURPOSE AND SCOPE

The purpose of this master plan is to provide direction to the City of Mapleton regarding decisions that will be made now and into the future to provide an adequate drinking water system and pressurized irrigation system for its customers at the most reasonable cost. Recommendations are based on demand data, growth projections, standards of the Utah Division of Drinking Water (DDW), City zoning, the Mapleton City general plan, known planned developments, and standard engineering practices.

The master plan is a study of the City's drinking water system, pressurized irrigation system, and customer water use as of 2022. The following topics are addressed herein: general planning, growth projections, water rights, water loss, source requirements, storage requirements, and distribution system requirements. Operational parameters for the City's drinking water and pressurized irrigation systems were reviewed, and recommendations are made to optimize the system based on stability, ease of use, and cost. Based on this study, needed capital improvements have been identified with conceptual-level cost estimates for the recommended improvements.

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; or, as significant changes are made to planned land uses.

BACKGROUND

Mapleton City is presently experiencing rapid growth. Additionally, the City is actively working to improve water conservation and energy-efficiency in the drinking water and pressurized irrigation system. Mapleton City commissioned this master plan to help meet the needs of the developing city, to plan for future development, and to help improve the efficiency of the water systems.

DRINKING WATER AND PRESSURIZED IRRIGATION SYSTEM DESCRIPTIONS

Mapleton lies in the middle of Utah County, bordering the Wasatch Mountains. The majority of the City lies in the valley with the eastern edge of the City climbing into the foothills of the mountains. Historically, development has occurred in the flat northern three quarters of the City. As development in the northern areas is starting to reach capacity, the more varied, hilly landscape of the City's southern areas is experiencing rapid development.

Construction began on the Mapleton City drinking water system in the mid-1900s. The system currently contains five storage tanks (Crowd Canyon Tank, Westwood Tank, Lower Tank, and Upper Tanks - Maple Canyon Tank #1 and Maple Canyon Tank #2), a group of springs, four wells (Carnesecca Well, Seal Well, Westwood Well, and Crowd Canyon Well), two booster pumps, and 136 miles of piping that serve the 12,390 residents of Mapleton City.

In the mid-1990's, to effectively use water from several non-potable wells, construction began on a pressurized irrigation (PI) system. Since 1998, Mapleton City has required developers to install pressurized irrigation pipe and laterals in their developments. As of 2023, the PI system is active in the northern and central portions of the City. The majority of existing developments throughout the rest of the City have dry PI pipe that is ready to be connected to the PI system. The PI system currently includes three wells (Orton Well, R3 Well, and Well 1), three turnouts from Central Utah Water Conservancy District's (CUWCD) Mapleton Springville Pipeline, a PI pond, 75 miles of active pipe, and 16 miles of dry piping.

The topography of Mapleton City separates the drinking water system into three pressure zones. Zone 1 covers the valley portion of the city up to the base of the foothills. Zones 2 and 3 cover development moving up the foothills and development high in the foothills respectively. Several springs (Service Berry, Mapleton City, Unnamed A & B, and Dunham 1, 2, & 3) flow out of Maple Canyon and, along with Crowd Canyon Well, serve as source for Zone 3. Water for Zone 3 is stored in the Upper Tanks and Crowd Canyon Tank. Water for Zone 2 is supplied through PRVs from the same tanks. Zone 1 is supplied from the Carnesecca Well, Seal Well, and Westwood Well with the water being stored in the Lower Tank. The elevation of Westwood Tank is too low to serve as equalization storage for Zone 1 but can provide emergency fire flow for the central portions of the City. If the sources in Zone 3 do not produce enough water to meet the demand, water is boosted from the Lower Tank to the Upper Tanks using booster pumps located in two vaults near the mouth of Mapleton Canyon, Booster 1 and Booster 2. The existing drinking water system is shown in Figure 1-1.

The PI system is currently served by a single pressure zone. Water is stored in the PI Pond, located on the eastern side of the City, from which it is pumped through two pumps to meet the fluctuating demand. Water from Hobble Creek can be supplied to the pond in the spring and from Mapleton Canyon runoff when available. All irrigation season, some water is supplied from Orton Well, R3 Well, and Well 1, but the majority comes from CUWCD's Mapleton Springville Pipeline. The head for this pipeline is set from the Mapleton Springville Regulating Tank located at the south end of Mapleton City. The City determines the amount of water needed each day and orders that amount from CUWCD. The water is delivered to the City through three turnouts: Turnout 8 (2200 South Main Street), the Dogwood Turnout, and the 1600 North Turnout. During low demand times, the excess water from the turnouts is used to fill the PI Pond. The existing PI system is shown in Figure 1-2.

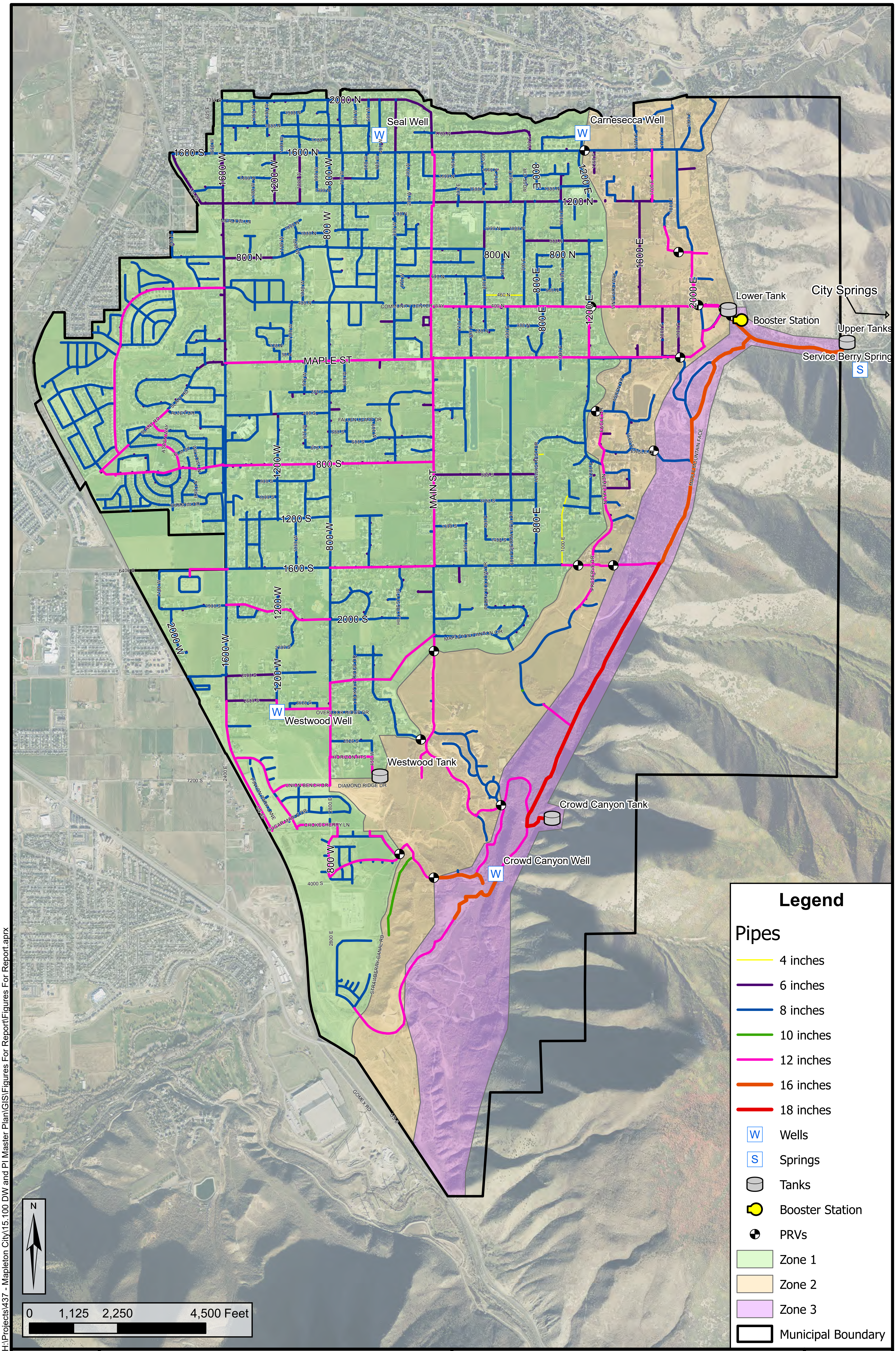
EQUIVALENT RESIDENTIAL CONNECTIONS

Drinking water demands are expressed in terms of equivalent residential connections (ERCs). The use of ERCs is a standard engineering practice to describe the entire system in a common unit of measurement. One ERC is equal to the average indoor demand of an average residential connection. Non-residential demands are converted to ERCs for planning purposes. For example, a commercial building requiring six times as much water as a typical residential connection is assigned an ERC count of 6.

For this report, water uses for the drinking water system and pressurized irrigation system are described separately. Water uses in the drinking water system are expressed in terms of demand per ERC for indoor use and demand per irrigated acre for outdoor use, while water uses in the pressurized irrigation system are expressed in terms of demand per irrigated acre.

LEVEL OF SERVICE

The level of service (LOS) is the water volume and pressure standard that the drinking water system and pressurized irrigation system are designed to meet. The level of service for the drinking water system is regulated by Utah Administrative Rule 309, which is administered by the DDW. In the past, the DDW set standard sizing requirements which all water utilities were required



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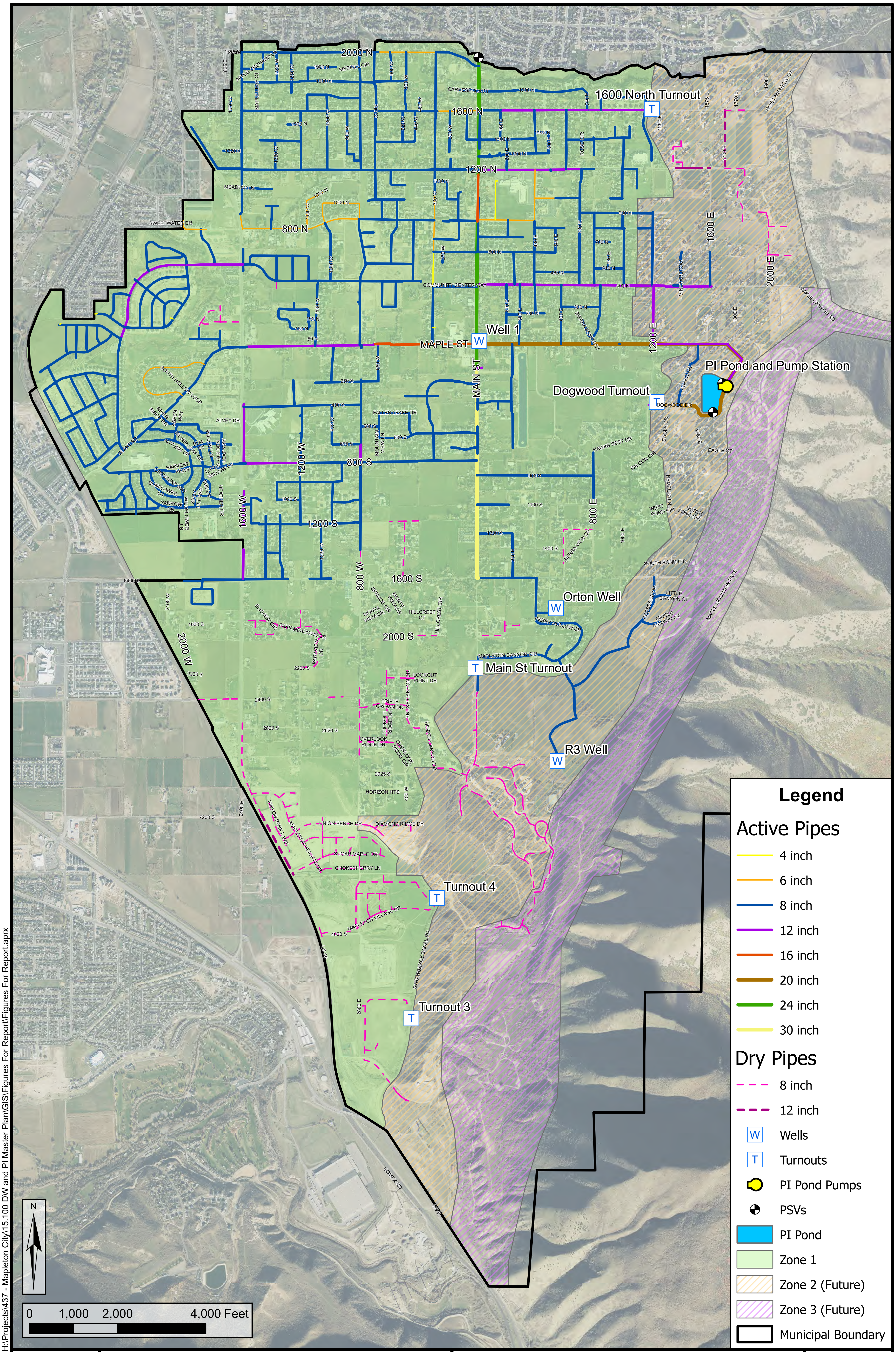
MAPLETON CITY
WATER MASTER PLAN

EXISTING FACILITIES
DRINKING WATER SYSTEM

FIGURE
1-1



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MAPLETON CITY WATER MASTER PLAN	EXISTING FACILITIES PRESSURIZED IRRIGATION SYSTEM	FIGURE 1-2

to meet, based on ERCs. In 2018, the DDW revised this approach to set system-specific sizing requirements.

The DDW has not established minimum sizing requirements for Mapleton. It is anticipated the sizing standards will be proposed by the DDW on a per ERC basis with ERCs defined as specified in Utah Code R309-110-4. The DDW calculation considers annual water use for both indoor and outdoor uses together. Using the DDW calculation method, Mapleton's drinking water system has sufficient source and storage for the existing customers (see Appendix A). Utah Code also permits water systems to complete an engineering study and proposed appropriate system-specific sizing requirements based on available data and sound engineering principles. The intent of this master plan is to meet the requirements of an engineering study for system-specific sizing.

In this master plan, the recommended level of service is expressed separately for indoor and outdoor uses because much of the City is served by the pressurized irrigation system. The intent of this methodology is to be compliant with Utah Code while providing more specific information to Mapleton City about both indoor and outdoor uses and the role they play in system operation and performance.

The level of service is based on metered water production and billed sales data collected and reported by Mapleton City over several years. It incorporates appropriate safety factors and is intended to produce a design which is responsible without being unnecessarily expensive. The LOS parameters used for this study are summarized in Table 1-1. The development of each LOS parameter is described in later chapters.

Table 1-1
Level of Service Parameters

Parameter	Proposed Level of Service	
	Drinking Water System (Indoor Use)	Pressurized Irrigation System (Outdoor Use)
Minimum system pressure[1]	30 psi (peak instantaneous) 40 psi (peak day)	30 psi (peak instantaneous) 40 psi (peak day)
Peak Day Demand	500 gpd/ERC	6.6 gpm/irr-ac
Average Yearly Demand	0.35 ac-ft/ERC	3.2 ac-ft/irr-ac
Storage	500 gal/ERC	7,200 gal/irr-ac
Fire Flow Preference	2,000 gpm	-
Maximum Fire Flow Storage[2]	0.96 MG (4,000 gpm x 4 hours)	-
Allowable Lot Area Irrigated[3]	50%	50%
Townhome[4]	0.85 ERC each	50%

1. Pressure requirements for the drinking water system are as stated in Utah Code R309-105-9(2). Consistent with this rule, the Mapleton City requirement for drinking water connections prior to 2007 is a minimum of 20 psi under all conditions.
2. Fire flow requirements for large nonresidential structures are determined by the local fire authority and may exceed the minimum requirements for the remainder of the system. See Chapter 4.
3. Lot area is the area shown on a typical plat for each lot and excludes roadways/public right of ways.
4. Townhome usage was evaluated separately and it was determined that indoor usage for townhomes can be calculated using 0.85 ERC for each unit.

MASTER PLANNING METHODOLOGY

Water systems consist of water sources, storage facilities, distribution pipes, pump stations, valves, 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 firefighting and other emergency situations.

Identifying present and future water system needs is essential in the management and planning of a water system. Existing water demands were calculated from SCADA data and billed water use. Existing water use data, together with planned land uses in the City General Plan (and proposed development concepts), were used to project future water use.

This report follows the DDW requirements of Rule R309-510 ("Facility Design and Operation: Minimum Sizing Requirements") and Rule R309-105 ("Administration: General Responsibilities of Public Water Systems") of the Utah Administrative Code. The report addresses sources, storage, distribution, minimum pressures, hydraulic modeling, capital improvements, funding, and other topics pertinent to Mapleton City's drinking water system.

Hydraulic models of the City's drinking water system and pressurized irrigation system were 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.

DESIGN AND PERFORMANCE CRITERIA

Summaries of the key design criteria and demand requirements for the drinking water system are included in Table 1-2. The design criteria were used in evaluating system performance and in recommending future improvements. Criteria development is described in later chapters.

Table 1-2
System Design Criteria

System	Component	Item	Criteria	Existing Requirements	Estimated Future
Drinking Water (Indoor Use)	**ERCs**		Billing data/LOS	3,466 ERCs	10,574 ERCs
Drinking Water (Indoor Use)	**Irrigated Acreage**		Billing data/LOS	482 ac	200 ac
Drinking Water (Indoor Use)	Source	Peak Day Demand	Section R309-510-7/LOS	4,380 gpm	4,990 gpm
Drinking Water (Indoor Use)	Source	Average Yearly Demand	Section R309-510-7/LOS	2,760 ac-ft	4,340 ac-ft
Drinking Water (Indoor Use)	Storage	Equalization	Section R309-501-8/LOS	5.2 MG	6.8 MG
Drinking Water (Indoor Use)	Storage	Emergency	Preferred	0 MG	0 MG
Drinking Water (Indoor Use)	Storage	Fire Suppression	IFC/ Fire Marshall	0.96 MG	0.96 MG
Drinking Water (Indoor Use)	Storage	Total	-	6.2 MG	7.8 MG
Drinking Water (Indoor Use)	Distribution	Peak Instantaneous Flow	Meter data/LOS	7,450 gpm	8,480 gpm
Drinking Water (Indoor Use)	Distribution	Peak Day Fire Flow Preference	IFC/ Fire Marshall	2,000 gpm	2,000 gpm
Drinking Water (Indoor Use)	Distribution	Maximum Fire Flow	IFC/ Fire Marshall/LOS	4,000 gpm	4,000 gpm
Drinking Water (Indoor Use)	Distribution	Maximum Operating Pressure	Preferred	150 psi	150 psi
Drinking Water (Indoor Use)	Distribution	Maximum Pressure Fluctuation	Preferred	20 psi	20 psi
Drinking Water (Indoor Use)	Distribution	Minimum Pressure – Peak Day	Section R309-510-9/LOS	40 psi	40 psi
Drinking Water (Indoor Use)	Distribution	Minimum Pressure – Peak Instantaneous	Section R309-510-9/LOS	30 psi	30 psi
Pressurized Irrigation (Outdoor Use)	**Irrigated Acreage**		Billing data/LOS	533 ac	1,802 ac
Pressurized Irrigation (Outdoor Use)	Source	Peak Day Demand	Section R309-510-7/LOS	3,520 gpm	11,890 gpm
Pressurized Irrigation (Outdoor Use)	Source	Average Yearly Demand	Section R309-510-7/LOS	1,700 ac-ft	5,770 ac-ft
Pressurized Irrigation (Outdoor Use)	Storage	Equalization	Section R309-501-8/LOS	3.8 MG	13.0 MG
Pressurized Irrigation (Outdoor Use)	Storage	Emergency	Preferred	0 MG	0 MG
Pressurized Irrigation (Outdoor Use)	Storage	Total	-	3.8 MG (11.7 AF)	13.0 MG (39.8 AF)
Pressurized Irrigation (Outdoor Use)	Distribution	Peak Instantaneous Flow	Meter data/LOS	5,980 gpm	20,210 gpm
Pressurized Irrigation (Outdoor Use)	Distribution	Maximum Operating Pressure	Preferred	150 psi	150 psi
Pressurized Irrigation (Outdoor Use)	Distribution	Minimum Pressure – Peak Day	Preferred	40 psi	40 psi
Pressurized Irrigation (Outdoor Use)	Distribution	Minimum Pressure – Peak Instantaneous	Preferred	30 psi	30 psi

CHAPTER 2 SYSTEM GROWTH

GROWTH PROJECTIONS

The development of impact fees requires growth projections over the next 10 years. In addition to impact fee projects, this report will provide costs for anticipated projects required over the next 20 years and will briefly discuss anticipated projects up to the time when the development density reaches the maximum allowed by the City's current general plan and zoning ordinances, referred to as buildout in this report. Growth projections for Mapleton City were evaluated as a part of this master planning effort.

The population of Mapleton City was projected through 2050 using the small area/city population projections provided by the Mountainland Association of Governments (2019). The Mapleton City Planning Department indicated these growth rates are likely underestimated but accepted their usage for this report. If the growth rate continues at the recent rapid pace, the timeline of future projects will be accelerated, but the general nature of the projects is not anticipated to change unless the City's general plan or zoning changes. Historic and projected population through 2050 is shown on Figure 2-1.

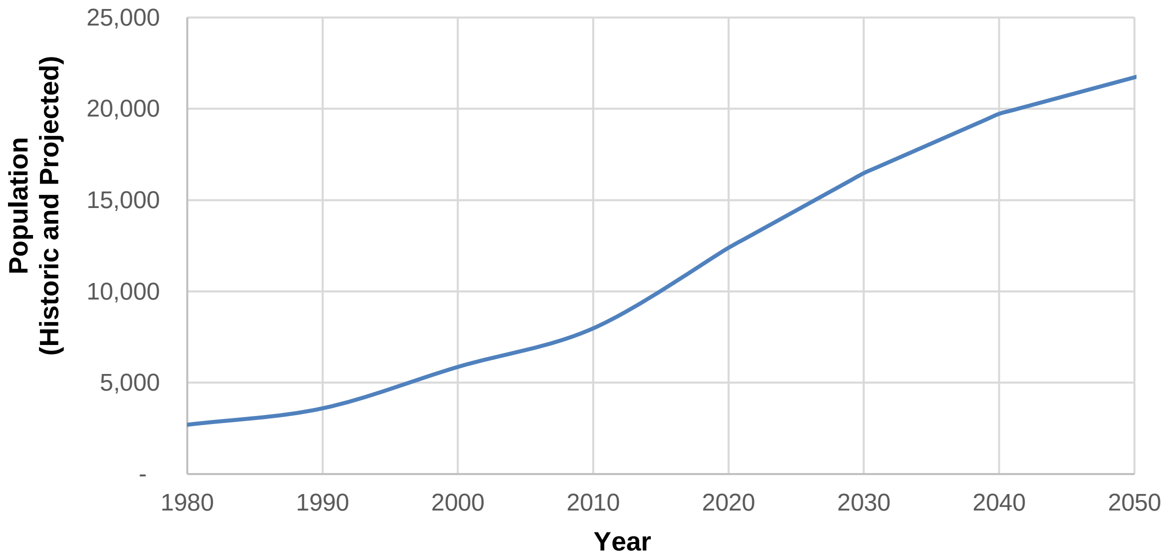


Figure 2-1: Mapleton Historic and Projected Population

With the current rate of growth, the City anticipates that nearly all of the developable residential land within the City boundary will be developed within the next 20 to 40 years. Population growth is expected to continue beyond 40 years as infill developments are constructed.

EXISTING AND FUTURE CONNECTIONS

Mapleton City meters customer usage on a monthly basis and bills customers according to actual water use. Water billing data points were used to characterize the existing indoor water usage (number of ERCs) in each pressure zone. Aerial infrared imagery for the City was analyzed to determine the total irrigated acreage and average percent irrigated area per residential lot in the pressurized irrigation system (see Appendix C). Because the utility billing rates for water in the drinking water and pressurized irrigation systems is similar, it was assumed that customers utilizing the drinking water system for outdoor watering will use similar amounts of water for outdoor uses as customers utilizing the pressurized irrigation system. Irrigated acreage in the drinking water system was determined by multiplying the average percent irrigated area by the number of existing ERCs using the drinking water system for outdoor watering.

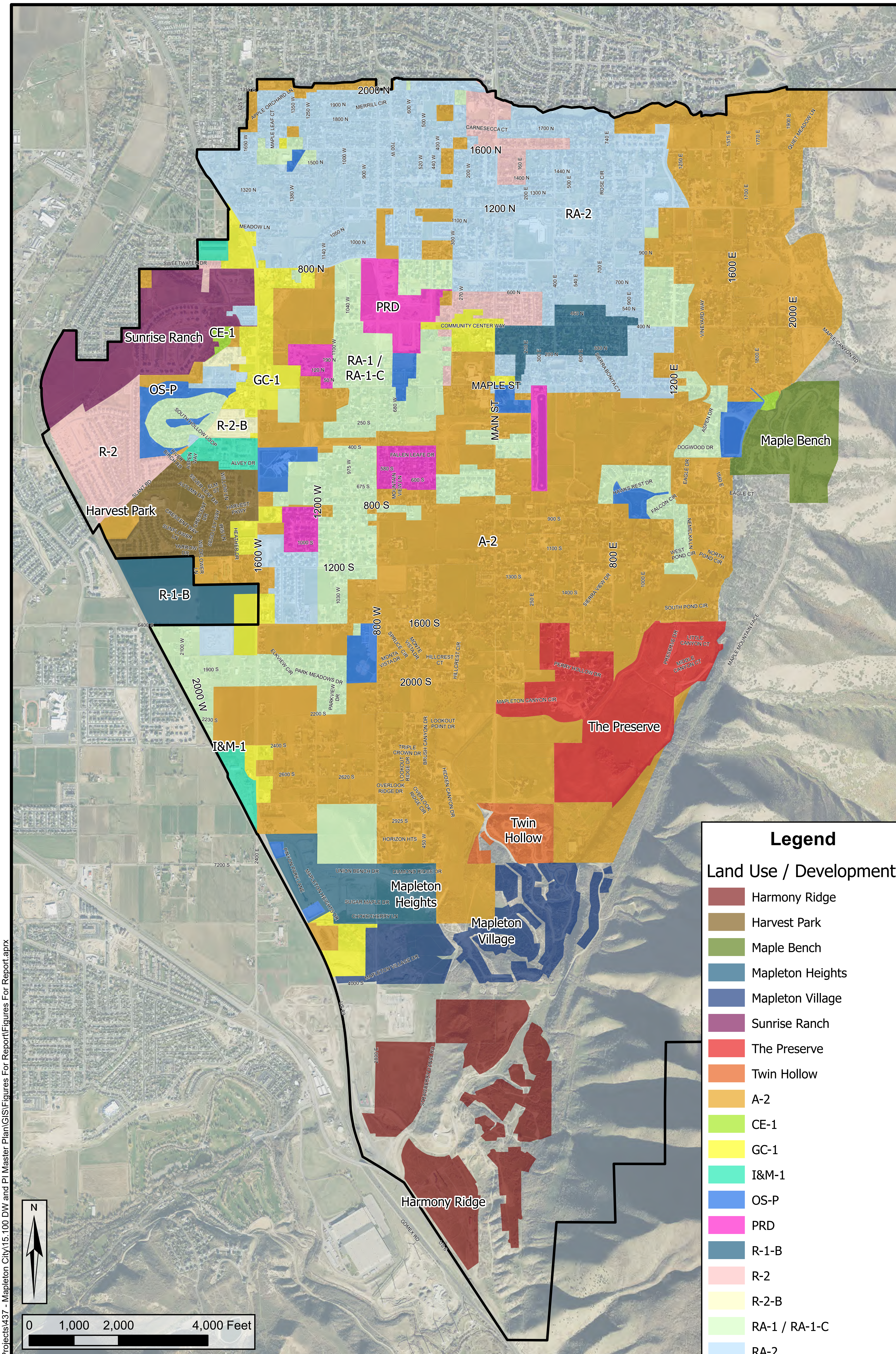
Planned future water usage intensities for indoor and outdoor usage, listed in Table 2-1, were developed for the various planned land uses using the City's zoning densities and development plans for specific developments. These water usage intensities were used to forecast the number of future ERCs and future irrigated acreage served by the drinking water system and pressurized irrigation system respectively.

Table 2-1
Planned Future Water Usage Intensity[1]

Land Use Category	ERCs per Acre	Percent Irrigated
Mapleton Village	3.4	50%
Mapleton Heights	2.7	50%
Twin Hollow	1.2	50%
The Preserve	0.4	50%
Harmony Ridge	4.6	50%
Sunrise Ranch	3.2	50%
Harvest Park	4.4	50%
Maple Bench	0.6	50%
A-2	0.5	50%
CE-1[2]	0.0	0%
GC-1[3]	4.0	20%
I&M-1[3]	4.0	20%
OS-P	1.4	50%
PRD	1.4	50%
R-1-B	3.0	50%
R-2	4.4	50%
R-2-B	4.3	50%
RA-1 / RA-1-C	1.0	50%
RA-2	3.0	50%

1. Townhomes and condos are equivalent to 0.85 of an ERC.
2. There are 70 transferable development right credits (TDR-S) originating from the CE-1 zone remaining to be allocated through the remainder of the city. These credits are accounted for in future development calculations.
3. It was determined through discussions with the City to use 4 ERCs per acre and 20% irrigated for commercial and industrial land uses.

Planned land uses are shown in Figure 2-2. The gross area of the planned land uses was used to forecast the number of ERCs and irrigated area at buildout. The City anticipates that at buildout, 10% of residents will use the drinking water system for irrigation even if the pressurized irrigation system is available. In addition, the pressurized irrigation system is not planned to serve the Maple



HANSEN ALLEN & LUCE INC ENGINEERS

MAPLETON CITY
WATER MASTER PLAN

SYSTEM GROWTH
PLANNED LAND USES

FIGURE
2-1

Date: 7/29/2024
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Bench development. Accordingly, irrigated area for the drinking water system was forecasted to capture these irrigation demands assumed to persist on this system. This master plan assumes that all other customers using the drinking water system for outdoor irrigation will transfer their outdoor usage to the pressurized irrigation system. The existing and future numbers of ERCs and existing and future irrigated area are shown in Table 2-2 and Table 2-3 respectively. Data used to calculate existing ERCs are included in Appendix B along with water usage and connection data. Calculations for future development are included in Appendix D.

Table 2-2
Existing and Future ERCs

Zone	Existing ERCs	Future ERCs
Zone 1	3,266	8,929
Zone 2	180	1,137
Zone 3	1	508
Quiet Meadows	19	-
Total	**3,466**	**10,574**

Table 2-3
Existing and Future Irrigated Area

	Zone	Existing Irrigated Area (ac)	Future Irrigated Area (ac)
Drinking Water	Zone 1	427	152
	Zone 2	51	43
	Zone 3	0	6
	Quiet Meadows*	4	-
	Total	**482**	**201**
Pressurized Irrigation	Zone 1	533	1367
	Zone 2	-	387
	Zone 3	-	50
	Quiet Meadows	-	-
	Total	**533**	**1,803**

While growth projections are an important component of this master plan, it should be noted that system capacity is dependent on the source, storage, and distribution requirements needed to serve approved ERCs and irrigated acreage in the system. Depending on actual growth, infrastructure improvements may be needed sooner or later than projected in this plan. Timing for capital improvement projects should be determined based on the development that occurs in the system, rather than target dates which are not known with certainty.

CHAPTER 3 WATER SOURCES AND DEMAND

This chapter presents an overview of existing and future source requirements and makes recommendations that will help the City meet these requirements as it grows.

EXISTING WATER SOURCES

The Mapleton drinking water system currently has four wells and several springs that provide the system with a total reliable peak day capacity of 6,425 gpm and an annual source capacity of 9,320 acre-feet per year. The Mapleton pressurized irrigation system currently has three wells and three active turnouts that provide the system with a total reliable peak day capacity of 4,920 gpm and an annual source capacity of 3,920 acre-feet per year. A summary of the capacity of these sources is shown in Table 3-1.

Table 3-1
Existing System Source Capacity

Source		Pressure Zone	Peak Day Capacity (gpm)	DDW Safe Yield (gpm)[1]	Annual Source Capacity (ac-ft)[2,4]
Drinking Water	Carnesecca Well	Zone 1	1,125	1,125	1,630
	Seal Well	Zone 1	1,800	1,800	2,610
	Westwood Well	Zone 1	1,950	1,200	2,830
	Crowd Canyon Well	Zone 3	1,550	1,667	2,250
	Springs[5]	Zone 3	0	0	0
	Total		**6,425**	**5,792**	**9,320[3]**
Pressurized Irrigation	Well 1[6]	Zone 1	770	-	610
	Orton Well	Zone 1	160	-	130
	R3 Well	Zone 1	40	-	30
	1600 North Turnout	Zone 1	1,000	-	800
	Dogwood Turnout	Zone 1	2,000	-	1,590
	Main St. Turnout	Zone 1	950	-	760
	Total		**4,920**	-	**3,920**

1. Safe yield is shown according to Division of Drinking Water records for drinking water sources.
2. The annual capacity of the drinking water wells is assumed to be equal to the amount of water that would be pumped if the well flows at its peak day capacity for 90% of the year.
3. This total volume is not available in the aquifer. See the Mapleton City Water Rights Master Plan (2022) for more information.
4. The annual capacity of the pressurized irrigation wells and turnouts is assumed to be equal to the amount of water that would be available if the sources flow at their peak day capacity for 180 days each year.
5. The springs group includes Service Berry, Mapleton City, Unnamed A & B, and Dunham 1, 2, & 3 springs. The springs are currently undergoing rehabilitation, resulting in an unknown capacity.
6. Well 1 may produce 1,000-1,300 gpm when the PI pond pumps are not running. This flow can be used to fill the PI pond in the spring before the system begins operation.

The reliable peak day capacity of each well was determined based on metered flow records and discussions with Mapleton City operators. The safe yield for the wells is shown according to flow rates on record with the Division of Drinking Water for drinking water sources. Utah Administrative Code R309-515 indicates that the reliable yield of a spring is typically set at the 25th percentile of available spring flow data; however, the City springs have not been used for several years and are currently undergoing rehabilitation. Consequently, the reliable flow rate for the springs is unknown and is considered to be zero for this report.

It is noted that the aquifer cannot provide the volumes shown for Annual Source Capacity in the drinking water system and pressurized irrigation wells. Modeling of the aquifer predicts an annual safe yield of 4,700 acre-feet, though this may be conservative. The historical beneficial use within the City's boundaries is approximately 5,200 acre-feet. The volume produced from city wells and springs should be restricted to approximately 4,700-5,200 acre-feet annually and the aquifer monitored for signs of excessive withdrawal (see Mapleton City Water Rights Master Plan [HAL, 2022] for more information).

Currently, the pressurized irrigation turnouts on the CUWCD Mapleton Springville Pipeline are not active in the early spring when Mapleton begins operating the pressurized irrigation system. The turnouts become available when CUWCD begins operating the Diamond Fork system, typically in May or June. In 2022 and 2023 these turnouts became available the second week of May. This leaves approximately one month (April 15 – May 15) where it is anticipated Mapleton will operate the pressurized irrigation system without the turnouts. It is possible that the turnouts could be activated later in the year, though this is expected to occur only when precipitation has been sufficient for growth of crops and warrants a later start date. As agricultural activity in the area decreases, CUWCD may begin to provide municipal water through the Diamond Fork system, and it is possible that the Mapleton Springville Pipeline and turnouts will be active earlier in the year or may be available year-round.

Condition of Existing Source Facilities

All the City's wells were drilled between 1950 and 1980, with the exception of Crowd Canyon Well which was drilled in 2007. Periodic maintenance and upgrades have been performed on these wells to keep them in service. It is anticipated that the wells will need continued proactive maintenance due to their age and that, in the coming years, several of these wells will reach the end of their useful life and require full replacement.

Drinking Water System

- **Carnesecca Well –** Carnesecca Well is in good condition and reliably produces good quality water. The well should be regularly tested and maintained to provide continued service.
- **Seal Well –** In 2018, Seal Well was retrofitted with a new pump to increase production capacity. A chlorination system was added in 2023 to mitigate water quality issues. Seal Well may need additional rehabilitation in the near future to further mitigate water quality issues and increase capacity.
- **Westwood Well –** Westwood Well produces reliable flow, but the water has high levels of manganese. The City is planning a project to reduce the manganese levels in this well that will be implemented in the near future.

Pressurized Irrigation System

- **Well 1 –** Well 1 is in good condition and reliably produces flow. However, the pump on the well is undersized for the system, causing the flow to decrease whenever pressures in the system rise.
- **Orton Well –** Orton Well is a smaller well but is in good condition and produces reliable flow. It is anticipated that this well will eventually be removed from the pressurized irrigation system.
- **R3 Well –** R3 Well is a smaller well but is in good condition and produces reliable flow. It is anticipated that this well will eventually be removed from the pressurized irrigation system.

Springs/Mapleton Canyon Runoff

The springs in Mapleton Canyon were the original source for the drinking water system and include Service Berry, Mapleton City, Unnamed A & B, and Dunham 1, 2, & 3 springs. The springs were most recently refurbished in the 1980s and produce a variable amount annually (see the Mapleton City Water Rights Master Plan for an analysis of spring flow.)

In 2021, the Springs were taken out of commission due to contamination. An extensive rehabilitation project is underway, with an expected completion date in 2024. It is anticipated that the rehabilitation project will eliminate the water quality issues and improve the capacity of the Springs.

During years with high runoff, the PI Pond can be filled with runoff from Mapleton Canyon. This is an excellent source of water for the pressurized irrigation system as there is no cost associated with delivering the water to the PI Pond. It is recommended that the City capitalize on this source of water by completing projects that increase the transmission from Mapleton Canyon to the PI Pond and adding a meter to track the amount of runoff that is delivered to the pond.

Pump Stations

The pump stations in the systems provide source from one portion of the system to another. The booster pumps in the drinking water system are located in two vaults near the mouth of Mapleton Canyon and move water from Zone 1 to Zone 3. The PI Pond Pumps are located at the pump station east of the pressurized irrigation pond and move water from the PI Pond to Zone 1 in the pressurized irrigation system. The City pump stations are summarized in Table 3-2.

Table 3-2
Existing Drinking Water Pump Stations

System	Name	From	To	Pumps	Rated Capacity (gpm)	VFD
Drinking Water	Booster Pumps	Zone 1	Zone 3	2[1]	1,200	No
Pressurized Irrigation	PI Pond Pumps	PI Pond	Zone 1	2	5,500	Yes

1. Only one pump is operated at a time.

EXISTING WATER SOURCE DEMAND

In 2018, House Bill 303 amended Title 19, Chapter 4 of the Utah Code (the Safe Drinking Water Act). Section 19-4-114 of the code directs the DDW to establish system-specific water source and storage minimum sizing requirements (rather than prescribing statewide sizing standards) based on at least three years of actual water use data and/or an engineering study. Minimum sizing calculations meeting the requirements of the DDW (based on reported data) are included in Appendix A. The intent of this master plan is to meet the requirements of an engineering study for system-specific sizing.

In addition to the DDW sizing standards, additional data were evaluated to differentiate indoor and outdoor water uses and provide additional insight into water use patterns in Mapleton City. Level of service (LOS) requirements were calculated based on available data and standard engineering principles as described in this section.

Peak Day

The drinking water system LOS for Peak Day Demand was determined as follows:

1. The City's drinking water billing database was analyzed to determine patterns of residential water use. Looking at water usage of residential connections with access to the pressurized irrigation system showed that at least a portion of these connections still utilized the drinking water system for outdoor irrigation. It was determined that average water usage during winter months would be more representative of indoor usage.
2. The City's drinking water billing database was analyzed to determine indoor water usage. During the peak year, it was found that residential connections were billed an average of **258 gpd (billed use)** of water during the winter months.
3. Water production and sales data for the years 2020 through 2022 were reviewed to investigate water loss in the system. Water losses between 23% and 29% were observed. Billed winter month usage was scaled up by the calculated yearly water loss to appropriately characterize the water production requirement. This produced a level of service requirement of **350 gpd / ERC (production requirement)**.
4. The monthly production requirement was scaled up by approximately 30%, including 20% to characterize the difference between peak month demand and peak day demand, and a 10% factor of safety. This produced a LOS requirement of **500 gpd / ERC (production requirement, peak day)**.
5. A group of 78 townhomes in the Harvest Park subdivision was analyzed to determine if townhome water usage differs from single family detached residences. It was determined that **a factor of 0.85 is appropriate to apply for indoor usage of multi-family residences**. It is recommended that this factor be applied to the number of ERCs, rather than applying it to the peak day production requirement.

The pressurized irrigation LOS for Peak Day Demand was determined as follows:

1. 2021 aerial and infrared imagery over the City were used to determine areas with vegetation likely irrigated by the pressurized irrigation system. These areas were then used to determine that, on average, 36% of a residential lot is irrigated.
2. The City's pressurized irrigation billing database was analyzed to determine outdoor water usage. During the peak month for the year 2021, it was found that residential connections were billed an average of **1.1 ac-ft / irr-ac (billed use, peak month)**, which equates to an average peak month flow of **7.8 gpm / irr-ac (billed use, peak month)**.
3. Water production and water billing data from the pressurized irrigation system for the year 2021 were analyzed to determine the ratio of peak month billed use to peak day flow produced. Increasing the average peak month flow by the resulting 17% increase between peak month billed use and peak day flow produced accounts for water losses in the system and a factor to characterize the difference between peak month demand and peak day

demand, and results in a LOS requirement of **9.1 gpm / irr-ac (production requirement, peak month)**.

4. To maintain consistency with the current city code, the City elected to select an allowable **50%** irrigated acreage instead of the observed 36%. Adjusting the LOS for the selected allowable irrigated acreage results in a LOS of **6.6 gpm / irr-ac (production requirement, peak day)**.

Average Year

Billing and production data were analyzed to determine typical annual water production requirements for indoor and outdoor uses in Mapleton.

The LOS for Average Yearly Demand was determined as follows:

1. The City's drinking water billing database was analyzed to determine patterns of residential water use. Usage during the winter months was used to predict annual indoor uses. It was found that residential connections had an average yearly bill of **0.23 ac-ft / ERC (billed use, average yearly)**.
2. Water production and billing data for the years 2020 through 2022 were reviewed to investigate water loss in the system. Water losses between 23% and 29% were observed. Billed usage was scaled up by the calculated yearly water loss to appropriately characterize the water production requirement. This produced a LOS requirement of **0.30 ac-ft / ERC (production requirement, average yearly)**.
3. A safety factor of approximately 17% was applied to the level of service to help the City be prepared for years of unusually high water use. This factor of safety was selected as it represented the variation observed between the lowest water usage year and the highest water usage year. This produced a level of service requirement of **0.35 ac-ft / ERC (production requirement, average yearly)**.
4. A group of 78 townhomes in the Harvest Park subdivision was analyzed to determine if townhome water usage differs from single family detached residences. It was determined that **a factor of 0.85 is appropriate to apply for indoor usage of multi-family residences**. It is recommended that this factor be applied to the number of ERCs, rather than applying it to the annual production requirement.

The pressurized irrigation LOS for Average Yearly Demand was determined as follows:

1. 2021 aerial and infrared imagery over the City were used to determine areas with vegetation likely irrigated by the pressurized irrigation system. These areas were then used to determine that, on average, 36% of a residential lot is irrigated.
2. The City's pressurized irrigation billing database was analyzed to determine outdoor water usage. For the year 2021, it was found that residential connections were billed an average of **3.72 ac-ft / irr-ac (billed use, average yearly)**.
3. Water production and billing data for the years 2020 through 2022 were reviewed to investigate water loss in the system. Water losses between 1% and 20% were observed. Billed usage was scaled up by 20% to appropriately characterize the water production requirement. The observed water loss of 20% was considered excessive when compared to water losses observed during subsequent years. Accordingly, an additional factor of safety was not added. This resulted in a LOS requirement of **4.47 ac-ft / irr-ac (production requirement, average yearly)**.
4. To maintain consistency with the current city code, the City elected to select an allowable **50%** irrigated acreage instead of the observed 36%. Adjusting the LOS for the selected

allowable irrigated acreage results in a LOS of **3.2 ac-ft / irr-ac (production requirement, average yearly)**.

A summary of the source level of service requirements is shown in Table 3-3.

Table 3-3
Mapleton City Water System Level of Service

Standard	Drinking Water System (Indoor Use)	Pressurized Irrigation System (Outdoor Use)
Peak Day Demand	500 gpd / ERC	6.6 gpm / irr-ac
Average Yearly Demand	0.35 ac-ft / ERC	3.2 ac-ft / irr-ac

EXISTING WATER SOURCE REQUIREMENTS

According to DDW standards (Section R309-510-7), water sources must be able to meet both the expected water demand on the peak day (flow requirement) and the average demand over the course of one year (volume requirement). The existing sources in the drinking water and pressurized irrigation systems have sufficient capacity to meet peak day annual requirements, as demonstrated in the following sections.

Existing Peak Day Demand

Peak day demand is the water demand on the day of the year with the highest water use. For the drinking water system peak day demand must be considered for both indoor uses and irrigated acreage served by the drinking water system. Table 3-4 shows the computed peak day demand by pressure zone.

Table 3-4
Existing LOS Peak Day Demand by Pressure Zone

	Pressure Zone	ERCs	Irrigated Acres[1]	Existing LOS Demand (gpm)
Drinking Water	Zone 1	3,266	427	3,950
	Zone 2	180	51	400
	Zone 3	1	0	0.3
	Quiet Meadows	19	4	33
	Total	**3,466**	**482**	**4,380**
Pressurized Irrigation	Zone 1	**-**	533	3,520
	Zone 2	**-**	-	**-**
	Zone 3	**-**	-	**-**
	Quiet Meadows	**-**	-	**-**
	Total	**-**	**533**	**3,520**

1. The pressurized irrigation (outdoor use) LOS is applied to all irrigated acreage in the drinking water and pressurized irrigation systems.

In the drinking water system, the City has three wells that pump directly into Zone 1 and one well that pumps into Zone 3. There is one booster pump station that pumps water from Zone 1 to Zone 3. The Quiet Meadows zone and Zone 2 are fed entirely by PRVs. There are three tanks located in Zone 3 and one functional tank in Zone 1. In the pressurized irrigation system, the City has three wells that pump directly into Zone 1 and a pump station that pumps out of the PI Pond into Zone 1. Table 3-5 lists the existing peak day system capacity by pressure zone.

Table 3-5
Existing Peak Day Capacity by Pressure Zone

<table>
<tr><th></th><th>Pressure Zone</th><th>Sources (gpm)</th><th>Pump Station Rated Capacity (gpm)</th><th>Peak Day Demand (gpm)</th><th>Surplus (+) or Deficit (−) (gpm)</th></tr>
<tr><td rowspan="5">Drinking Water</td><td>Zone 1</td><td>4,875</td><td>-</td><td>3,950</td><td>925</td></tr>
<tr><td>Zone 2</td><td>-</td><td>-</td><td>400</td><td>-[2]</td></tr>
<tr><td>Zone 3</td><td>1,550</td><td>1,200</td><td>433[1]</td><td>2,320</td></tr>
<tr><td>Quiet Meadows</td><td>-</td><td>-</td><td>33</td><td>-[2]</td></tr>
<tr><td>Total</td><td>6,425</td><td>-</td><td>4,380</td><td>2,045</td></tr>
<tr><td rowspan="6">Pressurized Irrigation</td><td>Zone 1</td><td>4,920</td><td>5,500</td><td>3,520[3]</td><td>6,900[3]</td></tr>
<tr><td>Zone 2</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Zone 3</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Quiet Meadows</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">Total</td><td>4,920</td><td>5,500</td><td rowspan="2">3,520</td><td rowspan="2">6,900</td></tr>
<tr><td colspan="2">10,420</td></tr>
</table>

1. The peak day demand for Zone 3 is 1 gpm. The table value includes the demand for zones fed solely by PRVs from Zone 3 (Zone 2 and Quiet Meadows Zone).
2. Fed solely by PRVs.

The drinking water and pressurized irrigation systems have sufficient capacity to meet peak day demand. Peak day demand represents the average flow on the peak day. In addition to peak day demand, it is important to consider peak instantaneous demand, the highest flow rate required on the peak day. In the drinking water system, storage provides the increased flow required in the system during these conditions. The pressurized irrigation system does not have any storage that feeds into the system by gravity. Peak instantaneous demand in the pressurized irrigation system is 5,980 gpm. The combined capacity of the wells, turnouts, and pump station is 10,420 gpm and is sufficient to meet this demand, leaving an excess peak instantaneous capacity of 4,440 gpm.

Existing Average Yearly Demand

Average yearly demand is the water demand required to operate the water system for one year. For the drinking water system average yearly demand must be considered for both indoor uses and outdoor uses. Table 3-6 shows the computed average yearly demand by pressure zone

Table 3-6
Existing LOS Average Yearly Demand

	Pressure Zone	ERCs	Irrigated Acres[1]	Existing LOS Demand (ac-ft)
Drinking Water	Zone 1	3,266	427	2,510
	Zone 2	180	51	230
	Zone 3	1	0	0.35
	Quiet Meadows	19	4	19
	Total	**3,466**	**482**	**2,760**
Pressurized Irrigation	Zone 1	-	533	1,710
	Zone 2	-	-	-
	Zone 3	-	-	-
	Quiet Meadows	-	-	-
	Total	**-**	**533**	**1,710**

1. The pressurized irrigation (outdoor use) LOS is applied to all irrigated acreage in the drinking water and pressurized irrigation systems.

The existing source capacity by pressure zone is summarized in Table 3-7.

Table 3-7
Existing Annual Source Capacity by Pressure Zone

	Pressure Zone	Sources (ac-ft)	Annual Demand (ac-ft)	Surplus (+) or Deficit (−) (ac-ft)
Drinking Water	Zone 1	7,070	2,510	4,560
	Zone 2	-	230	-[2]
	Zone 3	2,250	250[1]	2,000
	Quiet Meadows	-	19	-[2]
	Total	**9,320**	**2,760**	**6,560**
Pressurized Irrigation	Zone 1	3,920	1,710	2,210
	Zone 2	-	-	-
	Zone 3	-	-	-
	Quiet Meadows	-	-	-
	Total	**3,920**	**1,710**	**2,210**

1. The annual demand for Zone 3 is < 1 acre-foot. The table value includes the demand for zones fed solely by PRVs from Zone 3 (Zone 2 and Quiet Meadows Zone).
2. Fed solely by PRVs.

The drinking water and pressurized irrigation systems have capacity to meet the existing annual demand.

WATER RIGHTS

The City's existing water rights are sufficient to provide the required annual demands in the drinking water and pressurized irrigation systems. As noted above, the volume produced from city wells and springs should be restricted to approximately 4,700-5,200 acre-feet annually and the aquifer monitored for signs of excessive withdrawal. Refer to the Mapleton City Water Rights Master Plan & 40-Year Plan (HAL, 2022) for more information.

NON-REVENUE WATER

The cost to maintain and operate a water system is substantial. A portion of the cost is recouped from the customers. However, based on the City's production and billing data, 15% to 26% of the water produced in the drinking water is not billed to a customer and does not produce revenue. A portion of this non-revenue water is used to water City parks or provide drinking water to City buildings. The remainder of this non-revenue water is due to real losses in the system (leakage and overflows), metering or data handling inaccuracies, or unauthorized consumption. It is recommended that the City perform an AWWA Water Audit to evaluate non-revenue water and determine methods to reduce it. It is also recommended that meters be added to City parks and buildings to better track water usage.

Every water system experiences water loss between production at the water source and delivery to the customer. Most of the water lost is due to leaks. The volume of water lost is dependent on the age and condition of the water system. To minimize the amount of water lost due to leaks, it is recommended that the City commission a leak detection and repair study to identify pipes at risk of failure and reduce non-revenue water.

DRINKING WATER SYSTEM SOURCE REDUNDANCY

At times, water sources fail to produce the peak day or annual volumes necessary. Possible reasons for this include contamination, drought, decreasing groundwater levels, pump failure, etc. For this reason, it is recommended that source redundancy be considered. To ensure redundancy in the drinking water system, if any water source is out of commission, the peak day level of service should be able to be met. The largest source in the drinking water system is Westwood Well with a capacity of 1,950 gpm. Redundancy is not considered for the pressurized irrigation system because it is not a critical system.

Existing Source Redundancy

A comparison of supply and demand in the Mapleton systems if Westwood was taken out of service on a peak day is summarized in Table 3-8.

Table 3-8
Peak Day Supply and Demand, Assuming Source Failure

System	ERCs	Irrigated Acres	Demand (gpm)	Supply (gpm)	Surplus (+) or Deficit (−) (gpm)
Drinking Water	3,466	482	4,380	4,475	95

The drinking water system has capacity to meet existing peak day demand with Westwood Well out of service. Storage will provide the increased flow required in the system during peak instantaneous conditions.

Emergency Interconnections

Mapleton City currently has no emergency interconnections with other water providers or municipalities. It is recommended that Mapleton strategically pursue system interconnections with Spanish Fork City and Springville City if opportunities arise. This will allow the Mapleton City systems increased flexibility during times of source failure.

FUTURE WATER SOURCE REQUIREMENTS

As with existing water source requirements, future water source requirements were evaluated on criteria for both peak day and average yearly demand (Section R309-510-7).

Future Peak Day Demand

Following the methodology described for existing conditions, the future peak day source requirement was calculated for each pressure zone. The peak day source requirement for each pressure zone is shown in Table 3-9.

Table 3-9
Future Peak Day Demand by Pressure Zone

	Pressure Zone[1]	ERCs	Irrigated Acres[2]	Future LOS Demand (gpm)
Drinking Water	Zone 1	8,929	152	4,100
	Zone 2	1,137	43	680
	Zone 3	508	6	220
	Total	**10,574**	**200**	**4,990**
Pressurized Irrigation	Zone 1	-	1367	9,020
	Zone 2	-	385	2,540
	Zone 3	-	50	330
	Total	**-**	**1803**	**11,890**

1. It is assumed that the Quiet Meadow zone will be combined with Zone 2 in the future.
2. The pressurized irrigation (outdoor use) LOS is applied to all irrigated acreage in the drinking water and pressurized irrigation systems.
3. The R3 and Orton wells are planned to be removed from the City's pressurized irrigation system. The table excludes these two sources.

Comparing the future peak day demands to the existing system capacities for both the drinking water and pressurized irrigation systems, as shown in Table 3-10, provides the surplus or deficit that can be expected if no additional sources are added to the systems.

Table 3-10
Future Peak Day Capacity by Pressure Zone

	Pressure Zone	Sources (gpm)	Pump Station Rated Capacity (gpm)	Peak Day Demand (gpm)	Surplus (+) or Deficit (−) (gpm)
Drinking Water	Zone 1	4,875	-	4,100	775
	Zone 2	-	-	680	-[2]
	Zone 3	1,550	1,200	900[1]	1,850
	Total	**6,425**	**-**	**4,990**	**1,435**
Pressurized Irrigation	Zone 1	4,720	5,500	9,020[3]	1,200[3]
	Zone 2	**-**	-	2,550	-2,550
	Zone 3	**-**	-	330	-330
	Total	**4,720**	**5,500**	**11,900**	**-1,680**
		10,220			

1. The peak day demand for Zone 3 is 220 gpm. The table value includes the demand for zones fed solely by PRVs from Zone 3 (Zone 2).
2. Fed solely by PRVs.

In the drinking water system, there is sufficient capacity to meet future peak day demand. However, if the largest source (Westwood Well) were out of service, there would not be enough capacity to meet the demand. Several additional sources are necessary in the pressurized irrigation system to meet future peak day demand.

Future Average Yearly Demand

Following the methodology described for existing conditions, the future average yearly source requirement was calculated for each pressure zone. The average yearly source requirement for the system is shown in Table 3-11.

Table 3-11
Future Average Yearly Demand

	Pressure Zone	ERCs	Irrigated Acres	Future LOS Demand (ac-ft)
Drinking Water	Zone 1	8,929	152	3,610
	Zone 2	1,137	43	540
	Zone 3	508	6	200
	Total	**10,574**	**200**	**4,340**
Pressurized Irrigation	Zone 1	-	1,367	4,370
	Zone 2	-	385	1,230
	Zone 3	-	50	160
	Total	**-**	**1,802**	**5,770**

Table 3-12
Future Annual Source Capacity by Pressure Zone

	Pressure Zone	Sources (ac-ft)	Annual Demand (ac-ft)	Surplus (+) or Deficit (−) (ac-ft)
Drinking Water	Zone 1	7,070	3,610	3,460
	Zone 2	-	540	-[2]
	Zone 3	2,250	740[1]	1,510
	Total	**9,320**	**4,350**	**4,980**
Pressurized Irrigation	Zone 1	3,760[3]	4,370	-620
	Zone 2	**-**	1,240	-1,240
	Zone 3	**-**	160	-160
	Total	**3,760**	**5,770**	**-2,010**

1. The annual demand for Zone 3 is 200 acre-feet. The table value includes the demand for zones fed solely by PRVs from Zone 3 (Zone 2).
2. Fed solely by PRVs.
3. The R3 and Orton wells are planned to be removed from the City's pressurized irrigation system. The table excludes these two sources.

The system sources are adequate in the drinking water system to meet the future average yearly demand. Several additional sources are necessary in the pressurized irrigation system to meet future average yearly demand.

PLANNED SOURCES

Drinking Water System

The springs rehabilitation project is expected to be completed by Fall 2024 and is expected to add additional source capacity to the drinking water system. The springs will feed directly into the Upper Tanks and it is anticipated that they will provide more than 1,000 gpm of flow. This source will be available to all pressure zones in the system and will reduce the system's reliance on using the booster pumps to pump water from Zone 1 to the Upper Tanks.

Pressurized Irrigation System

Most of the water for the pressurized irrigation system comes from the CUWCD Mapleton Springville Pipeline. Two additional turnouts have been constructed (Turnout 3 in the Harmony Ridge subdivision and Turnout 4 in the Mapleton Village subdivision) and will be activated as soon as the developments to which they are connected are complete. A high-pressure turnout is under construction at the south end of the City. This turnout will connect to the CUWCD Spanish Fork Canyon Pipeline and provide water for all three pressure zones across the south end of the City. These three turnouts are expected to provide sufficient peak day and annual source supply for future needs. Additional turnouts may be added to the system to provide operational flexibility and redundancy.

SOURCE - CONCLUSIONS

Key conclusions from this analysis are as follows:

1. Additional source will be required in the drinking water system beyond the planned sources to provide sufficient capacity with the largest source out of service.
2. Additional turnout connections beyond the planned projects are recommended in the pressurized irrigation system to provide operational flexibility and redundancy.
3. Demand in the drinking water and pressurized irrigation systems should be closely tracked to ensure that demand never exceeds the available source capacity.

SOURCE OPTIONS AND RECOMMENDATIONS

Several possible approaches to provide adequate water supply and redundancy for future conditions were investigated and evaluated. This section summarizes the evaluation of various alternatives and recommendations for action.

Drinking Water System Interconnections

The possibility of constructing an interconnection with another city to provide emergency source was investigated. At this time, the City elected not to pursue this option. It is recommended that Mapleton strategically pursue system interconnections with Spanish Fork City and Springville City if opportunities arise.

- Springville City's drinking water pressure zones are at lower head than Mapleton City pressure zones at common locations. Interconnections with Springville City can provide water to Springville but will not be able to supply water to Mapleton except in a severe emergency where Mapleton tanks and sources are supplying no water to the system.
- Spanish Fork City's Cold Springs pressure zone has sufficient head to supply Mapleton City's drinking water Zone 1 along Highway 89 south of Mapleton 3000 South (County 7200 South). Mapleton's Zone 1 has sufficient head to supply Spanish Fork's central pressure zone north of this location. It is unknown if Spanish Fork's system has sufficient water supply to allow an emergency connection to Mapleton.

Drinking Water Wells

- Pumping data from Seal Well indicates that the aquifer from which it draws could provide additional flow. Seal Well was constructed without a grout seal which may contribute to water quality concerns in the well. It is recommended that Seal Well be rehabilitated or reconstructed to provide additional source capacity and mitigate water quality concerns. Reconstructing Seal Well could provide an excellent opportunity to add additional source to the system. However, it is unlikely that the additional source provided would provide all the source needed to meet future demand with the City's largest well out of service.
- Other existing wells may need to be reconstructed in the future as they reach the end of their useful life.
- A new well could be constructed in a new location. Based on the water from existing wells, water quality seems to be best at the north end of the City and worsens towards the south. A well siting study should be performed before a location is selected.
- For all these options, it is recommended that the distribution system be evaluated using the hydraulic model. Depending on the quantity of water from a new well, an additional

transmission main may be required to convey the flow to the system. Specific needs will vary depending on the site of the well.

Drinking Water Pump Stations

- Additional future pump stations are not recommended. The existing booster pumps (one pump in each of two vaults) near the mouth of Mapleton Canyon are expected to be adequate for future needs as long as they are maintained properly and sources in Zone 3 (Crowd Canyon well and the Mapleton Canyon Springs) continue to produce sufficient flow rates and volumes for future needs.
- When the booster pump vaults reach the end of their useful life, it is recommended that an above-ground pump station be constructed to replace them. At that time, it is recommended that the system be evaluated to determine if separate pumps should be provided to pump to Zone 2 and Zone 3. It is expected that if the springs produce sufficient water, separate booster pumps for each zone would be unnecessary.

Pressurized Irrigation Turnouts

- The existing and planned turnouts are expected to provide sufficient source for future needs. These are listed in Table 3-13.
- Additional turnouts may be added to the system to provide operational flexibility and redundancy.
- Recommended locations include east of Triple Crown subdivision (Turnout 7) 1600 South (Turnout 10), and 400 North (currently used by Mapleton Irrigation Company) or 1200 North. Several other turnout locations are available and should be evaluated when development extends near them or if the irrigation company discontinues using them.

Table 3-13
Existing and Future Turnouts for the Pressurized Irrigation System

Name	Location	Status
1600 North	Mapleton Lateral Canal and 1600 North	Active
Dogwood	Mapleton Lateral Canal and 400 South	Active
Main Street	Mapleton Lateral Canal and Main Street	Active
Turnout 4	Mapleton Lateral Canal and 7600 South	Under Construction
Turnout 3	Mapleton Lateral Canal near Heartwood Road	Under Construction
High Pressure Turnout	Near Highway 89 and Harmony Ridge Parkway	Under Construction

Water Conservation

A continued focus on water conservation is recommended for the following reasons:

- The Utah DDW periodically reviews water use data and issues system-specific sizing requirements based on actual water use data. If sustained water conservation can be demonstrated, the City's sizing requirements can be reduced, which would allow the City to extend the capacity of existing sources and storage tanks and delay or eliminate the need for future capital projects.

- If future water usage exceeds the estimates in this analysis, additional sources and other capital projects may be required.
- The CUWCD pressurized irrigation turnouts are not available in the early spring. The pressurized irrigation system will be required to operate with very low source capacity, relying on the stored volume in the PI pond during these conditions. The system will operate best under low demands when these turnouts are not available.
- CUWCD has considered the possibility of providing water through the ULS pipeline from Jordanelle Reservoir instead of Strawberry Reservoir during some years. It is anticipated that the system will only be run this way in the winter or early spring. It appears that sufficient pressure may not be available to operate the planned high-pressure turnout during this operating condition. The pressurized irrigation system will be capable of operating during these conditions utilizing the pond pump station and other turnouts, and it will operate best during lower demand conditions. Educating residents regarding the appropriate time to begin utilizing the pressurized irrigation system will help to alleviate demand on the system during these operating conditions.
- Water conservation results in better drought-preparedness and emergency preparedness.
- Water conservation can create a positive image for the City and a culture of conservation among residents.

It is recommended that the City promote water conservation through a variety of means including education, rate structuring, and implementation of conservation-oriented landscape requirements in City code.

General Source Recommendations

The following are recommended actions to take to ensure adequate source capacity is available for existing and future customers:

- Regularly update and continuously implement the City's Drinking Water Source Protection Plans.
- Take all necessary actions to protect existing water rights (Mapleton City Water Rights Master Plan & 40-Year Plan, HAL, 2022).
- Regularly clean and maintain wells so that their capacity does not diminish over time. Well cleaning is suggested whenever pumps are removed for maintenance or replacement, typically on an interval of 5 to 15 years.
- Track demand in the drinking water and pressurized irrigation system to ensure that adequate source capacity is always available.

CHAPTER 4 WATER STORAGE

EXISTING WATER STORAGE

The City's existing drinking water system includes four storage facilities with a total capacity of 9.1 MG. Their locations are shown in Figure 1-1. Westwood Tank is located at too low of an elevation and does not add functional storage to the system. It is excluded from the storage calculations in this section. The pressurized irrigation system only has one storage facility, known as the PI Pond, with a total capacity of 28.7 MG (88 acre-feet) between a low-pool depth of 6 feet and a high level of 18 feet. Its location is shown on Figure 1-2. Table 4-1 summarizes the capacity of each storage facility.

Table 4-1
Capacity of Existing Storage Facilities

Tank	Zone	Volume (MG)
Upper Tanks	3	4.1
Crowd Canyon Tank	3	4.0
Lower Tank	1	1.0
Westwood Tank	1	0.5
PI Pond	All (pumped)	28.7
Total in Drinking Water System		**9.1**[1]
Total in Pressurized Irrigation System		**28.7**

1. Calculated value excludes Westwood Tank.

Condition of Existing Storage Facilities

The drinking water storage tanks and the PI Pond are currently in good condition. As the tanks and pond age, they should be periodically cleaned and evaluated for leaks and other problems.

A summary of selected attributes of existing storage tanks and the PI Pond is shown in Table 4-2.

Table 4-2
Attributes of Existing Drinking Water Storage Tanks

Name	Pressure Zone	Dimensions[2]	Volume (MG)	Outlet Elevation (ft)	Fire Suppression Level[1](ft)	Overflow Level[1] (ft)
Maple Canyon (Upper) East Tank	Zone 3	125 ft	2.0	5228.12	3.0	23.0
Maple Canyon (Upper) West Tank	Zone 3	117 ft	2.0	5228.12	3.0	23.0
Crowd Canyon Tank	Zone 3	216 ft x 108 ft	4.0	5224.18	3.0	23.6
Lower Tank	Zone 1	78 ft	0.5	4920	3.0	15.0
Westwood Tank	Zone 1	75 ft	1.0	4889.75	NA	30.3
PI Pond	Zone 1	125 ac	28.7	4815.0	NA	25.0

1. Level is expressed as feet above the outlet elevation.
2. Dimensions given for Crowd Canyon Tank are height and width. Dimensions for all other tanks are given as diameter.

EXISTING DRINKING WATER STORAGE REQUIREMENTS

According to DDW standards outlined in Section R309-510-8, storage tanks must be able to provide: 1) fire suppression storage to supply water for firefighting; 2) emergency storage, as deemed necessary; and 3) equalization storage volume to make up the difference between source and demand. Each of the requirements is addressed below. Table 4-3 presents the existing drinking water storage requirements by pressure zone. These are then discussed below.

Table 4-3
Existing Drinking Water Storage Requirements by Zone

Pressure Zone	ERCs	Irrigated Acreage	Equalization (MG)	Fire[1] (MG)	Emergency (MG)	Total Required (MG)	Existing Storage (MG)	Remaining Capacity (MG)[3]
Zone 1	3,266	427	4.7	0	0	4.7	0.5[2]	-4.2
Zone 2	180	51	0.5	0	0	0.5	0	-0.5
Zone 3	1	0	0	0.96	0	1.0	8.0	7.0
Quiet Meadows	19	4	0	0	0	0	0	0
Total	3,466	482	5.2	0.96	0	6.2	8.5	2.3

1. Fire storage is required for all zones. Storage in Zone 3 is available to all zones in the system.
2. Westwood Tank does not provide functional storage for Zone 1 due to its elevation. The table excludes Westwood Tank.
3. A deficit in capacity can be met by storage in higher pressure zones.

Fire Suppression Storage

Fire suppression storage is required for water systems that provide water for firefighting (Subsection R309-510-8(3)). The local fire authority determines the need for fire suppression storage. The policy for Mapleton City is to provide 960,000 gal of fire storage (sufficient to supply a 4,000 gpm fire flow for 4 hours), as determined by the local fire authority.
Contact information for the Mapleton Fire department is as follows:

Fire Chief:	Nick Glasgow
Phone:	801-491-8048
Address:	305 North Main Street, Mapleton, Utah 84664

Storage was allocated to each tank according to simulations of fire flow during peak day conditions, considering that fire flow may be supplied by storage in higher zones.

Equalization Storage

Based on Utah Administrative Code requirements, a minimum equalization storage of 400 gpd/ERC is required for water systems for indoor use and (since Mapleton is primarily in Map Zone 3) 2,528 gal/irr-ac for outdoor use (Subsection R309-510-8(2)). The City elected to provide equalization storage at the level of service peak day demand (500 gal/ERC) for indoor usage and 75% of the level of service peak day demand (7,200 gal/irr-ac) for outdoor usage.

Emergency Storage

While there are no specific DDW requirements for emergency storage (Subsection R309-510-8(4)), water systems can choose to maintain emergency storage to mitigate risks, provide system reliability, and protect public health and welfare. Emergency storage may be used in case of pipeline failures, equipment failures, power outages, source contamination, and natural disasters.

The proposed level of service for equalization storage includes a substantial factor of safety. As such, no additional emergency storage is proposed.

FUTURE DRINKING WATER STORAGE REQUIREMENTS

Table 4-4 presents the future drinking water storage requirements by pressure zone. These are then discussed below.

Table 4-4
Future Drinking Water Storage Requirements

Pressure Zone	ERCs	Irrigated Acreage	Equalization (MG)	Fire (MG)	Emergency (MG)	Total Required (MG)	Existing Storage (MG)	Remaining Capacity (MG)
Zone 1	8,929	152	5.6	0	0	5.6	0.5	-5.1
Zone 2	1,137	43	0.9	0	0	0.9	0	-0.9
Zone 3	508	6	0.3	0.96	0	1.3	8.0	6.7
Total	10,574	200	6.8	0.96	0	7.8	8.5	0.7

Equalization Storage

Following the methodology described for existing conditions, and calculating 10,574 ERCs and 200 irrigated acres at buildout, the projected equalization storage requirement is 6.8 MG.

Fire Suppression Storage

For the buildout scenario, it is assumed that fire storage requirements will not exceed the existing requirements specified in this master plan. The total projected fire storage requirement is 0.96 MG. Mapleton City will require developers to utilize sprinkler systems in large buildings to maintain a fire flow requirement less than or equal to 4,000 gpm. In areas of the city where less than 4,000 gpm is available in the transmission system, Mapleton City will require developers to utilize fire prevention measures that reduce the required fire flow to match the existing available flow.

Emergency Storage

Due to the factors of safety built into the other storage requirements, no additional emergency storage was planned.

EXISTING AND FUTURE PRESSURIZED IRRIGATION SYSTEM STORAGE REQUIREMENTS

Because the pressurized irrigation system is not connected to the City's fire suppression system, fire suppression storage is not required. The City elected to maintain 75% of the level of service peak day demand as equalization storage (7,200 gal / irr-ac). Due to the factors of safety built into the equalization storage requirement, no additional emergency storage was planned. Table 4-5 presents the existing and future pressurized irrigation system storage requirements by pressure zone.

Table 4-5
Existing and Future Pressurized Irrigation System Storage Requirements

	Pressure Zone	Irrigated Acreage	Equalization (MG)	Emergency (MG)	Total Required (MG)	Existing Storage (MG)	Remaining Capacity (MG)
Existing Requirement	Zone 1	533	3.8	0	3.8	28.7	24.9
	Zone 2	0	0	0	0	0	0
	Zone 3	0	0	0	0	0	0
	Quiet Meadows	0	0	0	0	0	0
	Total	**533**	**3.8**	**0**	**3.8**	**28.7**	**24.9**
Future Requirement	Zone 1	1,367	9.8	0	9.8	28.7	18.9
	Zone 2	385	2.8	0	2.8	0	-2.8
	Zone 3	50	0.36	0	0.36	0	-0.36
	Total	**1,802**	**13.0**	**0**	**13.0**	**28.7**	**15.7**

STORAGE OPTIONS AND RECOMMENDATIONS

Based on the projected number of ERCs and irrigated area at buildout, the City has sufficient storage in both the drinking water system and the pressurized irrigation system. It is recommended that regular maintenance and inspections be performed on the existing storage facilities.

Drinking Water – Westwood Tank

Westwood Tank provides no storage benefit to the system during normal conditions, due to the elevation of the tank being too low. If a very large fire occurred near the tank while the drinking water wells were off, it is possible the tank may release water into the system. It is recommended that the City decommission Westwood Tank to eliminate unnecessary maintenance and reduce the risk of flooding were the tank to overtop. If the tank is not decommissioned, it is recommended that water quality be monitored and the tank drained and re-filled as needed.

Drinking Water – Lower Tank

As shown in the tables above, drinking water Zone 1 relies on storage in higher zones to meet the storage requirement. When the Lower Tank reaches the end of its useful life, it is recommended that the City consider demolishing existing tanks at this site and replacing them with a larger tank to provide additional storage at the correct elevation for Zone 1. If the spring flow diminishes in the future, it would be advantageous to have additional storage at the correct elevation for Zone 1 to avoid pumping as much water up the canyon to the Upper tanks.

Drinking Water – Crowd Canyon Tank

As shown in Table 4-2, the overflow of Crowd Canyon Tank is approximately four feet lower than the overflow of the Upper Tanks. When functioning properly, the Upper Tanks and Crowd Canyon Tank should operate together, with flow moving between the north and south ends of Zone 3 as required. It is recommended that an altitude valve be added to Crowd Canyon Tank to prevent overtopping of the tank and to help facilitate system optimization.

Pressurized Irrigation Storage

Pressurized irrigation Zone 2 and Zone 3 have not yet been constructed. Storage for these zones will be provided in the PI pond. During normal operations, a constant flow rate sufficient to provide peak flows for Zone 3 and a portion of Zone 2 will be provided from the high-pressure turnout into Zone 3. This will eliminate the need for storage to provide peak flows, and the excess flow during lower demand times will be conveyed to Zone 1 and to the PI pond.

CHAPTER 5 WATER DISTRIBUTION

HYDRAULIC MODEL

Hydraulic models were developed and used to analyze the performance of the drinking water and pressurized irrigation distribution systems. This chapter includes a summary of how the models were developed as well as the modeled performance of the distribution systems.

Development

Computer models were developed for the City's drinking water distribution system and the pressurized irrigation distribution system to analyze the existing and future performance and to prepare solutions for existing facilities not meeting the distribution system requirements. The model was developed with the InfoWater 12.5 software which runs on the EPANET 2.0 engine, published by the U.S. Environmental Protection Agency (EPA 2014; Rossman 2000). InfoWater and EPANET simulate the hydraulic behavior of pipe networks. Sources, pipes, tanks, valves, controls, and other data used to develop the model were obtained from GIS data of the city's drinking water and pressurized irrigation systems and other information supplied by the City.

HAL developed two models for each system, for different phases of system development. The first phase was a model representing the existing system (existing model). This model was used to calibrate and identify any deficiencies in the existing system. Calibration was performed by comparing model results to the City's SCADA output. A good match was achieved, and the model is believed to accurately represent existing conditions. Calibration data are included in Appendix E. 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 a water system 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, tank, or valve). Other components include tanks, 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.

<u>Pipe Network</u>

The pipe network layout originated from GIS data provided by the City. Elevation information was obtained from LiDAR data. Pipes in the system are generally ductile iron, with some newer pipes being PVC. Darcy-Weisbach roughness coefficients for pipes in this model ranged from 0.4 – 1.0, which is typical for these pipe materials in EPANET (Rossman 2000, 31).

Water Demands

Water demands were allocated in the model based on billed usage and billing addresses. Demand was determined for each billing address, and the addresses were geocoded to link the demands to a physical location. The geocoded demands were then assigned to the closest representative model node. With the proper spatial distribution, demands were scaled to reach the peak day demand determined in Chapter 3. For the future model, future demands were estimated according to the zoning and density shown in the City's general plan, and development concepts with approval. Future demands were assigned to new nodes representing the expected location of new development in each pressure zone.

The pattern of water demand over a 24-hour period is called the diurnal curve or daily demand curve. SCADA data was used to derive diurnal usage patterns for the peak summer demand period in both the drinking water system and the pressurized irrigation system. The diurnal curves were put into the models to simulate changes in water demand throughout the day. The Mapleton City diurnal curve for the drinking water system is shown in Figure 5-1 and the diurnal curve for the pressurized irrigation system is shown in Figure 5-2.

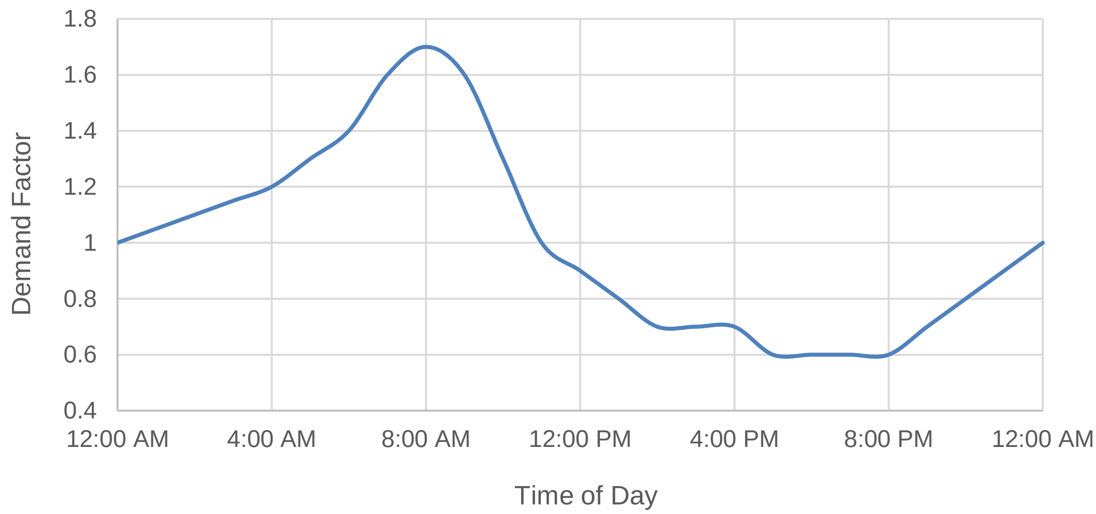


Figure 5-1: Drinking Water System Diurnal Curve

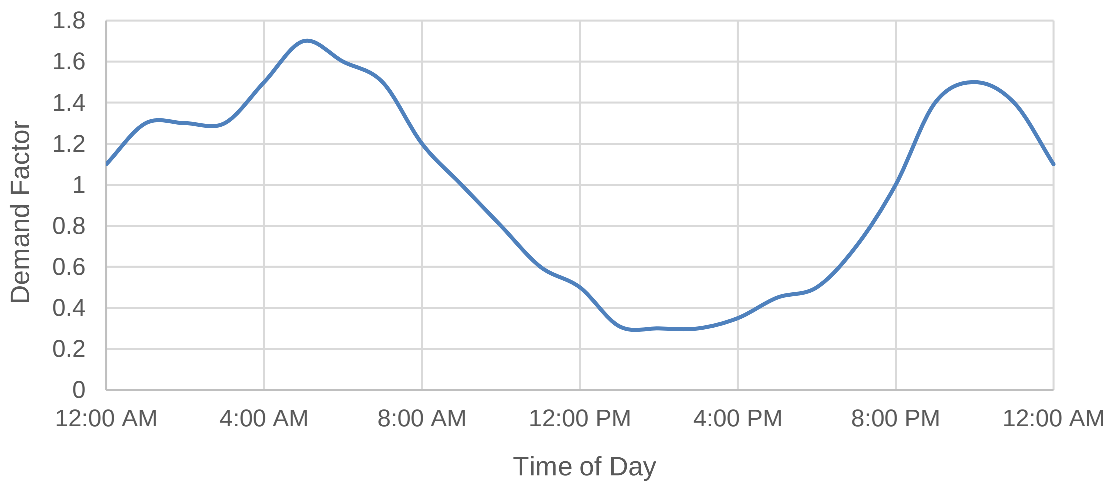


Figure 5-2: Pressurized Irrigation System Diurnal Curve

Diurnal curves are expressed using a unitless peaking factor which is defined as the flow rate at that time step divided by the average flow rate over the 24-hour period. The maximum peaking factor in Mapleton is approximately 1.7 in both systems.

Diurnal curves for indoor residential water use often have pronounced peaks during morning and evening time periods. Diurnal curves for outdoor use often display a peak throughout the nighttime hours, when most irrigation occurs. Diurnal curves for commercial and industrial uses tend to increase in the morning and remain relatively constant throughout the work day. The diurnal curve for the Mapleton water system is a composite of each of these types of uses.

In summary:

- The spatial distribution of demands was generated from geocoded water use data.
- The flow and volume of demands was generated from the proposed level of service described in Chapter 3.
- The temporal pattern of demand followed the diurnal curve as derived from available SCADA data.

Water Sources and Storage Tanks

The sources of water in the model are the existing wells and springs in the drinking water system and wells and turnouts in the pressurized irrigation system. A well is represented by a reservoir and pump. A spring is represented by a reservoir and a flow control valve. Tank location, height, diameter, and volume are represented in the model using tank elements. The PI Pond is represented using a tank element with an equivalent volume and elevation as the pond. The models were run over several days to predict water levels in the tanks as they fill from sources and as they empty to meet demand in the system.

ANALYSIS METHODOLOGY

HAL used extended-period and steady-state modeling 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: tanks filling and draining, pumps turning on or off, pressures fluctuating, and flows shifting in response to demands. A steady-state model represents a snapshot of system performance. The peak day extended period model was used to set system conditions for the steady-state model, calibrate zone to zone water transfers, analyze system controls and the performance of the system over time, and to analyze system recommendations for performance over time. The steady-state model was used for analyzing the peak day plus fire flow conditions.

Three operating conditions were analyzed with the extended period model: static conditions, peak day conditions, and peak instantaneous conditions. Peak day plus fire conditions were analyzed using the steady-state model. Each of these conditions is a worst-case situation so that the performance of the distribution system may be analyzed for compliance with DDW standards and City preferences.

EXISTING WATER DISTRIBUTION SYSTEM

Mapleton's drinking water distribution system consists of all pipelines, valves, fittings, and other appurtenances used to convey water from sources and storage tanks to water users. The existing drinking water system contains approximately 112 miles of pipe with diameters of 4 inches to 20 inches. The drinking water system distribution network has approximately 38 miles of PVC pipe and 74 miles of ductile iron pipe. The existing pressurized irrigation system contains approximately 78 miles of pipe with diameters of 4 inches to 30 inches. The pressurized irrigation system distribution network is composed almost entirely of PVC pipe. Figure 5-3 and 5-4 presents a summary of pipe length in each system by diameter.

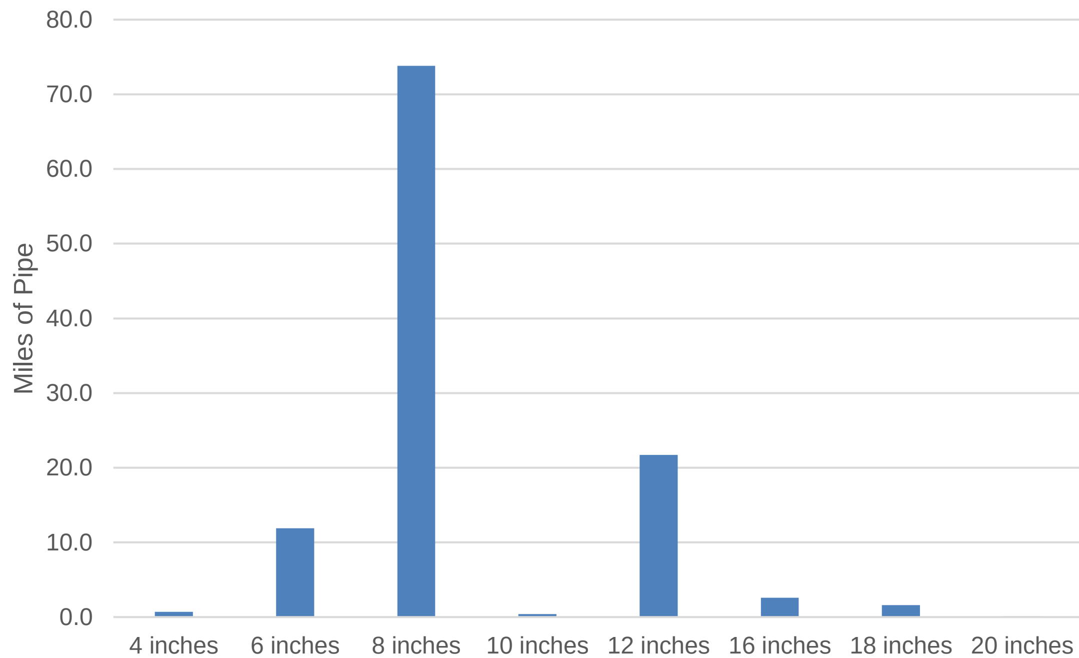


Figure 5-3: Summary of Pipe Lengths in the Drinking Water System by Diameter

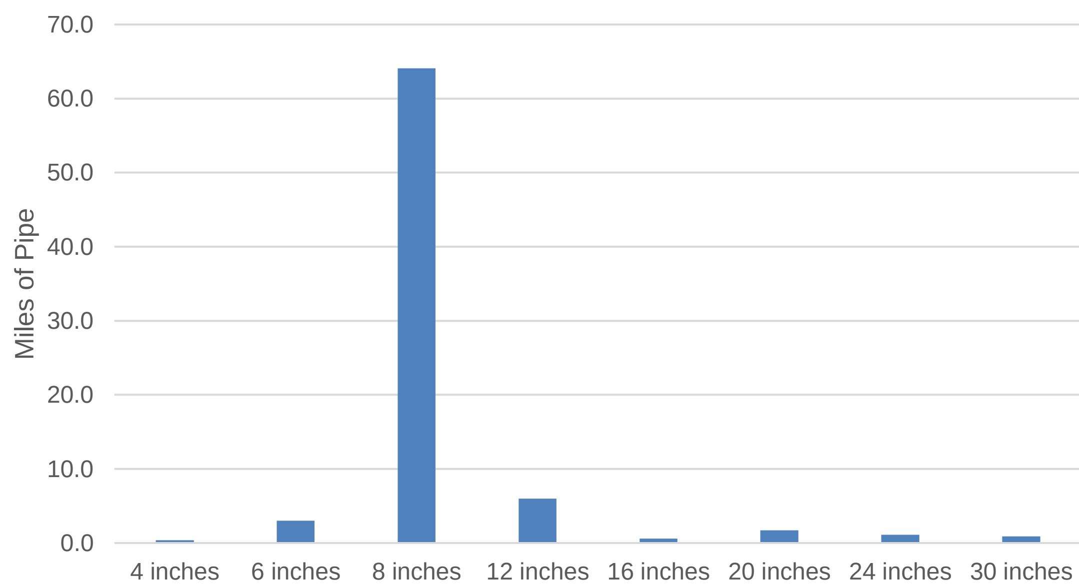


Figure 5-4: Summary of Pipe Lengths in the Pressurized Irrigation System by Diameter

The existing drinking water distribution system is divided into four (4) pressure zones. The existing pressurized irrigation system serves one (1) pressure zone. Key attributes of each pressure zone are listed in Table 5-1.

Table 5-1
Pressure Zone Summary

System	Zone	HGL (ft)	Source(s)	Tank(s)
Drinking Water	Zone 1	4930	Seal Well, Carnesecca Well, Westwood Well	Lower Tank, Westwood Tank
	Zone 2	5050	None (supplied by PRVs)	None
	Zone 3	5240	Mapleton Canyon Springs, Crowd Canyon Well	Maple Canyon (Upper) Tanks, Crowd Canyon Tank
	Quiet Meadows	5050	None (supplied by one PRV)	None
Pressurized Irrigation	Zone 1	4886	Well 1, Orton Well, R3 Well, CUWCD Mapleton Springville Pipeline Turnouts	PI Pond

See Figures 1-1 and 1-2 for a depiction of the existing pressure zones and facilities for both systems.

The topography of Mapleton City generally slopes upward from west to east. Zone 1 is the westernmost zone in the system. In the drinking water system, sources in Zone 1 pump up to the Lower Tank. The Booster Pumps pump water from the Lower Tank up Maple Canyon to the Maple Canyon (Upper) Tanks. The Springs feed directly into the Maple Canyon (Upper) Tanks and Crowd Canyon Well fills Crowd Canyon Tank. Water flows from the Zone 3 tanks through pressure reducing valves (PRVs) into the Quiet Meadow Zone and Zone 2. Excess water from Zone 2 flows through PRVs into Zone 1.

The existing pressurized irrigation system only serves Zone 1. Water from the wells and turnouts flows through Zone 1 and is deposited in the PI Pond through pressure sustaining valves (PSVs) on the north and south end of the pond. The PI Pond Pumps are controlled by a variable frequency drive (VFD) that increases or decreases the speed of the pumps to keep the pressure in the system consistent. If pressure in the pressurized irrigation system rises too high, water is released through a PSV into Hobble Creek to lower the pressure in the system.

Condition of Existing Distribution Pipes

The drinking water distribution system pipes in Mapleton consist of materials of varying age and condition. Most pipes in the system are ductile iron pipes. Corrosive soil conditions in certain areas of the system have degraded the condition of some of these pipes, while others are in good condition. Newer PVC pipes are also in good condition.

The pressurized irrigation distribution system pipes in Mapleton are relatively new and in good condition. Most pipes in the system are PVC pipes. Many areas of the City contain dry pipes (pressurized irrigation pipes that have been installed but not connected to the system). The condition of the dry pipes is unknown.

Ongoing pipe replacement will be important to minimize breaks and leakage from deteriorating iron pipes or dry PVC pipes.

LEVEL OF SERVICE

Mapleton City has established level of service parameters as described in Table 5-2.

Table 5-2
Level of Service for Existing Drinking Water Distribution System

	Demand Condition	Pressure Requirement (psi)[1]	Flow Requirement
Drinking Water	Peak Day	40	4,380 gpm
	Peak Instantaneous	30	7,450 gpm
	Peak Day plus Preferred Fire Flow[2]	20	6,380 gpm
Pressurized Irrigation	Peak Day	40	3,520 gpm
	Peak Instantaneous	30	5,980 gpm

1. Pressure requirements for the drinking water system are as stated in Utah Code R309-105-9(2). Consistent with this rule, the Mapleton City requirement for drinking water connections prior to 2007 is a minimum of 20 psi under all conditions.
2. The preferred fire flow for the City was determined by the local fire authority as 2,000 gpm. Flow requirement shown is peak day flow plus 2,000 gpm fire flow.

Performance of the drinking water system was evaluated using the hydraulic model and according to the requirements listed in Table 5-2. Modeled peak day and peak instantaneous pressures are shown on Figures 5-5 and 5-6, respectively. The ability of the distribution system to meet level of service parameters is described in Table 5-3.

Table 5-3
Compliance of Existing Distribution System with Level of Service

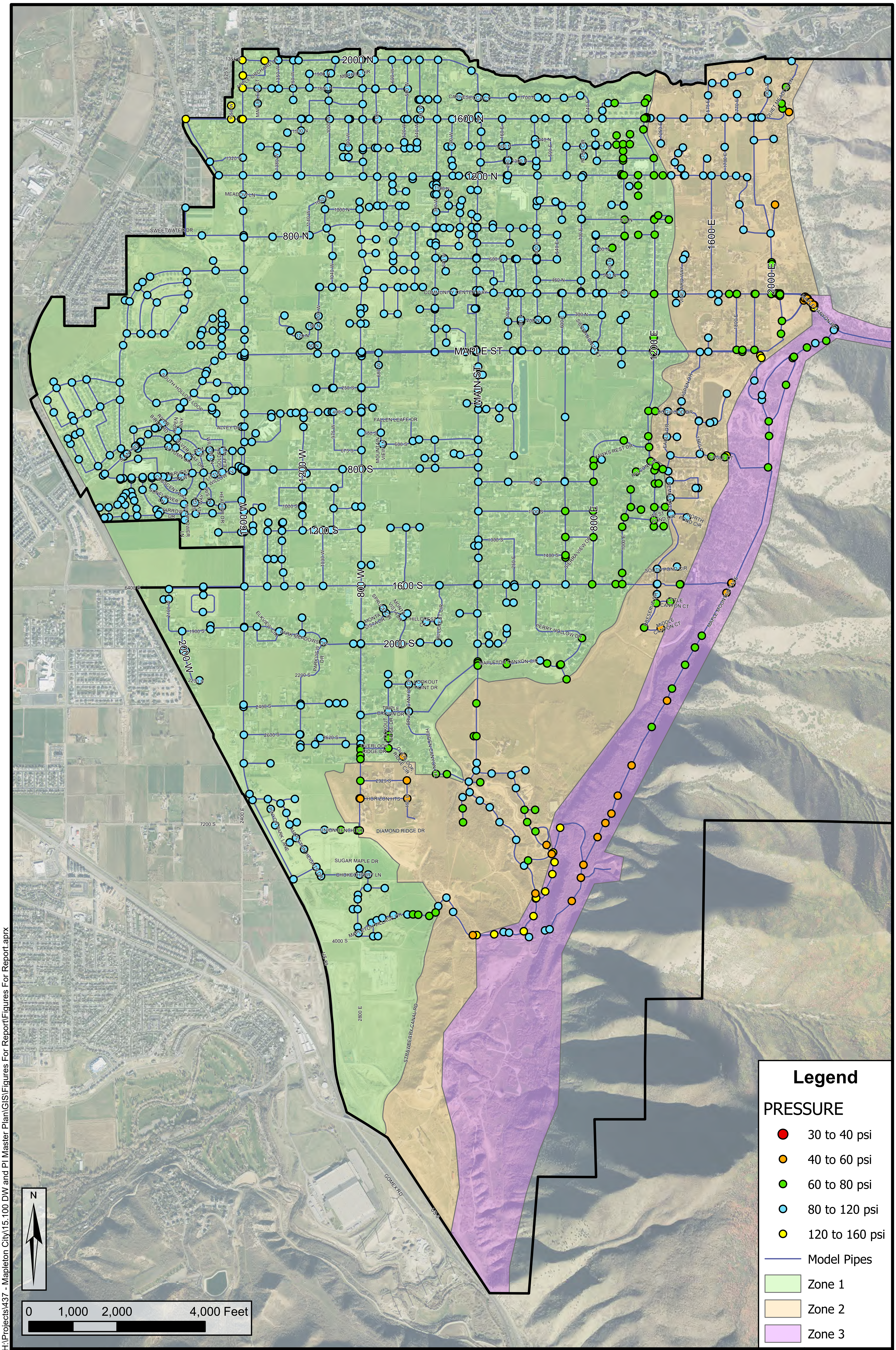
	Condition	Requirement[1]	Compliance Status
Drinking Water	Peak Day	Minimum 40 psi service pressure	All areas meet the minimum service pressure requirement at peak day demand.
	Peak Instantaneous	Minimum 30 psi service pressure	All areas meet the minimum service pressure requirement at peak instantaneous demand. Horizon Heights is approaching the minimum allowable pressure. It is recommended Horizon Heights be added to pressure zone 2 (see Chapter 7).
	Peak Day plus Preferred Fire Flow	2,000 gpm while retaining 20 psi service pressure	There are several areas in the City that do not meet the preferred fire flow (see Figure 5-7). This is due to undersized pipes. The size of these pipes will be increased when they are replaced (see Chapter 7).
Pressurized Irrigation[3]	Peak Day	Minimum 40 psi service pressure	Areas along the eastern edge of the pressurized irrigation system do not meet the desired pressure (see Figure 5-8). These areas will be connected to pressure zone 2 when it is constructed (see Chapter 7).
	Peak Instantaneous	Minimum 20 psi service pressure	Areas along the eastern edge of the pressurized irrigation system do not meet the desired pressure (see Figure 5-9). These areas will be connected to pressure zone 2 when it is constructed (see Chapter 7).

1. Requirements are as stated in Utah Code R309-105-9(2). The requirement for connections prior to 2007 is a minimum of 20 psi under all conditions.
2. Peak day system flows are discussed in Chapter 3. Peak day flow was multiplied by a factor of 1.7 to produce peak instantaneous flow.
3. Pressures in a pressurized irrigation system are not governed by Utah Code and are instead set based on City preference.

System Fire Flow

It can be observed in Figure 5-7 that several areas in the drinking water system do not meet the preferred fire flow as shown in Table 5-2. This is largely due to undersized pipes immediately adjacent to the location in question. These pipes will be upsized to provide the needed fire flow when they are replaced.

Available fire flows predicted by the model represent the flow rate available in the system distribution mains, not necessarily the flow available at a specific hydrant. Modeling should not be viewed as a substitution for physical hydrant testing. Ideally, the model and physical testing will both be used to better understand the distribution system. For best results, physical fire flow tests should be conducted during periods of peak demand (July and August) and during times of day when demands are not at a minimum. If physical fire flow tests are performed at times other than peak demand, they will not represent the peak day demand case, when pressures are likely to be lowest. When compared to flow tests not taken at peak day demand, the hydraulic model will typically be more conservative than the physical test, because it simulates peak day demand.



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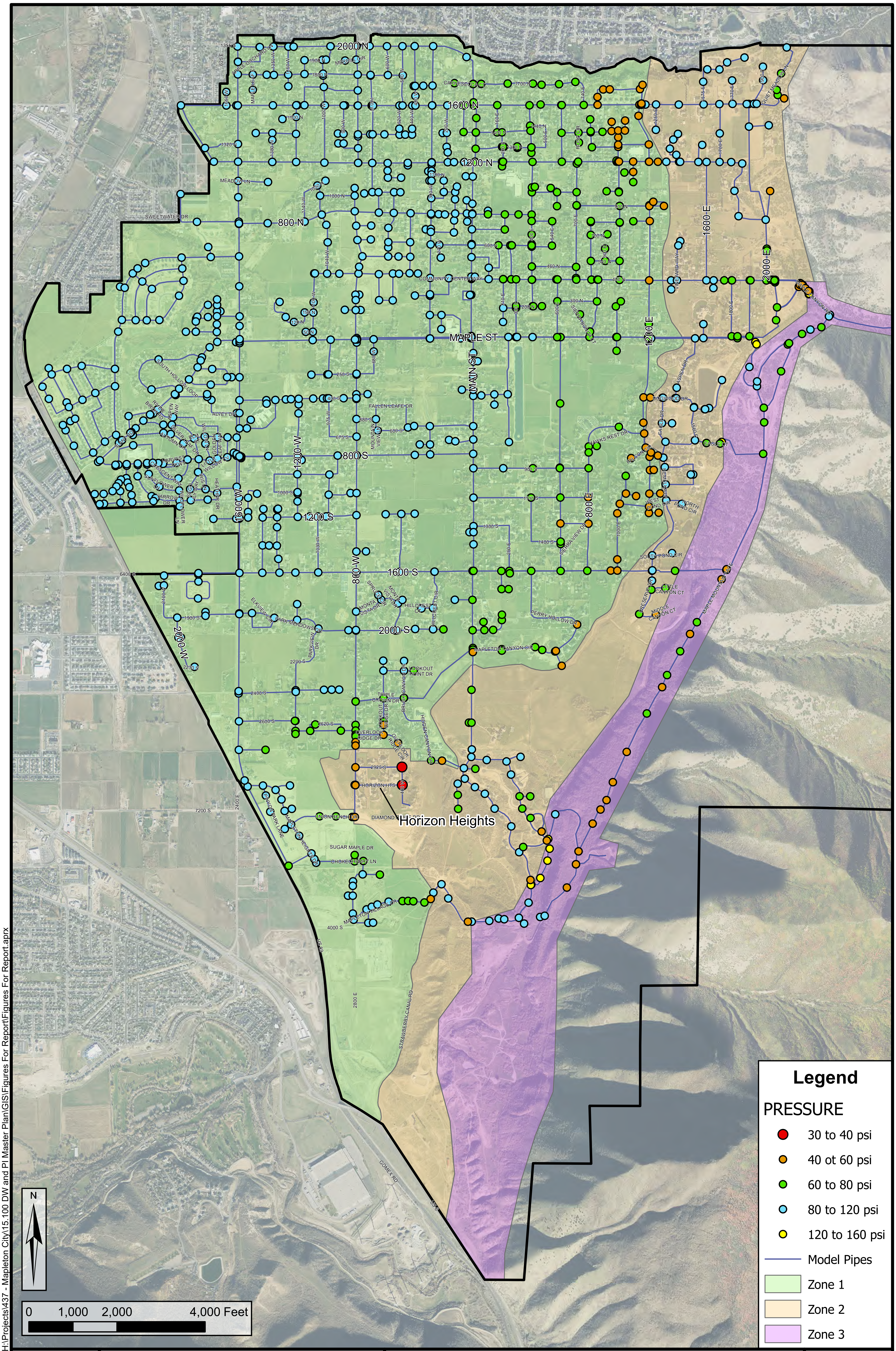
HANSEN ALLEN & LUCE INC ENGINEERS

MAPLETON CITY WATER MASTER PLAN	EXISTING DRINKING WATER SYSTEM PRESSURE DURING PEAK DAY DEMAND	FIGURE 5-5



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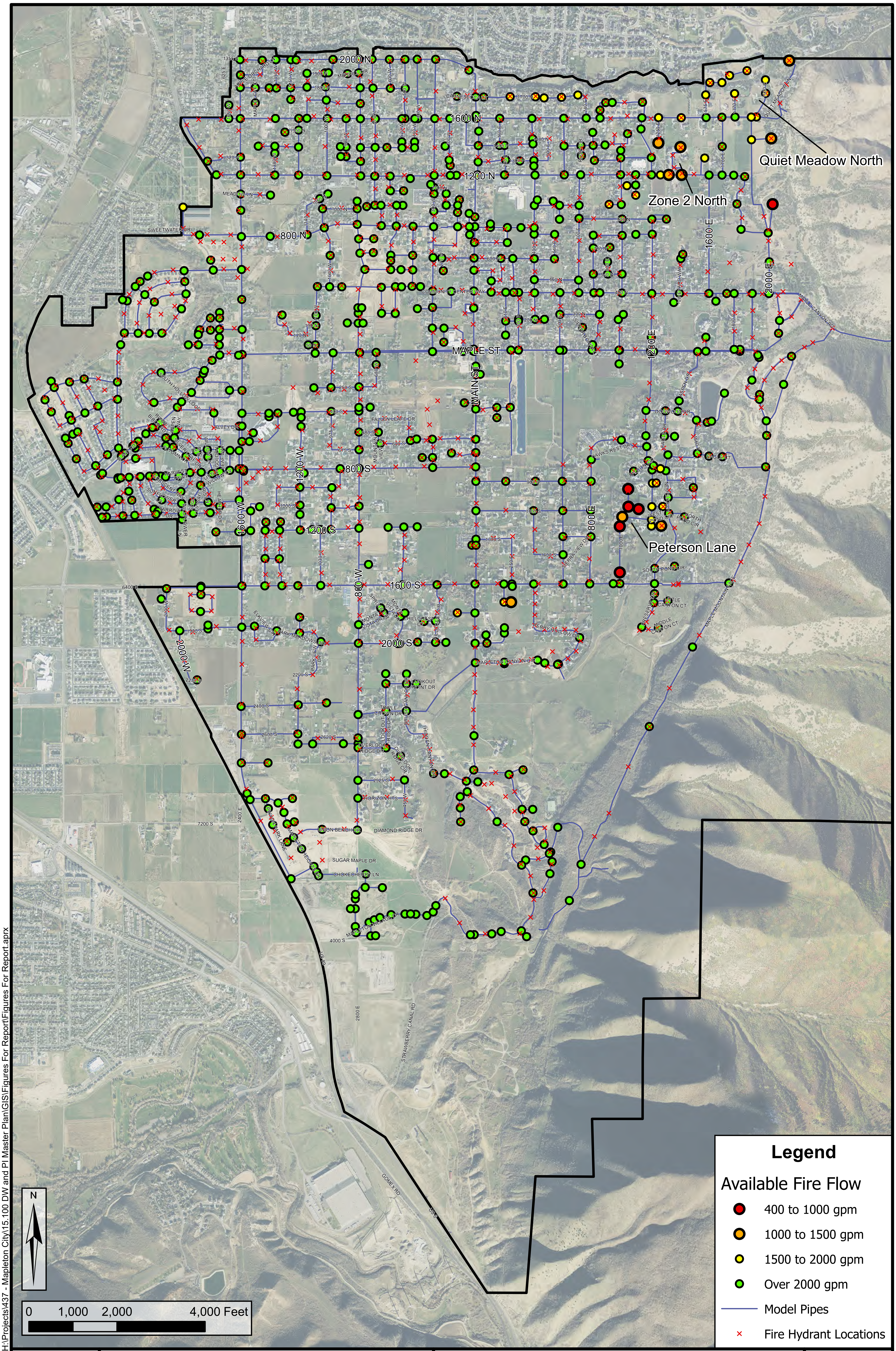
MAPLETON CITY WATER MASTER PLAN	EXISTING DRINKING WATER SYSTEM PRESSURE DURING PEAK INST. DEMAND	FIGURE 5-6



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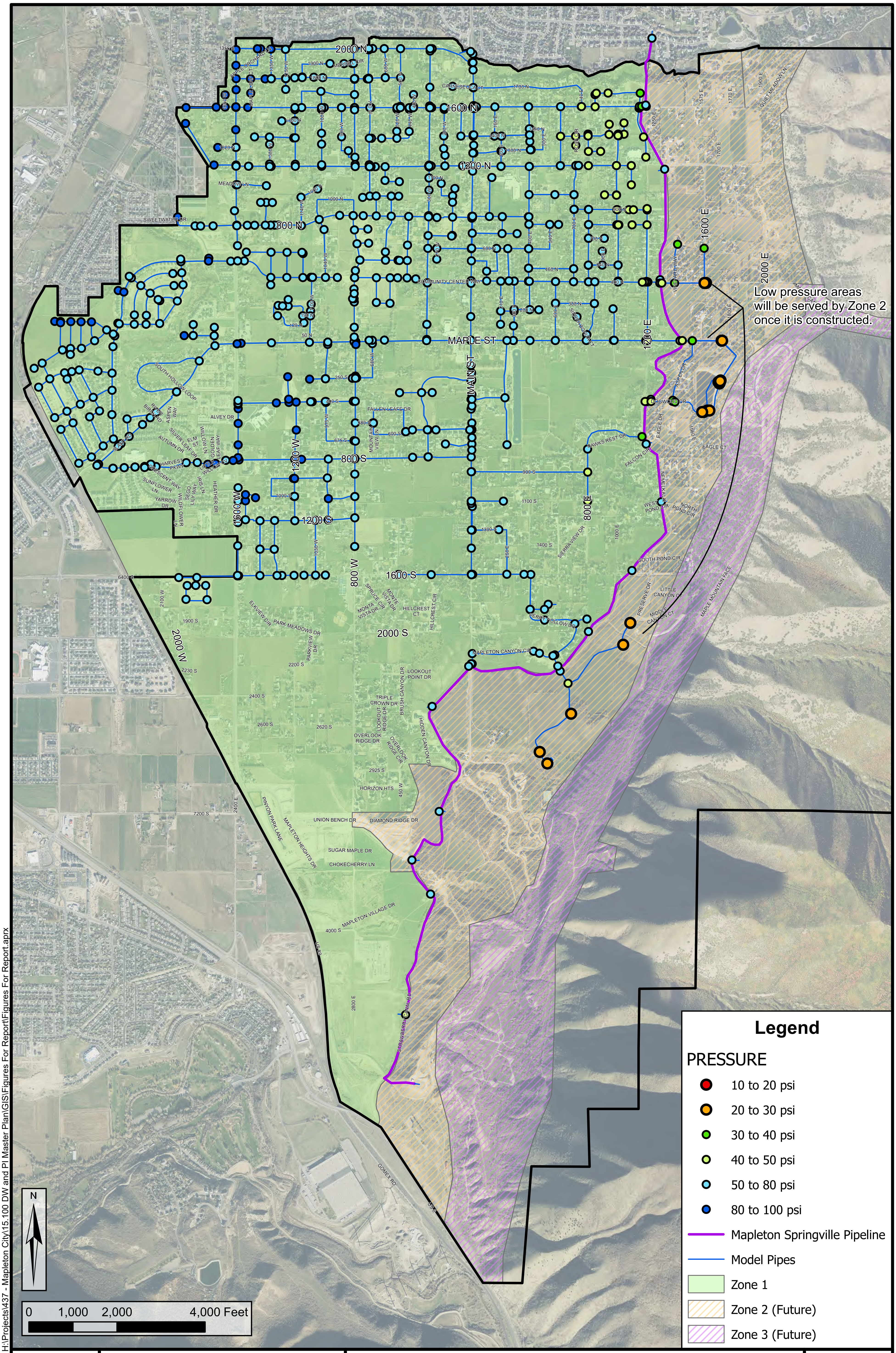
MAPLETON CITY WATER MASTER PLAN	EXISTING DRINKING WATER SYSTEM AVAILABLE FIRE FLOW	FIGURE 5-7



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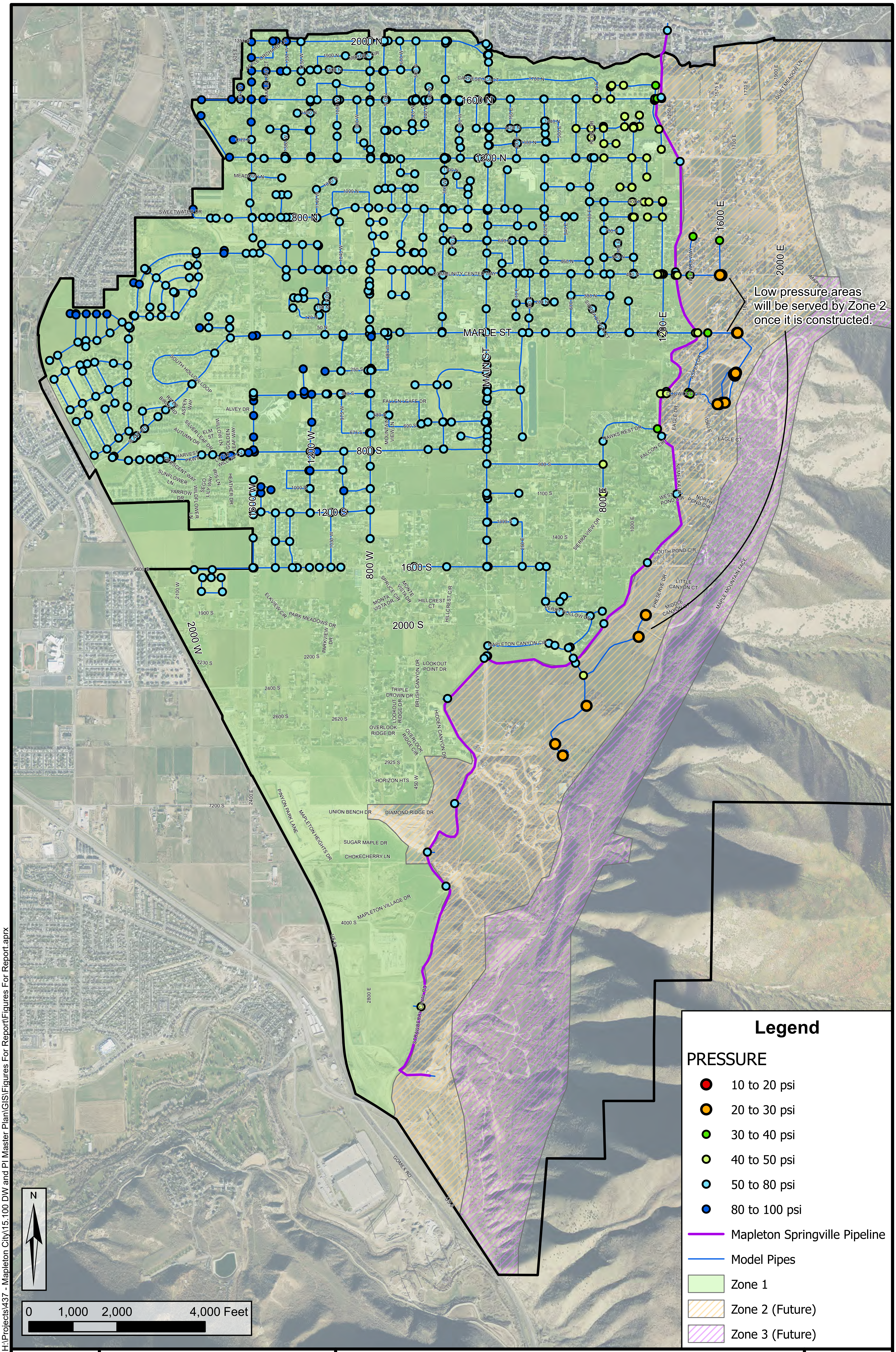
MAPLETON CITY
WATER MASTER PLAN

EXISTING PRESSURIZED IRRIGATION SYSTEM
PRESSURE DURING PEAK DAY DEMAND

FIGURE
5-8



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MAPLETON CITY WATER MASTER PLAN	EXISTING PRESSURIZED IRRIGATION SYSTEM PRESSURE DURING PEAK INST. DEMAND	FIGURE 5-9

Physical hydrant tests are still valuable and recommended because they provide model calibration points and enable the City to detect limitations in the field which may not be reflected in the hydraulic model (such as closed or partially closed valves, construction flaws, discrepancies between reality and GIS data, or other unexpected conditions which would affect fire flow).

When designing fire suppression systems for buildings, designers should be advised that results obtained during a flow test are not necessarily representative of peak day or anticipated future demands. The Mapleton City level of service is to provide a residual pressure of 20 psi during fire flow events, so it is recommended that fire suppression system designers should not assume that a residual pressure of more than 20 psi will be available.

FUTURE WATER DISTRIBUTION SYSTEM DEMANDS

Demands in the future water distribution model are shown in Table 5-4. The buildout system was designed to comply with all regulatory requirements and level of service parameters.

Table 5-4
Level of Service for Future Distribution System

	Condition	Pressure Requirement[1]	System Design Flow[2] (gpm)
Drinking Water	Peak Day	40	4,990
	Peak Instantaneous	30	8,480
	Peak Day plus Preferred Fire Flow[3]	20	6,990
Pressurized Irrigation[4]	Peak Day	40	11,890
	Peak Instantaneous	30	20,210

1. Requirements are as stated in Utah Code R309-105-9(2)
2. Peak day system flows are discussed in Chapter 3. Peak day flow was multiplied by a factor of 1.7 to produce peak instantaneous flow.
3. Fire flow is discussed in Chapter 4. The preferred fire flow in Mapleton is 2,000 gpm. Flow requirement shown is peak day flow plus 2,000 gpm fire flow.
4. Pressures in a pressurized irrigation system are not governed by Utah Code and are instead set based on City preference.

WATER DISTRIBUTION SYSTEM RECOMMENDATIONS

The model output primarily consists of the computed pressures at nodes and flow rates through pipes. The model also provides additional data related to pipeline flow velocity and head loss to help evaluate the performance of the various components of the distribution system. Results from the model have been provided to Mapleton City electronically.

Recommendations for distribution improvement projects were based on modeling, as outlined above, and guidance provided by Mapleton City personnel. Detailed recommendations regarding future distribution infrastructure are discussed in the Capital Facilities Plan. Anticipated future pipes 8 inches in diameter and larger are shown on the future system maps (Figure 7-1 and Figure 7-2). Minor adjustments may be needed as locations of wells and future roads are more precisely determined or as opportunities arise to coordinate pipeline projects with other construction activities.

PRESSURIZED IRRIGATION SYSTEM OPERATIONS

A connection with CUWCD's 96-inch Spanish Fork Canyon Pipeline is currently under construction. This turnout is located near the intersection of Highway 89 and Harmony Ridge Parkway and will provide high pressure water to pressure Zone 3 and the south end of Zone 2 in the pressurized irrigation system. Once the pressurized irrigation system is fully built out, additional pumps capable of providing water to Zone 3 will be added to the pump house at the PI Pond.

Under normal operating conditions, water for the pressurized irrigation system will be supplied from the turnouts on the Mapleton Springville Pipeline, the high-pressure turnout on the Spanish Fork Canyon Pipeline, and the irrigation system wells. The high-pressure turnout will provide water for all of Zone 3 and the southern portion of Zone 2, with excess water being stored in the PI Pond. The central and northern portions of Zone 2 will be supplied by pumping from the PI Pond.

As described in Chapter 3, the Spanish Fork Canyon Pipeline and the Mapleton Springville Pipeline are currently not active in the early spring when Mapleton begins operating the pressurized irrigation system. During this time, sources for the pressurized irrigation system include the system wells and snowmelt or runoff from Hobble Creek that is diverted to the PI Pond. Zone 1 will be supplied by the system wells and the Zone 1 pumps at the PI Pond. The total supply for Zones 2 and 3 will be pumped from the PI Pond at a high enough pressure to meet the required level of service for Zone 3, and then delivered to Zone 2 through PRVs. It is anticipated that in the future, the turnouts may be active earlier in the season.

To reduce energy waste, the Zone 3 Pond Pumps should be controlled by a VFD and designed to pump at a head and flow suitable for Zone 2 when the Spanish Fork Canyon Turnout is active and to pump at a head and flow suitable for Zone 3 when the turnout is unavailable. If such a design is not feasible, a pump sized to provide a head and flow suitable for Zone 2 could be installed in the remaining Zone 1 pump bay in the pump house at the PI Pond. Piping for this pump could potentially be rerouted to provide flow for Zone 2 under normal operating conditions, with the future Zone 3 pumps being used when the Spanish Fork Canyon Turnout is unavailable.

CHAPTER 6 SYSTEM OPTIMIZATION

ENERGY AND SYSTEM PERFORMANCE

Energy costs typically account for a substantial portion of a water utility's operating budget. The operation of water system facilities was previously analyzed to determine opportunities for energy saving. Full reports for the drinking water and pressurized irrigation systems were provided to the City in 2022 and 2023 (Energy Management Opportunities, Mapleton City Drinking Water System [HAL, December 2022], and Energy Management Opportunities, Mapleton City Pressurized Irrigation System [HAL, March 2023]). As a part of this master plan, energy saving opportunities were reviewed and key items are discussed further in this chapter.

ZONE TRANSFERS

Transferring water from one pressure zone to another has implications on the energy consumption of a water system. Energy is required to pump from a lower pressure zone to a higher pressure zone. If water is transferred to a lower pressure zone through a PRV, energy is released. In general, to maximize efficiency in a water system, water should be pumped no more than necessary, and energy released through PRVs no more than necessary.

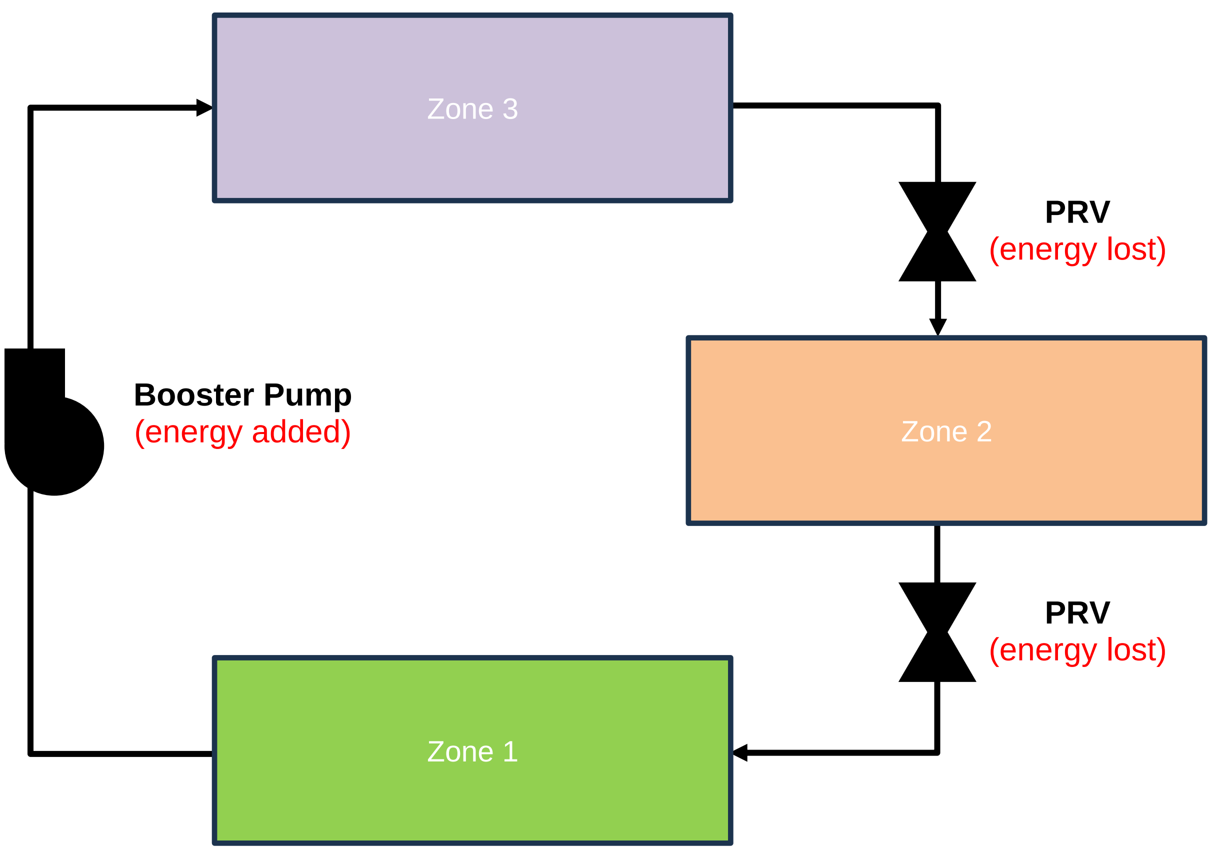


Figure 6-1: Existing Drinking Water System Zone Configuration

In the drinking water system, if there is a shortage of water in pressure zones 2 or 3, water is pumped from Zone 1 by the booster pumps up to Zone 3. The water then makes its way through PRVs through Zone 2 and back into Zone 1.

The unit of measurement used to measure the energy in the water at a given location is called *head* (expressed in units of feet). The head in the water at any location can be calculated as the elevation of the pipe at that location plus the pressure in the water times a conversion factor, or

$$\boldsymbol{head\ (ft) = elevation\ (ft) + [\,pressure\ (psi) * 2.31]}$$

The elevation of water in the Lower Tank sets the head for Zone 1 in the drinking water system. If the PRVs between Zone 2 and Zone 1 are set at a higher head than the elevation of water in the Lower Tank, then water will be pushed from Zone 2 into the Lower Tank and pumped back up to Zone 3. If the PRVs between Zone 2 and Zone 1 are set too high, it can potentially lead to overtopping in the Lower Tank. Figure 6-2 illustrates how energy can be conserved by properly setting the PRVs from Zone 2 to Zone 1. Appendix E includes a table with ideal settings for all existing system PRVs.

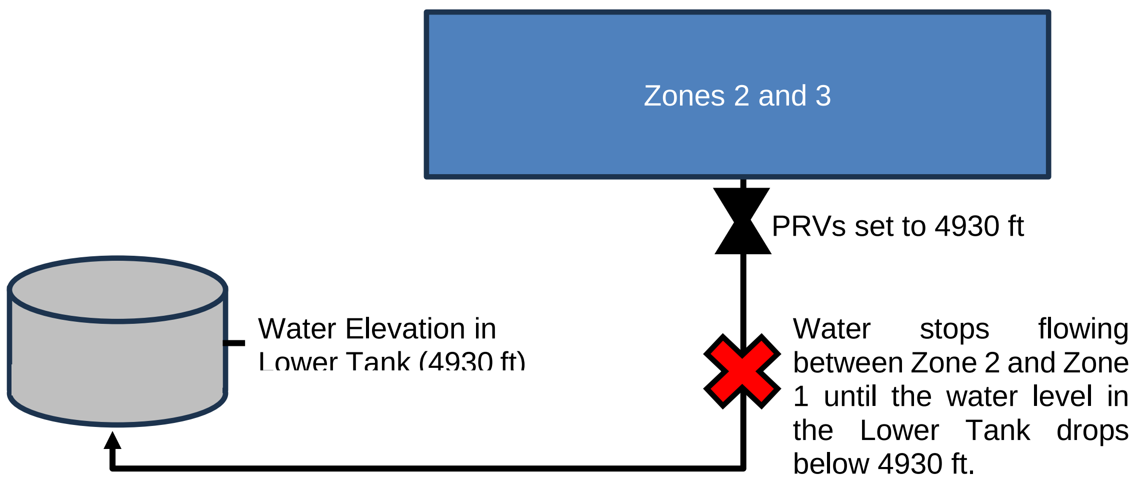


Figure 6-2: PRV Settings Between Zone 2 and Zone 1

Ideally, the demand in Zone 1 should be supplied by the sources in Zone 1 and the demand in Zones 2 and 3 should be supplied by the sources in Zone 3. Pumping between the zones or water transfer between Zones 2 and 1 should only occur when the sources in a zone are unable to meet the demand.

QUIET MEADOWS ZONE

Flow to the north end of Zone 2 is provided through a single 6-inch pipe from 400 North to the northerly boundary of the City. Flow to the north end of the Quiet Meadows Zone is provided through a single 8-inch or 12-inch pipe from 400 North to the northerly boundary of the City. This causes low fire flows in the north end of Zone 2 and the north end of the Quiet Meadows Zone. The elevation difference between Zone 2 and the Quiet Meadows Zone is not significant enough to require a zone change. Combining the Quiet Meadows Zone and Zone 2 would provide increased fire flow to the area and reduce the number of PRVs needing to be maintained.

PRESSURIZED IRRIGATION SYSTEM

The pressures in the pressurized irrigation system are controlled by the VFD on the Pond Pumps and the pressure sustaining valves (PSVs) into the PI Pond. If demand in the system exceeds what the wells and Mapleton Springville Pipeline can supply, the PI Pumps will turn on to keep the pressure in the system equal to the specified value. If demands are low, pressures in the system will rise until the PSV into the PI Pond opens, allowing water to flow into the pond. Maintaining the correct pressure in the pressurized irrigation system is important for the operation of Well 1 and the Mapleton Springville Turnouts. If pressures in the system rise too much, the flow from Well 1 and the Turnouts decreases. Flushing the PI Pumps requires a higher system pressure. It has been observed that the flows from Well 1 and the Mapleton Springville Turnouts decrease whenever the PI Pond Pumps are flushed. This is shown in an excerpt of the City's SCADA system in Figure 6-3. It appears the pond pumps are flushed approximately every 30 minutes. It is recommended the flushing cycle time be extended or the system programmed to flush when pressure loss through the filters increases to a specified threshold. It may also be possible to configure the flushing cycle to avoid such significant pressure spikes.

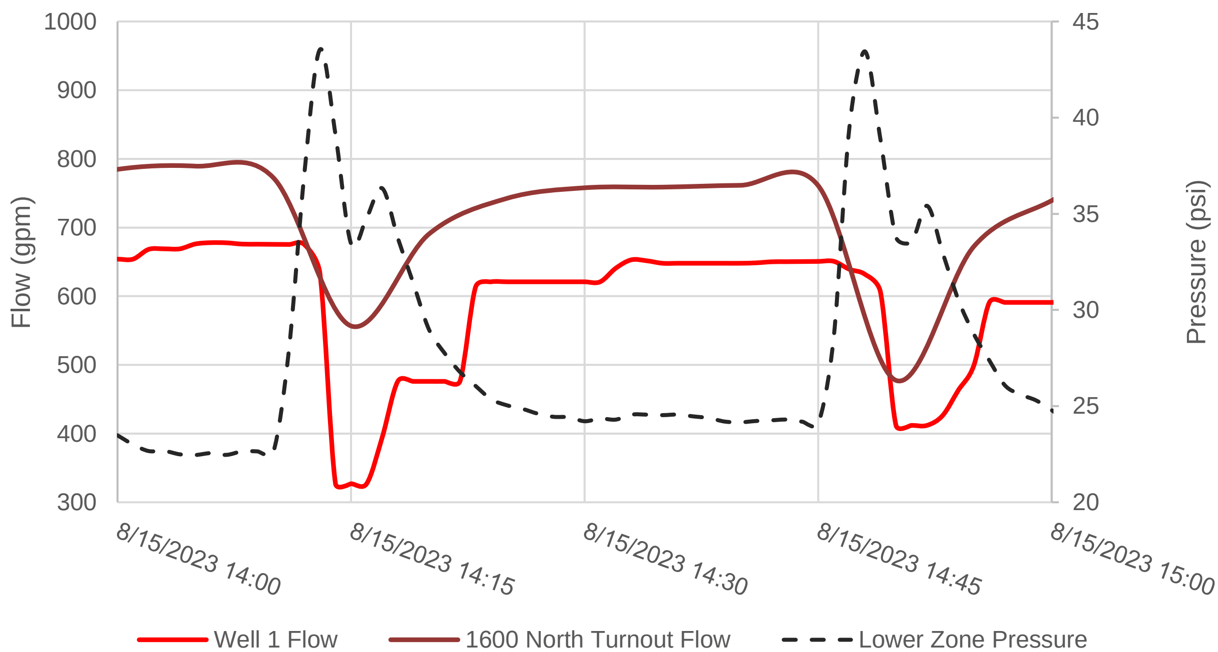


Figure 6-3: Flow Variations Due to Pressure Fluctuations

In the existing system, pressures in the system rise when the PI Pond Pumps are flushing and during times of low demand, when the PI Pumps are not running. If the setting on the PSV into the PI Pond is lowered, pressures will remain steady during demand fluctuations. However, if the PSV is allowing water into the PI Pond while the PI Pumps are running, then water is pumped in a circle, resulting in a large waste of energy. It is recommended that the PSV into the north end of the PI Pond is configured to close when the PI Pumps are running.

SUMMARY OF RECOMMENDATIONS

A summary of optimization recommendations is as follows:

Drinking Water System

- Set the system PRVs to match the head of the downstream pressure zone.
- Combine Quiet Meadows Zone with Zone 2.

Pressurized Irrigation

- Install a SCADA control to close the PSV into the north end of the PI Pond when the PI Pumps are running.
- Lower the PSV into the north end of the PI Pond to allow for stable pressures in Zone 1.

CHAPTER 7 CAPITAL FACILITY PLAN

INTRODUCTION

The purpose of this section is to identify the drinking water and pressurized irrigation facilities that are required, through the buildout planning period, to meet the demands placed on the systems by future development. Proposed facilities were sized to meet master plan requirements and located to accommodate future growth projections. Each capital facility plan project will require a detailed design analysis before construction to ensure that the location and sizing is appropriate for the actual growth that has taken place since this capital facility plan (CFP) was developed. Specific projects with estimated costs are presented at the end of this chapter.

GROWTH PROJECTIONS

The drinking water system will likely experience peak lifetime demands within the next 20 years due to normal development within the system and the not yet fully developed pressurized irrigation system. Any outdoor demand in areas where the pressurized irrigation system is not yet connected will need to be supplied by the drinking water system. In order to reduce demand in the drinking water system, the pressurized irrigation system will need to be developed as quickly as resources allow.

Expected Growth Areas

The Master Plan is intended to incorporate a reasonable degree of flexibility. Minor developments or infill developments are expected to occur over time and can generally be served after a site-level evaluation, without substantial changes to the master plan. If planned land use densities or water consumption levels change substantially from those predicted, it is recommended that the assumptions in this master plan be re-evaluated to ensure the City is planning properly for the growth that actually occurs.

METHODOLOGY

Development is occurring rapidly in the City. It is anticipated that all large developable areas will be developed within 20 years, though the selected growth rate indicates this will take much longer. Hydraulic models were developed for the purpose of assessing the drinking water and pressurized irrigation system operations 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 distribution pipelines, sources, pumps, and storage facilities. Solutions and alternatives were discussed with City staff.

The future systems were evaluated in the same manner as the existing systems, by modeling (1) peak instantaneous demands for both systems and (2) peak day demands plus fire flow conditions for the drinking water system.

RECOMMENDED PROJECTS AND COSTS

As discussed in previous chapters, source, storage and distribution system capacity expansion will be needed to meet the demands of future growth. Cost estimates have been prepared for the recommended projects and are summarized in following tables and included in detail in Appendix F.

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", 2023
2. Price quotes from equipment suppliers
3. Recent construction bids for similar work

All costs are presented in 2024 dollars.

Precision of Cost Estimates

Master plan projects are a high-level representation of the infrastructure the City will need to construct in order to correct deficiencies or meet growth. However, due to the many unknown factors at this stage of design (such as alignment and depth of pipelines, utility conflicts, the cost of land and easements, construction methodology, types of equipment and material to be used, interest and inflation rates, permitting requirements, etc.), there is a significant level of uncertainty in estimated costs. Master plan-level cost estimates can typically be expected to be accurate within +/- 50% of their actual cost. Prices have been exceptionally volatile since 2021 due to factors in the supply chain and labor market, further complicating attempts to estimate future construction costs.

Cost estimates listed in this report reflect existing market conditions as of spring 2024. It is recommended that these cost estimates be evaluated regularly as market conditions change. It is also recommended that the City evaluate costs in more detail as design proceeds, and plan additional contingency into the budget when preparing to solicit bids for individual projects. Projects are shown on Figures 7-1 and 7-2.

CAPITAL IMPROVEMENT PLAN PROJECTS

A summary of each recommended project and its estimated cost is included in Table 7-1. These projects are required due to growth and portions of these projects are eligible to be funded by impact fees. It is anticipated developers will participate in construction of some of these projects.

SYSTEM OPTIMIZATION, OPERATIONS, AND MAINTENANCE PROJECTS

A summary of recommended system optimization, operations, and maintenance projects with estimated costs is included in Table 7-2 for the City's consideration. These projects would not be impact fee-eligible, but will provide benefits that the City may find worthwhile. These projects should be considered and implemented as resources allow and as priority dictates.

The following project identification designations are used in Table 7-1, Table 7-2, and on Figures 7-1 and 7-2.

DW	Drinking water system
PI	Pressurized irrigation system
FS	Future source projects
FT	Future transmission projects
OM	Operations and maintenance projects

Table 7-1
Capital Improvement Plan Projects

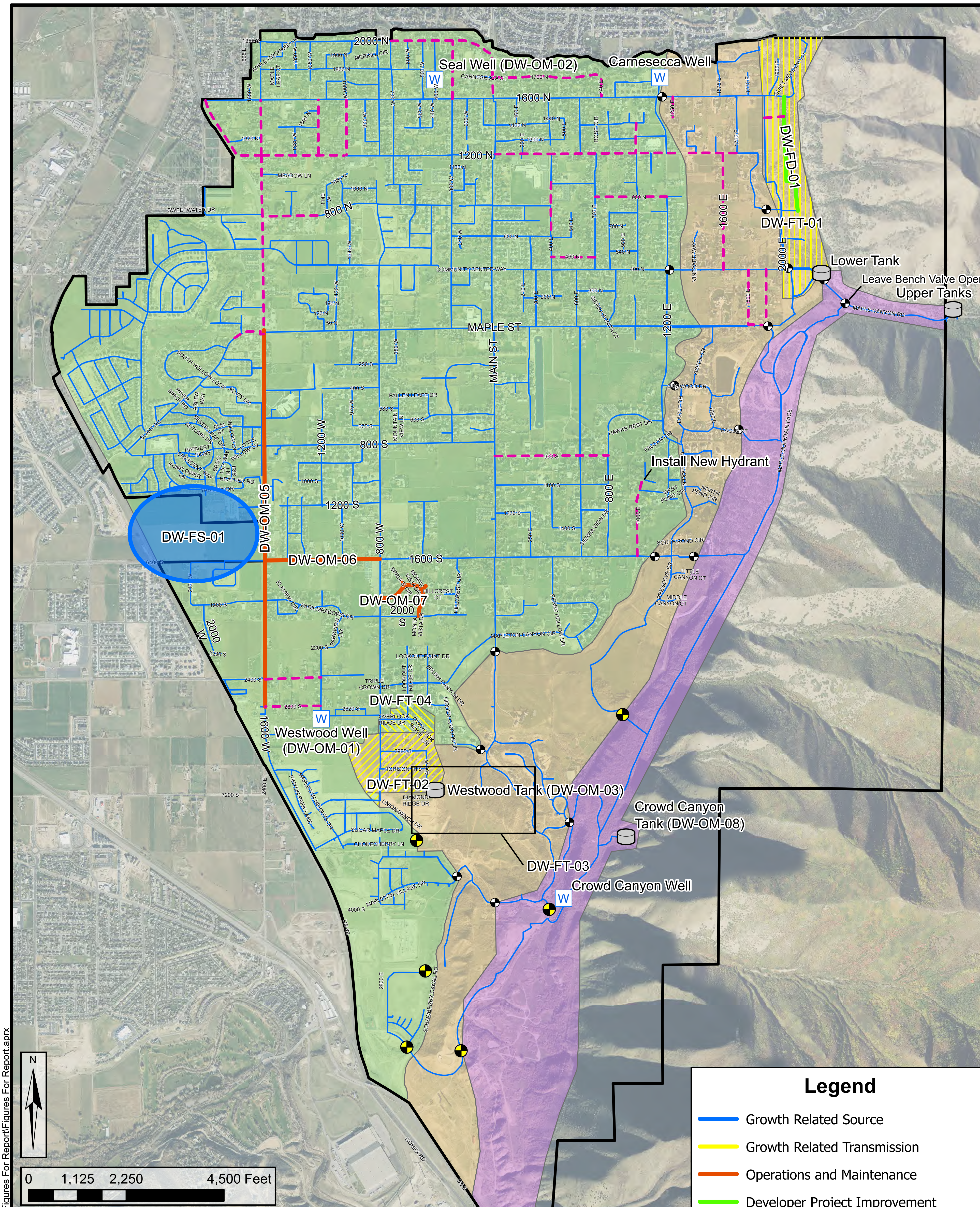
	Type	Map ID	Recommended Project	Cost
Drinking Water	Source	DW-FS-01	Locate and drill a new well.	$4,100,000
	Meet LOS	DW-FT-01	Incorporate the Clegg Canyon and Quiet Meadows pressure zones into Zone 2.	$20,000
	Meet LOS	DW-FT-02	Change the pressure zone of the Horizon Heights Subdivision from Zone 1 to Zone 2.	$20,000
	Transmission	DW-FT-03	Install an 8-inch water line to create a second path of water from Zone 2 into Horizon Heights.	$490,000
	Meet LOS	DW-FT-04	Change the pressure zone of Overlook Ridge Drive from Zone 1 to Zone 2.	$10,000
	Total Cost – Drinking Water			**$4,600,000**
Pressurized Irrigation	Source	PI-FS-01	Install two pumps capable of pumping to Zone 3 and Zone 2 in the PI Pond Pump Station.	$320,000
	Source	PI-FS-02	Connect additional turnouts from the Mapleton Springville Pipeline to the pressurized irrigation system.	$410,000
	Source	PI-FS-03	Install an air gap connection between Crowd Canyon Tank and the pressurized irrigation system to provide backup source to the PI system.	$100,000
	Transmission	PI-FT-01	Install a 12-inch transmission waterline on Main Street from the Main Street Turnout to 1600 South.	$850,000
	Transmission	PI-FT-02	Install a 20-inch transmission line from Harmony Ridge to the PI Pond. Install a PRV and bypass vault near The Preserve and at the north end of the PI Pond.	$9,140,000
	Transmission	PI-FT-03	Install a 20-inch transmission line from Dogwood turnout to the Main Street transmission line. Install a Zone 1 PSV into the PI Pond.	$3,640,000
	Transmission	PI-FT-04	Install a 12" transmission waterline on 1600 South from Main Street to 1300 West.	$1,740,000
	Transmission	PI-FT-05	Install a 12" transmission waterline from the PI Pond to the north end of Zone 2.	$2,070,000
	Transmission	PI-FT-06	Install a 16-inch transmission line from the Bench Pipeline to Twin Hollow/Main Street to provide Zone 2 water to the south end of Zone 2.	$1,610,000
	Transmission	PI-FT-07	Install a 12-inch transmission waterline on Highway 89 between Mapleton Village Drive and Sugar Maple Drive (Mapleton Heights).	$570,000
	Meet LOS	PI-FT-08	Change the pressure zone of 1200 East from Zone 1 to Zone 2.	$10,000

Table 7-1 - Continued
Capital Improvement Plan Projects

	Type	Map ID	Recommended Project	Cost
Pressurized Irrigation	Meet LOS	PI-FT-09	Change the pressure zone of the Horizon Heights Subdivision from Zone 1 to Zone 2. Install one valve.	$10,000
	Meet LOS	PI-FT-10	Install a Zone 1 8-inch line through Horizon Heights along 800 West from Union Bench Drive to Overlook Ridge Drive.	$750,000
	Meet LOS	PI-FT-11	Change the pressure zone of Overlook Ridge Drive from Zone 1 to Zone 2. Install one valve.	$10,000
	Meet LOS	PI-FT-12	Connect all existing customers to the pressurized irrigation system.	$16,490,000
	Total Cost – Pressurized Irrigation			**$37,700,000**
Drinking Water and Pressurized Irrigation Total Cost				**$42,300,000**

Table 7-2
Operations and Maintenance Projects

	Type	Map ID	Recommended Project	Cost	Priority
Drinking Water	Maintenance	DW-OM-01	Identify and implement a solution to mitigate manganese in Westwood Well.	$100,000	High
	Maintenance	DW-OM-02	Redevelop Seal Well.	$3,380,000	Medium
	Maintenance	DW-OM-03	Decommission Westwood Tank.	$100,000	Low
	Maintenance	DW-OM-04	Replace all existing 4-inch and 6-inch pipes in the drinking water system with 8-inch pipes.	$14,310,000	Low
	Maintenance	DW-OM-05	Replace the ductile iron pipe in 1600 West from Maple Street to 2600 South with a 12-inch PVC waterline.	$3,420,000	High
	Maintenance	DW-OM-06	Replace the ductile iron pipe in 1600 South from 800 West to 1600 West with an 8-inch PVC waterline.	$850,000	Medium
	Maintenance	DW-OM-07	Replace the ductile iron pipe in Monta Vista Drive from 800 West to 2000 South with an 8-inch PVC waterline.	$630,000	High
	Maintenance	DW-OM-08	Install an altitude valve on Crowd Canyon Tank.	$100,000	High
	Total Cost – Drinking Water			**$23,000,000**	**-**
Pressurized Irrigation	Meet LOS	PI-OM-01	Reduce pressure swings due to flushing the PI Pond Pumps.	$20,000	High
	Total Cost – Pressurized Irrigation			**$20,000**	**-**
Drinking Water and Pressurized Irrigation Total Cost				**$23,020,000**	**-**



Project ID	Project Type	Classification	Project Summary
DW-FS-01	New Source	Growth Related Source	Locate and drill a new well to add source to the system.
DW-FT-01	PRV Settings	Growth Related Transmission	Incorporate Clegg Canyon and Quiet Meadows Zones into Zone 2.
DW-FT-02	Install Pipe/Valves	Growth Related Transmission	Change Horizon Heights from Zone 1 to Zone 2 pressure.
DW-FT-03	Install Pipe	Growth Related Transmission	Connect Horizon Heights to Zone 2 from the East.
DW-FT-04	Install Valves	Growth Related Transmission	Change Overlook Ridge Drive from Zone 1 to Zone 2 pressure.
DW-OM-01	Engineering Study	Operations and Maintenance	Mitigate manganese in Westwood Well.
DW-OM-02	Source Redevelopment	Operations and Maintenance	Redevelop Seal Well.
DW-OM-03	Decommission Tank	Operations and Maintenance	Decommission Westwood Tank.
DW-OM-04	Replace Pipes	Operations and Maintenance	Replace all 4" and 6" pipes with 8" pipes.
DW-OM-05	Replace Pipes	Operations and Maintenance	Replace the ductile iron pipe in 1600 West with 12" PVC.
DW-OM-06	Replace Pipes	Operations and Maintenance	Replace the ductile iron pipe in 1600 South with 8" PVC.
DW-OM-07	Replace Pipes	Operations and Maintenance	Replace the ductile iron pipe in Monta Vista Drive with PVC.
DW-OM-08	Install Valve	Operations and Maintenance	Install an altitude valve on Crowd Canyon Tank.
DW-FD-01	Install Pipe	Developer Project	Install 12" transmission pipe in future 2000 East.

Date: 7/29/2024
Document Path: H:\Projects\437 - Mapleton City\15.100 DW and PI Master Plan\GIS\Figures For Report\Figures For Report.aprx

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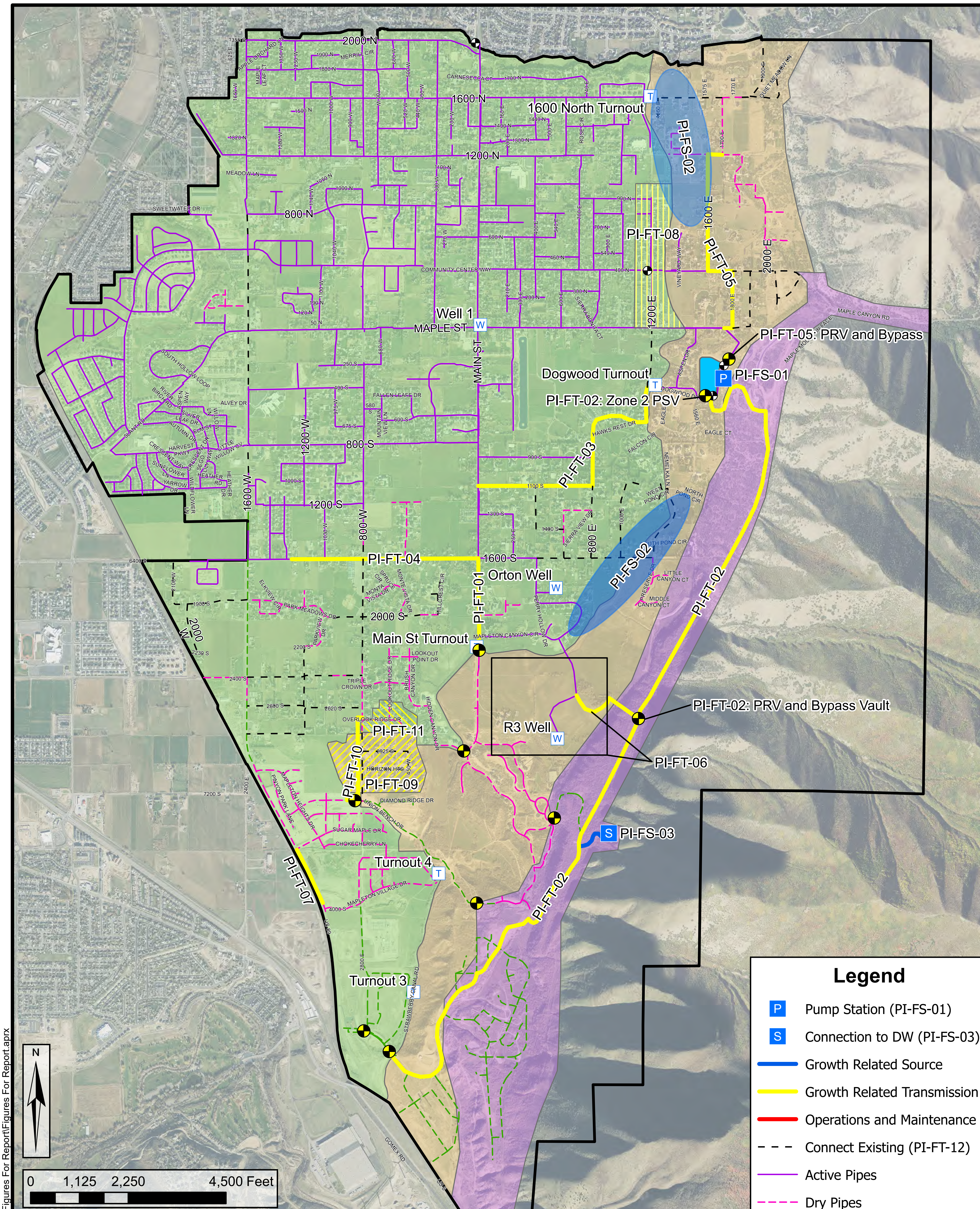
MAPLETON CITY
WATER MASTER PLAN

CAPITAL FACILITIES PROJECTS
DRINKING WATER SYSTEM

FIGURE 7-1



Project ID	Project Type	Classification	Project Summary
PI-FS-01	Update Pump Station	Growth Related Source	Install two pumps in the pump station to provide water to Zones 2 and 3.
PI-FS-02	New Source	Growth Related Source	Connect to additional CUWCD turnouts.
PI-FS-03	Install Connection	Growth Related Source	Add source for Zone 3 by installing an air gap connection to the drinking water system.
PI-FT-01	Install Pipe	Growth Related Transmission	Install a 12" pipe along Main Street to improve transmission.
PI-FT-02	Install Pipe and Valves	Growth Related Transmission	Install a 20" line and valves/bypass vaults to supply Zones 2 and 3 with water.
PI-FT-03	Install Pipe	Growth Related Transmission	Install a 20" line and valve to connect Dogwood Turnout to Zone 1.
PI-FT-04	Install Pipe	Growth Related Transmission	Install a 12" line in 1600 South.
PI-FT-05	Install Pipe	Growth Related Transmission	Install a 12" transmission line to the north end of Zone 2.
PI-FT-06	Install Pipe	Growth Related Transmission	Install a 16" pipe to provide Zone 2 water to the south end of Zone 2.
PI-FT-07	Install Pipe	Growth Related Transmission	Install an 8" pipe to improve connectivity between Mapleton Heights and the rest of Zone 1.
PI-FT-08	Install Valves	Growth Related Transmission	Change 1200 East from Zone 1 to Zone 2 pressure.
PI-FT-09	Install Valves	Growth Related Transmission	Change Horizon Heights from Zone 1 to Zone 2 pressure.
PI-FT-10	Install Pipe	Growth Related Transmission	Install an 8" pipe along 800 West to pass flow from Zone 2 to Zone 1.
PI-FT-11	Install Valves	Growth Related Transmission	Change Overlook Ridge Drive from Zone 1 to Zone 2 pressure.
PI-FT-12	Install Pipe	Growth Related Transmission	Connect all existing customers to the PI System.
PI-OM-01	Install Valve	Operations and Maintenance	Reduce pressure swings due to flushing the PI Pond Pumps.

HANSEN ALLEN & LUCE INC ENGINEERS

MAPLETON CITY WATER MASTER PLAN

CAPITAL FACILITIES PROJECTS PRESSURIZED IRRIGATION SYSTEM

FIGURE 7-2

Date: 8/27/2024
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FUTURE DEVELOPMENT PROJECTS

Project DW-FD-01 (shown on Figure 7-1) is required to provide adequate transmission for future development and primarily benefits only areas immediately adjacent to the future development. This project is likely not required to be constructed if development does not occur in areas adjacent to the project.

FACILITY REPLACEMENT

Costs for facility replacement are not discussed in detail in this master plan but are essential for maintaining a functioning system. Replacement costs should be a component of the City's annual budget and should be periodically re-evaluated to consider inflation, the construction market, and other relevant factors. An estimated annual cost needed to replace all the pipes in both the drinking water and pressurized irrigation systems is given in Table 7-3. Costs given here include costs associated with the pipeline replacement projects listed in Table 7-.

Table 7-3
Annual Cost to Replace All Pipes in Systems

System	Total Cost	Lifespan (years)	Annual Cost
Drinking Water	$149,500,000	65	$2,300,000
Pressurized Irrigation	$105,500,000	65	$1,700,000

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. G.O. bonds must be approved by a citizen vote.

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 lender 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. Due to this increased risk, revenue bonds generally require a higher interest rate than G.O. bonds. 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 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 secondary 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

System-Specific Sizing Calculations For Mapleton City

MAPLETON CITY WATER SYSTEM	PWS ID: UTAH25018/1220

MINIMUM SIZING STANDARD

Date:	4/11/2024	*Resulting Total for City*	
Peak Day Source Demand per ERC (gal/day):	**1,461**	*4,277 gpm*	1.01 gpm/ERC
Average Annual Demand per ERC (gal/year):	**258,204**	*3,341 AF*	0.79 AF/ERC
Equalization Storage per ERC (gallons):	**707**	*3.0 MG*	

ERC CALCULATIONS

Data Year	Water Use Billed (ac-ft)	Residential Connections	Total Connections	Residential Use Billed (ac-ft)	Avg Residential Flow Rate Billed (gpm)	Residential Demand Billed per ERC (gpm/ERC)	Non-Res Connections	Non-Residential water use billed (ac-ft)	Non-Residential Flow Rate Billed (gpm)	Non-Residential ERCs	ERCs
2023	2,153	3,893	3,998	1,988	1,233	0.317	105	165	102	323	4,216
2022	2,137	3,572	3,668	1,941	1,203	0.337	96	196	122	362	3,934
2021	2,178	3,317	3,405	1,987	1,232	0.371	88	191	118	319	3,636

MINIMUM SIZING STANDARD CALCULATIONS

Data from these reporting years:	2021	to	2023	
Max Peak Day Source Demand per ERC (gal/day):	1,461	x 100% =	1,461	
Max Average Annual Demand per ERC (gal/year):	258,204	x 100% =	258,204	0.79 acre-feet
Max Equalization Storage per ERC (gal/day):	707	x 100% =	707	

*variability requirement eliminated 06/28/23

DWRi WATER USE DATA REPORTED

Data Year	Peak Day Source Demand (gal/day)	Average Annual Demand (gallons) [Production]	ERCs	Peak Demand per ERC (gal/day/ERC)	Avg Annual Demand per ERC (gal/year/ERC)	Equalization Storage per ERC (gal/day/ERC)	Op Days	Peak Day Source Demand (gal/min)	Avg Annual Demand per ERC (AF/year/ERC)
2023	5,966,885	890,242,457	4,216	1,415	211,158	579	365	4,144	0.65
2022	5,646,420	943,147,699	3,934	1,435	239,743	657	365	3,921	0.74
2021	5,310,935	938,830,167	3,636	**1,461**	**258,204**	**707**	365	3,688	0.79
Variability:		**6.0%**	**16.0%**	**3.3%**	**22.3%**	**22.3%**			**22.3%**

Data Year	Peak Month Average (gal/day)	Peak Month Average per ERC (gal/day/ERC)	Ratio of PD/ERC to Peak Month Avg/ERC	Peak Month
2023	5,434,467	1,289	1.10	Aug
2022	5,115,633	1,300	1.10	Jul
2021	3,720,558	1,023	1.43	Jun

^from total production reported to DWRi.

Data Year	ERCs	Peak Demand per ERC (gal/day/ERC)	Peak Day Source Demand (gal/min)
2023	4,216	1,415	4,144
2022	3,934	1,435	3,921
2021	3,636	1,461	3,688
Variability:		**1.8%**	**6.3%**

CAPACITY CALCULATIONS FOR STORAGE

STORAGE CALCULATION		
Equalization per ERC (gal):	707	
Existing Storage (gal):	9,500,000	
ERCs:	4,216	
Required Storage w/o Fire Flow (gal)	2,982,434	
Required Fire Storage (gal):	960,000	
Required Storage w/ Fire (gal):	3,942,434	
Storage Deficiency:	0	0.0%
	No Storage Deficiency	

CAPACITY CALCULATIONS FOR SOURCES

SOURCE CALCULATION		
Peak Day Source Demand per ERC (gpm)	1.01	
Existing Source Capacity (gpm):	6,400	
ERCs:	4,216	
Required Source Capacity (gpm)	4,277	
Source Deficiency (gpm):	0	0.0%
	No Source Deficiency	

SYSTEM STORAGE AND SOURCE INVENTORY

SYSTEM STORAGE DETAILS

Name	Volume	
Crowd Tank	4,000,000	Gal
Lower Tank	500,000	Gal
Upper Tank	4,000,000	Gal
Westwood Tank	1,000,000	Gal
Storage Totals:	**9,500,000**	**GAL**

SYSTEM SOURCE DETAILS

Source No.	Name	Pump Capacity		Safe Yield	
WS006	Carnesecca Well	1,100	GPM	1,125	GPM
WS008	Crowd Canyon Well	1,550	GPM	1,667	GPM
WS007	Seals Well	1,800	GPM	1,800	GPM
WS005	Westwood Well	1,950	GPM	1,200	GPM
7948	Sample Group	0	GPM	0	GPM
	Source Totals:	**6,400**	**GPM**	**5,792**	**GPM**

APPENDIX B

Water System Data and Calculations

CLIENT Mapleton City SHEET 1 OF 1
PROJECT 2024 Master Plan
FEATURE 2024 ERC Calculations COMPUTED JEJ
PROJECT NO 437.15.100 DATE 11/09/23

HANSEN ALLEN & LUCE INC ENGINEERS

Abbreviations:
AF = acre-feet ERC = equivalent residential connection
DWR = Utah Division of Water Rights gpm = gallon per minute

Referenced DWR data can be found at:
https://waterrights.utah.gov/asp_apps/viewEditPWS/pwsView.asp?SYSTEM_ID=1220

Key: Input Calculated Value

of ERCs on DW System Calculated using the Winter Billing Data (Jan to Apr)

The existing number of ERCs and existing irrigated area was calculated for Mapleton using the City's billing data and the results of the NDVI Analysis. Looking at just indoor water use, for each year (from 2020 to 2022) and each zone the residential and non-residential amounts of water used in the City's drinking water (DW) system were calculated using the billing data. These values were used to calculate the number of non-residential ERCs on the DW system. This added to the number of residential ERCs on the DW system resulted in the total number of ERCs on the DW system.

2020 Zone 1

Mapleton service area population =	NA	*(estimate)*
Total water use =	203,683,643	*GAL/Year*
Residential connections =	2,429	*(from April 2020 Billing data)**
Total Connections =	2,515	*(from April 2020 Billing data)**
Residential water use =	189,553,799	*GAL/Year*
Average Residential flow rate (all residents) =	360	gpm
Residential demand per ERC =	0.148	gpm/ERC
	213	gpd/ERC
	0.239	AF/ERC
Non residential water use =	14,129,844	GAL/Yr
Non residential water use =	27	gpm
Summation of ERCs from non-residential demands =	181	ERCs
Total ERCs =	2,610	ERCs
Adjustment Factor =	1.0146	
Adjusted ERCs =	2648	*Adjusted to account for water use from hydrants

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

2020 Zone 2

Mapleton service area population =	NA	*(estimate)*
Total water use =	14,370,037	*GAL/Year*
Residential connections =	143	*(from April 2020 Billing data)**
Total Connections =	143	*(from April 2020 Billing data)**
Residential water use =	14,370,037	*GAL/Year*
Average Residential flow rate (all residents) =	27	gpm
Residential demand per ERC =	0.191	gpm/ERC
	275	gpd/ERC
	0.308	AF/ERC
Non residential water use =	0	GAL/Yr
Non residential water use =	0	gpm
Summation of ERCs from non-residential demands =	0	ERCs
Total ERCs =	143	ERCs
	145	

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

2020 Quiet Meadows

Mapleton service area population =	NA	*(estimate)*
Total water use =	1,188,048	*GAL/Year*
Residential connections =	18	*(from April 2020 Billing data)**
Total Connections =	18	*(from April 2020 Billing data)**
Residential water use =	1,188,048	*GAL/Year*
Average Residential flow rate (all residents) =	2	gpm
Residential demand per ERC =	0.125	gpm/ERC
	180	gpd/ERC
	0.203	AF/ERC
Non residential water use =	0	GAL/Yr
Non residential water use =	0	gpm
Summation of ERCs from non-residential demands =	0	ERCs
Total ERCs =	18	ERCs
	18	

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

2021 Zone 1

Mapleton service area population =	NA	*(estimate)*
Total water use =	233,950,899	*GAL/Year*
Residential connections =	2,682	*(from April 2021 Billing data)**
Total Connections =	2,765	*(from April 2021 Billing data)**
Residential water use =	219,012,538	*GAL/Year*
Average Residential flow rate (all residents) =	416	gpm
Residential demand per ERC =	0.155	gpm/ERC
	223	gpd/ERC
	0.251	AF/ERC
Non residential water use =	14,938,361	GAL/Yr
Non residential water use =	28	gpm
Summation of ERCs from non-residential demands =	183	ERCs
Total ERCs =	2,865	ERCs
Adjustment Factor =	1.0319	
Adjusted ERCs =	2956	*Adjusted to account for water use from hydrants

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

2021 Zone 2

Mapleton service area population =	NA	*(estimate)*
Total water use =	15,546,211	*GAL/Year*
Residential connections =	152	*(from April 2021 Billing data)**
Total Connections =	152	*(from April 2021 Billing data)**
Residential water use =	15,546,211	*GAL/Year*
Average Residential flow rate (all residents) =	29	gpm
Residential demand per ERC =	0.194	gpm/ERC
	279	gpd/ERC
	0.314	AF/ERC
Non residential water use =	0	GAL/Yr
Non residential water use =	0	gpm
Summation of ERCs from non-residential demands =	0	ERCs
Total ERCs =	152	ERCs
	157	

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

2021 Quiet Meadows

Mapleton service area population =	NA	*(estimate)*
Total water use =	1,428,917	*GAL/Year*
Residential connections =	16	*(from April 2021 Billing data)**
Total Connections =	16	*(from April 2021 Billing data)**
Residential water use =	1,428,917	*GAL/Year*
Average Residential flow rate (all residents) =	3	gpm
Residential demand per ERC =	0.169	gpm/ERC
	244	gpd/ERC
	0.274	AF/ERC
Non residential water use =	0	GAL/Yr
Non residential water use =	0	gpm
Summation of ERCs from non-residential demands =	0	ERCs
Total ERCs =	16	ERCs
	17	

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

2022 Zone 1

Mapleton service area population =	NA	*(estimate)*
Total water use =	231,182,131	*GAL/Year*
Residential connections =	2,854	*(from April 2022 Billing data)**
Total Connections =	2,942	*(from April 2022 Billing data)**
Residential water use =	212,920,907	*GAL/Year*
Average Residential flow rate (all residents) =	404	gpm
Residential demand per ERC =	0.142	gpm/ERC
	204	gpd/ERC
	0.229	AF/ERC
Non residential water use =	18,261,224	GAL/Yr
Non residential water use =	35	gpm
Summation of ERCs from non-residential demands =	245	ERCs
Total ERCs =	3,099	ERCs
Adjustment Factor =	1.0538	
Adjusted ERCs =	3266	*Adjusted to account for water use from hydrants

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

2022 Zone 2

Mapleton service area population =	NA	*(estimate)*
Total water use =	13,770,446	*GAL/Year*
Residential connections =	172	*(from April 2022 Billing data)**
Total Connections =	172	*(from April 2022 Billing data)**
Residential water use =	13,770,446	*GAL/Year*
Average Residential flow rate (all residents) =	26	gpm
Residential demand per ERC =	0.152	gpm/ERC
	219	gpd/ERC
	0.246	AF/ERC
Non residential water use =	0	GAL/Yr
Non residential water use =	0	gpm
Summation of ERCs from non-residential demands =	0	ERCs
Total ERCs =	172	ERCs
	181	

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

2022 Quiet Meadows

Mapleton service area population =	NA	*(estimate)*
Total water use =	1,211,237	*GAL/Year*
Residential connections =	18	*(from April 2022 Billing data)**
Total Connections =	18	*(from April 2022 Billing data)**
Residential water use =	1,211,237	*GAL/Year*
Average Residential flow rate (all residents) =	2	gpm
Residential demand per ERC =	0.128	gpm/ERC
	184	gpd/ERC
	0.207	AF/ERC
Non residential water use =	0	GAL/Yr
Non residential water use =	0	gpm
Summation of ERCs from non-residential demands =	0	ERCs
Total ERCs =	18	ERCs
	19	

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

CLIENT Mapleton City		SHEET 1 OF 2	
PROJECT 2024 Master Plan			
FEATURE ERC Calculations		COMPUTED JEJ	
PROJECT NO 437.15.100		DATE 11/09/23	

Abbreviations:

AF = acre-feet

DWR = Utah Division of Water Rights

ERC = equivalent residential connection

gpm = gallon per minute

Referenced DWR data can be found at:

https://waterrights.utah.gov/asp_apps/viewEditPWS/pwsView.asp?SYSTEM_ID=1220

Key: Input | Calculated Value

of ERCs on DW System Calculated using the Winter Billing Data (Jan to Apr)

The existing number of ERCs and existing irrigated area was calculated for Mapleton using the City's billing data and the results of the NDVI Analysis. Looking at just indoor water use, for each year (from 2020 to 2022) the residential and non-residential amounts of water used in the City's drinking water (DW) system were calculated using the billing data. These values were used to calculate the number of non-residential ERCs on the DW system. This added to the number of residential ERCs on the DW system resulted in the total number of ERCs on the DW system.

2020

Mapleton service area population =	11,365	*(estimate)*
Total water use =	222,742,131	*GAL/Year*
Residential connections =	2,589	*(from April 2020 Billing data)**
Total connections =	2,675	*(from April 2020 Billing data)**
Residential water use =	205,111,884	*GAL/Year*
Average Residential flow rate (all residents) =	389	gpm
Residential demand per ERC =	0.150	gpm/ERC
	216	gpd/ERC
	0.243	AF/ERC
Non residential water use =	17,630,247	GAL/Yr
Non residential flow rate =	33	gpm
Non-residential ERCs =	223	ERCs
Total ERCs =	2,812	ERCs
Population Per ERC =	4.0	

ERCs were calculated based on R309-110-4 of Utah Admin. Code

* See .\Number of Connections.xlsx

2021

Mapleton service area population =	11,740	*(estimate)*
Total water use =	259,142,831	*GAL/Year*
Residential connections =	2,850	*(from April 2021 Billing data)**
Total Connections =	2,933	*(from April 2021 Billing data)**
Residential water use =	235,987,666	*GAL/Year*
Average Residential flow rate (all residents) =	448	gpm
Residential demand per ERC =	0.157	gpm/ERC
	226	gpd/ERC
	0.254	AF/ERC
Non residential water use =	23,155,165	GAL/Yr

Non residential water use =	44	gpm	*ERCs were calculated based on R309-110-4 of Utah Admin. Code*
Non-residential ERCs =	280	ERCs	
Total ERCs =	3,130	ERCs	
Population Per ERC =	3.8		

* See .\Number of Connections.xlsx

2022

Mapleton service area population =	12,128	*(estimate)*	
Total water use =	259,477,755	*GAL/Year*	
Residential connections =	3,044	*(from April 2022 Billing data)**	
Total Connections =	3,132	*(from April 2022 Billing data)**	
Residential water use =	227,902,590	*GAL/Year*	
Average Residential flow rate (all residents) =	432	gpm	
Residential demand per ERC =	0.142	gpm/ERC	
	205	gpd/ERC	
	0.230	AF/ERC	
Non residential water use =	31,575,165	GAL/Yr	
Non residential water use =	60	gpm	*ERCs were calculated based on R309-110-4 of Utah Admin. Code*
Non-residential ERCs =	422	ERCs	
Total ERCs =	3,466	ERCs	
Population Per ERC =	3.5		

* See .\Number of Connections.xlsx

Mapleton City
Drinking Water and Pressurized Irrigation Master Plan
April 2023

	Losses From Yearly Report			Losses Calculated			
Year	Total Retail Use (ACFT)	Total From Sources (ACFT)	Estimated Water Loss %	Total Retail Use From Billing (ACFT)	Total From Sources (ACFT)	Estimated Water Loss %	Total From Sources (gal)
2022	2,137	2,894	26	2,074	2,894	28	943,145,639
2021	2,178	2,881	24	2,045	2,881	29	938,830,167
2020	2,384	2,905	18	2,232	2,905	23	946,595,207

Indoor Water Use (All Residents) - Winter

Year	Avg Monthly Residential Water Usage (Jan to Apr) (gal)	# of Connections (Jan to April Avg) (from billing)	# of Connections (Total from State Report)	Avg # of Days Per Month	Avg Daily Usage (gal/day)	Avg Daily Usage Per Connection (gal/day/connection)	Avg Daily Production Per Connection (gal/day/connection)	Required Annual Indoor Water Production (ac-ft/yr/connection)	Required Peak Day Production (gal/day/connection)
2022	16,952,553	3016	3572	30	565,085	187	240	0.269	289
2021	19,396,247	2809	3317	30	646,542	230	297	0.333	356
2020	18,731,720	2607	2964	30.25	619,230	238	293	0.328	351

Indoor Water Use (Not on PI) - Winter

Year	Avg Monthly Residential Water Usage (Jan to Apr) (gal)	# of Connections (Jan to April Avg) (from billing)	# of Connections (Total from State Report)	Avg # of Days Per Month	Avg Daily Usage (gal/day)	Avg Daily Usage Per Connection (gal/day/connection)	Avg Daily Production Per Connection (gal/day/connection)	Required Annual Indoor Water Production (ac-ft/yr/connection)	Required Peak Day Production (gal/day/connection)
2022	9,214,467	1362	3572	30	307,149	226	289	0.324	347
2021	9,440,831	1218	3317	30	314,694	258	333	0.373	400
2020	7,973,383	1091	2964	30.25	263,583	242	297	0.333	357

Indoor Water Use (on PI) - Winter

Year	Avg Residential Water Usage (Jan to Apr) (gal)	# of Connections (from billing)	# of Connections (Total from State Report)	Avg # of Days Per Month	Avg Daily Usage (gal/day)	Avg Daily Usage Per Connection (gal/day/connection)	Avg Daily Production Per Connection (gal/day/connection)	Required Annual Indoor Water Production (ac-ft/yr/connection)	Required Peak Day Production (gal/day/connection)
2022	8,352,078	1464	3572	30	278,403	190	244	0.273	293
2021	8,735,553	1409	3317	30	291,185	207	267	0.299	320
2020	7,775,041	1328	2964	30.25	257,026	194	238	0.267	286

Indoor Water Use (on PI) - Annual

Year	Residential Water Usage (gal)	# of Connections (from billing)	# of Connections (Total from State Report)	# of Days Per Year	Avg Daily Usage (gal/day)	Avg Daily Usage Per Connection (gal/day/connection)	Avg Daily Production Per Connection (gal/day/connection)	Required Annual Indoor Water Production (ac-ft/yr/connection)	Compared to Winter Usage for All Residents	Compared to Winter Usage for Residents on PI
2022	130,949,886	1598	3572	365	358,767	224	288	0.323	1.20	1.18
2021	121,658,968	1472	3317	365	333,312	226	292	0.327	0.98	1.10
2020	126,947,373	1418	2964	366	346,851	245	301	0.337	1.03	1.26

Indoor Water Use (on PI) - Peak *month* only

Year	Residential Water Usage (gal)	# of Connections (from billing)	# of Connections (Total from State Report)	# of Days in Peak Month	Avg Daily Usage (gal/day)	Avg Daily Usage Per Connection (gal/day/connection)	Avg Daily Production Per Connection (gal/day/connection)	Required Annual Indoor Water Production (ac-ft/yr/connection)	Compared to Winter Usage of All Residents	Compared to Winter Usage for Residents on PI
2022	14,500,899	1715	3572	30	483,363	282	362	0.251	1.50	1.48
2021	14,679,739	1439	3317	31	473,540	329	425	0.295	1.43	1.59
2020	17,021,322	1380	2964	31	549,075	398	490	0.340	1.68	2.05

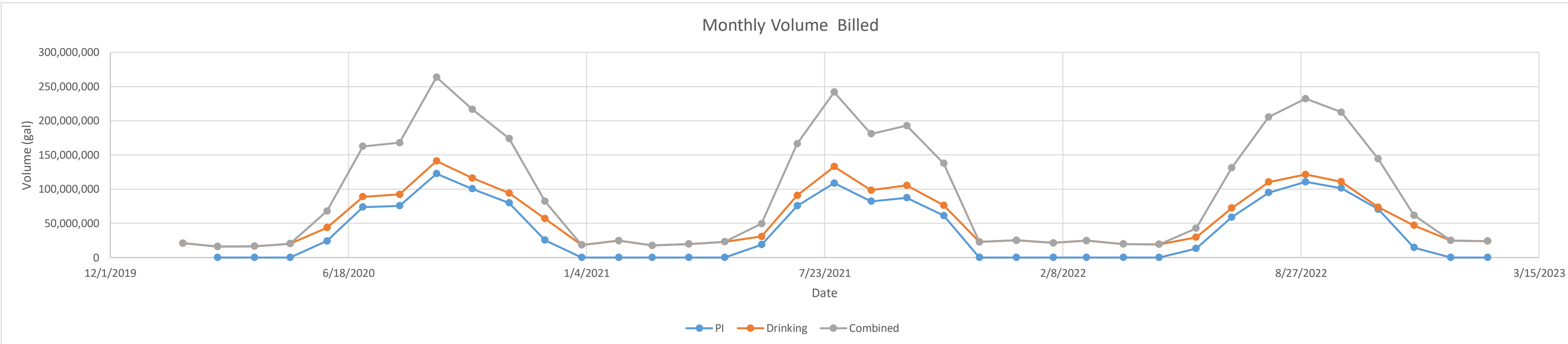
Townhome Water Use (Center of Harvest Park - 47 units) - Winter

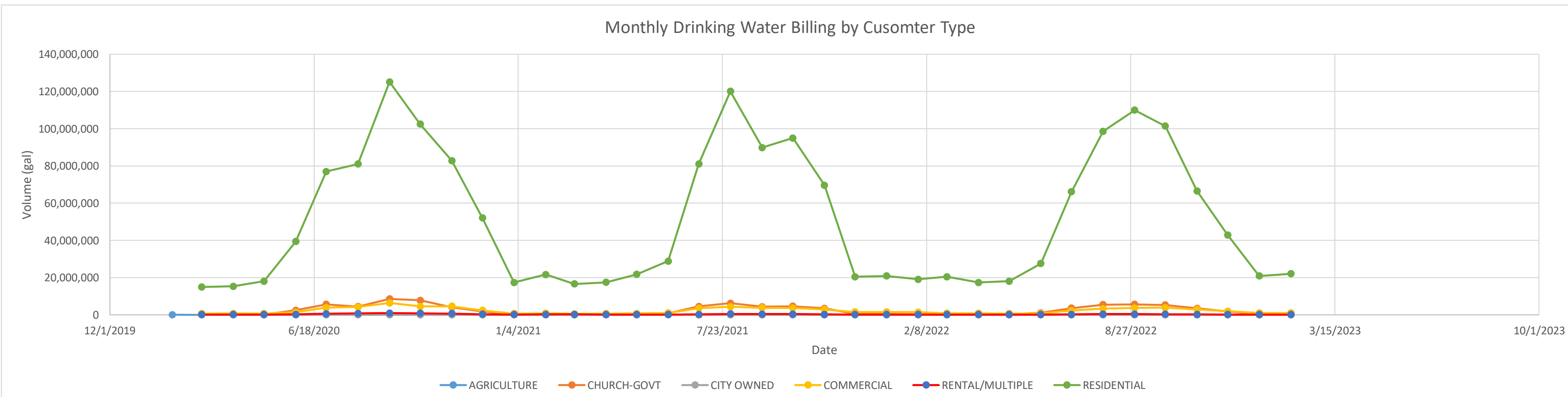
Year	Avg Residential Water Usage/Unit (Jan to Apr) (gal)	Avg # of Days Per Month	Avg Daily Usage Per Connection (gal/day/connection)	Avg Daily Production Per Connection (gal/day/connection)	Required Annual Indoor Water Production (ac-ft/yr/connection)	Required Peak Day Production (gal/day/connection)
2022	8,367	30	279	358	0.401	430
2021	8,169	30	272	349	0.391	419
2020	6,763	30.25	224	287	0.321	344

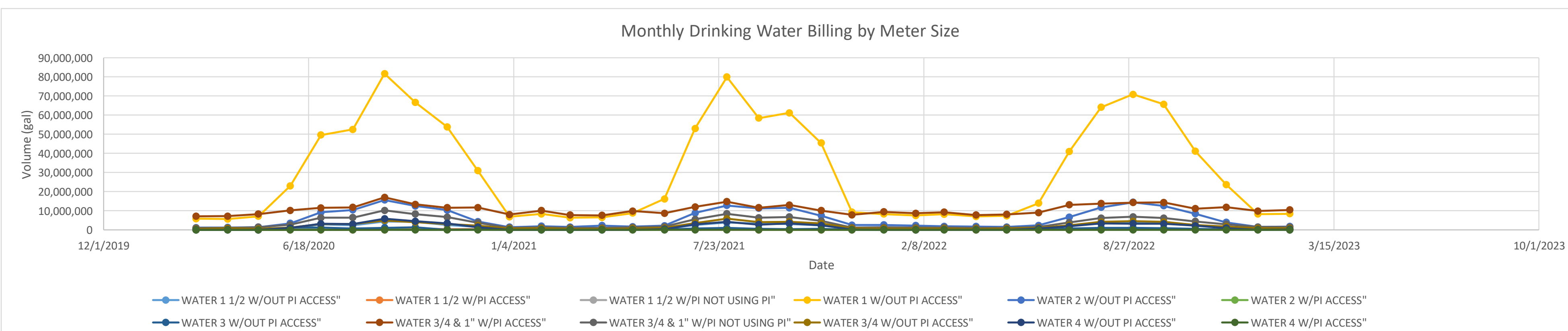
Townhome Water Use Individual Meters (Southwest - 40-78 units) - Winter

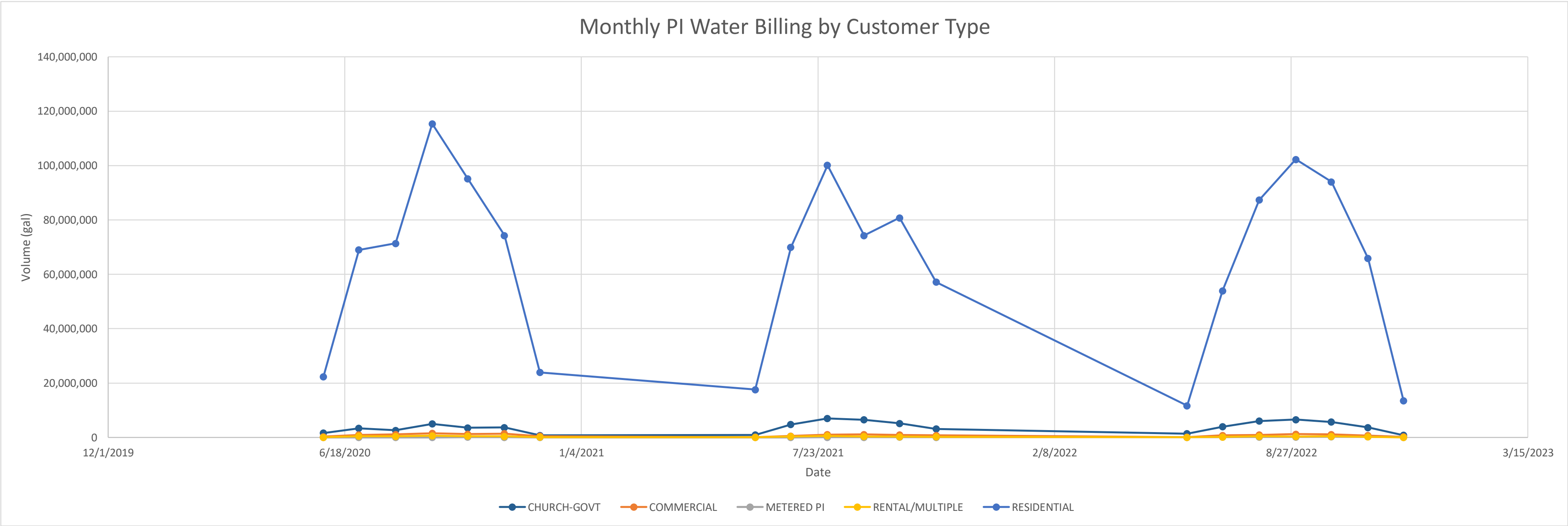
Year	Avg Residential Water Usage/Unit (Jan to Apr) (gal)	Avg # of Days Per Month	Avg Daily Usage Per Connection (gal/day/connection)	Avg Daily Production Per Connection (gal/day/connection)	Required Annual Indoor Water Production (ac-ft/yr/connection)	Required Peak Day Production (gal/day/connection)
2022	3,525	30	117	151	0.169	181
2021	3,317	30	111	142	0.159	170
2020	0	30.25	0	0	0.000	0

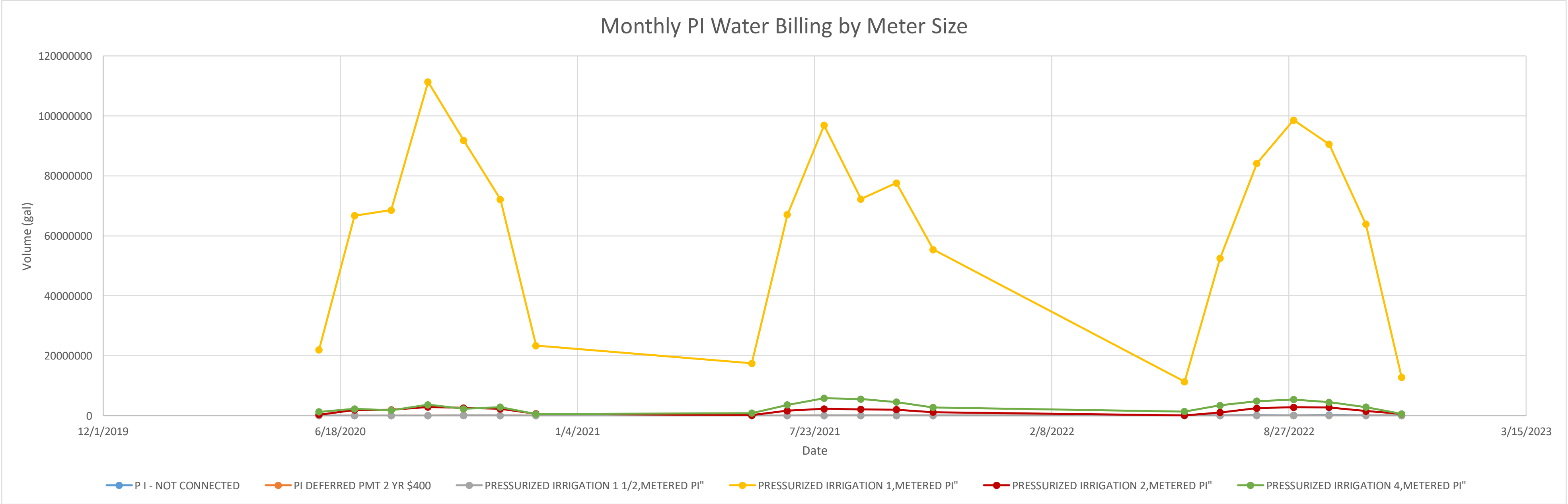
Mapleton City
Drinking Water and Pressurized Irrigation Master Plan
April 2023








Monthly PI Water Billing by Customer Type
Volume (gal)
140,000,000
120,000,000
100,000,000
80,000,000
60,000,000
40,000,000
20,000,000
0
12/1/2019
6/18/2020
1/4/2021
7/23/2021
2/8/2022
8/27/2022
3/15/2023
Date
CHURCH-GOVT
COMMERCIAL
METERED PI
RENTAL/MULTIPLE
RESIDENTIAL


Monthly PI Water Billing by Meter Size
Volume (gal)
120000000
100000000
80000000
60000000
40000000
20000000
0
12/1/2019
6/18/2020
1/4/2021
7/23/2021
2/8/2022
8/27/2022
3/15/2023
Date
P I - NOT CONNECTED
PI DEFERRED PMT 2 YR $400
PRESSURIZED IRRIGATION 1 1/2,METERED PI"
PRESSURIZED IRRIGATION 1,METERED PI"
PRESSURIZED IRRIGATION 2,METERED PI"
PRESSURIZED IRRIGATION 4,METERED PI"

APPENDIX C

Irrigated Area Calculations

CLIENT Mapleton City SHEET 1 OF 2
PROJECT 2024 Master Plan
FEATURE 2024 Outdoor Irrigation Calculations COMPUTED JEJ
PROJECT NO 437.15.100 DATE 11/09/23

HANSEN ALLEN & LUCE INC ENGINEERS

Abbreviations:
AF = acre-feet
ERC = equivalent residential connection
DWR = Utah Division of Water Rights
gpm = gallon per minute

Referenced DWR data can be found at:
https://waterrights.utah.gov/asp_apps/viewEditSEC/secView.asp?SYSTEM_ID=11376

Key: Input | Calculated Value

The existing number of ERCs and existing irrigated area was calculated for Mapleton using the City's billing data and the results of the NDVI Analysis. As part of the NDVI analysis, an average water use per irrigated acre was calculated for each year (2020 to 2022). The average water use per irrigated acre times the total water use for the drinking water and PI systems resulted in the total area irrigated by each system in the City. The NDVI analysis found that the average percent of parcel irrigated was 36%. City officials elected to use 50% as their allowable irrigated area to better match the existing city ordinances. The Allowable Area Irrigated calculation is based off this 50%.

Area Irrigated by DW System By Zone Calculated using the Billing Data

2020 - Zone 1

1	Total water use (DW without PI) =	1,152	AF/Year	Total outdoor water use (DW) =	1,366	AF/Year
2	Average Water Use Per Irrigated Acre =	4.58	AF/Irr Acre *	Average Water Use Per Irrigated Acre =	4.58	AF/Irr Acre *
	Area Irrigated by DW System (1 / 2) =	251	Irr Acres	Area Irrigated by DW System (1 / 2) =	298	Irr Acres
	Allowable Area Irriagated by DW system =	349	Irr Acres	Allowable Area Irriagated by DW system =	414	Irr Acres

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection devided by the average irrigated area per connection.

2021 - Zone 1

1	Total water use (DW without PI) =	992	AF/Year	Total outdoor water use (DW) =	1,126	AF/Year
2	Average Water Use Per Irrigated Acre =	3.86	AF/Irr Acre *	Average Water Use Per Irrigated Acre =	3.86	AF/Irr Acre *
	Area Irrigated by DW System (1 / 2) =	257	Irr Acres	Area Irrigated by DW System (1 / 2) =	292	Irr Acres
	Allowable Area Irriagated by DW system =	357	Irr Acres	Allowable Area Irriagated by DW system =	405	Irr Acres

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection devided by the average irrigated area per connection.

2022 - Zone 1

1	Total water use (DW without PI) =	975	AF/Year	Total outdoor water use (DW) =	1,144	AF/Year
2	Average Water Use Per Irrigated Acre =	3.72	AF/Irr Acre *	Average Water Use Per Irrigated Acre =	3.72	AF/Irr Acre *
	Area Irrigated by DW System (1 / 2) =	262	Irr Acres	Area Irrigated by DW System (1 / 2) =	307	Irr Acres
	Allowable Area Irriagated by DW system =	364	Irr Acres	Allowable Area Irriagated by DW system =	427	Irr Acres

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection devided by the average irrigated area per connection.

2020 - Zone 2

1	Total water use (DW without PI) =	150	AF/Year	Total outdoor water use (DW) =	152	AF/Year
2	Average Water Use Per Irrigated Acre =	4.58	AF/Irr Acre *	Average Water Use Per Irrigated Acre =	4.58	AF/Irr Acre *
	Area Irrigated by DW System (1 / 2) =	33	Irr Acres	Area Irrigated by DW System (1 / 2) =	33	Irr Acres
	Allowable Area Irriagated by DW system =	46	Irr Acres	Allowable Area Irriagated by DW system =	46	Irr Acres

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection devided by the average irrigated area per connection.

2021 - Zone 2

1	Total water use (DW without PI) =	122	AF/Year	Total outdoor water use (DW) =	123	AF/Year
2	Average Water Use Per Irrigated Acre =	3.86	AF/Irr Acre *	Average Water Use Per Irrigated Acre =	3.86	AF/Irr Acre *
	Area Irrigated by DW System (1 / 2) =	32	Irr Acres	Area Irrigated by DW System (1 / 2) =	32	Irr Acres
	Allowable Area Irriagated by DW system =	44	Irr Acres	Allowable Area Irriagated by DW system =	44	Irr Acres

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection devided by the average irrigated area per connection.

2022 - Zone 2

1	Total water use (DW without PI) =	136	*AF/Year*	Total outdoor water use (DW) =	137	*AF/Year*
2	Average Water Use Per Irrigated Acre =	3.72	*AF/Irr Acre* *	Average Water Use Per Irrigated Acre =	3.72	*AF/Irr Acre* *
	Area Irrigated by DW System (1 / 2) =	37	Irr Acres	Area Irrigated by DW System (1 / 2) =	37	Irr Acres
	Allowable Area Irriagated by DW system =	51	Irr Acres	Allowable Area Irriagated by DW system =	51	Irr Acres

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection devided by the average irrigated area per connection.

2020 - Quiet Meadows

1	Total water use (DW without PI) =	19	*AF/Year*	Total outdoor water use (DW) =	19	*AF/Year*
2	Average Water Use Per Irrigated Acre =	4.58	*AF/Irr Acre* *	Average Water Use Per Irrigated Acre =	4.58	*AF/Irr Acre* *
	Area Irrigated by DW System (1 / 2) =	4	Irr Acres	Area Irrigated by DW System (1 / 2) =	4	Irr Acres
	Allowable Area Irriagated by DW system =	6	Irr Acres	Allowable Area Irriagated by DW system =	6	Irr Acres

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection devided by the average irrigated area per connection.

2021 - Quiet Meadows

1	Total water use (DW without PI) =	12	*AF/Year*	Total outdoor water use (DW) =	12	*AF/Year*
2	Average Water Use Per Irrigated Acre =	3.86	*AF/Irr Acre* *	Average Water Use Per Irrigated Acre =	3.86	*AF/Irr Acre* *
	Area Irrigated by DW System (1 / 2) =	3	Irr Acres	Area Irrigated by DW System (1 / 2) =	3	Irr Acres
	Allowable Area Irriagated by DW system =	4	Irr Acres	Allowable Area Irriagated by DW system =	4	Irr Acres

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection devided by the average irrigated area per connection.

2022 - Quiet Meadows

1	Total water use (DW without PI) =	11	*AF/Year*	Total outdoor water use (DW) =	11	*AF/Year*
2	Average Water Use Per Irrigated Acre =	3.72	*AF/Irr Acre* *	Average Water Use Per Irrigated Acre =	3.72	*AF/Irr Acre* *
	Area Irrigated by DW System (1 / 2) =	3	Irr Acres	Area Irrigated by DW System (1 / 2) =	3	Irr Acres
	Allowable Area Irriagated by DW system =	4	Irr Acres	Allowable Area Irriagated by DW system =	4	Irr Acres

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection devided by the average irrigated area per connection.

CLIENT	Mapleton City	SHEET	1 OF 2
PROJECT	2024 Master Plan		
FEATURE	2024 Outdoor Irrigation Calculations	COMPUTED	JEJ
PROJECT NO	437.15.100	DATE	11/09/23

Abbreviations:
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https://waterrights.utah.gov/asp_apps/viewEditSEC/secView.asp?SYSTEM_ID=11376

Key: Input | Calculated Value

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Area Irrigated by PI System Calculated using the Billing Data

2020				
	Annual Rainfall =	11.64	in	
1	Total water use =	1,541	*AF/Year*	
2	Average Water Use Per Irrigated Acre =	4.58	*AF/Irr Acre* *	
3	Total Number of PI Connections =	1,412	**	
4	Average Irrigated Area Per Connection =	0.23	*Acres*	
5	Total Area of all Parcels on PI =	912.53	*Acres*	
6	Average Percent of Parcel Irrigated =	36%	***	
	Area Irrigated by PI System (1 / 2) =	336	Irr Acres	
	Allowable Area Irriagated by PI system =	467	Irr Acres	
	Area Irrigated by PI System (3 * 4) =	325	Irr Acres	
	Area Irrigated by PI System (5 * 6) =	329	Irr Acres	

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection divided by the average irrigated area per connection.

2021				
	Annual Rainfall =	19.46	in	
1	Total water use =	1,333	*AF/Year*	
2	Average Water Use Per Irrigated Acre =	3.86	*AF/Irr Acre* *	billing, NDVI acres
3	Total Number of PI Connections =	1,470	**	
4	Average Irrigated Area Per Connection =	0.23	*Acres*	NDVI acres, number of connections
5	Total Area of all Parcels on PI =	954.07	*Acres*	
6	Average Percent of Parcel Irrigated =	36%	***	NDVI acres, number of connections, lot size
	Area Irrigated by PI System (1 / 2) =	345	Irr Acres	
	Allowable Area Irriagated by PI system =	480	Irr Acres	
	Area Irrigated by PI System (3 * 4) =	338	Irr Acres	
	Area Irrigated by PI System (5 * 6) =	343	Irr Acres	

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection divided by the average irrigated area per connection.

2022				
	Annual Rainfall =	15.87	in	
1	Total water use =	1,426	*AF/Year*	
2	Average Water Use Per Irrigated Acre =	3.72	*AF/Irr Acre* *	
3	Total Number of PI Connections =	1,730	**	
4	Average Irrigated Area Per Connection =	0.23	*Acres*	
5	Total Area of all Parcels on PI =	1,102.98	*Acres*	
6	Average Percent of Parcel Irrigated =	36%	***	
	Area Irrigated by PI System (1 / 2) =	383	Irr Acres	
	Allowable Area Irriagated by PI system =	533	Irr Acres	
	Area Irrigated by PI System (3 * 4) =	398	Irr Acres	
	Area Irrigated by PI System (5 * 6) =	397	Irr Acres	

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection divided by the average irrigated area per connection.

Area Irrigated by DW System Calculated using the Billing Data

2020						
1	Total outdoor water use (DW without PI) =	1,321	*AF/Year*	Total outdoor water use (DW) =	1,536	*AF/Year*
2	Average Water Use Per Irrigated Acre =	4.58	*AF/Irr Acre* *	Average Water Use Per Irrigated Acre =	4.58	*AF/Irr Acre* *

3	Total Number of DW Connections Without PI =	1,412	**	
4	Average Irrigated Area Per Connection =	0.23	*Acres*	
5	Total Area of all Parcels on DW without PI =	1,566.90	*Acres*	
6	Average Percent of Parcel Irrigated =	36%	***	

Area Irrigated by DW System (1 / 2) =	288	Irr Acres	Area Irrigated by DW System (1 / 2) =	335	Irr Acres
Allowable Area Irrigated by DW system =	400	Irr Acres	Allowable Area Irrigated by PI system =	466	Irr Acres
Area Irrigated by DW System (3 * 4) =	325	Irr Acres			
Area Irrigated by DW System (5 * 6) =	564	Irr Acres			

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection divided by the average irrigated area per connection.

2021

1	Total outdoor water use (DW without PI) =	1,125	*AF/Year*	Total outdoor water use (DW) =	1,261	*AF/Year*
2	Average Water Use Per Irrigated Acre =	3.86	*AF/Irr Acre* *	Average Water Use Per Irrigated Acre =	3.86	*AF/Irr Acre* *
3	Total Number of DW Connections Without PI =	1,425	**			
4	Average Irrigated Area Per Connection =	0.23	*Acres*			
5	Total Area of all Parcels on DW without PI =	1,581.45	*Acres*			
6	Average Percent of Parcel Irrigated =	36%	***			

Area Irrigated by DW System (1 / 2) =	292	Irr Acres	Area Irrigated by DW System (1 / 2) =	327	Irr Acres
Allowable Area Irrigated by DW system =	405	Irr Acres	Allowable Area Irrigated by DW system =	454	Irr Acres
Area Irrigated by DW System (3 * 4) =	328	Irr Acres			
Area Irrigated by DW System (5 * 6) =	569	Irr Acres			

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection divided by the average irrigated area per connection.

2022

1	Total outdoor water use (DW without PI) =	1,122	*AF/Year*	Total outdoor water use (DW) =	1,292	*AF/Year*
2	Average Water Use Per Irrigated Acre =	3.72	*AF/Irr Acre* *	Average Water Use Per Irrigated Acre =	3.72	*AF/Irr Acre* *
3	Total Number of DW Connections Without PI =	1,531	**			
4	Average Irrigated Area Per Connection =	0.23	*Acres*			
5	Total Area of all Parcels on DW without PI =	1,664.96	*Acres*			
6	Average Percent of Parcel Irrigated =	36%	***			

Area Irrigated by DW System (1 / 2) =	302	Irr Acres	Area Irrigated by DW System (1 / 2) =	347	Irr Acres
Allowable Area Irrigated by DW system =	419	Irr Acres	Allowable Area Irrigated by DW system =	482	Irr Acres
Area Irrigated by DW System (3 * 4) =	352	Irr Acres			
Area Irrigated by DW System (5 * 6) =	599	Irr Acres			

*Calculated as part of the NDVI analysis. Total volume used divided by the number of acres.
**See .\Number of Connections.xlsx
***Calculated as part of the NDVI analysis. Average area per connection divided by the average irrigated area per connection.

Client:	Mapleton City
Project:	Mapleton PI and Drinking Water Master Plan
Project #:	437.15.100
Completed by:	Enoch Jones
Date:	4/17/2023

HANSEN ALLEN & LUCE INC ENGINEERS

Description

An analysis was performed to determine the volume of water used per acre from the Mapleton City PI System. The Normalized Difference Vegetation INdex (NDVI) Equation was used on 2021 National Agriculture Imagery Program (NAIP) imagery to identify healthy vegetation within Mapleton City. The city land parcels were filtered by parcels with PI, according to the September 2022 billing data, and intersected with the area covered by healthy vegetation to find the amount of area irrigated by the city PI system. Total usage for 2021 was used to calculate the usage per acre. ArcGIS Pro was used to perform the analysis.

Data

2021 Monthly Billing Data:	Included on the Monthly PI Usage tab
Sep 2022 Georeferenced Billing Data:	H:\Projects\437 - Mapleton City\15.100 DW and PI Master Plan\GIS\Geocoding\Sept22_PI_Billing.shp
2021 NAIP Imagery:	H:\Projects\437 - Mapleton City\15.100 DW and PI Master Plan\GIS\Data\Rasters\FinalRasters\Mapleton_RGB.tif
	H:\Projects\437 - Mapleton City\15.100 DW and PI Master Plan\GIS\Data\Rasters\FinalRasters\Mapleton_NIR.tif
Billing Data:	H:\Projects\437 - Mapleton City\15.100 DW and PI Master Plan\ENG\Calculations\Water Usage and Billing Data.xlsx
NDVI Analysis GIS Model:	H:\Projects\437 - Mapleton City\15.100 DW and PI Master Plan\GIS\NDVI Analysis Model\GIS_Models.atbx

NDVI Analysis

The NDVI Equation (see Equation 1) was used to identify vegetation. Once the initial raster was generated, the values were scaled from -1 to 1 to 0 to 155 (see Equation 2). A threshold value of 147 was chosen through visual inspection of the imagery to represent irrigated area. All cell values below the threshold were discarded and values above the threshold were kept as representative of irrigated area.

Equation 1	(RED - NIR) / (RED + NIR)	Where RED is the red band and NIR is the near infrared band.
Equation 2	(CV + 1) * 255 / 2	Where CV is the cell value.

After the NDVI equation was run, the resulting area was visually inspected to remove or add any areas that were deemed to be in error. The total area was divided by the parcels and the volume of water used at each parcel was associated with the irrigated area. The total annual volume used divided by the irrigated area resulted in annual use per acre. The annual use per acre for all the parcels were analyzed to determine an average annual use per acre representative of the typical resident of Mapleton City.

Number of Connections:	1454	connections	This is the total number of connections used in the NDVI Analysis.
Number of Connections from Billing:	1513	Connections	This is the number of connections from the 2021 billing data for all categories.
Total PI Usage For 2021 from Billing:	1332.89	acre-feet	Total usage for 2021 from the billing data for all categories.
Total PI Production For 2021 from Report:	1351.20	acre-feet	Total production for 2021 from the yearly report for all categories.

Results

Total Area Used in Analysis:	928.58		
Area Irrigated by Mapleton City PI:	335.56	acres	This is the total resulting area from the NDVI Analysis.
Average Area Per Connection:	0.64	acres/connection	This is the average lot size based on all parcels used in the NDVI Analysis.
Average Irr Area Per Connection:	0.23	acres/connection	This is the total number of connections used in the NDVI Analysis divided by the total resulting area from the NDVI Analysis.
Percent Irrigated:	36%		
Average Annual Usage Per Acre:	3.72	acre-feet / irr acre / year	This is the average of individual annual usage per acre from the NDVI Analysis.
Required PI Production (calculated LOS):	4.47	acre-feet / irr acre / year	This is the average PI usage with a factor of safety to account for system losses and peak demands.
Required PI Production Capacity (calculated LOS):	9.17	gpm / irr acre	

Selected LOS:

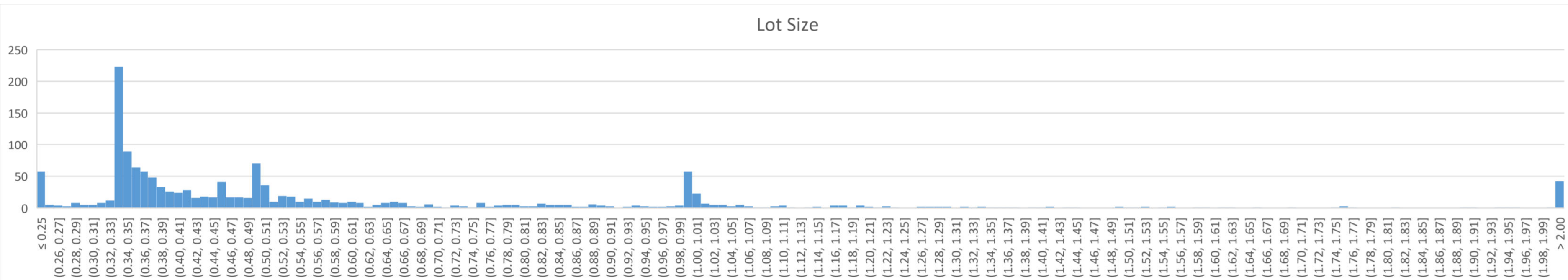
Percent Irrigated: 50%

Required PI Production (LOS): 3.2 gpm/irr acre/year

Required PI Production Capacity (LOS): 6.6 gpm/irr acre

Analysis by Lot Size

Water usage varies by different lot size. For example, washing a car would account for a much larger portion of the total outdoor usage for a small lot than it would for a large lot. A histogram of lot sizes was used to determine if there were natural breakpoints which could be used to lump the lots into 4 or 5 bins. The application rate and percent irrigated for each of these bins was then calculated.



Analysis by Lot Size

Bin	From	To	Production Application Rate (Ac-Ft / Acre)	Peak Day Production Flow (gpm / Acre)	% Irrigated
< 0.3	0	0.3	6.31	13.41	33.7%
0.3 to 0.5	0.3	0.5	5.39	10.76	38.8%
0.5 to 1	0.5	1	4.25	8.88	38.2%
1 <	1	100	3.55	7.21	32.3%

Number of Future Lots by Size

Bin	From	To	Number of Lots	Developable Area (Acres)
< 0.3	0	0.3	3206	522
0.3 to 0.5	0.3	0.5	501	175
0.5 to 1	0.5	1	377	266
1 <	1	100	475	845

APPENDIX D

Growth Projections and Future Development

CLIENT Mapleton City
PROJECT 2024 Master Plan
FEATURE Requirements at Buildout
PROJECT NO 437.15.100

COMPUTED JEJ
DATE 11/14/2023
CHECKED KJ

The existing number of ERCs and existing irrigated area was calculated for Mapleton using the City's billing data and the results of the NDVI Analysis. The resulting number of ERCs and area irrigated by each system for the year 2022 is shown in Table 1.

Table 1. Number of ERCs and Acres of Area Irrigated in 2022

	Total	Zone 1	Zone 2	Zone 3	Clegg Canyon	Quiet Meadows
ERCs	3466	3266	181	0	0	19
DW Irr Area (Acres)	482	427	51	0	0	4
PI Irr Area (Acres)	533	533	-	-	-	-
Total Area Irrigated:	1015					

The future number of ERCs and irrigated acres was calculated using Mapleton City's zoning and planned developments. Any planned developments were reviewed and the number of lots in the planned development recorded. The number of ERC's across the remainder of the City was determined using the density allowed under Mapleton's zoning times the area of each land usage zone. The number of ERCs was grown proportionally with the population to determine the approximate year when full development would be reached. Table 2 summarizes the number of ERCs and irrigated area in each pressure zone at the year full development is reached. Table 3 is the projected water usage requirements at full development. Table 4 is the projected requirements at a given percentage of buildout.

Table 2. Number of ERCs and Acres of Area Irrigated at Buildout

		Total	Zone 1	Zone 2	Zone 3	Clegg Canyon	Quiet Meadows
	ERCs	10574	8929	1065	508	8	64
	DW Irr Area (Acres)	200	152	38	6	1	4
2002	PI Irr Area (Acres)	1802	1367	341	50	5	40
	Estimated Population	37010	31253	3727	1778	28	224

Indoor LOS

	Value	Unit
Peak Day Source	500	GPD / ERC
Annual Source	0.35	AF / ERC
Storage	500	GAL / ERC

Table 3. Projected Requirements by Area at Buildout

Select Zone	System	ERCs	Allowable Irrigated Acres	Peak Day Source (GPM)	Annual Source (AF)	Equalization & Emergency Storage (GAL)
Total	Drinking Water System - Indoor	10574	-	3,700	3,700	5,287,000
	Drinking Water System - Outdoor	-	200	1,300	640	1,442,000
	Drinking Water System - Total	10574	200	5,000	4,340	6,729,000
	PI System	-	1802	11,900	5,800	12,976,000
			2002	13215.84		

Outdoor LOS - Based on Allowable Irrigated Acres (50% Irrigated)

	Value	Unit
Allowable Percent	50	%
Peak Day Source	6.6	GPM / IRR AC
Annual Source	3.2	AF / IRR AC
Storage	7200	GAL / IRR AC

Buildout Percentage: 85%
Estimated Year: 2117
Occurs in 93 Years

Table 4. Projected Requirements at 85% of Buildout

System	ERCs	Allowable Irrigated Acres	Peak Day Source (GPM)	Annual Source (AF)	Equalization & Emergency Storage (GAL)
Drinking Water System - Indoor	8988	-	3,121	3,146	4,494,040
Drinking Water System - Outdoor	-	170	1,123	545	1,225,469
Drinking Water System - Total	8988	170	4,244	5,723,199	5,719,509
PI System		1532	10,110	4,902	11,029,223
Estimated Population	32207				

*Multiplier for Development:	30%	assume 30% of gross area is roads or non-developable
**Multiplier for % Irrigated:	50%	
***Multiplier for Townhomes:	85%	
†ERCs per Acre for Commercial:	4.00	
‡% Irrigated for Commercial:	20%	
§ERCs per Acre for Parks:	2.00	
Percentage of Area Irr by DW:	10%	
People per ERC:	3.50	3.59
*Multiplier for Dev (Density Reduction):	0%	

Note 1: Includes Open Spaces and Parks and Commercial at buildout

Mapleton City

	Number of Existing Single Family Lots	Number Single Family Lots at Buildout	ERCs from Single Family Lots at Buildout	Single Family Lots Total Area (Acres)	Single Family Lots Lot Area at Buildout (Acres)*	Single Family Lots Irrigable Area at Buildout (Acres)**	Number of Existing Townhomes and Condos	Number of Townhomes and Condos at Buildout	ERCs from Townhomes and Condos at Buildout	Townhomes and Condos Total Area (Acres)	Townhomes and Condos Lot Area at Buildout (Acres)*	Townhomes and Condos Irrigable Area at Buildout (Acres)	Open Spaces and Parks Total Area at Buildout (Acres)	ERCs from Open Spaces and Parks at Buildout §	Open Spaces and Parks Irrigable Area at Buildout (Acres)*	Commercial Total Area at Buildout (Acres)	ERCs from Commercial at Buildout †	Commercial Irrigable Area at Buildout (Acres) ‡	Total Number of Existing ERCs	Total Number of ERCs at Buildout	Total Number of Residential Units at Buildout	Total Buildout Irrigable Area with Active PI Pipe (Acres)	Total Buildout Irrigable Area with Dry PI Pipe (Acres)	Total Buildout Irrigable Area with Planned PI Pipe (Acres)	Total Buildout Irrigable Area with no Planned PI Pipe (Acres)	Total Buildout Irrigable Area Irrigated by DW (Acres)	Total Existing Irrigable Area (Acres) (see note 1)	Total Irrigable Area at Buildout (Acres)	Zoning Density (Lots / Acre)	DW GPM/Acre
Mapleton Village	10	372	372	131.4	101.5	50.7	0	206	175	25.0	17.5	8.7	9.0	12.6	6.3	0.0	0.0	0.0	4	560	578	0.0	42.1	19.0	0.0	0.0	7.7	61.1	NA	1.174877
Mapleton Heights	38	285	285	107.0	74.9	37.5	0	0	0	0.0	0.0	0.0	0.7	1.0	0.5	0.0	0.0	0.0	2	286	285	0.0	38.0	0.0	0.0	0.0	4.8	38.0	NA	0.921509
Twin Hollow	8	52	52	45.0	31.5	15.7	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6	52	52	0.0	15.7	0.0	0.0	0.0	2.4	15.7	NA	0.401525
The Preserve	32	92	92	238.1	166.7	83.3	0	0	0	0.0	0.0	0.0	7.9	11.0	5.5	0.0	0.0	0.0	30	103	92	24.5	16.8	47.5	0.0	0.0	20.0	88.8	NA	0.145419
Harmony Ridge	0	376	376	107.4	75.2	37.6	0	614	522	58.3	40.8	20.4	30.0	42.0	21.0	60.0	240.0	12.0	0	1180	990	0.0	0.0	91.0	0.0	0.0	33.0	91.0	NA	1.602305
Sunrise Ranch	98	282	282	91.1	63.8	31.9	0	258	219	47.9	33.5	16.8	29.4	41.1	20.5	3.2	12.6	0.6	31	555	540	69.8	0.0	0.0	0.0	0.0	32.3	69.8	NA	1.123697
Harvest Park	376	376	376	92.5	64.7	32.4	127	127	108	12.0	8.4	4.2	8.4	11.8	5.9	9.5	38.2	1.9	329	534	503	44.4	0.0	0.0	0.0	0.0	44.4	44.4	NA	1.513638
Maple Bench	0	60	60	102.9	72.0	36.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	60	60	0.0	0.0	0.0	0.0	36.0	0.0	0.0	NA	0.202418
A-2	639	1134	1134	2266.3	1586.4	793.2	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	763	1134	1134	268.4	121.6	391.9	11.3	0.0	435.9	781.9	0.5	0.173744
CE-1	0	0	0	7.6	5.3	2.7	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0	0
GC-1	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	176.8	707.1	35.4	102	707	0	24.9	0.0	10.4	0.0	0.0	35.4	35.4	NA	1.388889
I&M-1	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	47.2	188.8	9.4	0	189	0	6.0	0.0	3.5	0.0	0.0	9.4	9.4	NA	1.388889
OS-P	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	119.5	167.3	83.6	0.0	0.0	0.0	0	167	0	36.7	0.0	13.1	33.9	0.0	49.7	49.7	NA	0.486111
PRD	123	190	190	139.7	97.8	48.9	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	190	190	48.9	0.0	0.0	0.0	0.0	31.6	48.9	NA	0.472341
R-1-B	113	397	397	132.1	92.5	46.2	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124	397	397	22.3	0.0	23.9	0.0	0.0	13.2	46.2	3.004138	1.043233
R-2	201	803	803	184.2	129.0	64.5	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	222	803	803	64.5	0.0	0.0	0.0	0.0	16.1	64.5	4.356	1.513422
R-2-B	22	22	22	5.6	3.9	2.0	76	76	65	14.6	10.2	5.1	0.0	0.0	0.0	0.0	0.0	0.0	67	87	98	0.0	2.3	4.8	0.0	0.0	7.1	7.1	NA	1.490581
RA-1 / RA-1-C	373	611	611	610.8	427.5	213.8	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	410	611	611	149.1	14.8	49.9	0.0	0.0	130.5	213.8	1	0.347347
RA-2	1125	2890	2890	962.0	673.4	336.7	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1272	2890	2890	336.7	0.0	0.0	0.0	0.0	131.1	336.7	3.004138	1.043069
TDRs	0	70	70	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	70	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	24.30556
Total	3158	8012	8012	5224	3666	1833	203	1281	1089	158	110	55	205	287	143	297	1187	59	3362	10574	9293	1096	251	655	47	36	1005	2002		0.864896
																		Additional ERCs:		7212						Additional Irrigable Area (Acres):		998		

Zone 1

	Number of Existing Single Family Lots	Number Single Family Lots at Buildout	ERCs from Single Family Lots at Buildout	Single Family Lots Total Area (Acres)	Single Family Lots Lot Area at Buildout (Acres)*	Single Family Lots Irrigable Area at Buildout (Acres)**	Number of Existing Townhomes and Condos	Number of Townhomes and Condos at Buildout	ERCs from Townhomes and Condos at Buildout	Townhomes and Condos Total Area (Acres)	Townhomes and Condos Lot Area at Buildout (Acres)*	Townhomes and Condos Irrigable Area at Buildout	Open Spaces and Parks Total Area at Buildout (Acres)	ERCs from Open Spaces and Parks at Buildout §	Open Spaces and Parks Irrigable Area at Buildout (Acres)*	Commercial Total Area at Buildout (Acres)	ERCs from Commercial at Buildout †	Commercial Irrigable Area at Buildout (Acres) ‡	Total Number of Existing ERCs	Total Number of ERCs at Buildout	Total Number of Residential Units at Buildout	Total Buildout Irrigable Area with Active PI Pipe (Acres)	Total Buildout Irrigable Area with Dry PI Pipe (Acres)	Total Buildout Irrigable Area with Planned PI Pipe (Acres)	Total Buildout Irrigable Area with no Planned PI Pipe (Acres)	Total Buildout Irrigable Area Irrigated by DW (Acres)	Total Existing Irrigable Area (Acres) (see note 1)	Total Irrigable Area at Buildout (Acres)	Zoning Density (Lots / Acre)	DW GPM/Acre
Mapleton Village	0	124	124	24.0	16.8	8.4	0	206	175	25.0	17.5	8.7	9.0	12.6	6.3	0.0	0.0	0.0	0	312	330	0.0	23.5	0.0	0.0	0.0	6.3	23.5	NA	1.864971
Mapleton Heights	38	252	252	81.8	57.3	28.6	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2	252	252	0.0	28.6	0.0	0.0	0.0	4.3	28.6	NA	1.069761
Twin Hollow	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
The Preserve	32	54	54	70.1	49.0	24.5	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30	54	54	24.5	0.0	0.0	0.0	0.0	14.5	24.5	NA	0.267603
Harmony Ridge	0	0	0	0.0	0.0	0.0	0	492	418	48.1	33.7	16.8	0.9	1.3	0.6	7.1	28.5	1.4	0	448	492	0.0	0.0	18.9	0.0	0.0	2.1	18.9	NA	2.769744
Sunrise Ranch	98	282	282	91.1	63.8	31.9	0	258	219	47.9	33.5	16.8	29.4	41.1	20.5	3.2	12.6	0.6	31	555	540	69.8	0.0	0.0	0.0	0.0	32.3	69.8	NA	1.123697
Harvest Park	376	376	376	92.5	64.7	32.4	127	127	108	12.0	8.4	4.2	8.4	11.8	5.9	9.5	38.2	1.9	329	534	503	44.4	0.0	0.0	0.0	0.0	44.4	44.4	NA	1.513638
Maple Bench	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
A-2	470	731	731	1461.8	1023.2	511.6	0	0	0	0.0	0.0	0.0	0.0000	0.0	0.0	0.0	0.0	0.0	585	731	731	248.6	59.4	203.7	0.0	0.0	328.9	511.6	0.5	0.173638
CE-1	0	0	0	4.5	3.2	1.6	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0	0
GC-1	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	176.8	707.1	35.4	102	707	0	24.9	0.0	10.4	0.0	0.0	35.4	35.4	NA	1.388889
I&M-1	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	47.2	188.8	9.4	0	189	0	6.0	0.0	3.5	0.0	0.0	9.4	9.4	NA	1.388889
OS-P	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	101.7	142.4	71.2	0.0	0.0	0.0	0	142	0	36.7	0.0	13.1	21.5	0.0	49.7	49.7	NA	0.486111
PRD	123	190	190	139.7	97.8	48.9	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	190	190	48.9	0.0	0.0	0.0	0.0	31.6	48.9	NA	0.472341
R-1-B	113	397	397	132.1	92.5	46.2	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124	397	397	22.3	0.0	23.9	0.0	0.0	13.2	46.2	3.004138	1.043233
R-2	201	803	803	184.2	129.0	64.5	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	222	803	803	64.5	0.0	0.0	0.0	0.0	16.1	64.5	4.356	1.513422
R-2-B	22	22	22	5.6	3.9	2.0	76	76	65	14.6	10.2	5.1	0.0	0.0	0.0	0.0	0.0	0.0	67	87	98	0.0	2.3	4.8	0.0	0.0	7.1	7.1	NA	1.490581
RA-1 / RA-1-C	362	569	569	568.9	398.2	199.1	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	399	569	569	140.8	14.8	43.6	0.0	0.0	126.7	199.1	1	0.347292
RA-2	1125	2890	2890	962.0	673.4	336.7	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1272	2890	2890	336.7	0.0	0.0	0.0	0.0	131.1	336.7	3.004138	1.043069
TDRs	0	70	70	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	70	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	24.30556
Total	2960	6760		3818	2673	1336	203	1159	985	148	103	52	149	209	105	244	975	49	3162	8929	7919	1068	129	322	23		853	1518		

Zone 2

	Number of Existing Single Family Lots	Number Single Family Lots at Buildout	ERCs from Single Family Lots at Buildout	Single Family Lots Total Area (Acres)	Single Family Lots Lot Area at Buildout (Acres)*	Single Family Lots Irrigable Area at Buildout (Acres)**	Number of Existing Townhomes and Condos	Number of Townhomes and Condos at Buildout	ERCs from Townhomes and Condos at Buildout***	Townhomes and Condos Total Area (Acres)	Townhomes and Condos Lot Area at Buildout (Acres)*	Townhomes and Condos Irrigable Area at Buildout (Acres) **	Open Spaces and Parks Total Area at Buildout (Acres)	ERCs from Open Spaces and Parks at Buildout §	Open Spaces and Parks Irrigable Area at Buildout (Acres)*	Commercial Total Area at Buildout (Acres)	ERCs from Commercial at Buildout †	Commercial Irrigable Area at Buildout (Acres) ‡	Total Number of Existing ERCs	Total Number of ERCs at Buildout	Total Number of Residential Units at Buildout	Total Buildout Irrigable Area with Active PI Pipe (Acres)	Total Buildout Irrigable Area with Dry PI Pipe (Acres)	Total Buildout Irrigable Area with Planned PI Pipe (Acres)	Total Buildout Irrigable Area with no Planned PI Pipe (Acres)	Total Buildout Irrigable Area Irrigated by DW (Acres)	Total Existing Irrigable Area (Acres) (see note 1)	Total Irrigable Area at Buildout (Acres)	Zoning Density (Lots / Acre)	DW GPM/Acre
Mapleton Village	10	186	186	75.7	53.0	26.5	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	186	186	0.0	11.3	15.2	0.0	0.0	1.4	26.5	NA	0.852748
Mapleton Heights	0	33	33	25.2	17.7	8.8	0	0	0	0.0	0.0	0.0	0.7	1.0	0.5	0.0	0.0	0.0	0	34	33	0.0	9.4	0.0	0.0	0.0	0.5	9.4	NA	0.454771
Twin Hollow	8	52	52	45.0	31.5	15.7	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6	52	52	0.0	15.7	0.0	0.0	0.0	2.4	15.7	NA	0.401525
The Preserve	0	38	38	168.0	117.6	58.8	0	0	0	0.0	0.0	0.0	7.9	11.0	5.5	0.0	0.0	0.0	0	49	38	0.0	16.8	47.5	0.0	0.0	5.5	64.3	NA	0.096742
Harmony Ridge	0	0	0	0.0	0.0	0.0	0	122	104	10.2	7.1	3.6	29.1	40.7	20.3	52.9	211.5	10.6	0	356	122	0.0	0.0	34.5	0.0	0.0	30.9	34.5	NA	1.341353
Sunrise Ranch	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
Harvest Park	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
Maple Bench	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
A-2	149	321	321	641.8	449.2	224.6	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	158	321	321	19.9	45.0	148.5	11.3	0.0	93.0	213.4	0.5	0.17367
CE-1	0	0	0	3.1	2.2	1.1	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
GC-1	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
I&M-1	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
OS-P	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	17.8	24.9	12.4	0.0	0.0	0.0	0	25	0	0.0	0.0	0.0	12.4	0.0	0.0	0.0	NA	0.486111
PRD	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
R-1-B	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.004138	0
R-2	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.356	0
R-2-B	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
RA-1 / RA-1-C	11	42	42	41.9	29.3	14.7	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12	42	42	8.3	0.0	6.3	0.0	0.0	3.8	14.7	1	0.348088
RA-2	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.004138	0
TDRs	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
Total	178	672	672	1001	701	350	0	122	104	10	7	4	55	78	39	53	211	11	180	1065	794	28	98	252	24		138	378		

Zone 3

	Number of Existing Single Family Lots	Number Single Family Lots at Buildout	ERCs from Single Family Lots at Buildout	Single Family Lots Total Area (Acres)	Single Family Lots Lot Area at Buildout (Acres)*	Single Family Lots Irrigable Area at Buildout (Acres)**	Number of Existing Townhomes and Condos	Number of Townhomes and Condos at Buildout	ERCs from Townhomes and Condos at Buildout***	Townhomes and Condos Total Area (Acres)	Townhomes and Condos Lot Area at Buildout (Acres)*	Townhomes and Condos Irrigable Area at Buildout (Acres) **	Open Spaces and Parks Total Area at Buildout (Acres)	ERCs from Open Spaces and Parks at Buildout §	Open Spaces and Parks Irrigable Area at Buildout (Acres)*	Commercial Total Area at Buildout (Acres)	ERCs from Commercial at Buildout †	Commercial Irrigable Area at Buildout (Acres) ‡	Total Number of Existing ERCs	Total Number of ERCs at Buildout	Total Number of Residential Units at Buildout	Total Buildout Irrigable Area with Active PI Pipe (Acres)	Total Buildout Irrigable Area with Dry PI Pipe (Acres)	Total Buildout Irrigable Area with Planned PI Pipe (Acres)	Total Buildout Irrigable Area with no Planned PI Pipe (Acres)	Total Buildout Irrigable Area Irrigated by DW (Acres)	Total Existing Irrigable Area (Acres) (see note 1)	Total Irrigable Area at Buildout (Acres)	Zoning Density (Lots / Acre)	DW GPM/Acre
Mapleton Village	0	62	62	31.6	31.6	15.8	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	62	62	0.0	7.3	3.8	0.0	0.0	0.0	11.1	NA	0.6802
Mapleton Heights	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
Twin Hollow	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
The Preserve	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
Harmony Ridge	0	376	376	107.4	75.2	37.6	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	376	376	0.0	0.0	37.6	0.0	0.0	0.0	37.6	NA	1.215634
Sunrise Ranch	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
Harvest Park	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
Maple Bench	0	60	60	102.9	72.0	36.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	60	60	0.0	0.0	0.0	0.0	36.0	0.0	0.0	NA	0.202418
A-2	1	10	10	20.0	14.0	7.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	10	10	0.0	0.0	7.0	0.0	0.0	0.7	7.0	0.5	0.173581
CE-1	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
GC-1	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
I&M-1	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
OS-P	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
PRD	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
R-1-B	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.004138	0
R-2	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.356	0
R-2-B	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
RA-1 / RA-1-C	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	0
RA-2	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.004138	0
TDRs	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0
Total	1	508	508	262	193	96	0	0	0	0	0	0	0	0	0	0	0	0	1	508	508	0	7	48	0		1	56		

Clegg Canyon

	Number of Existing Single Family Lots	Number Single Family Lots at Buildout	ERCs from Single Family Lots at Buildout	Single Family Lots Total Area (Acres)	Single Family Lots Lot Area at Buldout (Acres)*	Single Family Lots Irrigable Area at Buldout (Acres)**	Number of Existing Townhomes and Condos	Number of Townhomes and Condos at Buildout	ERCs from Townhomes and Condos at Buildout***	Townhomes and Condos Total Area (Acres)	Townhomes and Condos Lot Area at Buldout (Acres)*	Townhomes and Condos Irrigable Area at Buldout (Acres) **	Open Spaces and Parks Total Area at Buldout (Acres)	ERCs from Open Spaces and Parks at Buildout §	Open Spaces and Parks Irrigable Area at Buldout (Acres)*	Commercial Total Area at Buldout (Acres)	ERCs from Commercial at Buildout †	Commercial Irrigable Area at Buldout (Acres) ‡	Total Number of Existing ERCs	Total Number of ERCs at Buildout	Total Number of Residential Units at Buildout	Total Buildout Irrigable Area with Active PI Pipe (Acres)	Total Buildout Irrigable Area with Dry PI Pipe (Acres)	Total Buildout Irrigable Area with Planned PI Pipe (Acres)	Total Buildout Irrigable Area with no Planned PI Pipe (Acres)	Total Buildout Irrigable Area Irrigated by DW (Acres)	Total Existing Irrigable Area (Acres) (see note 1)	Total Irrigable Area at Buildout (Acres)	Zoning Density (Lots / Acre)	DW GPM/Acre
A-2	0	8	8	15.4	10.8	5.4	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	8	8	0.0	0.0	5.4	0.0	0.0	0.0	5.4	0.5	0.180366

Quiet Meadows

	Number of Existing Single Family Lots	Number Single Family Lots at Buildout	ERCs from Single Family Lots at Buildout	Single Family Lots Total Area (Acres)	Single Family Lots Lot Area at Buldout (Acres)*	Single Family Lots Irrigable Area at Buldout (Acres)**	Number of Existing Townhomes and Condos	Number of Townhomes and Condos at Buildout	ERCs from Townhomes and Condos at Buildout***	Townhomes and Condos Total Area (Acres)	Townhomes and Condos Lot Area at Buldout (Acres)*	Townhomes and Condos Irrigable Area at Buldout (Acres) **	Open Spaces and Parks Total Area at Buldout (Acres)	ERCs from Open Spaces and Parks at Buildout §	Open Spaces and Parks Irrigable Area at Buldout (Acres)*	Commercial Total Area at Buldout (Acres)	ERCs from Commercial at Buildout †	Commercial Irrigable Area at Buldout (Acres) ‡	Total Number of Existing ERCs	Total Number of ERCs at Buildout	Total Number of Residential Units at Buildout	Total Buildout Irrigable Area with Active PI Pipe (Acres)	Total Buildout Irrigable Area with Dry PI Pipe (Acres)	Total Buildout Irrigable Area with Planned PI Pipe (Acres)	Total Buildout Irrigable Area with no Planned PI Pipe (Acres)	Total Buildout Irrigable Area Irrigated by DW (Acres)	Total Existing Irrigable Area (Acres) (see note 1)	Total Irrigable Area at Buildout (Acres)	Zoning Density (Lots / Acre)	DW GPM/Acre
A-2	19	64	64	127.3	89.1	44.6	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19	64	64	0.0	17.2	27.4	0.0	0.0	13.2	44.6	0.5	0.174555

CLIENT Mapleton City SHEET 1 OF 1
PROJECT 2024 Master Plan
FEATURE Population Projections COMPUTED JEJ
PROJECT NO 437.15.100 DATE 5/08/24

Population projections are used in the master plan to estimate the rate of growth of ERCs in the city. The number of ERCs is then used in the capital facilities plan to estimate a time range for the various planned projects.

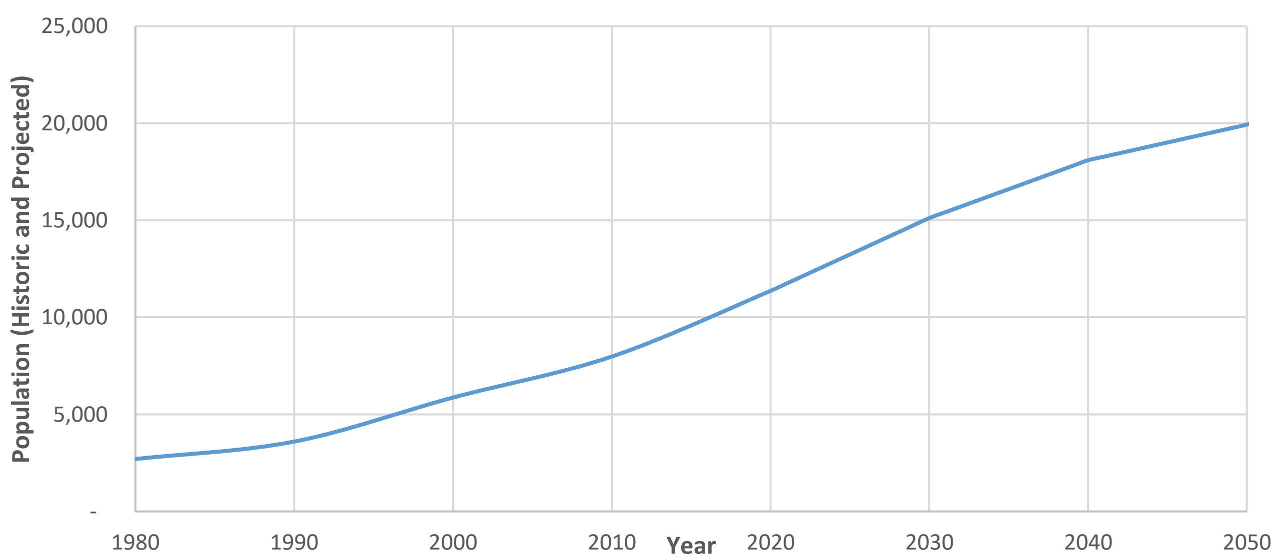
Population projections for Mapleton City were downloaded from the Mountainland Association of Governments' (MAG) website. MAG provides population projections for cities in Utah for 2020, 2030, 2040, and 2050. The percent change for each 10 year period was calculated using the given population value for each corrisponding year. The population projections provided by MAG and the calculated percent change are given in Table 1.

Table 1. MAG Small Area Population Projections

Year	Pop.	% Change
2020	12390	3.30%
2030	16480	1.97%
2040	19726	1.01%
2050	21724	1.0%

Table 2. Census Adjusted MAG Small Area Population Projections

Year	Pop.	ERCs	% Change
2020	11365	2812	3.30%
2030	15116	4805	1.97%
2040	18094	5698	1.01%
2050	19927	6269	0.92%
2060	21759	6840	



APPENDIX E

Model Calibration Data

MAPLETON DRINKING WATER SYSTEM
IDEAL PRV SETTINGS
DECEMBER 2023

Zone From	Zone To	Approximate Address	Approximate Ground Elevation (FT)	Measured Ground Elevation (FT)	Measured Depth to PRV (FT)	Approximate Valve Elevation (FT)	PRV Setting based on Valve Elevation (PSI)
Clegg Canyon	Quiet Meadows	450 N 2000 E	4900			4896	67
Quiet Meadows	2	1800 E 900 N	4847			4843	90
3	Clegg Canyon	365 N Clegg Canyon Loop (~2500 E 400 N)	4923			4919	57
3	2	2600 E 400 N	4937			4933	51
3	2	1900 E Maple St	4888			4884	72
3	2	1730 E Eagle Ct	4898			4894	68
3	2	1395 E 1600 S	4873			4869	78
3	2	285 E Maple Ridge Drive (near Twin Hollow Drive)	4920			4916	58
3	2	Mapleton Estates Drive near Hidden Hollow Cove (above Mapleton Village)	4956			4952	42
2	1	1202 E 1600 N	4810			4806	54
2	1	1215 E 400 N	4799			4795	55
2	1	1300 E Dogwood Dr	4819			4815	50
2	1	1100 E 1600 S	4823			4819	48
2	1	Main St (Mapleton Lateral Canal)	4829			4825	46
2	1	Twin Hollow A (Hidden Canyon Dr near Mapleton Estates Dr)	4830			4826	45
2	1	229 W Powderwood Lane (Mapleton Village Drive west of the canal)	4826			4822	47

To save energy in the drinking water system:
- Set the PRVs to the settings given in the table above
- Set the boosters to turn off if the Lower Tank is below 11 feet

Mapleton Masterplan
Model Calibration

Background

As part of the 2023 Mapleton Masterplan, a pressure logger was attached to multiple locations around the City of Mapleton, on both their drinking water (DW) and pressurized irrigation (PI) systems, to collect data points to which the models of their systems could be calibrated. One pressure logger was used and was left at each location for 2 to 5 days before being moved. Table 1 lists the point identifiers, whether the pressure logger was connected to the DW system or the PI system, dates the pressure logger was at the location, and locations (latitude/longitude) where the pressure logger was attached.

Table 1. Pressure Logger Locations

ID	SYSTEM	Date (2023)	ELEVATION (FT)	LATITUDE	LONGITUDE
1-1	DW	May 9 – May 11	4731	40.147775	-111.587632
1-2	DW	May 11 – May 15	4712	40.13499	-111.604351
1-3	DW	May 15 – May 17	4891	40.146054	-111.553594
1-4	DW	May 17 – May 19	4838	40.127891	-111.558732
1-5	DW	May 19 – May 21	4830	40.144972	-111.559264
1-6	DW	May 21 – May 23	4851	40.103035	-111.584714
1-7	DW	May 23 – May 25	4907	40.103009	-111.575845
1-8	DW	May 25 – May 30	5103	40.116338	-111.558052
1-9	PI	May 30 – June 1	4718	40.114224	-111.600371
1-10	PI	June 5 – June 6	4713	40.135201	-111.598212
1-11	PI	June 6 – June 8	4787	40.110671	-111.572092
2-1	DW	July 5 – July 10	4828	40.144474	-111.558777
2-2	DW	July 10 – July 12	4813	40.146126	-111.565010
2-3	DW	July 12 – July 14	4866	40.134052	-111.558327
2-4	DW	July 14 – July 17	4839	40.127766	-111.558655
2-5	DW	July 17 – July 19	4865	40.115925	-111.562584
2-6	DW	July 19 – July 25	4712	40.134571	-111.606163
2-7	PI	July 25 – July 27	4789	40.110920	-111.572960

The City of Mapleton is split into 4 pressure zones for their DW system and 3 for the PI system. The remainder of this document summarizes the data gathered with the pressure logger in each zone individually.

Drinking Water Zone 1

Most of Mapleton is in Zone 1, as it serves everyone in the valley. The pressure logger data points in Zone 1 are 1-1, 1-2, 1-6, 2-2, and 2-6. The hydraulic grade for these points should all be relatively similar. Table 2 gives the maximum, minimum and average hydraulic grade and pressure for each point and Figure 1 shows each location over a 24-hour time period. The data collected at location 1-2 is unnaturally flat and it is suspected that something was interfering with the pressure logger at this location.

Table 2. Drinking Water Zone 1 Pressure Logger Results

ID	Hydraulic Grade (ft)			Pressure (psi)		
	Avg	Max	Min	Avg	Max	Min
1-1	4929.1	4970.3	4911.2	86.8	98.5	78.0
1-2	4978.1	4981.5	4961.0	115.3	116.5	113.9
1-6	4944.1	4985.4	4909.2	39.0	58.2	26.0
2-2	4951.8	4972.1	4933.1	60.1	67.1	53.2
2-6	4936.8	4957.1	4909.7	98.2	106.2	87.6

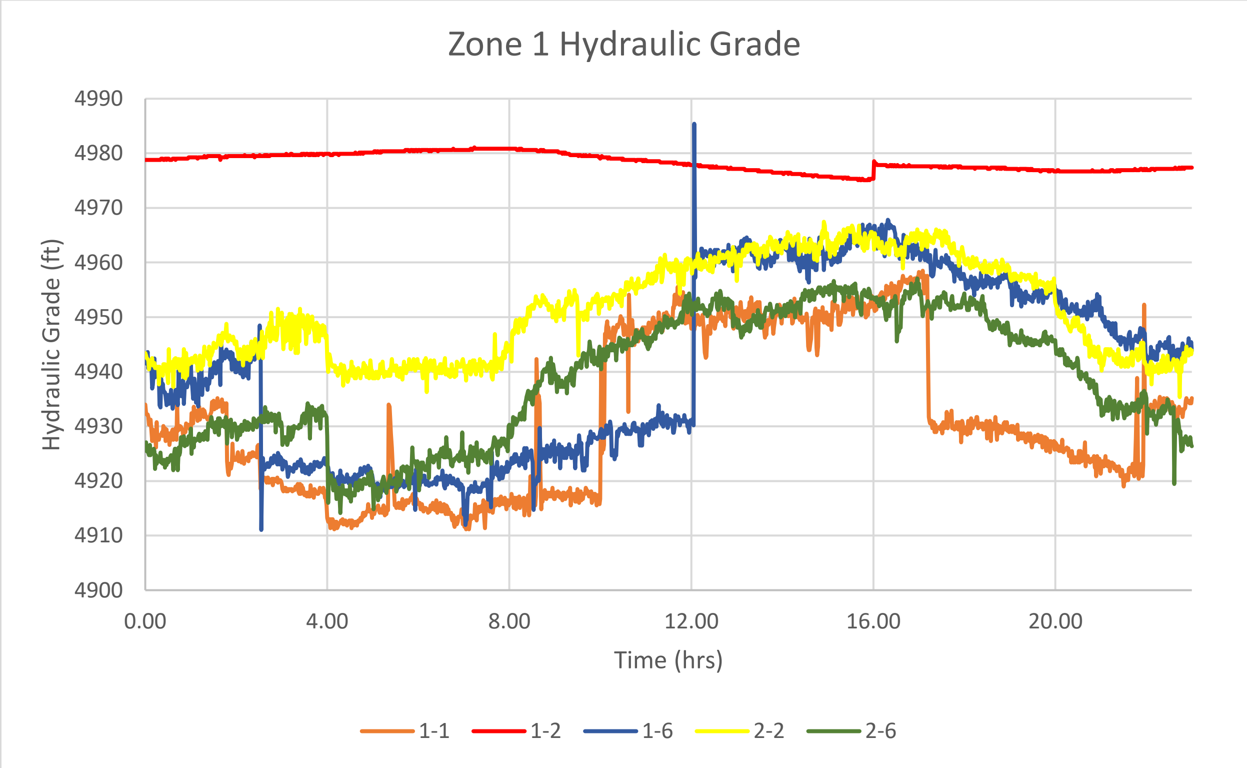


Figure 2. Drinking Water Zone 1 Hydraulic Grade

The pressures logged at each location, except 1-2, follow a similar trend and are within a normal operating range of one another. To calibrate the DW model, the hydraulic grade in Zone 1 should be within 4925 ft and 4960 ft.

Drinking Water Zone 2

Zone 2 serves the foothills, moving up onto the mountain in Mapleton. The data points within Zone 2 are 1-5, 2-1, 2-3, 1-4, 2-4, 2-5, and 1-7 moving north to south respectively. Table 3 summarizes the hydraulic grade and pressure at each location and Figure 3 shows the pressure trends over a 24-hour period.

Table 3. Drinking Water Zone 2 Pressure Logger Results

ID	Hydraulic Grade (ft)			Pressure (psi)		
	Avg	Max	Min	Avg	Max	Min
1-5	4984.9	4989.6	4977.8	67.1	69.1	64.0
2-1	4984.4	4988.3	4977.2	67.8	69.5	64.7
2-3	5063.6	5143.6	5052.8	85.4	120.0	80.7
1-4	5071.5	5178.5	5005.4	101.1	147.4	72.5
2-4	5050.5	5104.6	5032.5	91.4	114.8	83.6
2-5	5081.9	5203.5	5027.9	93.8	146.4	70.4
1-7	5049.9	5055.7	5039.8	61.9	64.4	57.5

The pressures in Zone 2 show three distinct patterns. The pressures in the north end of the zone were very consistent with pressures fluctuations of 5 psi over a 24-hour period. In the middle of the zone, pressures were erratic, with pressure fluctuations of 30 to 80 psi over a 20-hour period. The data point furthest south (1-7) is in a section of pipe disconnected from the rest of Zone 2. The pressures here were consistent throughout the day with fluctuations of 7 psi.

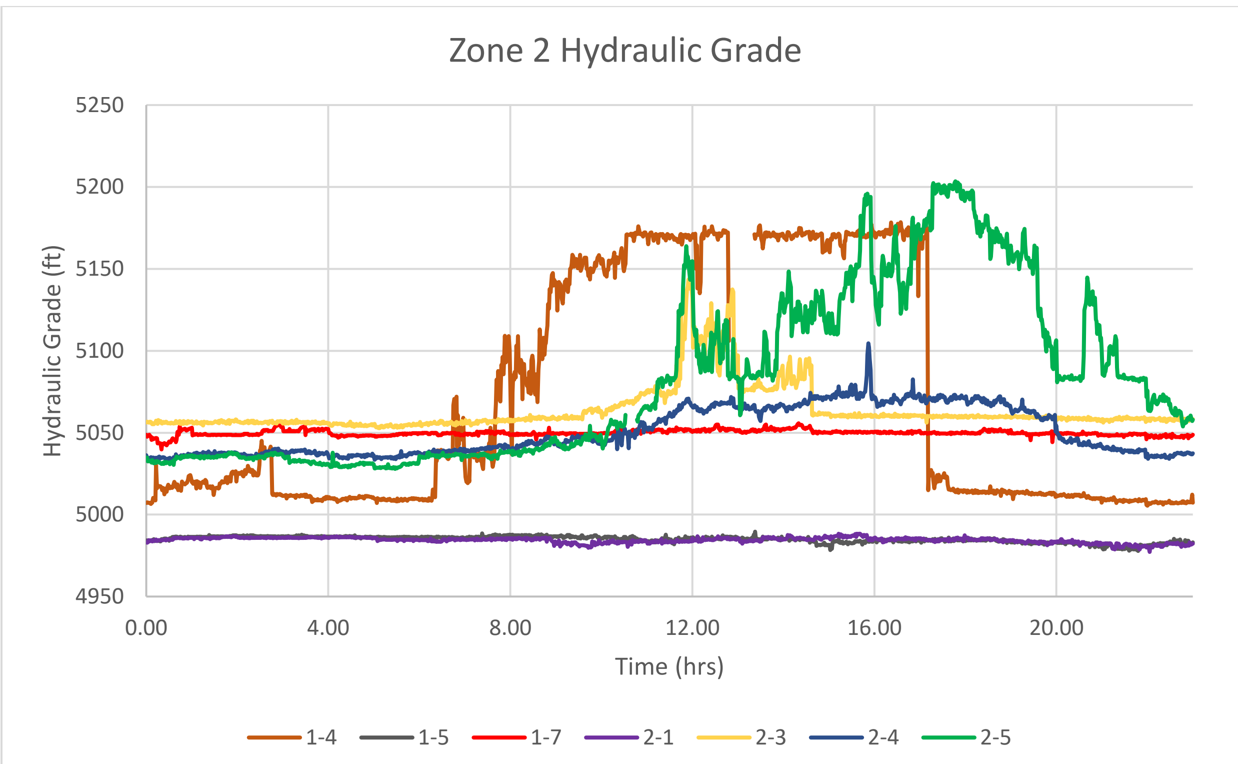


Figure 3. Drinking Water Zone 2 Hydraulic Grade

The pressure fluctuations seen in the middle of Zone 2 would indicate that something is isolating the northern portion of the zone. This could indicate a closed valve somewhere between the data point locations. Additionally, the fluctuations seem to be closely correlated with Westwood Well. When the well turns on, the pressure in Zone 1 increases, which closes the PRVs between Zones 2 and 1. Since water is no longer leaving Zone 2, pressure begins to build up in Zone 2.

The pressures in Zone 2 are much higher than the PRVs from Zone 3 to 2 should allow. There may be an open PRV which allows the high pressures.

The isolated northern portion of Zone 2 and the potentially open PRV make it difficult to calibrate the model. However, a hydraulic grade in the model of around 5050 feet would be reasonable.

Drinking Water Quiet Medows Zone and Zone 2

The highest elevations in Mapleton are served by the Quiet Medows Zone and Zone 3. Data point 1-3 is in the Quiet Medows Zone and data point 1-8 is in Zone 3. Both locations maintained consistent pressures with pressure fluctuations of 10 to 15 psi. Table 4 gives summarizes the hydraulic grade and pressure recorded. Figure 4 shows the pressure trend over a 24-hour period.

Table 4. Drinking Water Quiet Medows Zone and Zone 2 Pressure Logger Results

ID	Hydraulic Grade (ft)			Pressure (psi)		
	Avg	Max	Min	Avg	Max	Min
1-3	5067.0	5083.2	5051.3	76.2	83.2	69.4
1-8	5243.3	5250.3	5214.3	60.7	63.8	48.2

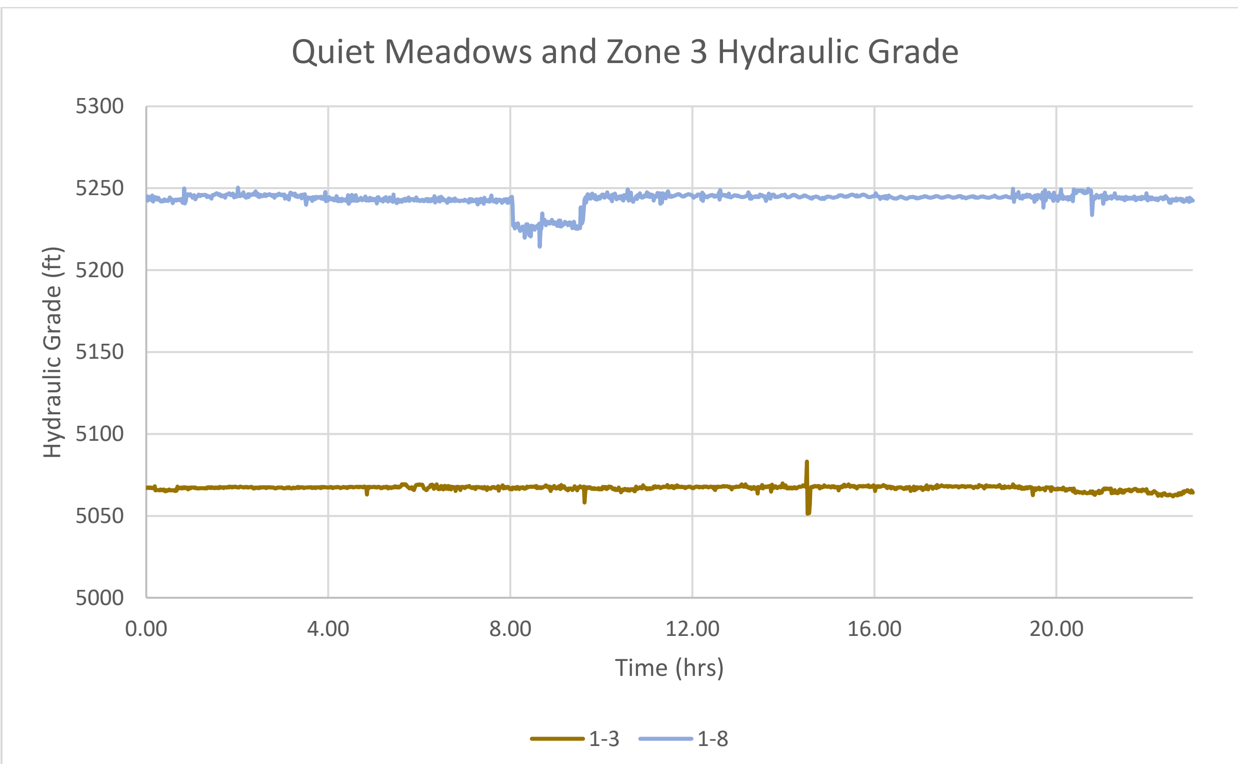


Figure 4. Drinking Water Quiet Meadows and Zone 3 Hydraulic Grade

Pressurized Irrigation System

Mapleton City's PI system is currently completely within Zone 1. Additional zones will be added as the system is expanded. Data points 1-9, 1-10, 1-11, and 2-7 were collected from the PI system. Table 5 summarizes the hydraulic grade and pressures recorded.

Table 5. Pressurized Irrigation System Pressure Logger Results

ID	Hydraulic Grade (ft)			Pressure (psi)		
	Avg	Max	Min	Avg	Max	Min
1-9	4881.8	4941.8	4862.5	70.9	96.9	62.6
1-10	4879.3	4939.8	4860.5	72	98.2	63.9
1-11	4896.1	4934.3	4864.8	47.3	63.8	33.7
2-7	4938.6	4962.0	4907.0	64.8	74.9	51.1

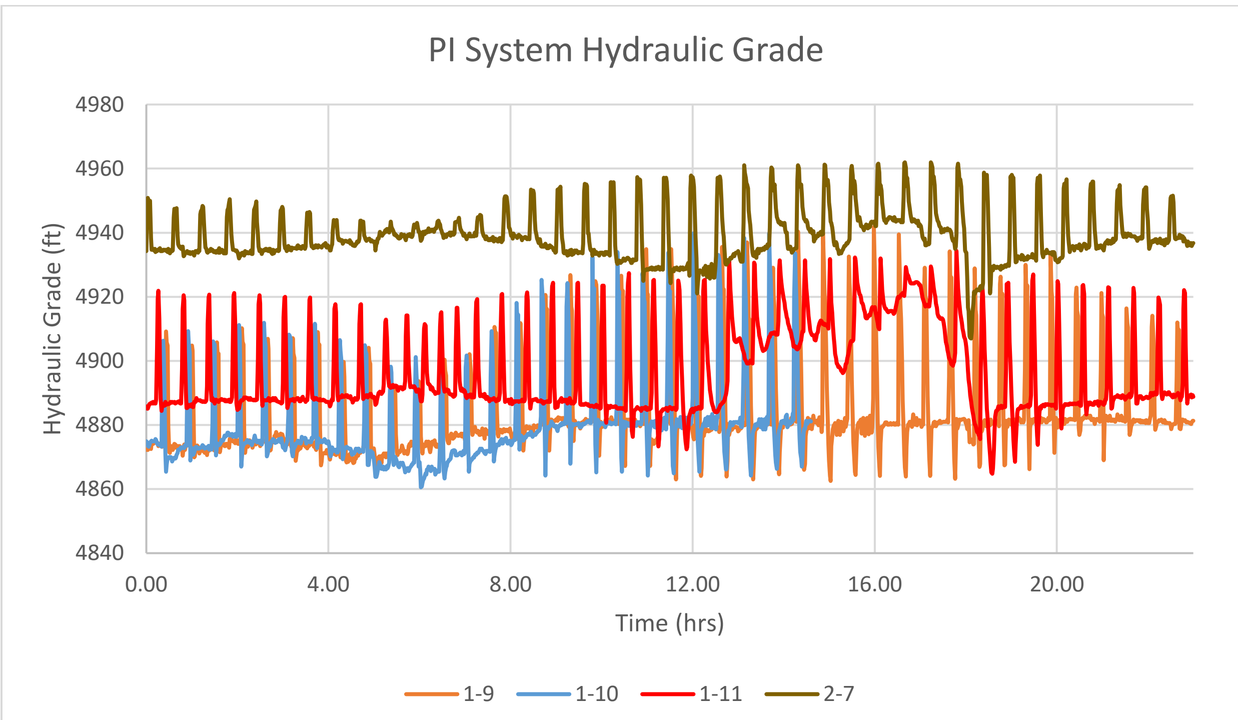


Figure 5. Pressurized Irrigation Hydraulic Grade

All the data points collected from the PI system were within the expected operating range. As can be seen in Figure 5, there are regular pressure spikes of 30 psi that correspond to the flushing pumps turning on. The model of the PI system should have a hydraulic grade between 4870 and 4940 feet.

PRV Analysis

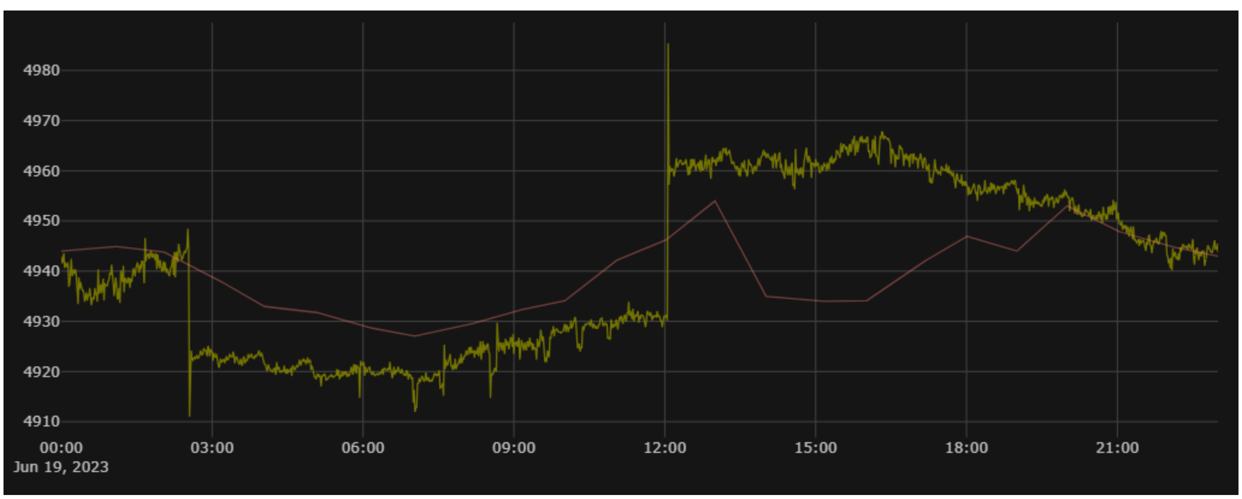
Starting in February 2023, Mapleton personnel have been recording the pressures up and down from the PRVs in the city's drinking water system. These pressure records provide additional data points for model calibration and system optimization.

Drinking Water Model Calibration

The pressure logger data was compared with model results at corresponding locations. While the model will never capture the exact shape of the pressure fluctuations in the real system, for a well calibrated model, the range of pressures should be similar and the general trend should match. After analyzing the pressure logger data and comparing it with the model results, it was determined that the model of the drinking water system provides a good representation of the existing system. The following figures show some of the location comparisons.

Location 1-1 Model Location

Figure 6. Model Comparison at Location 1-1 (Zone 1)



Location 1-6 Model Location

Figure 7. Model Comparison at Location 1-6 (Zone 1)

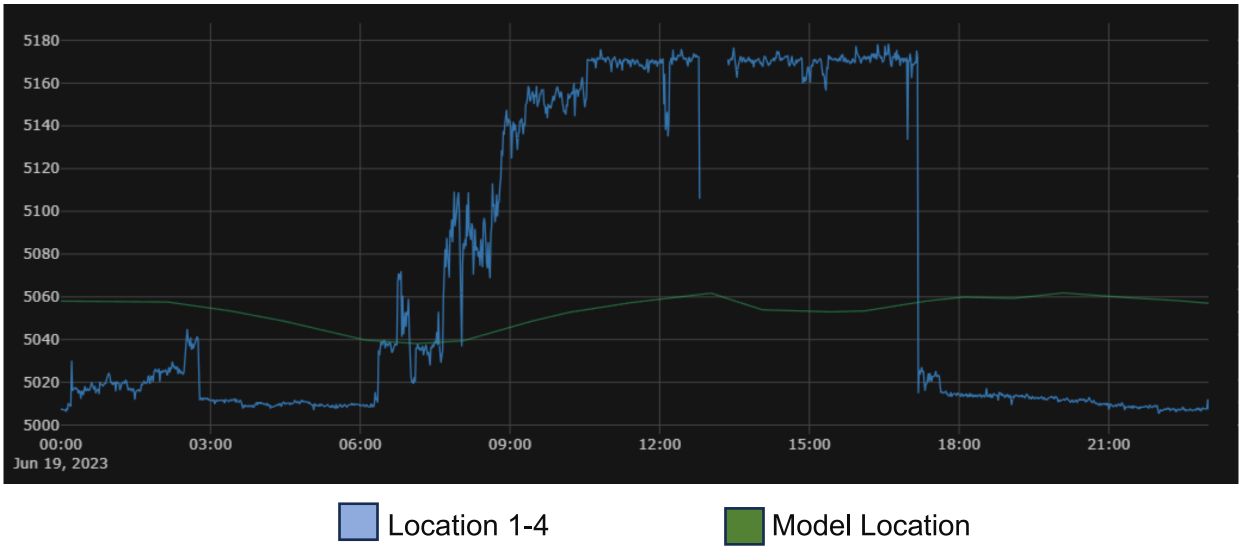
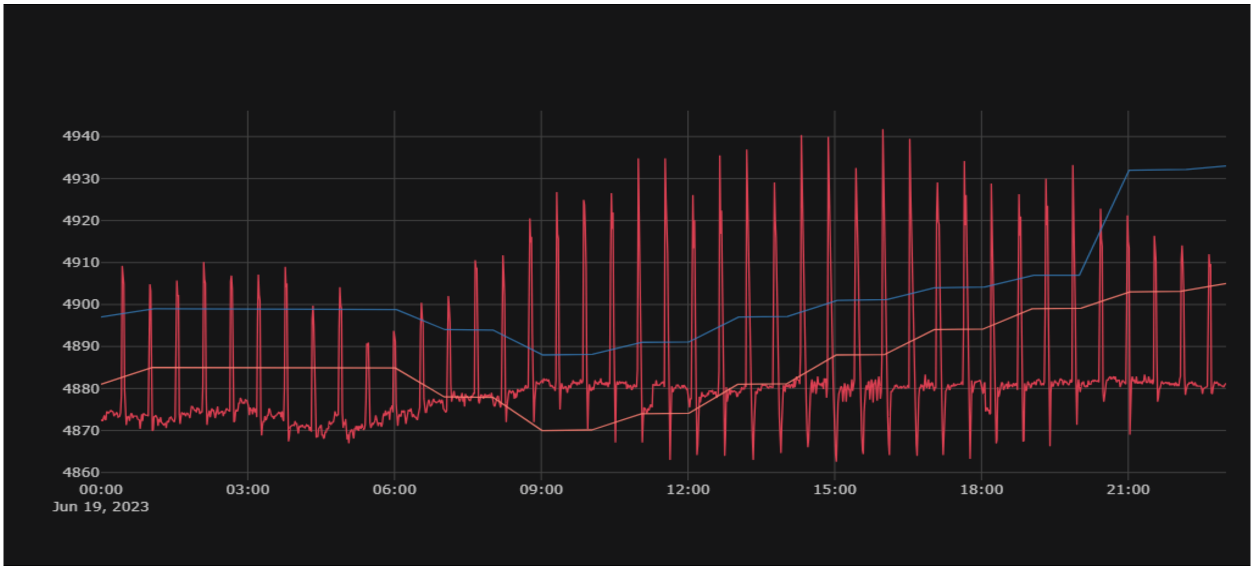


Figure 8. Model Comparison at Location 1-4 (Zone 2)

Figure 9. Model Comparison at Location 1-8 (Zone 3)

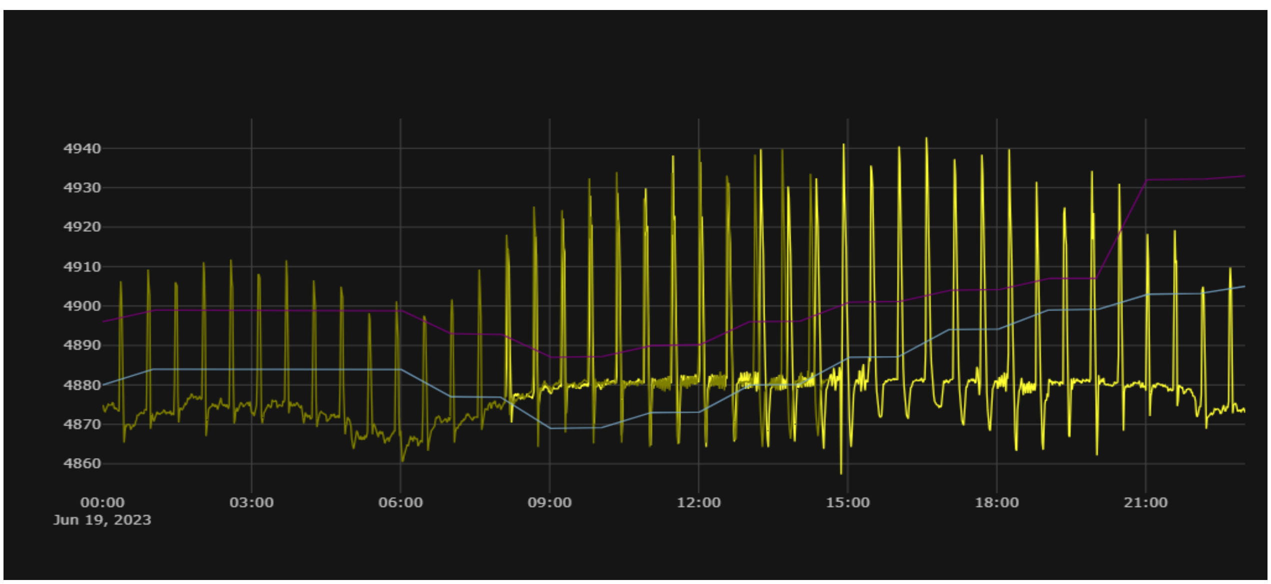
PI Model Calibration

The pressure logger data was compared with results from the pressurized irrigation model at comparable locations. It was determined that the model provides a good representation of the existing system. The following figures show the comparison between the pressure logger data and the model results.



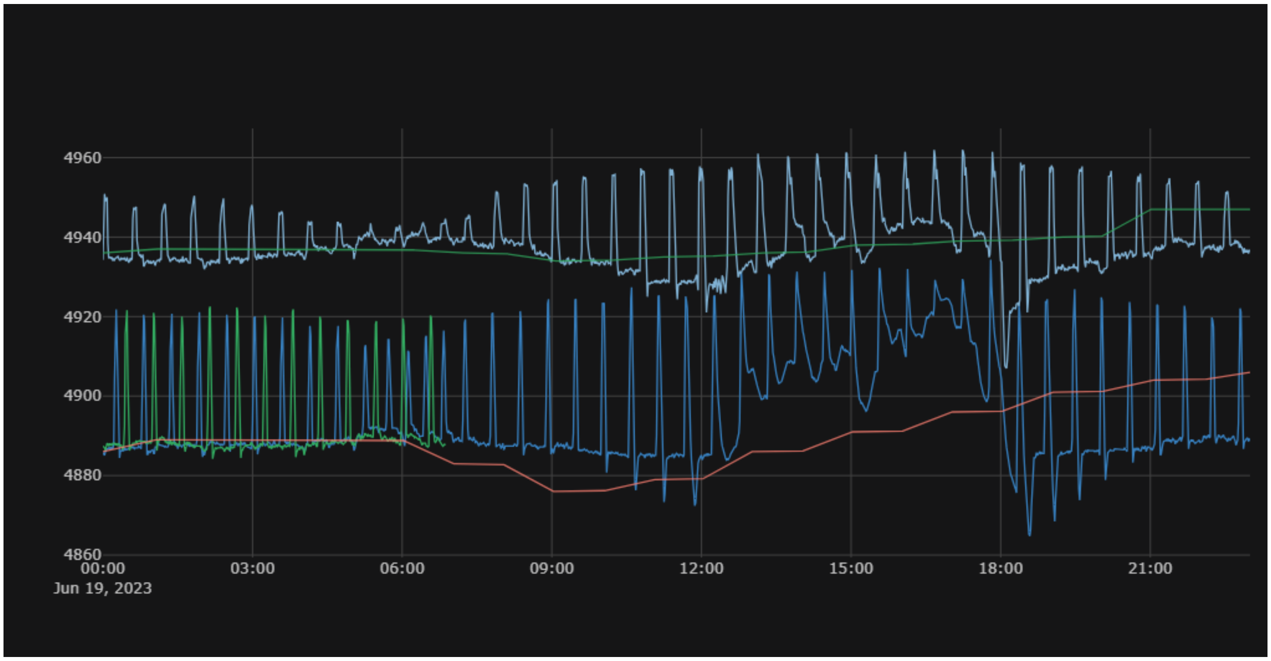
Location 1-9 Pre-turnout   Model Pre-turnout   Model Post-turnout

Figure 10. Model Comparison at Location 1-9



Location 1-10 Pre-turnout   Model Pre-turnout

Figure 11. Model Comparison at Location 1-10



Location 1-11 Pre-turnout
Model Pre-turnout
Location 2-7 Post-turnout
Model Post-turnout

Figure 12. Model Comparison at Locations 1-11 and 2-7

The following figures show the pressure logger locations throughout Mapleton.

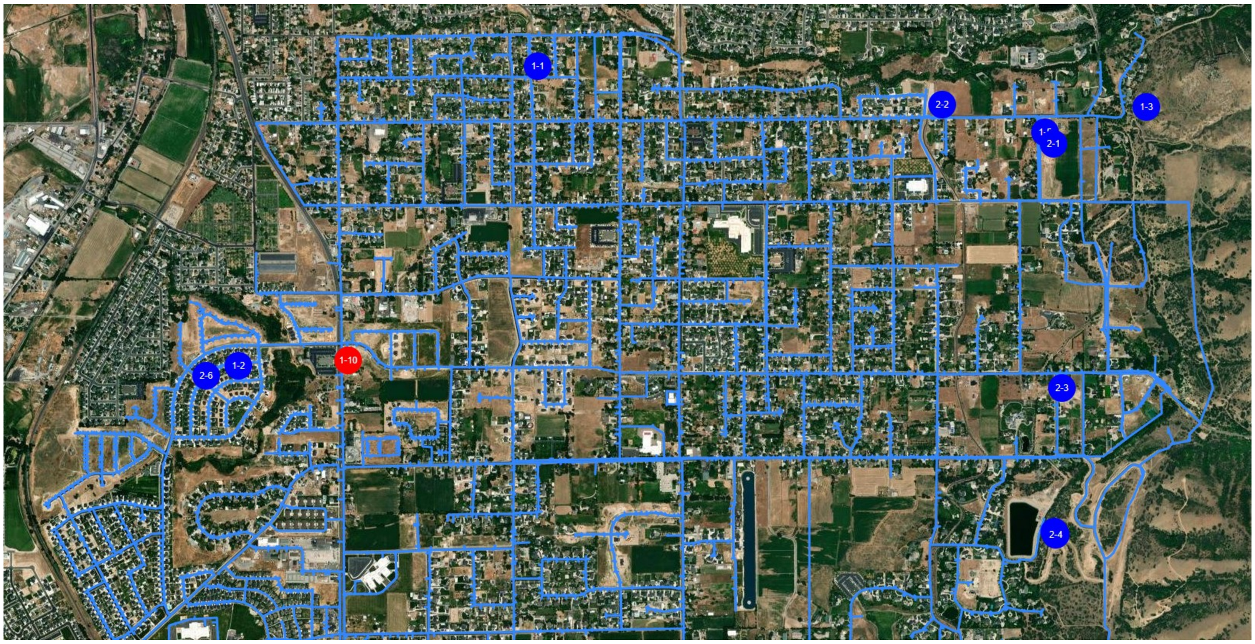


Figure 13. Pressure Logger Locations in the North End of Mapleton

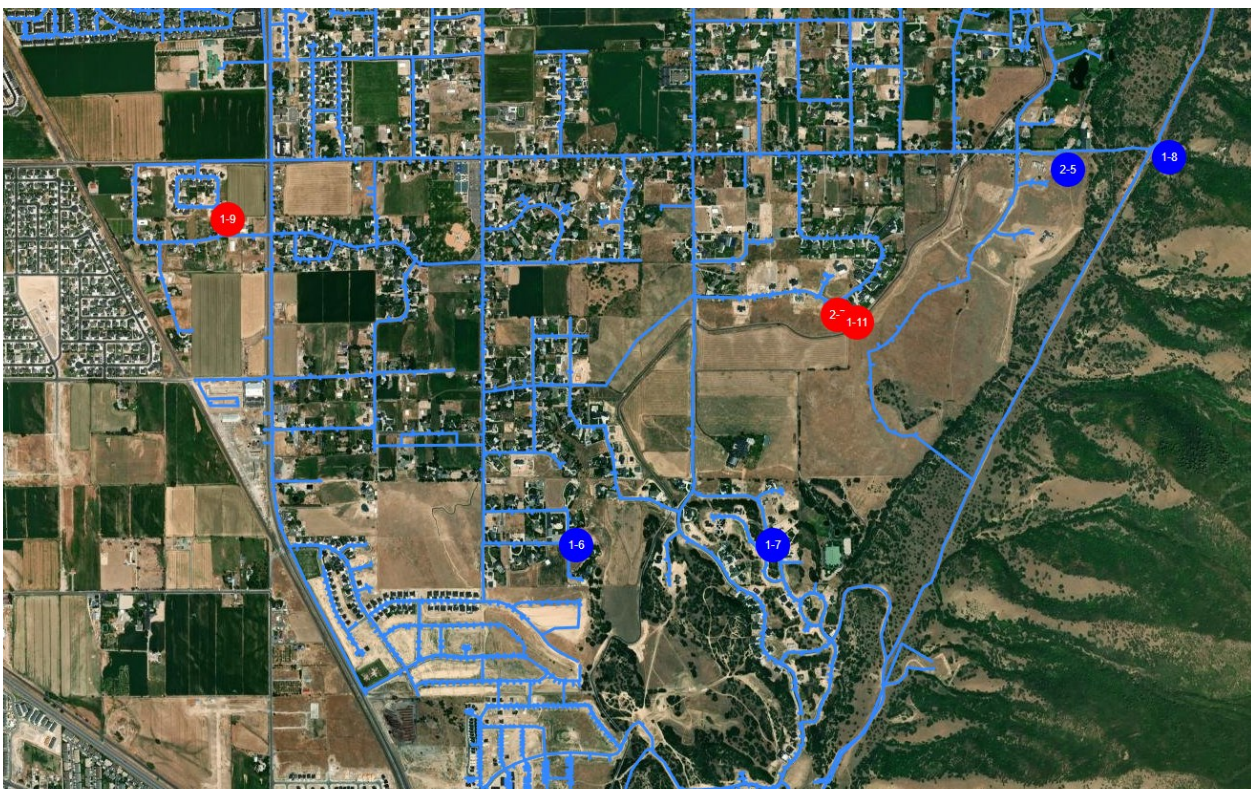


Figure 14. Pressure Logger Locations in the South End of Mapleton

APPENDIX F

Estimated Project Costs

Mapleton City Capital Facility Plan
Drinking Water Recommended Improvements
Preliminary Engineers Cost Estimates

	Item	Unit	Pipe Diameter	2024 Unit Price	Quantity	Total Price
Capital Improvement Plan Projects						
DW-FS-01	***New Well***					
	Drill New Well	LS	NA	$ 3,000,000	1	$ 3,000,000
					Total	$ 3,000,000
					Engineering & Admin. (10%)	$ 300,000
					Contingency (25%)	$ 750,000
					Total to New Well	**$ 4,050,000**
DW-FT-01	***Quiet Meadows Zone Change***					
	Engineering, Install and/or Close Valves				**Total to Quiet Meadows Zone Change**	**$ 20,000**
DW-FT-02	***Horizon Heights Zone Change***					
	Engineering, Install and/or Close Valves				**Total to Horizon Heights Zone Change**	**$ 20,000**
DW-FT-03	***Second Path of Water to Horizon Heights***					
	Install Pipe	LF	8	$ 240	1,500	$ 360,000
					Total	$ 360,000
					Engineering & Admin. (10%)	$ 36,000
					Contingency (25%)	$ 90,000
					Total to Second Path of Water to Horizon Heights	**$ 490,000**
DW-FT-04	***Overlook Ridge Drive Zone Change***					
	Engineering, Install and/or Close Valves				**Total to Overlook Ridge Drive Zone Change**	**$ 10,000**
					Total Costs:	**$ 4,600,000**
Operations and Maintenance Projects						
DW-OM-01	***Westwood Well Manganese Mitigation***					
	Engineering and Implementation				**Total to Westwood Well Manganese Mitigation**	**$ 100,000**
DW-OM-02	***Seal Well Redevelopment***					
	Well Redevelopment	LS	NA	$ 2,500,000	1	$ 2,500,000
					Total	$ 2,500,000
					Engineering & Admin. (10%)	$ 250,000
					Contingency (25%)	$ 625,000
					Total to Seal Well Redevelopment	**$ 3,380,000**
DW-OM-03	***Westwood Tank Decommissioning***					
	Decommission Tank				**Total to Westwood Tank Decommissioning**	**$ 100,000**
DW-OM-04	***Replace 4" and 6" Pipes***					
	Install 8" water line	LF	8	$ 233	45,600	$ 10,602,912
					Total	$ 10,602,912
					Engineering & Admin. (10%)	$ 1,060,291
					Contingency (25%)	$ 2,650,728
					Total to Replace 4" and 6" Pipes	**$ 14,310,000**

	Item	Unit	Pipe Diameter	2024 Unit Price	Quantity	Total Price
DW-OM-05	***1600 West Transmission Line***					
	Install 12" Line	LF	12	$ 292	8,700	$ 2,536,311
					Total	$ 2,536,311
					Engineering & Admin. (10%)	$ 253,631
					Contingency (25%)	$ 634,078
					Total to 1600 West Transmission Line	**$ 3,420,000**
DW-OM-06	***1600 South Replacement***					
	Install 8" Line	LF	8	$ 233	2,700	$ 627,804
					Total	$ 627,804
					Engineering & Admin. (10%)	$ 62,780
					Contingency (25%)	$ 156,951
					Total to 1600 South Replacement	**$ 850,000**
DW-OM-07	***Monta Vista Replacement***					
	Install 8" Line	LF	8	$ 233	2,000	$ 465,040
					Total	$ 465,040
					Engineering & Admin. (10%)	$ 46,504
					Contingency (25%)	$ 116,260
					Total to Monta Vista Replacement	**$ 630,000**
DW-OM-08	***Crowd Canyon Tank Altitude Valve***					
	Install altitude valve	LS	NA	$ 75,000	1	$ 75,000
					Total	$ 75,000
					Engineering & Admin. (10%)	$ 7,500
					Contingency (25%)	$ 18,750
					Total to Crowd Canyon Tank Altitude Valve	**$ 101,000**
					Total Costs:	**$ 23,000,000**

Annual System Replacement Cost					
4-inch Line	LF	4	$ 200	3270	$ 654,000
6-inch Line	LF	6	$ 220	56560	$ 12,443,200
8-inch Line	LF	8	$ 240	389880	$ 93,571,200
10-inch Line	LF	10	$ 270	2130	$ 575,100
12-inch Line	LF	12	$ 300	114000	$ 34,200,000
16-inch Line	LF	16	$ 340	13590	$ 4,620,600
18-inch Line	LF	18	$ 380	8470	$ 3,218,600
20-inch Line	LF	20	$ 410	480	$ 196,800
				Total Cost	$ 149,479,500
				Lifespan (yr)	65
				Ann. Cost	$ 2,299,700

Mapleton City Capital Facility Plan
Pressurized Irrigation Recommended Improvements
Preliminary Engineers Cost Estimates

	Item	Unit	Pipe Diameter	2024 Unit Price	Quantity	Total Price
PI-FS-01	***Zone 3 Pumps***					
	Install 2 Zone 3 Pumps	EA	NA	$ 120,000	2	$ 240,000
					Total	$ 240,000
					Engineering & Admin. (10%)	$ 24,000
					Contingency (25%)	$ 60,000
					Total to Zone 3 Pumps	**$ 320,000**
PI-FS-02	***New Turnouts***					
	Connect Turnouts to System	LF	12	$ 300	1,000	$ 300,000
					Total	$ 300,000
					Engineering & Admin. (10%)	$ 30,000
					Contingency (25%)	$ 75,000
					Total to New Turnouts	**$ 410,000**
PI-FS-03	***Crowd Canyon Tank Air Gap***					
	Install Air Gap System	LS	NA	$ 75,000	1	$ 75,000
					Total	$ 75,000
					Engineering & Admin. (10%)	$ 7,500
					Contingency (25%)	$ 18,750
					Total to Crowd Canyon Tank Air Gap	**$ 100,000**
PI-FT-01	***Main St. Transmission Line***					
	Install 12" Line	LF	12	$ 300	2,100	$ 630,000
					Total	$ 630,000
					Engineering & Admin. (10%)	$ 63,000
					Contingency (25%)	$ 157,500
					Total to Main St. Transmission Line	**$ 850,000**
PI-FT-02	***The Bench Pipeline***					
	Install 20" Line	LF	20	$ 410	13,900	$ 5,699,000
	Pay for Upsize from 12" to 20" Line	LF	20	$ 410	8,400	$ 3,444,000
	Pay for Upsize from 12" to 20" Line	LF	12	$ (300)	8,400	$ (2,520,000)
	Install PSV	EA	NA	$ 75,000	2	$ 150,000
					Total	$ 6,773,000
					Engineering & Admin. (10%)	$ 677,300
					Contingency (25%)	$ 1,693,250
					Total to The Bench Pipeline	**$ 9,140,000**
PI-FT-03	***Dogwood Transmission***					
	Install 20" Line	LF	20	$ 410	6,400	$ 2,624,000
	Install PSV	EA	NA	$ 75,000	1	$ 75,000
					Total	$ 2,699,000
					Engineering & Admin. (10%)	$ 269,900
					Contingency (25%)	$ 674,750
					Total to Dogwood Transmission	**$ 3,640,000**

	Item	Unit	Pipe Diameter	2024 Unit Price	Quantity	Total Price
PI-FT-04	***1600 South Transmission***					
	Install 12" Line	LF	12	$ 300	4,300	$ 1,290,000
					Total	$ 1,290,000
					Engineering & Admin. (10%)	$ 129,000
					Contingency (25%)	$ 322,500
					Total to 1600 South Transmission	**$ 1,740,000**
PI-FT-05	***Zone 2 North Transmission***					
	Install 12" water line	LF	12	$ 300	5,100	$ 1,530,000
					Total	$ 1,530,000
					Engineering & Admin. (10%)	$ 153,000
					Contingency (25%)	$ 382,500
					Total to Zone 2 North Transmission	**$ 2,070,000**
PI-FT-06	***Zone 2 South Transmission Line***					
	Install 16" Line	LF	16	$ 340	3,500	$ 1,190,000
					Total	$ 1,190,000
					Engineering & Admin. (10%)	$ 119,000
					Contingency (25%)	$ 297,500
					Total to Zone 2 South Transmission Line	**$ 1,610,000**
PI-FT-07	***HW 89 Transmission Line***					
	Install 12" Line	LF	12	$ 300	1,400	$ 420,000
					Total	$ 420,000
					Engineering & Admin. (10%)	$ 42,000
					Contingency (25%)	$ 105,000
					Total to HW 89 Transmission Line	**$ 570,000**
PI-FT-08	***1200 East Zone Change***					
	Engineering, Install and/or Close Valves				**Total to 1200 East Zone Change**	**$ 10,000**
PI-FT-09	***Horizon Heights Zone Change***					
	Engineering, Install and/or Close Valves				**Total to Horizon Heights Zone Change**	**$ 10,000**
PI-FT-10	***Mapleton Heights Looping***					
	Install 8" Line	LF	8	$ 240	2,300	$ 552,000
					Total	$ 552,000
					Engineering & Admin. (10%)	$ 55,200
					Contingency (25%)	$ 138,000
					Total to Mapleton Heights Looping	**$ 750,000**
PI-FT-11	***Overlook Ridge Drive Zone Change***					
	Engineering, Install and/or Close Valves				**Total to Overlook Ridge Drive Zone Change**	**$ 10,000**
PI-FT-12	***Connect Existing Customers***					
	Install 8" Line	LF	8	$ 240	50,900	$ 12,216,000
					Total	$ 12,216,000
					Engineering & Admin. (10%)	$ 1,221,600
					Contingency (25%)	$ 3,054,000
					Total to Connect Exiting Customers	**$ 16,490,000**
					Total Costs:	**$ 37,720,000**

	Item	Unit	Pipe Diameter	2024 Unit Price	Quantity	Total Price
PI-OM-01	***Pressure Swing Reduction***					
	Engineering and Implementation			**Total to Pressure Swing Reduction**		**$ 20,000**
					Total Costs:	**$ 20,000**
	Annual System Replacement Cost					
	4-inch Line	LF	4	$ 200	1940	$ 388,000
	6-inch Line	LF	6	$ 220	15700	$ 3,454,000
	8-inch Line	LF	8	$ 240	339180	$ 81,403,200
	10-inch Line	LF	10	$ 270	0	$ -
	12-inch Line	LF	12	$ 300	31700	$ 9,510,000
	14-inch Line	LF	14	$ 300	0	$ -
	16-inch Line	LF	16	$ 340	3390	$ 1,152,600
	20-inch Line	LF	20	$ 410	9230	$ 3,784,300
	24-inch Line	LF	24	$ 480	6000	$ 2,880,000
	30-inch Line	LF	30	$ 600	4780	$ 2,868,000
					Total Cost	$ 105,440,100
					Lifespan (yr)	65
					Ann. Cost	$ 1,622,200