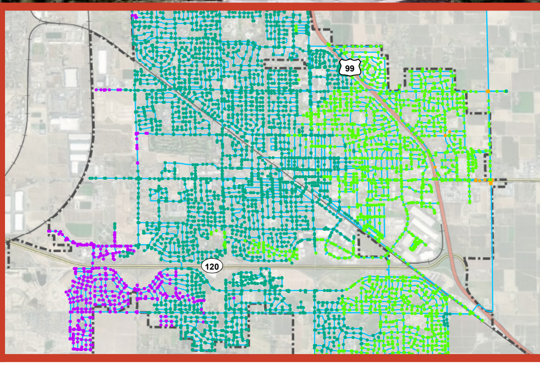

FINAL

Water Master Plan

February 2024

Prepared for
City of Manteca

Prepared by
HydroScience Engineers

HydroScience

City of Manteca

Water Master Plan

FINAL

Prepared by HydroScience Engineers, Inc.

Approved by:
Kevin Jorgensen II
Director of Engineering/City Engineer

Recommended for Approval by:
Somporn Boonsalat
Acting Deputy Director of Engineering

Note: Presently, the 2043 General Plan Update relied upon for purposes of this Master Plan is stayed, subject to a potential referendum and litigation. As such, the matrixes and designations relied upon herein may be subject to change.

February 2024

HydroScience

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LIST OF ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
ACP	asbestos cement pipe
acre(s)/DU	acre(s) per dwelling unit
ADD	average day demand
AF	acre-feet
AFY	acre-feet per year
AG	agriculture
AI	agricultural industrial
AOI	Area of Interest
APN	assessor’s parcel number
ATPS	Atherton Tank Pump Station
AWWA	American Water Works Association
BIP	business industrial park
BRIC	Building Resilient Infrastructure and Communities
C	commercial
C-factor	coefficient of friction factor
CA-120	California State Route 120
CA-99	California State Route 99
Cal OES	California Governor’s Office of Emergency Services
CATF	Central Arsenic Treatment Facility
CCR	California Code of Regulations
CDBG	Community Development Block Grant
CDFW	California Department of Fish & Wildlife
CEQA	California Environmental Quality Act
CFCC	California Financing Coordinating Committee
CFD	community facilities district
CIMIS	California Irrigation Management Information System
CIP	cast iron pipe, capital improvement program/plan
City	City of Manteca
CMU	commercial mixed use
CVP	Central Valley Project
CVPIA	Central Valey Project Improvement Act
DBP	Disinfection Byproduct
DDW	Division of Drinking Water
DEM	digital elevation model
DIP	ductile iron pipe
DLR	detection limit for the purposes of reporting
DOF	Department of Finance
DU	dwelling unit
DU(s)/ac	dwelling unit(s) per acre
DU(s)/parcel	dwelling unit(s) per parcel

LIST OF ACRONYMS AND ABBREVIATIONS

DW	downtown
DWR	Department of Water Resources
EPA	Environmental Protection Agency
EPS	extended period simulation
ESDC	engineering services during construction
ESJ Subbasin	Eastern San Joaquin Subbasin
FCOC	French Camp Outlet Canal
FCV	flow control valve
FEMA	Federal Emergency Management Act
ft	feet, foot
ft/s	feet per second
FTE	full-time employee/equivalent
FY	fiscal year
GPA	General Plan Amendment
GIS	Geographic Information System
gpcd	gallon(s) per capita per day
gpd	gallon(s) per day
gpd/acre	gallon(s) per day per acre
gpd/DU	gallon(s) per day per dwelling unit
gpm	gallon(s) per minute
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HAA	Haloacetic acids
HCD	California Department of Housing and Community Development
HDR	high density residential
HGL	hydraulic grade line
hp	horsepower
HUD	U.S. Department of Housing and Urban Development
HydroScience	HydroScience Engineers, Inc.
I-5	Interstate 5
I	industrial
in	inch(es)
ISRF	Infrastructure State Revolving Fund
LAPS	Louise Ave Pump Station
LDR	low density residential
LMD	landscape maintenance district
MAR	managed aquifer recharge
MCL	Maximum Contaminant Level
MDD	maximum day demand
MDD+FF	maximum day demand plus fire flow
MDR	medium density residential

LIST OF ACRONYMS AND ABBREVIATIONS

MFR	multi-family residential
MG	million gallon
MGD	million gallons per day
mg/L	milligrams per liter
µg/L	micrograms per liter
mi	miles
MOB	mobile home parks
MSR	Manteca Municipal Services Review
MUSD	Manteca Unified School District
MWELO	Model Water Efficient Landscape Ordinance
NDMA	N-nitroso-dimethylamine
NL	Notification Limit
NOAA	National Oceanic and Atmospheric Administration
NOFO	notice of funding opportunity
O&M	operations and maintenance
OS	open space
P	park irrigation
PF	peaking factor
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluoro-octanoic acid
PFOS	perfluoro-octane sulfonic acid
PHD	peak hour demand
PHD+FF	peak hour demand plus fire flow
PHG	Public Health Goal
ppb	parts per billion
ppt	parts per trillion
PQP	public/quasi-public
PRV	pressure-reducing valve
psi	pounds per square inch
PSV	pressure-sustaining valve
PVC	polyvinyl chloride pipe
RCP	reinforced concrete pipe
ROW	right-of-way
RTU	remote telemetry unit
RWFMP	Reclaimed Water Facilities Master Plan
SB X7-7	Senate Bill No. 7
SCADA	supervisory control and data acquisition
SCAP	Site Cleanup Subaccount Program
SCWSP	South County Water Supply Program
SDMP	Storm Drain Master Plan
SGMA	Sustainable Groundwater Management Act

LIST OF ACRONYMS AND ABBREVIATIONS

SSJID	South San Joaquin Irrigation District
SFR	single-family residential
SOI	sphere of influence
SS	steady-state
SW	surface water
SWRCB	State Water Resources Control Board
TCP	1,2,3-Trichloropropane
TDS	total dissolved solids
TM	technical memoranda, technical memorandum
UCMR	Unregulated Contaminant Monitoring Rule
UPRR	Union Pacific Railroad
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
VFD	variable frequency drive
VLDR	very low density residential
VOC	volatile organic compound
VSP	variable speed pump
WaterSMART	Sustain and Manage America's Resources for Tomorrow
WIP	wrought iron pipe
WMP	Water Master Plan
WQCF	City of Manteca Wastewater Quality Control Facility
WSCP	Water Shortage Contingency Plan
WTP	Nick C. DeGroot Water Treatment Plant
WY	water year

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SECTION 1 – INTRODUCTION AND PURPOSE

HydroScience Engineers, Inc. (HydroScience) was retained by the City of Manteca (City), to prepare an update to the City's Water Master Plan (Master Plan), which includes development of a Capital Improvement Plan (CIP) based on the current and future planning horizons (Study). For the purposes of this Master Plan, "current" and "existing" is defined as the year 2021, the onset of the Study and the basis for data analysis. This section outlines the background, data sources, and Master Plan objectives.

1.1 Background

The City is located in the San Joaquin Valley in south San Joaquin County (see **Figure 1-1**) about 70 miles due east of San Francisco, 10 miles south of Stockton, and 15 miles northwest of Modesto.

Since incorporation in 1918, the City's boundary area has grown from 575 acres to 13,737 acres by 2020 for an average annual area growth rate of 3.2%. The City's 2020 population, according to the 2020 Census (https://dof.ca.gov/forecasting/demographics/estimates/) was 84,842. Between 1990 and 2020, the City experienced an average annual population growth rate of 2.5%. During this period, peak population growth occurred between 2000 and 2005 with an average growth rate of over 4%. Recent population growth since 2015 averages 3.3% per year.

Today, rich agricultural lands abut the City on the north, east, and south while areas to the west are primarily industrial. California State Route 120 (CA-120) crosses the southern portion of the City and provides a connection between Interstate 5 (I-5), located approximately four miles to the west of the City, and California State Route 99 (CA-99) along the eastern boundary of the City. This location creates a good setting for Bay Area commuter housing as well as new commercial and industrial land uses.

The City's last Water Master Plan was prepared in 2005 (2005 WMP). Since then, the City has annexed new lands into City limits and correspondingly expanded the water distribution system; planned development is booming. To ensure the safety and reliability of the water supply and distribution system, the City initiated the development of this Master Plan. Considerations for drought and population growth have prompted retailers throughout the State to more thoroughly evaluate available water supplies and conditions that may require the use of emergency storage, additional supply, and updated operation. Additionally, the City's infrastructure is aging and simultaneously expanding. To that end, the City has developed a hydraulic model using Bentley's WaterGEMS® (WaterGEMS) to evaluate the City's infrastructure under both existing and projected future scenarios as part of this Master Plan.

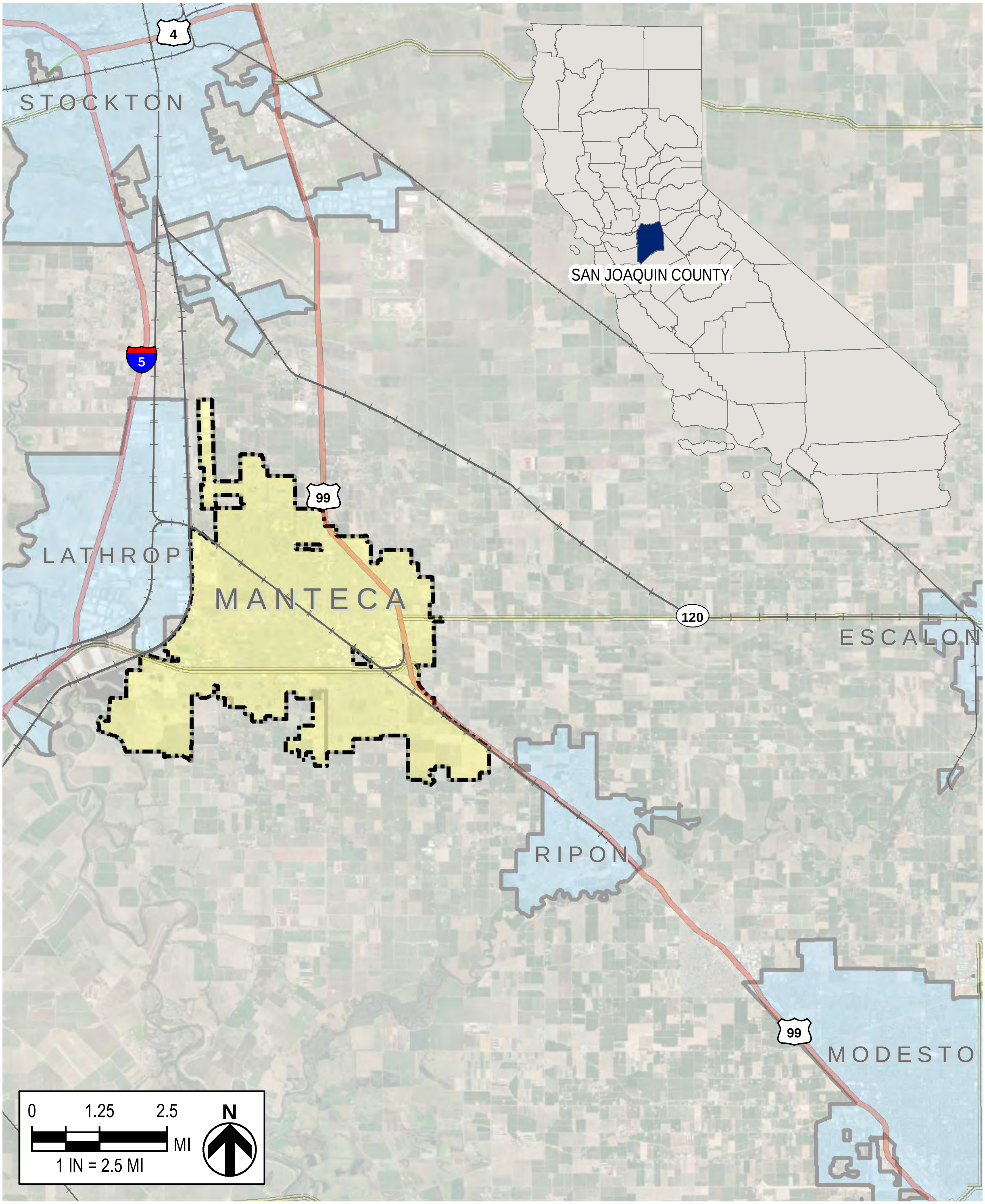


FIGURE 1-1
CITY OF MANTECA
WATER MASTER PLAN
PROJECT LOCATION MAP

HydroScience

1.2 Objectives

The objectives of this Master Plan Study are to:

- Examine the long-term reliability of the City's water supply sources;
- Build and calibrate the City's potable water distribution system hydraulic model;
- Evaluate the City's distribution system under both normal and peak operating conditions for existing and future scenarios;
- Perform a desktop condition assessment of the City's pipelines;
- Develop a CIP and time schedule to address any identified system deficiencies; and
- Upon completion of the Master Plan, perform a water rate study to establish the resources needed to fund the recommended CIP projects.

1.3 Previous Studies/Existing Documents

The following are brief descriptions of previous studies and documents reviewed and referenced in the preparation of this Master Plan:

- **City of Manteca Water Master Plan (2005 WMP) [May 2005]:** The 2005 WMP performed an evaluation of the City's water supply and distribution system intended for use as a tool by the City for planning future improvements to its water system through the year 2035. It provided an estimate of water facility requirements at full buildout of the Primary Urban Service Area defined by the 2003 General Plan.
- **City of Manteca 2015 Urban Water Management Plan (2015 UWMP) [September 2016]:** The Urban Water Management Plan (UWMP) provides an analysis of the City's available water supply, during normal and dry-year scenarios, compared to historical and projected water demand. The UWMP is a link between land use planning and water supply planning, developed to evaluate if sufficient water is available to meet the needs of the City's existing and future water customers. Projected demands look 20 years into the future to ensure that the City has planned for, and is prepared to address, the water needs within their service area. It is noted that the 2015 UWMP is referenced in this document because the 2020 UWMP was published in September 2023 after the drafting of this Master Plan.

The following technical memoranda (TMs) were completed in conjunction with the Master Plan Study, the contents of which are incorporated into the Master Plan:

- **TM #1 Software Evaluation (TM #1) [February 2022]:** This TM presents an evaluation of available water hydraulic modeling software programs from the two leading software vendors: Innovyze and Bentley. The software evaluation included multiple criteria including: purchase and subscription pricing; available features and applications; software stability; software accuracy; platform compatibility needs/interface (i.e. AutoCAD, Geographic Information System (GIS), supervisory control and data acquisition (SCADA)); ease of use; technical support; and vendor reputation. In conjunction with City Staff, WaterGEMS was chosen to build the City's potable water distribution system hydraulic model. This TM is attached as **Appendix A**.

- **TM #2 Calibration Plan (TM #2) [October 2021]:** The purpose of this TM was to establish a calibration plan complete with hydrant test locations and field testing procedures. Field testing as detailed in the plan was implemented by the City with support from HydroScience in October 2021. Results from the hydrant testing and system monitoring served as the basis for calibration of the updated hydraulic model. This TM is attached as **Appendix B**.
- **TM #3 Growth and Development Study (TM #3) [May 2023]:** This TM presents the details of the baseline unit demand analysis using the City's customer meter billing data as well as the future growth and water use projections based on projected development.
- **TM #4 Water Sustainability Study (TM #4) [April 2023]:** The purpose of this TM was to examine the long-term reliability of the City's water supply sources and delivery allocations. Upon examinations, recommendations were provided to develop a water supply strategy that diversifies and strengthens the City's water supply portfolio to help secure long-term water resources sustainability. This TM is attached as **Appendix C**.
- **TM #5 Regulations Potentially Affecting City Water Operations (TM #5) [August 2023]:** This TM identifies and discusses the various existing, ongoing, and anticipated future regulatory constraints and risks associated with maintaining current and projected future City water supplies. This TM is attached as **Appendix D**.
- **TM #6 Water System and Pipe Network Design Alternatives (TM #6) [May 2023]:** The purpose of this TM was to present the data and process used to build the potable water distribution system hydraulic model as well as the results of the hydraulic analysis. This TM also presents a description of the City's existing water supply portfolio with a brief analysis of the future of the supply. Finally, this TM presents the recommendations associated with the hydraulic modeling and supply portfolio analysis.

1.4 Data Sources

This section briefly describes each of the data sources used in this Study to develop potable water demands, perform a desktop assessment of the City's existing distribution system, and build and calibrate a hydraulic model. The utilization of this data is described throughout this Master Plan.

Water Meter Billing Data: The City provided potable water meter billing records for individual meters from 2016 through 2021 which include monthly meter readings and billing data; in 2021, there were a total of 25,872 individual water meters. Each record contains an associated address, meter number, account number, property class, account class, and assessor's parcel number (APN).

Geographic Information System (GIS): The City provided a GIS geodatabase containing feature classes – a geospatial representation of a system component represented as points, lines, or polygons and containing associated metadata – of the most up-to-date records of the City's potable water distribution system, including:

- SSJID Surface Water Pipes
- Surface Water Pipes
- Non-Potable Water Mains
- Water Mains
- Private Water Lines
- Service Water Lines

- Water Laterals
- Water Meters
- Water Valves
- Fire Hydrants
- Fire Hydrant Laterals
- Water Wells (potable and non-potable)
- Water Tanks
- Water Facilities

Land Use: The City also provided GIS shapefiles of the City's General Plan Amendment (GPA) land use.

Elevation Data: Regional digital elevation model (DEM) data with a resolution of 1/9 arc-second (approximately 10 ft) was downloaded from the USGS web database. The DEM data was used to obtain surface elevations of distribution system infrastructure.

System-Wide Pressure Monitoring: System-wide pressure monitoring provides a baseline for understanding system hydraulics and performance during normal conditions. The City collected 168 hours (seven days) of pressure monitoring data at six different locations throughout the system.

Monarch Instrument Track-It™ pressure and temperature data loggers were installed at each of these six locations to capture pressure readings at six-second intervals from October 25 – November 1, 2021; this is referred to as the "monitoring period." This data was used for calibration of the 24-hour EPS, detailed in **Section 8.2**.

Hydrant Flow Testing: Hydrant flow testing is intended to provide calibration points representing flow and pressure under a controlled condition for comparison of modeled flows to an actual system response. The goal is to stress the system by drawing a measured flow from a hydrant and recording the static pressure before flowing and the residual pressure during flowing at an adjacent hydrant. Hydrant flow testing was performed during the monitoring period on October 27, 2021 between 8:00 AM and 2:00 PM; this is referred to as the "testing period."

C-Factor Testing: To calculate friction head losses, WaterGEMS allows the user to choose between the Manning, Hazen-Williams, or Darcy-Weisbach set of friction equations. For this project, the Hazen-Williams friction equation was selected, and each pipeline was assigned a C-factor based on pipe material. The intent of C-factor testing is to measure the actual headloss experienced along the length of a pipeline and then estimate the roughness coefficient using the Hazen-Williams equation. Similar to unidirectional flushing, water flows in one direction through a long stretch of pipeline of a specified diameter and material while measuring the pressure differential across the length of the pipe. C-factor testing was performed in conjunction with hydrant flow testing.

SCADA Data: The City's distribution system is operated by a centralized SCADA system (see **Section 3.6**). The SCADA system tracks pressures and flows at many points throughout the system, specifically at each supply facility. For this analysis, City Staff compiled all available SCADA data for the monitoring and testing periods. This data was used to develop diurnal patterns, understand typical operations of the supply sources over the course of a week, and establish operating conditions in the model for calibration.

1.5 Report Organization

This Master Plan consists of 12 sections followed by appendices that provide supporting documentation for the analyses present in the body of the Master Plan. The sections are as follows:

- **SECTION 1 – Introduction and Purpose:** This section presents the background and objectives for the development of this Study, a description of previous studies and data sources utilized herein, and organization of the Master Plan.
- **SECTION 2 – Existing Water Supply:** This section provides a general overview of the available water supplies to the service area including surface water turnouts, groundwater wells, and reclaimed water.
- **SECTION 3– Existing Distribution System:** This section describes the City's water supply, storage, and distribution system infrastructure and general system operation.
- **SECTION 4 – Potable Water Demand Analysis:** This section outlines the land use categories identified for existing and future conditions and details the methodology and results of the water demand analysis, which in turn was used to populate and calibrate the hydraulic model.
- **SECTION 5 – Source and Storage Capacity Analysis:** This section briefly analyzes the options to meet future increased potable water demands through new groundwater wells, storage tanks, or a combination of both.
- **SECTION 6 – Water Supply Reliability Analysis:** This section summarizes the analyses conducted as part of TM #4 and TM #5. It looks at the reliability of the City's water supply sources and delivery allocations given factors such as climate change and regulatory impositions, and it identifies potential ways to strengthen the City's future water supply and delivery reliability.
- **SECTION 7 – Desktop Condition Assessment:** This section summarizes the results of the desktop assessment of the distribution pipeline, which form the basis of the CIP recommendations.
- **SECTION 8 – Hydraulic Model Building and Calibration:** This section documents the process and updates made to the hydraulic model as well as the method, assumptions, and results of the model calibration.
- **SECTION 9 – Hydraulic Analyses:** This section details the scenarios developed as part of the hydraulic model development and reviews the results and notable deficiencies identified under each scenario.
- **SECTION 10 – Capital Improvement Plan (CIP):** This section presents the recommended capital improvement projects, costs, and timeline for implementation.
- **SECTION 11** – **Water Group Staffing Plan:** This section presents recommended staffing levels based on AWWA Utility Benchmarking for both 2021 and 2045.
- **SECTION 12 – References:** This section provides a list of the references used in the development of the Master Plan.

SECTION 2 – EXISTING WATER SUPPLY

The current water service area generally coincides with the City's municipal boundary (see **Figure 2-2**). The City's water supply sources consist of treated surface water from South San Joaquin Irrigation District (SSJID) through the South County Water Supply Program (SCWSP), local groundwater, and reclaimed water produced at the City's Wastewater Quality Control Facility (WQCF), each detailed in this section.

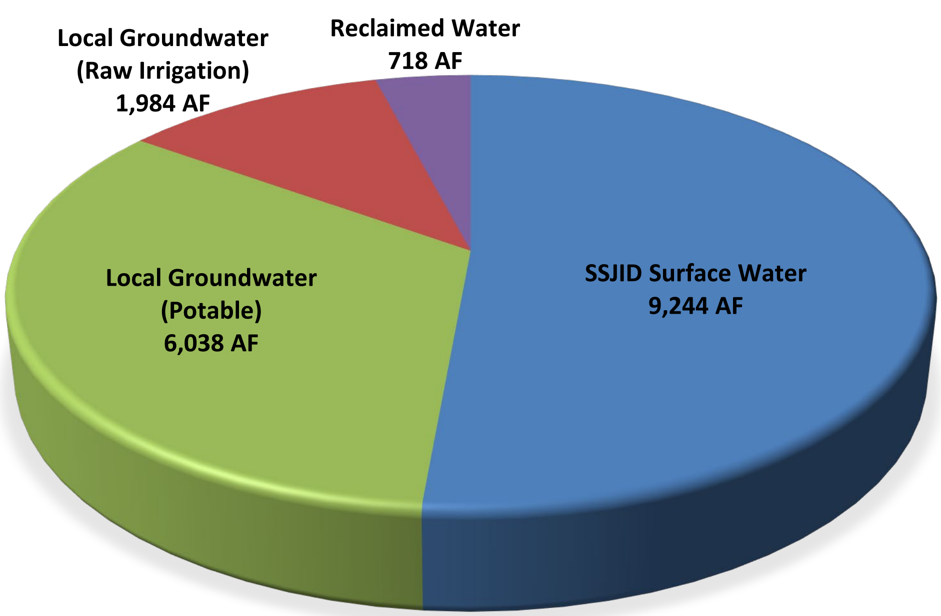
Potable water is supplied by surface water from SSJID and local groundwater. In general, the City's goal is to maintain an annual average potable water supply ratio of 53% surface water to 47% groundwater (2015 UWMP, page 6-2). It is noted that this is a target and the actual supply ratio varies from year to year; i.e., in 2020, the City's potable water supply ratio was 60% surface water to 40% groundwater.

Raw groundwater is also pumped for park irrigation throughout the City. Though raw water is not considered in the demand analysis, it is necessary to consider from a supply availability standpoint because the City is limited by how much total groundwater it is permitted to pump within the sustainable yield (further detailed in **Section 2.2**); total pumping within the sustainable yield includes both raw irrigation and potable drinking water.

City wastewater is treated at the Manteca WQCF and some of the tertiary treated effluent is returned to the City as reclaimed water.

As a reference, **Figure 2-1** represents the total water supplied from each source for the year 2020.

Figure 2-1: Total City Water Supply Sources (2020)



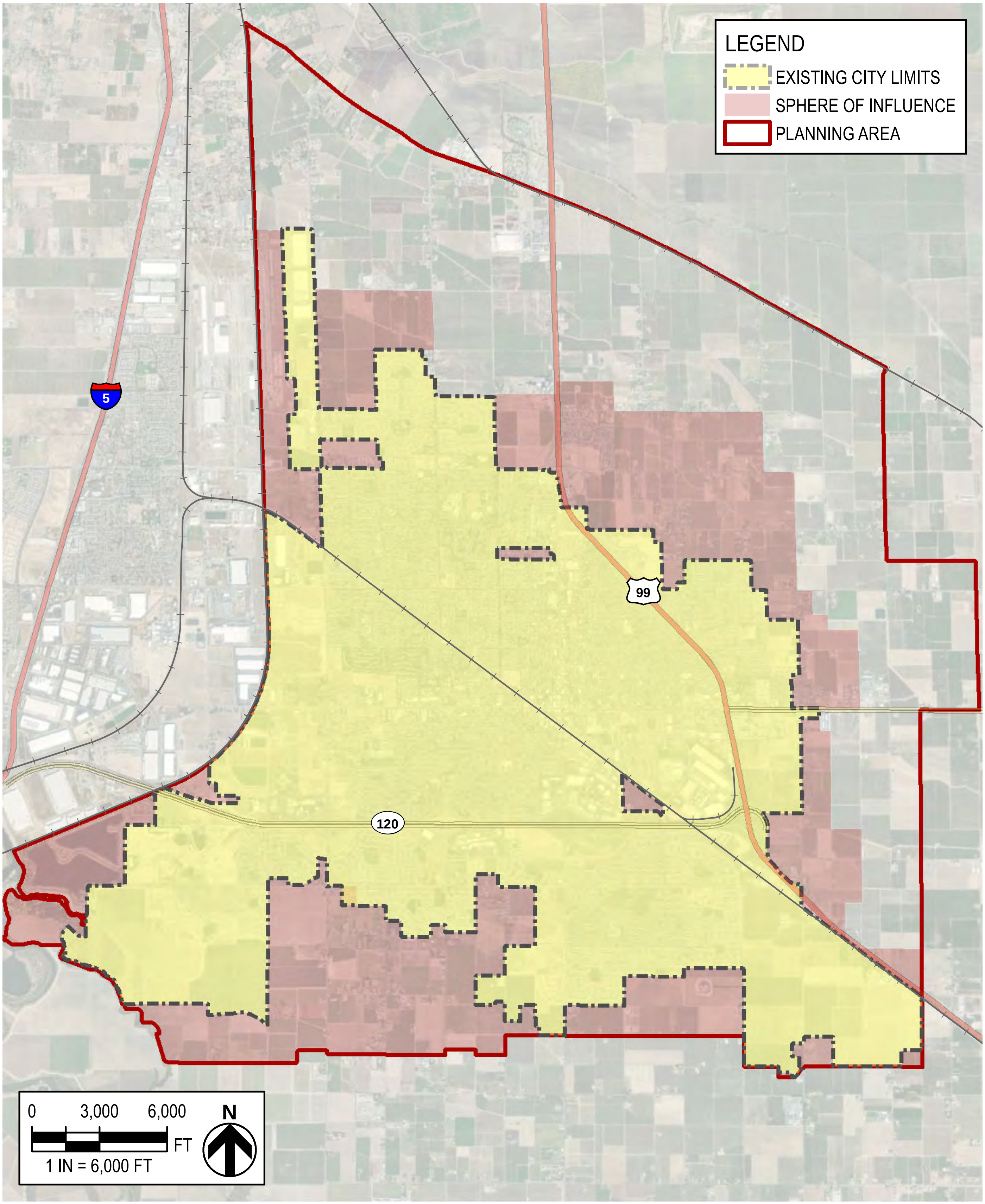


FIGURE 2-2
CITY OF MANTECA
WATER MASTER PLAN
WATER SERVICE AREA

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2.1 Purchased Surface Water

The City has been supplied surface water by SSJID since 2005 when the Nick C. DeGroot Water Treatment Plant (WTP) was commissioned for the SCWSP. The City, along with three other cities/retail water suppliers – Escalon, Lathrop, and Tracy – signed water supply agreements with SSJID and began the planning phases of the SCWSP in the late 1990s. Currently, the WTP has a capacity of 40 million gallons per day (MGD) and treats water from the Stanislaus River that is stored in SSJID's Woodward Reservoir. SCWSP currently delivers potable water to the cities of Manteca, Tracy, and Lathrop, and with the implementation of Phase II, the WTP is expected to connect to Escalon and its capacity will increase with the addition of a pump station and two tanks. In its 2020 UWMP, SSJID stated that discussions regarding implementation of Phase II will commence when SCWSP demand exceeds 80% of the existing WTP capacity. For the purposes of the UWMP, SSJID assumed Phase II would begin production in 2040.

The City is currently allotted a maximum of 11,500 acre-feet per year (AFY) from the existing WTP which will increase to 18,500 AFY when Phase II is constructed. The latest water supply agreement between the City and SSJID was signed in December 2020, and the term of this water supply agreement is through December 2049. Historically, the City has not utilized its full allocation of surface water due to system constraints and State and SSJID supply limits in response to the 2013-2015 drought.

2.1.1 Water Exchanges and Transfers

According to the agreement with SSJID for the SCWSP, each participating city can transfer a portion or all of their water supply allotment to another participating city without SSJID approval. The Cities of Escalon and Tracy have historically utilized inter-city transfers due to the City of Escalon's lack of infrastructure to accept their full allotment.

To date, the City has not utilized any water supply transfers and has not yet encountered any circumstances where it was necessary.

2.2 Local Groundwater

The total groundwater pumping that occurs within City limits includes City-owned municipal and park irrigation wells with additional domestic and irrigation wells owned and operated by private users and SSJID.

This section includes a summary of the estimated groundwater pumping within the current City limits; however, it is noted that groundwater pumping data collection is ongoing and there are potentially groundwater wells that are unmetered and unidentified.

2.2.1 Groundwater Management

The City is in the Eastern San Joaquin Subbasin (ESJ Subbasin) – Subbasin 5-22.01 of the San Joaquin Valley Groundwater Basin (see **Figure 2-3**). The groundwater aquifers underlying the City extend to depths of over 600 feet (ft). In general, the two aquifers the City extracts groundwater from are a shallow and a deep aquifer, separated by a Corcoran Clay and/or equivalent aquitard. The depth to groundwater in the shallow aquifer varies throughout the City, averaging around 15 ft on the west side (closer to the San Joaquin River) and 25 ft on the east side. Groundwater levels in the shallow aquifer underlying the City have been relatively stable for about two decades even as groundwater levels have dropped elsewhere in the basin. The deep aquifer, located below the aquitard, ranges in depth from approximately 190 to 400 ft below the ground surface.

The City pumps from the shallow aquifer for irrigation and other non-potable uses, and pumps from the deep aquifer into the distribution system for potable uses.

According to the Department of Water Resources (DWR) 2020 update of the Bulletin 118 Critically Overdrafted Basins Map (https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118/Critically-Overdrafted-Basins), the ESJ Subbasin remains classified as a basin in critical condition of overdraft. Overdraft occurs when the average annual amount of groundwater extraction exceeds the long-term average annual supply of water to the basin. Effects of overdraft can include saltwater intrusion, land subsidence, groundwater depletion, and/or chronic lowering of groundwater levels.

As presented in Section 2.2.1.1 of the ESJ Subbasin Groundwater Sustainability Plan (GSP), groundwater levels in the ESJ Subbasin decreased at an average rate of 0.5 ft/year from 1996-2015. The largest decrease in groundwater elevation has taken place in the center of the Subbasin, east of the City of Stockton, resulting in a pumping depression in this area. There are other localized pumping depressions, however, the central depression east of the City of Stockton is the most significant consideration in achieving sustainable groundwater use in the ESJ Subbasin as a whole.

The 2014 Sustainable Groundwater Management Act (SGMA) enacted groundwater management legislation in California in response to continued overdraft of the State's groundwater resources. It required the formation of Groundwater Sustainability Agencies (GSAs) responsible for developing GSPs with plans to achieve sustainable groundwater use in each basin by 2040. The SGMA defines sustainable groundwater management as "management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results." These GSPs are intended to foster long-term and coordinated management of high- and medium-priority groundwater basins, which includes the ESJ Subbasin.

The City, along with 15 other GSAs formed the Eastern San Joaquin Groundwater Authority in 2017 to prepare its first GSP (http://www.esjgroundwater.org/Documents/GSP) – the ESJ Subbasin GSP was initially submitted in 2019, revised in 2022, and approved by DWR in 2023. This GSP presents a set of 11 planned and 15 potential projects designed to offset groundwater use by shifting water supply to other sources or to supplement groundwater supplies through groundwater recharge to meet current and future water demands and achieve sustainable groundwater use. Two of the projects in the GSP pertain to the City:

- Project 3: City of Manteca Advanced Metering Infrastructure – anticipated annual water savings of 272 AFY.
- Project 19: Recycled Water Transfer to Agriculture – anticipated annual water savings of 5,193 AFY.

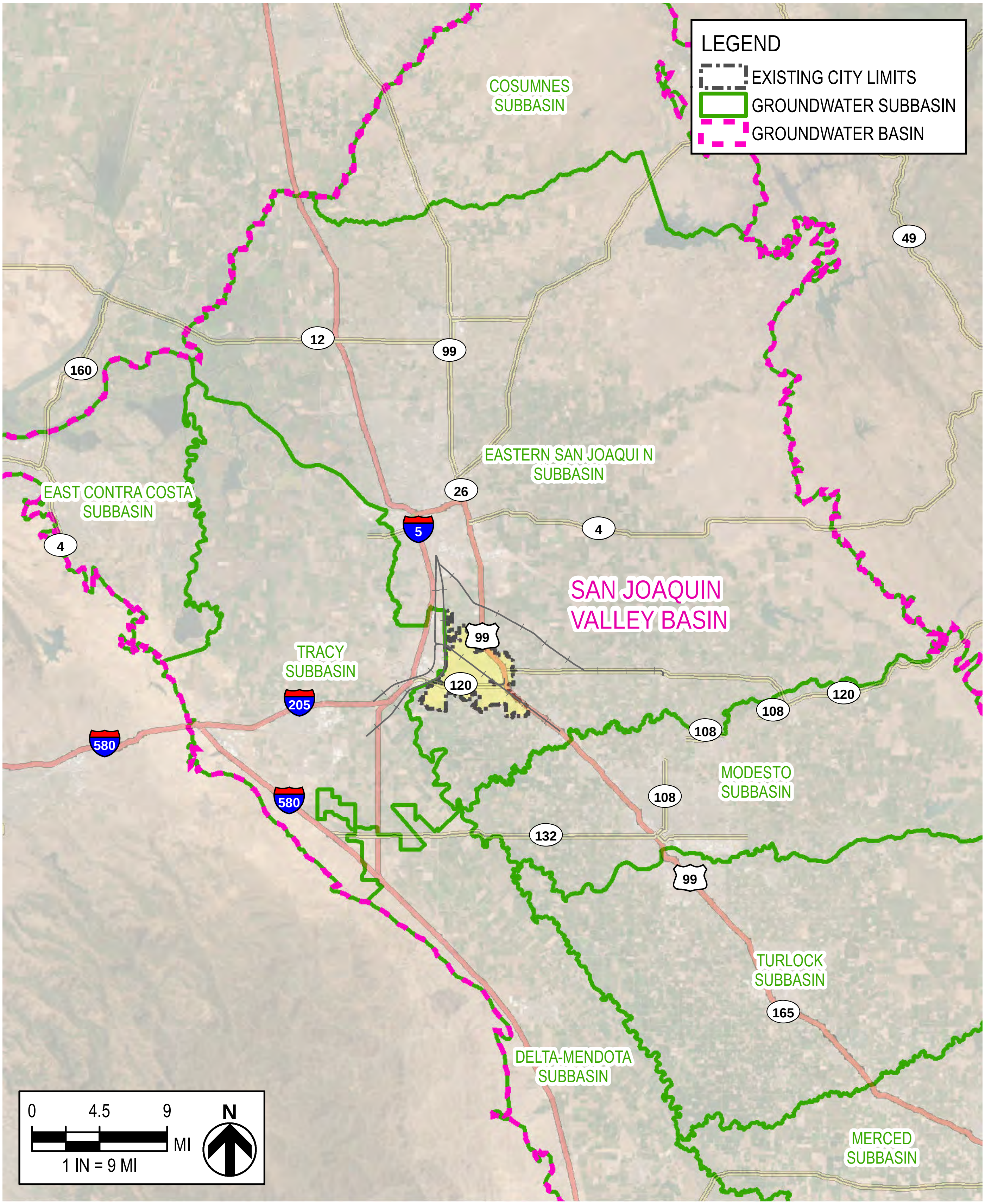


FIGURE 2-3
CITY OF MANTECA
WATER MASTER PLAN
GROUNDWATER BASIN MAP

HydroScience

Sustainable groundwater supply is a key element of the City's long term water supply portfolio. The SGMA defines sustainable yield as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result" (California Water Code §10721(w)). Sustainable yield for the ESJ Subbasin was calculated through development of a "sustainable conditions" scenario model run to generate a long-term (50-year) change in subbasin groundwater storage of zero. A range of assumptions was used in the development of the sustainable yield to address the uncertainties associated with varying hydrologic conditions, cropping patterns, irrigation practices, etc. Further details of this process are presented in Section 2.3.6 of the ESJ Subbasin GSP. Based on this analysis, the sustainable yield of the ESJ Subbasin is approximately 715,000 AFY ± 10%. Given the total area of the Subbasin of 764,803 acres (2019 SGMA Basin Prioritization, Appendix 1 published by DWR), this translates to approximately 1 AFY per acre (AFY/Ac). The City aims to maintain total groundwater pumping below the sustainable yield and thus, projected groundwater supply availability is based on the assumption that 1 AFY of groundwater is available per acre of City service area.

The commissioning of the WTP in 2005 decreased the City's reliance on groundwater as a supply source and reduced groundwater pumping rates within City limits to below the ESJ Subbasin sustainable yield. This has stabilized groundwater levels within the City and according to the ESJ Integrated Regional Water Management Plan 2014 Update, long-term groundwater elevations suggest water level recovery in some areas of the Subbasin. California's latest groundwater information and conditions are updated regularly by DWR and provided at https://sgma.water.ca.gov/CalGWLive/.

Continued water conservation efforts, increased utilization of reclaimed water, and the continued balance of surface water and groundwater use will help maintain the City's water supply reliability and preserve groundwater levels into the future.

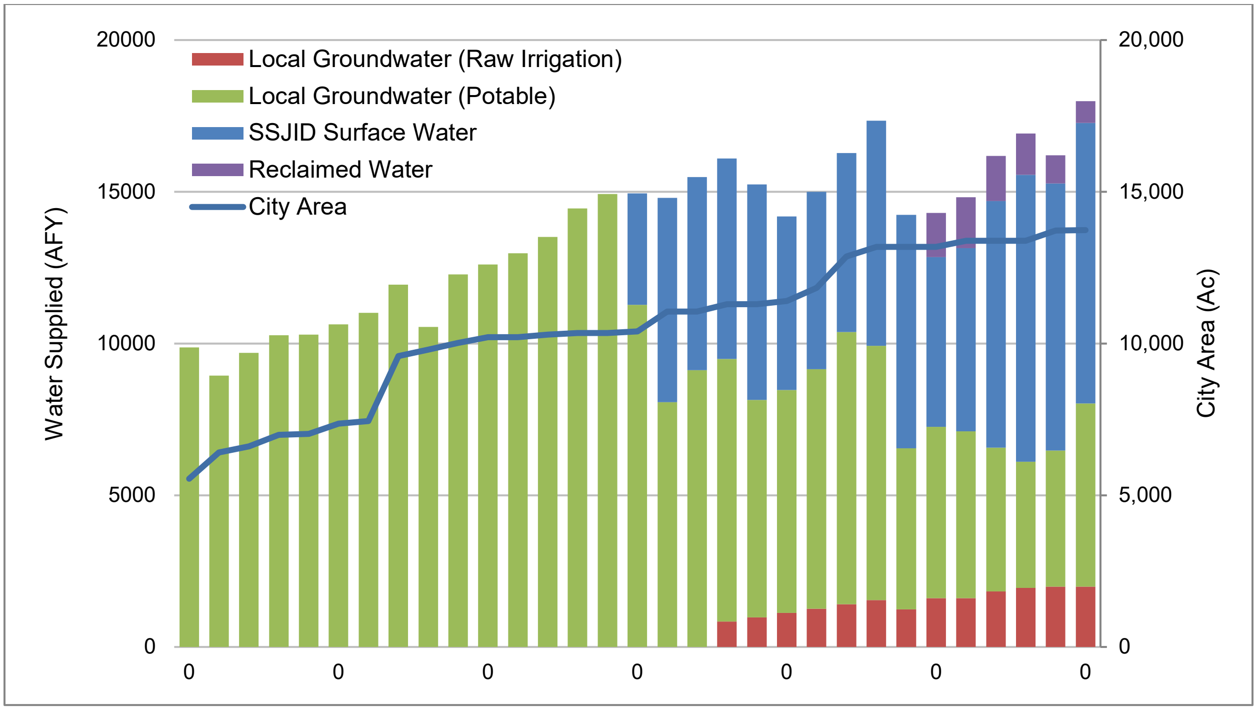
2.2.2 Groundwater Pumping

The City experienced a peak pumping rate of 1.8 AFY/Ac in 1990. Groundwater pumping steadily increased along with City growth after that, reaching a peak pumped volume of 14,900 AF in 2004 (based on the approximate City limits, this translates to a rate of 1.4 AFY/Ac).

Since 2015, SSJID surface water has supplied an average of approximately 60% of the City's annual potable water supply, which is greater than the goal of 53% (refer to the beginning of **SECTION 2**). This has allowed the City to reduce local groundwater extraction rates to significantly less than the basin sustainable yield of 1 AFY/Ac. **Figure 2-4** presents the annual quantities of groundwater pumped by the City in relation to the increasing area within the City limits. This figure clearly displays the decrease in reliance on groundwater pumping following the construction of the WTP in 2005. Note that the sharp dip in water usage in 2015 and 2016 is indicative of State-mandated conservation and the City's implementation of the Water Shortage Contingency Plan (WSCP) during the 2015-2016 State-wide drought.

Today, the City owns and operates 15 active and two standby potable water wells, as well as 31 dedicated irrigation wells at City parks. To date, 12 wells have been abandoned due to facility deterioration and/or water quality issues. Shallower wells have higher rates of nitrogen contamination than deeper wells and are thus typically used for raw water irrigation.

Figure 2-4: Historical Water Supplies and City Area



Notes:
1. Includes both potable and non-potable groundwater pumped.

For water supply evaluation purposes, groundwater pumping within City limits by entities other than the City must be included in groundwater sustainable yield accounting. Manteca Unified School District (MUSD), SSJID, and others own and operate groundwater wells within the City area. Below is a list of all known entities that pump groundwater within City limits as well as a description of the method used to estimate pumping quantities of each for supply availability accounting purposes:

- **MUSD** – It is assumed that MUSD irrigates 25% of the acreage of its parcels, at a rate of 4 AFY/Ac. Given that MUSD has approximately 500 acres of land, total annual water use is estimated at 500 AFY.
- **SSJID** – The best available groundwater pumping data for SSJID is pumping records from 2010-2015 as presented in the City's 2015 UWMP. Based on this data, an average of 4,860 AFY was pumped from SSJID-leased wells, and of this, an average of 2,860 AFY was pumped within the City planning area. For planning purposes, it is assumed that 2,860 AFY is pumped by SSJID through the planning horizon of 2045.
- **Eckert Cold Storage** – The City treated an average of 101 AFY of wastewater produced by Eckert for the period of 2016-2020. Using an estimated return-to-sewer ratio of 85%, groundwater pumping by Eckert is estimated at 120 AFY.
- **Others** – There are potentially other industrial and commercial users that pump groundwater within City limits. Well completion reports from DWR suggest that over 1,300 water wells have been constructed within City limits since record keeping began in the 1960s; however, many have likely not been registered as abandoned. It is anticipated that most domestic wells are no longer in use, though further investigation would be required to confirm this.

When the City annexes new areas, there is a corresponding increase in total available groundwater within the sustainable yield. Annexations of land into City limits are estimated based on the projection horizons detailed later in **Section 4.2.1**. **Figure 2-5** displays the existing, 2030, and 2045 projected City limits based on these growth projections. These three scenarios are the basis for analyzing the City's water supply and distribution system capacity. Because the timing of annexation is unknown, City areas are linearly interpolated in the interim years for water supply availability purposes. **Table 2-1** presents the current and projected City areas along with the corresponding groundwater pumping sustainable yield for supply availability purposes.

Table 2-1: Current and Projected City Area

	2021	2025	2030	2035	2040	2045
City Area (acres)	13,737	14,037	14,411	16,057	17,702	19,350
Sustainable Yield (AFY)	13,737	14,037	14,411	16,057	17,702	19,350
Available Groundwater Supply (AFY)[1]	10,257	10,737	11,111	12,757	14,402	16,050

Notes:
1. Sustainable yield less pumping by MUSD, SSJID, and Eckert Cold Storage.

2.2.3 Groundwater Quality

Water quality in the shallow aquifer is generally acceptable for irrigation purposes, though there are some concerns throughout the ESJ Subbasin regarding salinity intrusion from the San Joaquin River. This is reflected in some instances of higher sodium and chloride levels, increasing total dissolved solids (TDS) concentrations, and general degradation of water quality from overlying land uses. Additionally, as stated in Section 4.2.2 of the City's Reclaimed Water Facilities Master Plan (RWFMP), the City Parks and Recreation Department has reported that some wells in the southeast section of the City are likely suffering from poor water quality as evidenced by trees in those parks showing signs of salt stress.

In general, the water quality in the deeper aquifer is suitable for potable use with minimal treatment, though arsenic, nitrate, and other contaminants are a growing concern.

On December 14, 2017, the State Water Resources Control Board (SWRCB) adopted a new Maximum Contaminant Level (MCL) for 1,2,3-Trichloropropane (TCP) of 5 parts per trillion (ppt) and required all water suppliers in California to begin testing their sources for the contaminant in the first quarter of 2018. As of the end of 2020, the City had five wells with average TCP concentrations over the new MCL. While the City works to address the water quality issue by constructing new water treatment systems at the affected wells, water production has been shifted to sources that meet all drinking water standards. Common sources of TCP in groundwater include solvent-related dischargers. Aside from these exceedances, the City has historically consistently complied with all water quality standards for groundwater.

To meet potable drinking water standards, affected potable groundwater wells require treatment for nitrate, arsenic, manganese, and TCP. The City has utilized approved treatment methods to achieve groundwater quality standards including wellhead treatment, centralized treatment facilities (e.g., Central Arsenic Treatment Facility [CATF]), and blending with SSJID surface water. **Table 2-2** details the contaminants of concern at each City well location and lists the treatment method used to address these contaminants at each well. Refer to **Section 3.2** for a discussion of the groundwater wells and locations.

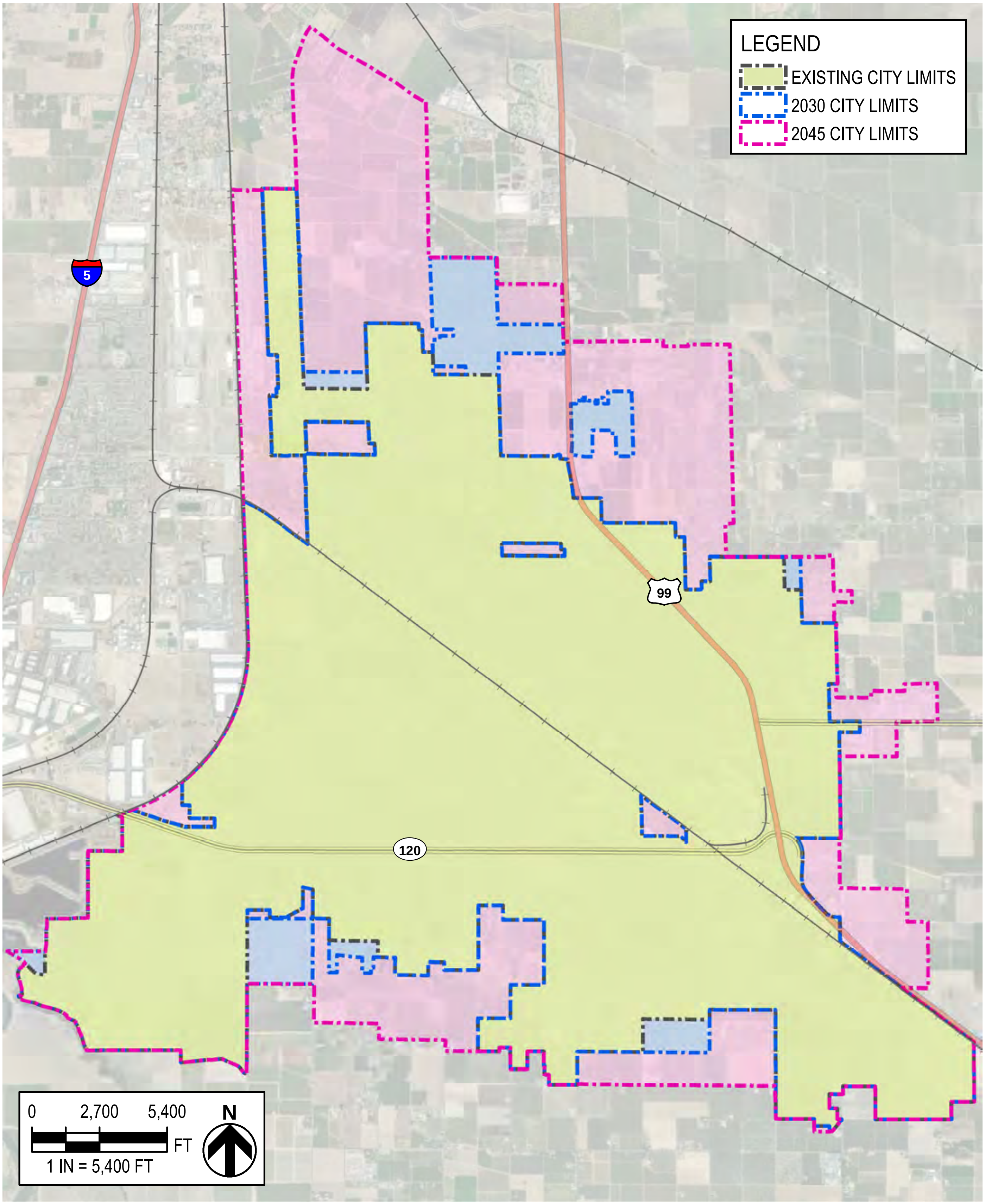


FIGURE **2-5**
CITY OF MANTECA
WATER MASTER PLAN
CURRENT AND PROJECTED CITY LIMITS

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Table 2-2: Groundwater Treatment for City Wells

Well #	Nitrate	Arsenic	Manganese	TCP	Treatment Method(s)
12	✓	✓			Blending with SSJID surface water
13		✓		✓	Treatment media at CATF
14		✓	✓		Wellhead treatment
15		✓			Blending with SSJID surface water
16		✓			Blending with SSJID surface water
17					None
18 [1]	✓			✓	None
19		✓		✓	Treatment media at CATF
20 [1]	✓	✓		✓	Wellhead treatment
21	✓	✓			Blending with Well 19, treatment media at CATF
22		✓			Blending with SSJID surface water
23	✓	✓		✓	Wellhead treatment, blending with SSJID surface water
24	✓	✓		✓	Wellhead treatment, blending with SSJID surface water
25		✓			Wellhead treatment
27	✓			✓	Wellhead treatment, blending with SSJID surface water
28		✓	✓		Wellhead treatment
29		✓		✓ [2]	Wellhead treatment
30		✓			To be determined

Notes:
1. Standby well.
2. Design for wellhead TCP treatment at Well 29 is in progress.
3. See **Figure 3-1** for well locations.

Summaries of recent/upcoming regulations that could affect the City's monitoring and treatment requirements in the future are described below.

- **Perchlorate:** The Division of Drinking Water (DDW) intends to review the perchlorate MCL; as part of the review process, their recommendation was to first establish a lower detection limit for the purposes of reporting (DLR) to gather additional occurrence data and revise the MCL if the new data support development of a new standard. The DLR for perchlorate is reduced to 0.002 milligrams per liter (mg/L) (from 0.004 mg/L) as of July 1, 2021 and will be further reduced to 0.001 mg/L on January 1, 2024. There have been no reportable detections at the City's wells in recent history, and thus no anticipated effect on the City's operations.
- **Hexavalent Chromium (Chromium-VI):** On May 31, 2017, the Superior Court of Sacramento County issued a judgment invalidating the hexavalent chromium MCL for drinking water. The court ordered the SWRCB to take the necessary actions to delete the hexavalent chromium MCL from the Consumer Confidence Report, which became effective on September 11, 2017. Thus, as of September 11, 2017, the MCL for hexavalent chromium is no longer in effect. However, the MCL for total chromium of 50 parts per billion (ppb) remains in place. The

SWRCB is actively working to establish a new MCL of 10 micrograms per liter (μg/L) and has identified this as one of its priorities in 2023. Historically, the City has been in compliance with the proposed MCL and thus there is no anticipated effect on the City's operations.

- **Manganese:** On February 16, 2023, DDW proposed revised notification limits (NLs) and response levels for manganese of 20 ppb and 200 ppb, respectively. Manganese has been detected in the City's treated water consistently at levels below the proposed NL. Thus, there is no anticipated effect on the City's operations.
- **Arsenic:** California's revised arsenic MCL of 0.010 mg/L (or 10 μg/L) became effective on November 28, 2008. The DDW is currently investigating the technological and economic feasibility of lowering the MCL below the current State and federal MCL and closer to the Public Health Goal (PHG) of 0.004 μg/L. DDW has identified this as one of its priorities in 2023.

  The MCL is currently 2,500 times the PHG. While the City's drinking water is treated to meet the current arsenic MCL, this has the potential to significantly impact the City and its operations as current levels are above the PHG. This MCL change can have the effect of potentially reducing the availability of groundwater in the City that is compliant with the new MCL and increase the City's reliance on surface water.
- **Per- and polyfluoroalkyl substances (PFAS):** In September 2020, DDW sent orders to select public water systems located near military facilities throughout California, excluding the City, requiring monitoring for PFAS under the authority of Assembly Bill (AB) 756. Although the City is currently not required to monitor for PFAS, in the future, new understanding of the risks of PFAS in drinking water could result in more stringent drinking water standards and increased regulation concerning PFAS monitoring.
- **New MCLs:** Three constituents currently unregulated with NLs have been identified as priorities in 2023 including:
  - Perfluoro-octanoic acid (PFOA);
  - Perfluoro-octane sulfonic acid (PFOS); and
  - N-nitroso-dimethylamine (NDMA).

  MCLs for these constituents may be forthcoming; the potential effect on the City is currently unknown.

  MCL review and considered for revision: In 2017, cadmium, mercury, and styrene MCLs were reviewed and at that time were not considered for revision in 2018. However, DDW has listed these as a priority in 2023 and thus changes may be forthcoming. There have been no reportable detections at the City's wells in recent history and thus there is no anticipated effect on the City's operations.
- **Disinfection Byproducts (DBPs):** This has been identified by DDW as a priority for 2023. DBPs are currently regulated under Title 22, specifically for total trihalomethanes and haloacetic acids (HAA5); however, the U.S. Environmental Protection Agency (EPA) has been evaluating DBPs. During Unregulated Contaminant Monitoring Rule (UCMR) 4, expanded DBP monitoring beyond HAA5 was required including for HAA6Br and HAA9. The EPA has also identified DBPs in the Contaminant Candidate List 5 issued on November 14, 2022. It is conceivable that the EPA may implement more stringent limits on existing DBPs or limits on other DBPs not currently regulated. The potential effect on the City is currently unknown.

2.3 Reclaimed Water

Since 1959, municipal wastewater has been treated at the WQCF, located southwest of downtown Manteca on 22 acres of City-owned land. The WQCF is owned and operated by the City and treats municipal wastewater from the City of Manteca, portions of the City of Lathrop, Raymus Village just northeast of the City, Oakwood Shores Community located just southwest of the City, and seasonally accepts industrial food processing waste effluent from Eckert Cold Storage. Per contractual agreement, 8.42 MGD (9,440 AFY) of plant capacity is allocated to the City of Manteca and 1.45 MGD (1,630 AFY) is allocated to the City of Lathrop.

The City plans to expand the WQCF from the currently permitted 9.87 MGD to 27 MGD at buildout. Between 2016 and 2020, the WQCF collected and treated an average of 6.6 MGD (8,880 AFY) with influent flow rates peaking during the late fall and early winter months.

Undisinfected secondary effluent is either stored for agricultural use in a 15-million gallon (MG) pond or blended with food processing waste and applied directly on the agricultural fields owned by the City (190 acres) and Dutra Farms, Inc. (70 acres) surrounding the WQCF – primarily during the dry season. Between 2016 and 2020, this use averaged about 1.09 MGD (1,220 AFY) with a steady decline over those five years and it is expected be eliminated by 2040 as these lands are developed.

The remaining secondary effluent undergoes tertiary treatment and is utilized or disposed of in one of the following ways:

1. Reclaimed water is pumped to a truck fill station at the WQCF entrance for use in construction and dust control purposes. Water for the truck fill station is chlorinated prior to distribution. Since the implementation of the reclaimed water fill station in 2015, reclaimed water used for construction purposes has averaged 2.7 MG annually (8.2 AFY), though quantities fluctuate significantly from year-to-year commensurate with construction activities. It is expected that reclaimed water fill station use will increase with City growth and development activity.

   The City now requires that all "Water Truck Drivers" that are currently using City potable water for construction purposes attend a workshop on reclaimed water use and handling for local construction purposes. Contractors are now required to utilize reclaimed water if the project is within one mile of the WQCF and greater than 20 acres in size; if the project is greater than one mile from the WQCF and is less than 20 acres in size, then potable water may still be utilized. Reclaimed water is currently free of charge for drivers who have attended the workshop.
2. In 2019, the City constructed a 12-in reclaimed water pipeline between the WQCF and the Great Wolf Lodge. In 2020, the Great Wolf Lodge began utilizing reclaimed water for landscape irrigation.
3. Effluent is discharged through a 36-in diameter pipe into the San Joaquin River. As the practice of discharging to agricultural fields is gradually phased out due to land development, effluent will increasingly be diverted for reclaimed water uses and/or discharged to the San Joaquin River.

Figure 2-6 shows the extents of the existing reclaimed water distribution system.

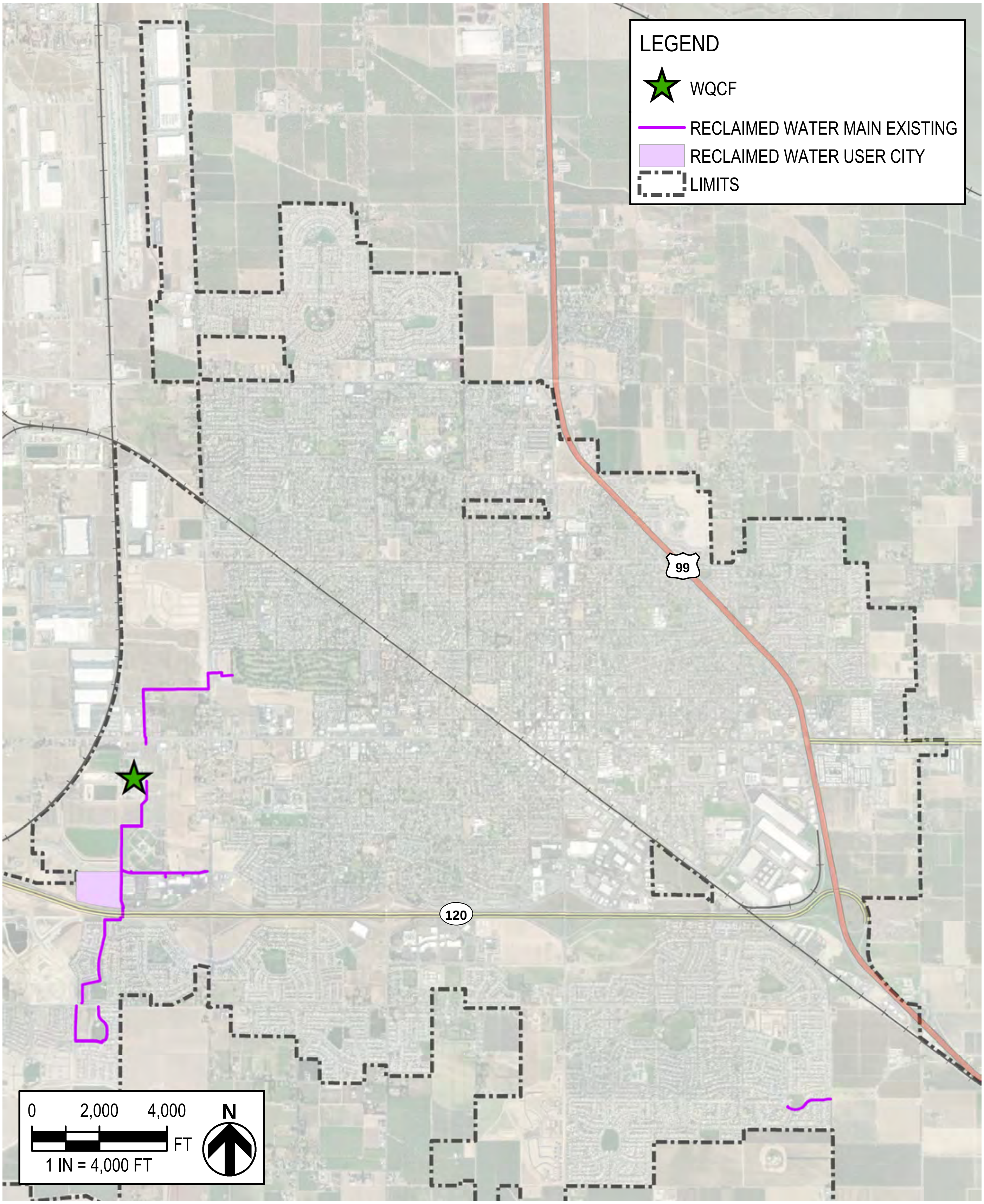

FIGURE 2-6
CITY OF MANTECA
WATER MASTER PLAN
EXISTING RECLAIMED WATER DISTRIBUTION SYSTEM

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2.4 Stormwater

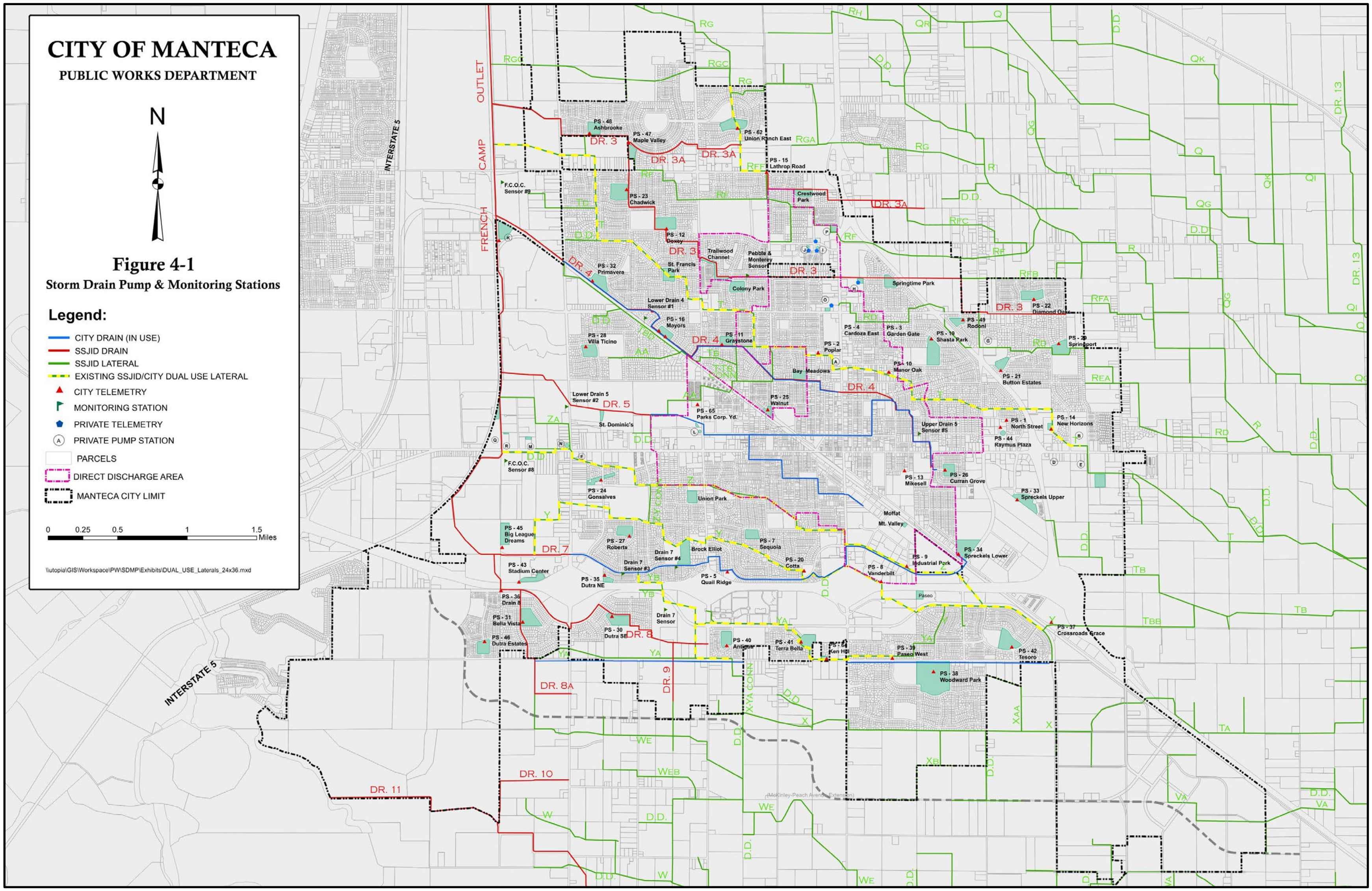
SSJID owns and operates an extensive network of irrigation drains and laterals that run through the City. These facilities deliver irrigation water to various farming operations in and around the City and they convey excess irrigation water and stormwater runoff to the San Joaquin River. In 1975, the City entered into a Storm Drainage Agreement with SSJID and in 2006, this agreement was renewed. Under this agreement, the City can pump stormwater into SSJID's irrigation facilities for conveyance either directly to the San Joaquin River or via the French Camp Outlet Canal (FCOC). Per the agreement, the City is required to monitor stormwater discharges into SSJID facilities to ensure their capacities are not exceeded and that stormwater quality meets applicable regulations. To meet this requirement, the City requires all new development to attenuate its runoff in a storage facility before pumping it into SSJID facilities. In addition, the City uses real-time water level monitoring stations at critical low points in the conveyance system complete with supervisory control and data acquisition (SCADA) facilities.

The City also maintains and operates its own stormwater collection system consisting of 214 miles of pipeline, 70 pump stations including 6 level sensors, and 67 retention basins to convey stormwater to the SSJID drainage network. **Figure 2-7** presents a map of the existing storm drain collection system taken from the City's 2013 Storm Drain Master Plan (SDMP).

The feasibility of utilizing stormwater as a supply source has not been studied to date. Although there are no specific stormwater reuse projects planned, the City's SDMP presents the following recommendations to utilize stormwater and storm drain infrastructure:

- Where feasible, drainage facilities should be utilized to accomplish open space requirements of the Manteca General Plan and the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan, and to provide opportunities for public education.
- Design of storm drain systems within new developments should consider the use of open drainage corridors where feasible as an alternative to an underground pipe drainage system. Open drainage corridors may provide short-term detention storage and storm water quality treatment. The use of open drainage corridor is subject to approval by SSJID and City Council.
- Where feasible, drainage channels should be integrated into the City's bicycle and pedestrian trail system.
- Buffers, grassy swales, and landscaped areas may all be used to break the hydraulic connectivity of runoff across paved surfaces and reduce downstream peak flows.
- Where feasible, drainage channels should be designed as multi-use facilities, incorporating a "natural" appearance, providing habitat, open space, and a range of mixed use.
- Where feasible, drainage facilities should incorporate interpretive and educational trails.

Figure 2-7: Existing Storm Drain Collection System



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SECTION 3 – EXISTING DISTRIBUTION SYSTEM

The City's distribution system operates as a single pressure zone with a decentralized operating system. This section provides a more detailed description of the potable water distribution facilities including turnouts, storage facilities, groundwater wells, and pumps, each identified on **Figure 3-1**; **Figure 3-2** presents a schematic of the supply and distribution system.

3.1 SSJID Turnouts

The City receives treated surface water from SSJID through four turnouts located along the SSJID transmission main running along the western and northern boundaries of the City (see **Figure 3-1**):

- **M1** – Water from M1 turnout flows to the Louise Ave Pump Station (LAPS). From there, treated surface water is conveyed to the City through a 16-in pipeline (LAPS 16-in) or feeds Atherton Tank through a 24-in pipeline (LAPS 24-in). While LAPS is equipped with pumps, water often flows by head differential from the turnout without the pumps operating.
- **M2** – Water from M2 turnout flows to the 1.0 MG M2 Tank which is operated by SSJID. Water is pumped from the tank through three booster pumps (two active and one standby) with a total firm capacity of 5,600 gallons per minute (gpm). All three pumps are equipped with variable frequency drives (VFDs) to provide for variable discharge to the City system. This pumping facility is designed to discharge the maximum inflow capacity at the turnout and does not have long-term peaking capacity. For this reason, the M2 tank is not considered in the City's total storage capacity for peaking purposes.
    - Water from M2 is blended with Wells 12, 15, 22, and 27 with the option for some flow to also bypass blending and flow directly to the distribution system.
- **M3** – Water from M3 turnout flows to the 1.0 MG M3 Tank which is operated by SSJID. Water is pumped from the tank through three booster pumps (two active and one standby) with a total firm capacity of 5,600 gpm. All three pumps are equipped with VFDs to provide for variable discharge to the City system. This pumping facility is designed to discharge the maximum inflow capacity at the turnout and does not have long-term peaking capacity. For this reason, the M3 tank is not considered in the City's total storage capacity for peaking purposes.
    - Water from M3 is blended with Well 16 with the option for some flow to bypass blending and flow directly to the distribution system.
- **M4** – Water from M4 turnout flows directly from the SCWSP pipeline to blend with Well 23 with no storage tank and no option to bypass blending. At Well 23, a single booster pump is used to increase pressure when M4 water is used for blending.

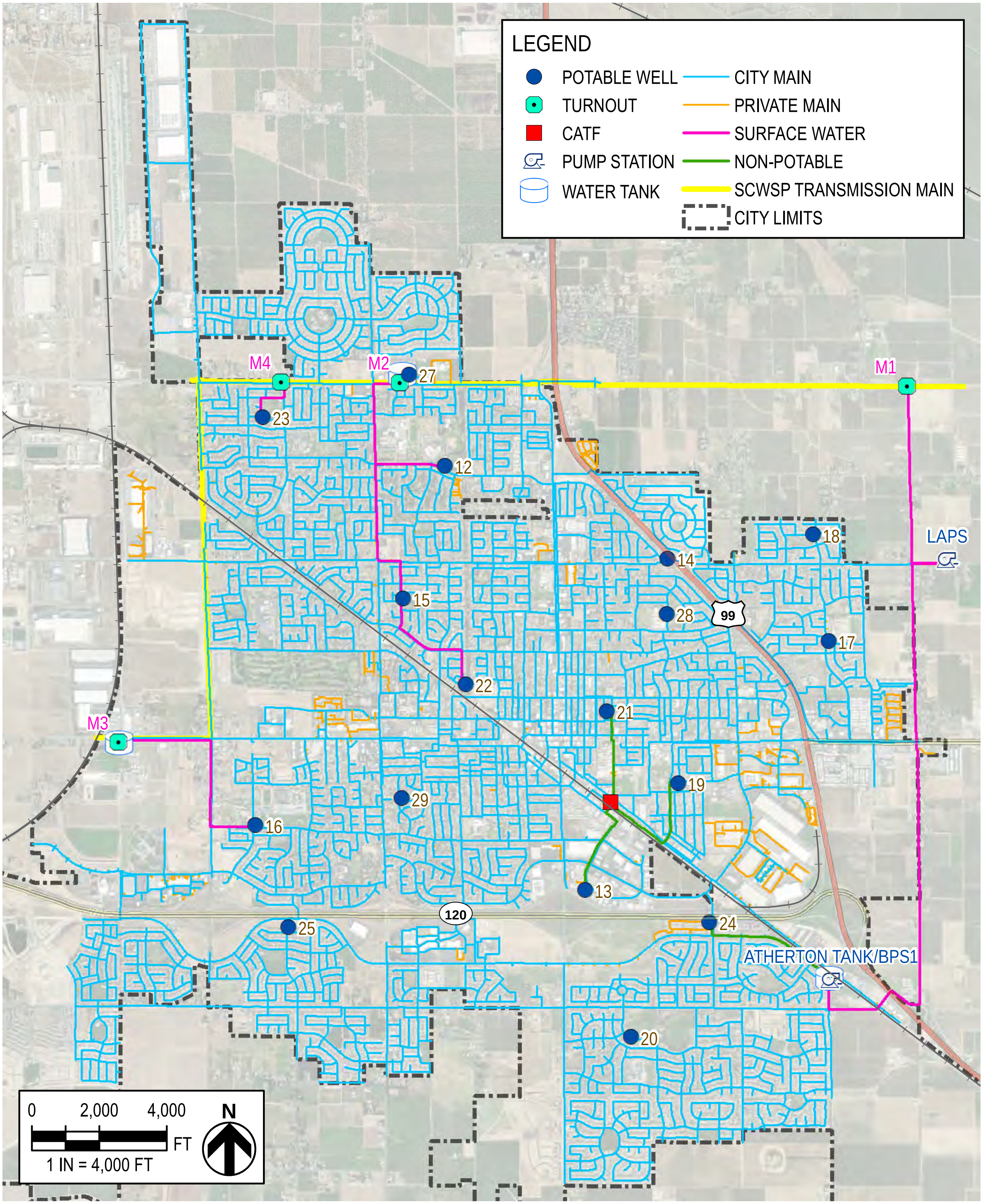

FIGURE 3-1
CITY OF MANTECA
WATER MASTER PLAN
WATER SUPPLY, STORAGE, AND DISTRIBUTION FACILITIES

HydroScience

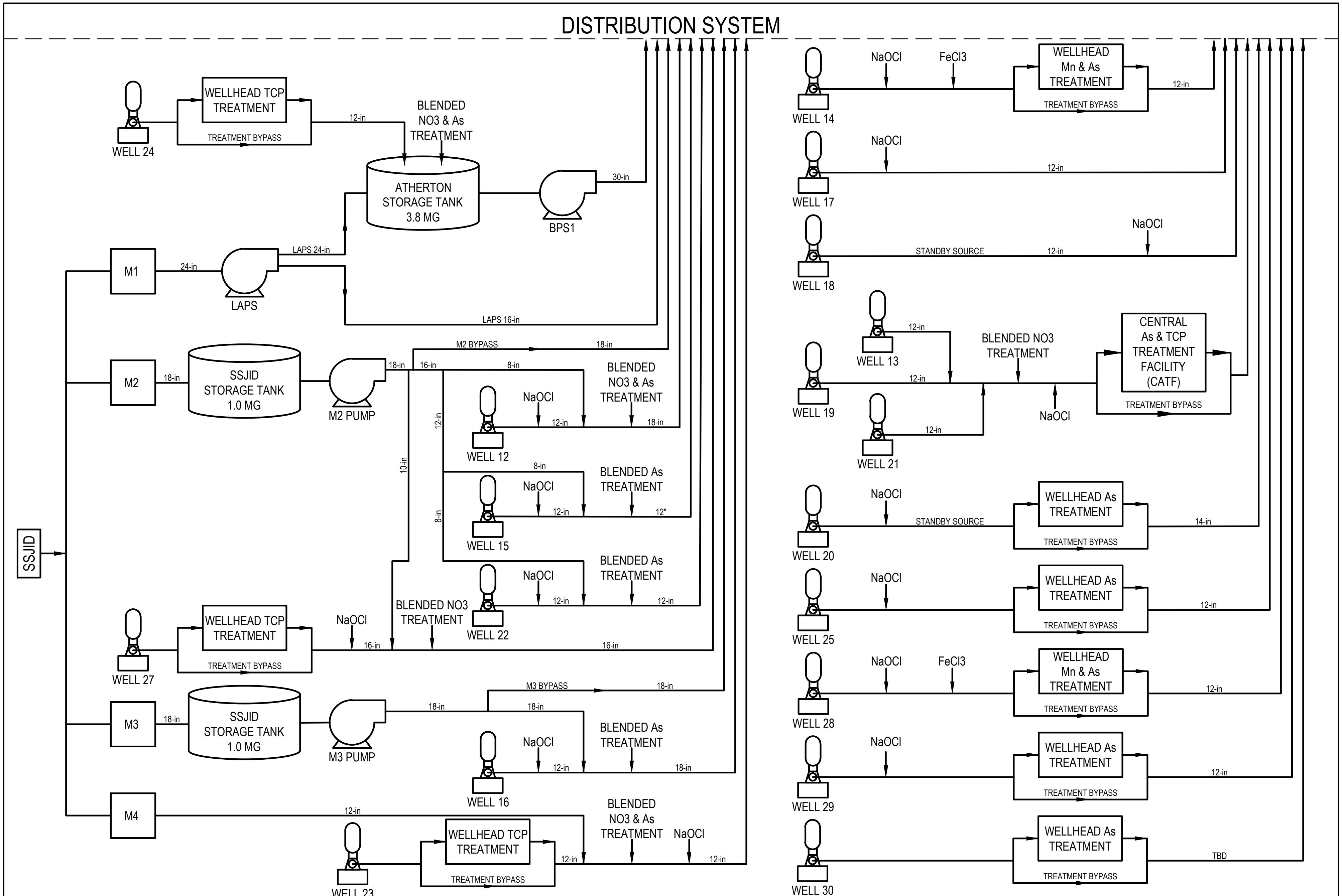

FIGURE 3-2
CITY OF MANTECA
WATER MASTER PLAN
DISTRIBUTION SYSTEM SCHEMATIC DIAGRAM

HydroScience

Each turnout connection is metered and M2 and M3 are equipped with backup power. M1 turnout is also equipped with backup power, though LAPS currently is not; in the event of a power outage, M1 would rely solely on head differential from the SSJID pipeline to feed the City's distribution system. **Table 3-1** lists the estimated capacity of each of the four turnout connections based on the size of the turnout and corresponding SCADA data provided by the City. Currently, the capacity of the turnouts is not fully utilized due to distribution system constraints within City infrastructure. To expand surface water use from the SSJID turnouts, either the City's infrastructure will need to be upgraded or new SSJID turnouts will need to be constructed.

Table 3-1: SSJID Turnout Connections

Turnout	In City?	Location	Elevation (ft)	Capacity (gpm)
Manteca – 1 (M1)	No	E Lathrop Rd & S Austin Rd	47	- [1]
Manteca – 2 (M2)	Yes	E Lathrop Rd & Arrowsmith Dr	32	5,600
Manteca – 3 (M3)	Yes	2500 W Yosemite Ave	30	5,600
Manteca – 4 (M4)	Yes	3333 Lathrop Rd	27	- [1]

Notes:
1. Data unavailable.

3.2 Groundwater Wells

The City currently owns and operates 15 active and two standby potable water wells, two of which began production in 2019, and each of which are identified on **Figure 3-1**.

Groundwater treatment is detailed in **Section 2.2**. The treatment methods for each well are listed in **Table 2-2** and displayed in **Figure 3-2**.

Each well is equipped with a VFD-powered pump with the exception of Well 14 which has a single speed pump. Each well pump is controlled by remote telemetry units (RTUs) which communicate via radio to the Master RTU and supervisory computer located at Well 19.

Table 3-2 identifies each municipal potable groundwater well and its maximum flow rate as noted in SCADA. System operation and control of each of the wells is detailed further in **Section 3.6**.

In the City's system, Wells 18 and 20 are both designated standby wells. Well 18 is standby due to elevated nitrate levels, and Well 20 is standby due to TCP levels exceeding 10 times the MCL and occasionally reaching 20 times the MCL. DDW considers any well containing TCP at levels exceeding 10 times the MCL to be "extremely impaired" and recommends that the source be removed from active status.

Standby sources are subject to less frequent monitoring requirements but are still required to meet all primary MCLs. A standby well that exceeds one or more of the secondary MCLs may be used as long as the City meets certain reporting and notification requirements. The California Health and Safety Code, Title 22, Section 64414 Standby Sources describes requirements for standby wells; Section 64449.4 details the exception to secondary MCLs for standby sources and the requirements for use.

Table 3-2: Groundwater Wells

Well #	Location[1]	Drill Date[1]	Well/Bowl Depth (ft)[1]	Max Flow Rate (gpm)[1,2]	Pump Type	Backup Power?	Status
12	1750 Hoyt Ln	1973	330/125	2,000	Turbine	Yes	Active
13	1147 Vanderbilt Cir	1980	370/135	800	Turbine	No	Active
14	801 E Louise Ave	1982	365/190	1,200	Turbine	Yes	Active
15	810 Agate Ave	1985	260/100	2,010	Turbine	Yes	Active
16	1895 Wawona St	1991	304/0	2,145	Turbine	Yes	Active
17	658 Pestana Ave	1995	372/110	1,147	Turbine	Yes	Active
18	1193 Pestana Ave	1996	350/141	600	-	Yes	Standby
19	286 S Powers Ave	1997	390/150	1,500	Turbine	Yes	Active
20	1920 Buena Vista Dr	1998	350/170	800	-	Yes	Standby
21	432 Pine St	1999	390/175	1,000	Turbine	Yes	Active
22	364 Victory Ave	1999	425/175	1,000	Submersible	Yes	Active
23	1912 Bedford Ln	1999	364/130	2,200	Turbine	Yes	Active
24	1339 Van Ryn Ave	2004	424/180	1,800	Turbine	Yes	Active
25	1374 Oleander Ave	2003	305/0	2,500	Turbine	Yes	Active
27	921 W Lathrop Rd	1969	240/0	2,500	Turbine	Yes	Active
28	696 Slalom Dr	2017	450/289	1,500	Turbine	Yes	Active
29	614 El Portal Ave	2017	420/196	2,000	Turbine	Yes	Active
30	Palmer Pike	2024	To be determined				Planned

Notes:
1. Source: SCADA system screenshots (see **Figure 8-2**).
2. Maximum flow rates may be less than those listed here due to surface water blending requirements.

3.3 Storage Facilities

Figure 3-1 shows the three tanks, M2 Tank, M3 Tank, and Atherton Tank, operating in the City's distribution system within the City limits.

As detailed in **Section 3.1**, the M2 Tank and M3 Tank are each 1.0 MG aboveground tanks located at the M2 and M3 turnouts, respectively, and are owned and operated by SSJID. These two tanks operate to maintain relatively constant levels to accommodate average day demand (ADD). These storage tanks do not contribute to the City's emergency storage as they are not owned by the City and the City does not control their operation.

The third tank, which is owned and operated by the City, is located in the southeastern part of the City on E Atherton Dr (Atherton Tank). Atherton Tank is filled by a combination of surface water from M1 turnout flowing through LAPS 24-in and groundwater pumped from Well 24. The primary purpose of this tank is for mixing and to provide the system with operational flexibility.

Table 3-3 lists the potable water storage facilities.

Table 3-3: Storage Facilities

Facility Name	Location	Owned By	Surface Elevation (ft)	Capacity (MG)
M2 Tank	Lathrop Rd	SSJID	32	1.0
M3 Tank	W Yosemite Ave	SSJID	30	1.0
Atherton Tank	E Atherton Dr	City	47	3.8

3.4 Pump Stations

In addition to the pumps at each well and at each turnout, the City operates two pump stations, a description of each is provided as follows:

- **Louise Ave Pump Station (LAPS):** LAPS receives water from SSJID Turnout M1. From LAPS, water flows through LAPS 16-in directly to the distribution system or through LAPS 24-in to fill Atherton Tank. LAPS 16-in includes a 50-horsepower (hp) centrifugal pump with a capacity of 3,000 gpm that only operates when LAPS 24-in is not filling Atherton Tank; otherwise, water flows through LAPS 16-in by pressure head from M1 and is controlled by a control valve with a distribution system target pressure. Atherton Tank fill rates from LAPS 24-in are controlled by a flow control valve located near the Atherton Tank site.
- **Atherton Tank Pump Station (ATPS):** ATPS is located adjacent to Atherton Tank and pumps water from the tank directly into the distribution system through a 30-in pipe. ATPS is one of the single largest sources of flow in the City's distribution system, supplying approximately 30% of the total demand on an average day. ATPS consists of four identical 150-hp (turbine) pumps, each with a capacity of 3,500 gpm and a 60-hp jockey pump with a pumping capacity of 1,300 gpm. The maximum pumping capacity is 11,800 gpm (three 150-hp pumps and one 60-hp jockey pump).

Table 3-4: Pump Stations

Pump	Capacity (gpm)	Horsepower (hp)	Pump Type
LAPS – 16-in	3,000	50	Centrifugal
ATPS – 1	3,500	150	Turbine
ATPS – 2	3,500	150	Turbine
ATPS – 3	3,500	150	Turbine
ATPS – 4	3,500	150	Turbine
ATPS – 5	1,300	60	Turbine

3.5 Distribution System Network

The City's distribution system consists of over 300 miles of potable water pipelines ranging from 1-in to 30-in and a variety of materials. As displayed in **Figure 3-1**, this consists of four main categories of pipeline:

- **Surface Water** – These are the pipelines that carry potable water from each of the four SSJID turnouts to each blending point with a City well. There are no services or hydrants connected to these pipelines.
- **Non-Potable** – These are the pipelines that carry untreated water from Wells 13, 19, and 21 to be treated at the CATF and from Well 24 to Atherton Tank to blend with SSJID surface water. There are no services or hydrants connected to these pipelines.
- **City Main** – This is the bulk of the distribution system which carries potable water from each of the supply sources to each user. This consists of all pipelines owned and maintained by the City. For this analysis, only the City Main pipelines were evaluated for condition and capacity.
- **Private Main** – These private water mains are typically smaller in diameter and are owned and maintained by private entities.

The discussion in this section pertains only to the City Main pipelines. According to the City's Geographic Information System (GIS) database, over half of the system is 8-in pipe and almost three quarters of the system is polyvinyl chloride (PVC). Most of the system has been built since 1970, though the oldest pipelines date back to the 1900s. Older pipelines are generally located in the City center with newer pipelines around the edges of the City consistent with City development and expansion. **Table 3-5**, **Table 3-6**, and **Table 3-7** present a breakdown of the City's distribution system according to diameter, material, and age, respectively, and each of these are also reflected in **Figure 3-3**, **Figure 3-4**, and **Figure 3-5**, respectively.

Table 3-5: Distribution System Pipeline Diameter

Diameter	Length (ft)	Length (mi)	Length as % of Total
<6-in	61,838	11.7	4%
6-in	256,253	48.5	16%
8-in	820,752	155.5	52%
10-in	25,826	4.9	2%
12-in	325,885	61.7	21%
14-in	27	0.0	< 1%
16-in	65,773	12.5	4%
18-in	2,767	0.5	< 1%
24-in	566	0.1	< 1%
30-in	933	0.2	< 1%
Unknown	737	0.1	< 1%
Total	**1,561,357**	**295.7**	**100%**

Table 3-6: Distribution System Pipeline Material

Material[1]	Length (ft)	Length (mi)	Length as % of Total
ACP	425,322	80.6	27%
CIP	3,671	0.7	< 1%
DIP	8,162	1.5	1%
PVC	1,116,282	211.4	71%
RCP	249	0.0	< 1%
Steel	6,698	1.3	< 1%
WIP	286	0.1	< 1%
Unknown	687	0.1	< 1%
Total	**1,561,357**	**295.7**	**100%**

Notes:
1. ACP = asbestos cement pipe
   CIP = cast iron pipe
   DIP = ductile iron pipe
   PVC = polyvinyl chloride
   RCP = reinforced concrete pipe
   WIP = wrought iron pipe

Table 3-7: Distribution System Pipeline Age

Decade Installed	Length (ft)	Length (mi)	Length as % of Total
1900s	1,385	0.3	< 1%
1910s	65,262	12.4	4%
1920s	4,352	0.8	< 1%
1940s	13,274	2.5	1%
1950s	59,723	11.3	4%
1960s	65,660	12.4	4%
1970s	148,926	28.2	9%
1980s	211,344	40.0	14%
1990s	150,342	28.5	10%
2000s	452,705	85.7	29%
2010s	287,385	54.4	18%
2020s	23,144	4.4	1%
Unknown	77,855	14.8	5%
Total	**1,561,357**	**295.7**	**100%**

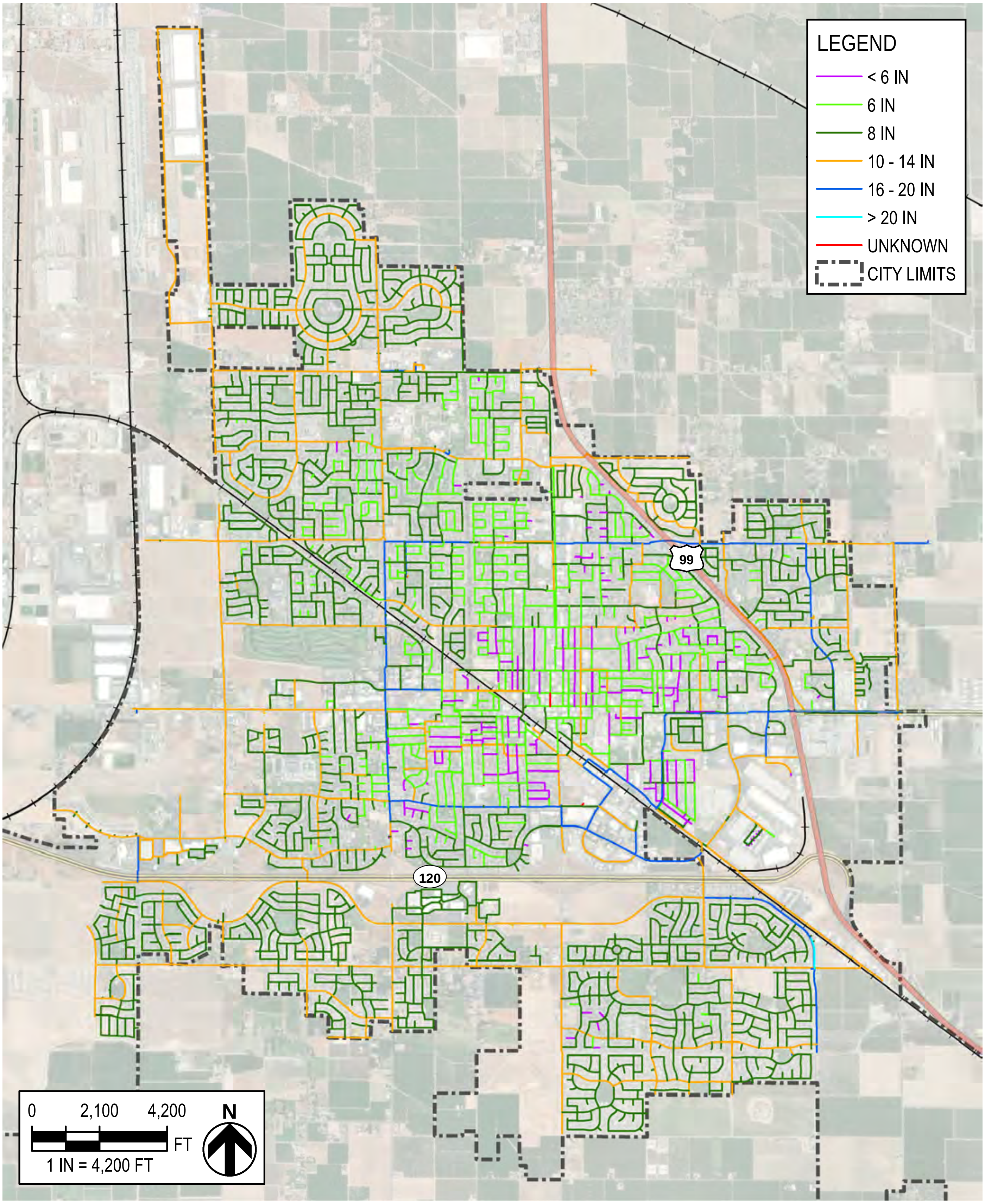

FIGURE 3-3
CITY OF MANTECA
WATER MASTER PLAN
DISTRIBUTION SYSTEM PIPELINE DIAMETERS

HydroScience

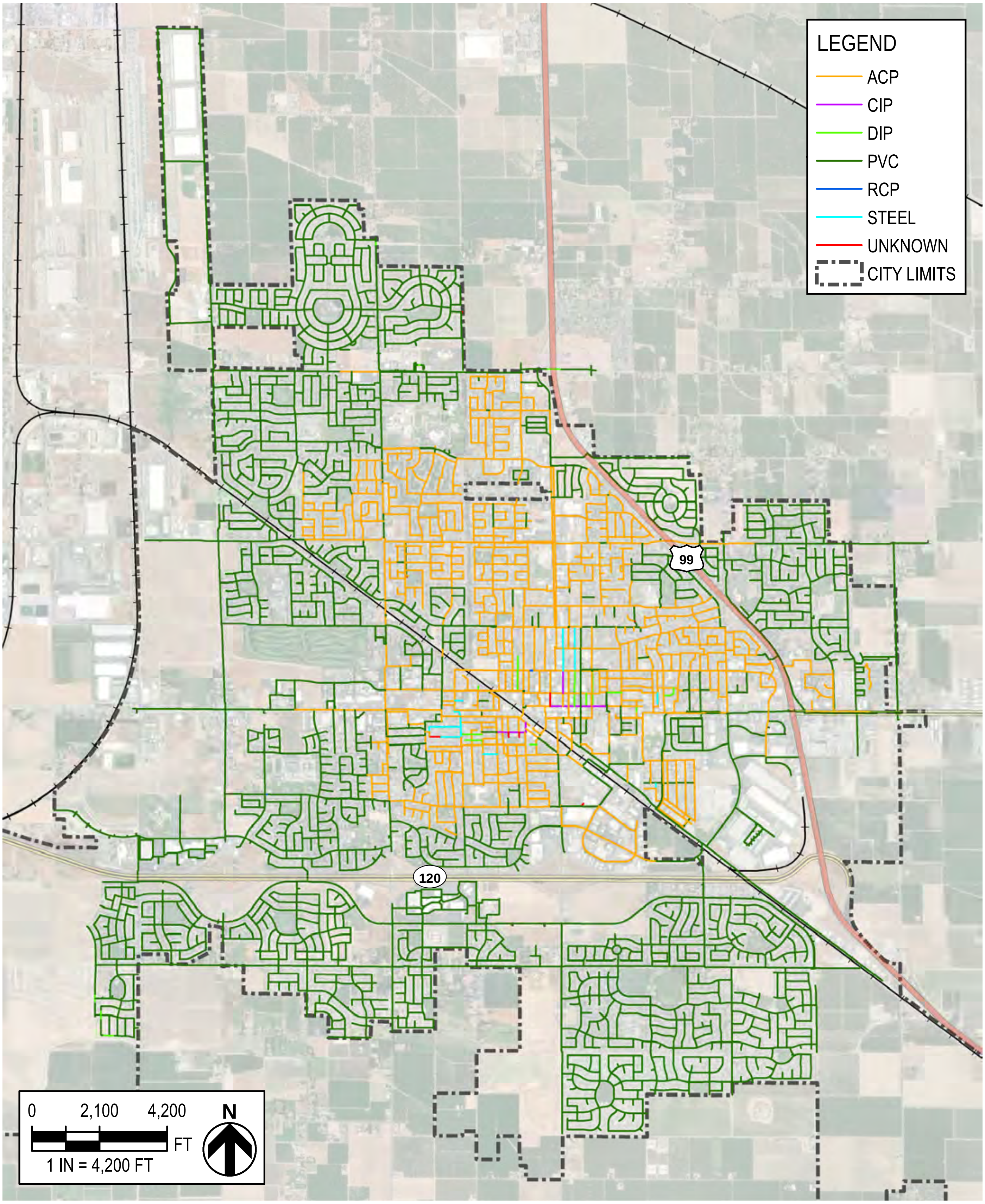

FIGURE 3-4
CITY OF MANTECA
WATER MASTER PLAN
DISTRIBUTION SYSTEM PIPELINE MATERIALS

HydroScience

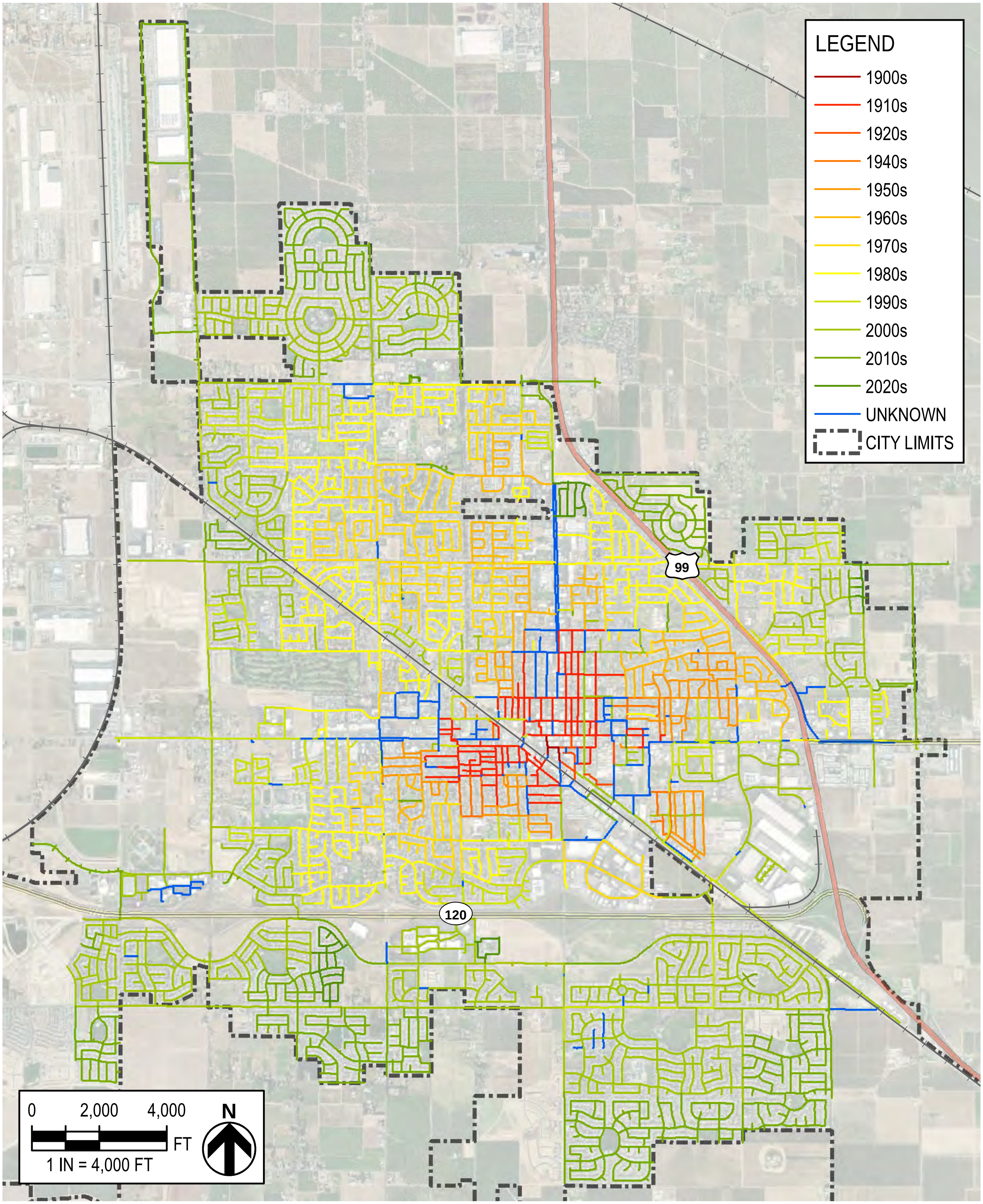

FIGURE 3-5
CITY OF MANTECA
WATER MASTER PLAN
DISTRIBUTION SYSTEM PIPELINE AGE

HydroScience

3.6 System Operation and Control

Most of the City water system wells turn on and off based on assigned pressure settings. The exception is Well 24, which is operated based on a target flow. Each well that is blended with another well (i.e., at CATF) or with SSJID surface water also has a target blend percentage. In general, these blend percentages operate as a maximum groundwater percentage to ensure compliance with groundwater quality regulations. During the wet winter season, these blending percentages are lower as a majority of the City's demand is met with surface water; during the drier summer months, the mix may approach these target blend percentages as additional customer demand is met with supplemental groundwater pumping. Targets for each facility on October 27, 2021, the day of hydrant testing (detailed in **SECTION 8**), were provided by the City and are presented in **Appendix E**.

The pressure and flow settings are set individually at each well and can be monitored or adjusted both manually and remotely via SCADA. Through practical application and experience, the City has sequenced the wells in order of priority based on water quality, reliability, location, and capacity. These assigned pressure settings are adjusted seasonally to accommodate different demand patterns throughout the year.

The SCADA system utilizes RTUs at the storage tank and well sites which communicate via radio to the Master RTU and supervisory computer located at Well 19. The supervisory computer includes operator interface software. The Master RTU also communicates via leased telephone line to a second computer at the Corporation Yard. The SCADA system monitors tank levels, well discharge pressures, flows, power demands, groundwater levels, and pressure setpoints to start and stop each well pump. It also displays intrusion, power fail, standby generator engine running, standby generator engine fail alarms, and it can remotely disable alarms. SCADA data totalizes well flows and pump run time hours; and has a historical trending feature that helps City Staff continue to adjust and optimize controls.

The following are descriptions of additional operations not captured in the discussion above:

- **LAPS** – Water from turnout M1 flows to LAPS where it continues through either LAPS 24-in to fill Atherton Tank or LAPS 16-in directly to the distribution system. LAPS 16-in is equipped with a 50-hp pump providing up to 2,700 gpm directly to the distribution system during peak production. Due to head limitations at M1, LAPS is unable to supply water to Atherton Tank and operate the 50-hp pump on LAPS 16-in simultaneously. During two four-hour periods in the morning and the evening, LAPS 24-in will close and stop the Atherton Tank fill, during which time the pump on LAPS 16-in will pump up to 2,700 gpm directly to the distribution system. For the remainder of the day when Atherton Tank is filling, there is sufficient residual pressure from M1 for LAPS 16-in to draw up to 1,200 gpm controlled by a control valve with a desired distribution system target pressure without operation of the 50-hp pump.
- **M2** – There is a pressure-sustaining valve (PSV) that allows flow from M2 to bypass blending with any wells and directly enter the distribution system. This operates to maintain 70 pounds per square inch (psi) upstream in the "Surface Water" pipelines (see **Figure 3-1**) that carry M2 flow to blend with Wells 27, 12, 22, and 15.

- **M3** – There is a manual valve at the M3 turnout that allows flow bypass blending with Well 16 and directly enter the distribution system. In the summer, this valve is more closed due to higher system demands to ensure sufficient flow for blending with Well 16. In the winter, this valve is more open allowing more flow directly to the distribution system. There is an additional interconnection between the M3 blending line and the distribution system downstream of the turnout at S Airport Way and Wawona St, though this valve typically remains closed.
- **Atherton Tank** – Flow from LAPS 24-in can bypass the Atherton Tank fill line, though this valve normally remains closed. The City operates this bypass about once a month to flush water.
- **CATF** – CATF has a master pressure set point that controls all three contributing wells. Generally, Well 13 is the lead well and activates first if the pressure drops to a specified level below the set point. If the pressure continues to drop with Well 13 flowing at the maximum allowed flow, Well 19 is activated next. If the pressure continues to drop with Wells 13 and 19 flowing at their maximum allowed flows, Well 21 activates last. The allowed flows at each of the wells varies throughout the year and is set by the operators. In the winter during lower demands, Wells 13 and 19 will be set to lower allowed flows to ensure Well 21 is exercised.

Figure 3-2 presents a schematic diagram of the City's water distribution system including each turnout, tank, well, and represents all blending between surface water and groundwater. Total system flows are captured by effluent flows at each of the facilities listed below, which can be seen on **Figure 3-2**.

- Well 12
- Well 12 SW
- Well 13
- Well 14
- Well 15
- Well 15 SW
- Well 16
- Well 16 SW
- Well 17
- Well 19
- Well 21
- Well 22
- Well 22 SW
- Well 23
- Well 23 SW
- Well 25
- Well 27
- Well 27 SW
- Well 28
- Well 29
- ATPS
- LAPS 16-in
- M2 Bypass
- M3 Bypass

The following items are noted regarding the total system flows:

- M1 flows to LAPS which is split into LAPS 16-in and LAPS 24-in flows. M1 supply is captured by a combination of ATPS and LAPS 16-in flows, i.e., LAPS 24-in effluent flows are captured by ATPS flows.
- Well 24 feeds directly into Atherton Tank which feeds the distribution system through ATPS. Thus, Well 24 flows are also captured by ATPS flows.
- M2 is blended with Wells 12, 15, 22, and 27. These flows are identified in the SCADA reports as *Well 12 surface water* (SW), *Well 15 SW*, *Well 22 SW*, and *Well 27 SW*.
- M3 is blended with Well 16 and is identified in the SCADA reports as *Well 16 SW*.
- M4 is blended with Well 23 and is identified in the SCADA reports as *Well 23 SW*.
- Wells 13, 19, and 21 flow to CATF before entering the distribution system. There is no storage at CATF, so it is assumed that the flow at each of these wells is representative of what is entering the distribution system at that time.

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SECTION 4 – POTABLE WATER DEMAND ANALYSIS

This section describes the potable water demand analysis and development of land use-based unit water demands. A land use-based approach was used to assign a demand to each customer served by the City's potable water distribution system based on its area and land use. Demands were based on water meter billing data for 2016 through 2021 which was related to land use using GIS to develop land use-based unit factors. These factors were then used to populate the hydraulic model.

The intent of the analysis is to first develop a baseline average annual water demand. Once the baseline is established, other scenarios can be developed for analysis (see **Section 9.2**).

4.1 Existing Demand Analysis

This section presents the unit water demand analysis conducted to calibrate the hydraulic model flows to existing conditions.

4.1.1 Metered Water Use

Potable water meter billing data was used to develop total ADD and maximum day demand (MDD) for the entire service area as well as average unit demand factors for each land use type. Upon review of the data, it was observed that many of the quantities in the column titled *Actual Consumption* were either missing a digit, contained an extra digit, or were listed as negative values. To reconcile this, consumption values were alternatively calculated based on the tiered billing amounts using the City's tiered water rate schedule. These calculated quantities were used for the remainder of this analysis.

To avoid misrepresentation of actual demands and unit factors, billing records where the calculated consumption from the billed amounts did not match the *Actual Consumption* listed for that record were excluded from the unit demand factor analysis. Parcels associated with these billing records were ultimately assigned a demand in the hydraulic model based on their land use.

<u>**Average Day Demand (ADD)**</u>

ADD is defined as the average daily system demand over a specific period of interest. Potable water billing records from 2016 through 2021 were used to estimate the City's total ADD. The average water use for each individual customer was calculated for each calendar year; the sum of all City customers average water use throughout the fiscal year is the system ADD. **Table 4-1** summarizes the calculated total ADD for the years 2016 through 2021 in units of MGD and AFY.

Table 4-1: Annual ADD

ADD	2016	2017	2018	2019	2020	2021
MGD	9.3	10.4	10.7	10.7	11.9	12.1
AFY	10,424	11,601	11,971	12,038	13,372	13,507

Notes:
1. Data is missing for the month of May 2018. May 2018 demand is taken as the average of May 2017 and May 2019 demand.

The increase in water use from 2016 to 2017 can likely be attributed to a rebound effect from drought-related conservation measures following the state-wide drought between 2012 and 2016. Additionally, water use trends everywhere for 2020 were greatly affected by the COVID-19 pandemic which began in early 2020 and led to several regional shelter-in-place/stay-at-home orders and local emergency restrictions. There was a distinct shift in the distribution of water use from commercial to residential areas due to an increased number of people working from home.

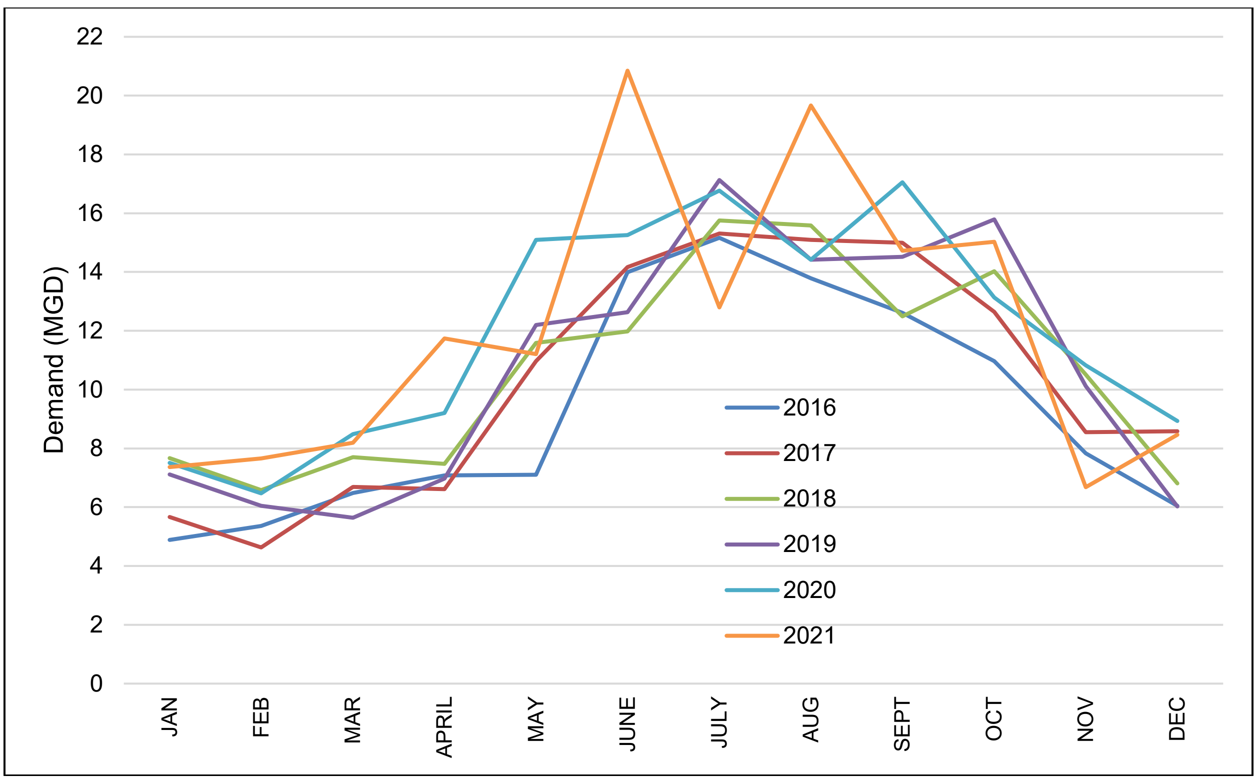
Every five years, each water supplier in the state of California is required to report their historical water use and provide future water demand projections in an UWMP. For comparison, the City's 2015 UWMP projected a potable water demand in 2020 (excluding water losses) of 14.5 MGD (16,230 AFY) which exceeded actual usage.

Maximum Day Demand (MDD)

MDD represents a typical peak summer day demand condition. To analyze summer demands, the customer meter billing data was analyzed on a monthly basis. Water demands were totaled by month for 2016 through 2021 using the meter read dates listed in the billing data.

Figure 4-1 displays the average monthly demands for each year.

Figure 4-1: Monthly Demand



Notes:
1. Data is missing for the month of May 2018. May 2018 demand is taken as the average of May 2017 and May 2019 demand.

As displayed, the monthly demands for 2016 through 2020 are consistent in their patterns; whereas 2021 appears as an anomaly, which can likely be attributed to the timing of meter reads. For this reason, 2021 was excluded from the MDD analysis. Excluding 2021, the month of July is consistently the highest demand month. The July demand for each year was divided by the correlating year's ADD listed in **Table 4-1** to obtain a MDD peaking factor (PF): the ratio of MDD to ADD. **Table 4-2** provides the MDD (July demand) for each year and the corresponding PF.

For this analysis, the MDDs and PFs for 2016 through 2020 were averaged to obtain a representative PF of 1.52. This PF will be applied to all demands in the hydraulic model for MDD scenario analyses.

Table 4-2: Annual MDD and PF

MDD	2016	2017	2018	2019	2020	2021	Average (2016-2020)
MGD	15.16	15.31	15.75	17.13	16.77	12.79	16.03
PF (unitless)	1.63	1.48	1.48	1.60	1.41	1.06	1.52

Peak Hour Demand (PHD)

The City provided flow and pressure SCADA data for each potable water supply, storage, and distribution facility during the monitoring period. This SCADA data was used to develop a diurnal pattern to account for hourly fluctuations in water use throughout the day.

The City's distribution system operates as a single pressure zone and thus, a single diurnal pattern is representative of the entire system. By summing the flows from all facilities listed in **Section 3.6**, the total hourly system flows were calculated for each day of the monitoring period. **Figure 4-2** presents the total systems flows for each day of that week.

As shown in this figure, Saturdays and Sundays have a slightly different diurnal pattern than weekdays. Additionally, Mondays are no-watering days for City residents, which results in a different pattern than Tuesday through Friday. Thursday was chosen as the representative day because it appears as a typical weekday and has the highest peaks in both the morning and the afternoon.

The hourly flows were then normalized by the average day flow for Thursday, October 28 to establish a dimensionless diurnal pattern. The PHD is represented by a PF (the ratio of PHD to MDD) calculated as the maximum of the normalized diurnal pattern as displayed in **Figure 4-3**. This PHD PF will be applied to MDD in the hydraulic model for PHD scenario analyses and is also represented by the diurnal pattern applied to the MDD extended period simulation (EPS) scenario analysis – see **Section 9.2**.

Figure 4-2: Total System Flows

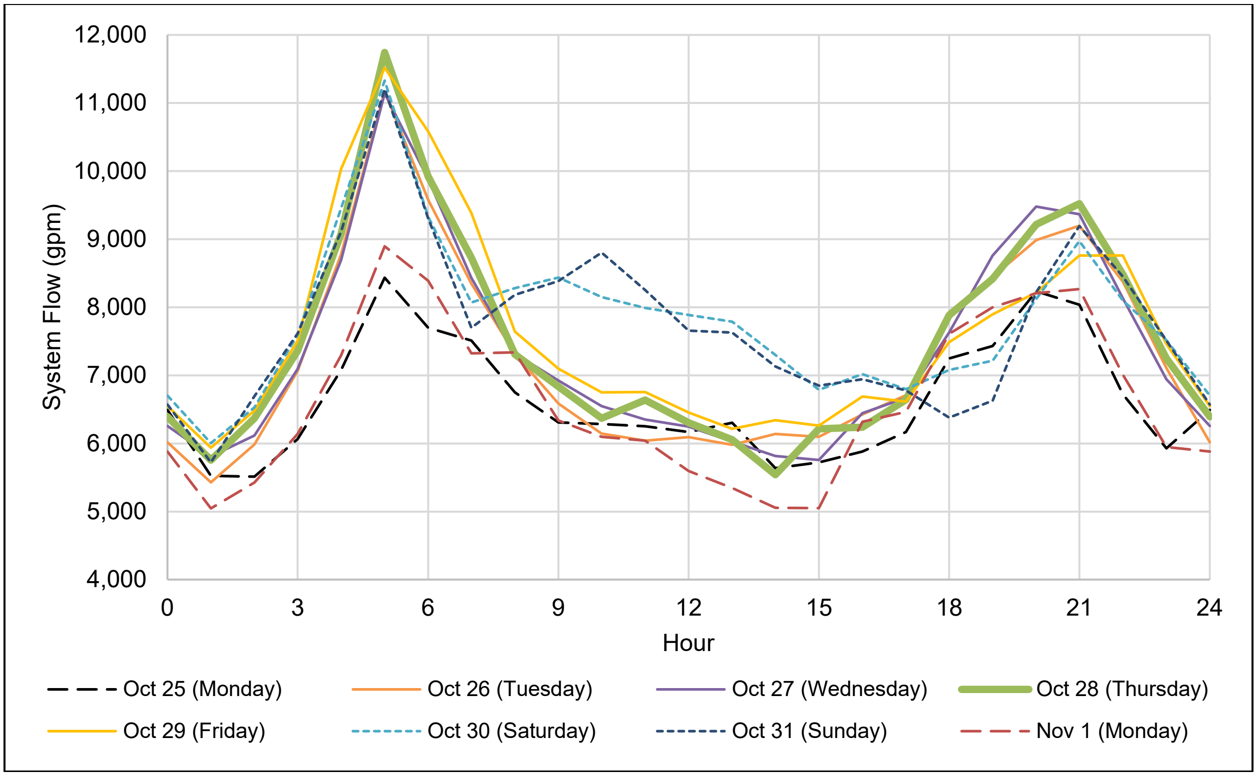
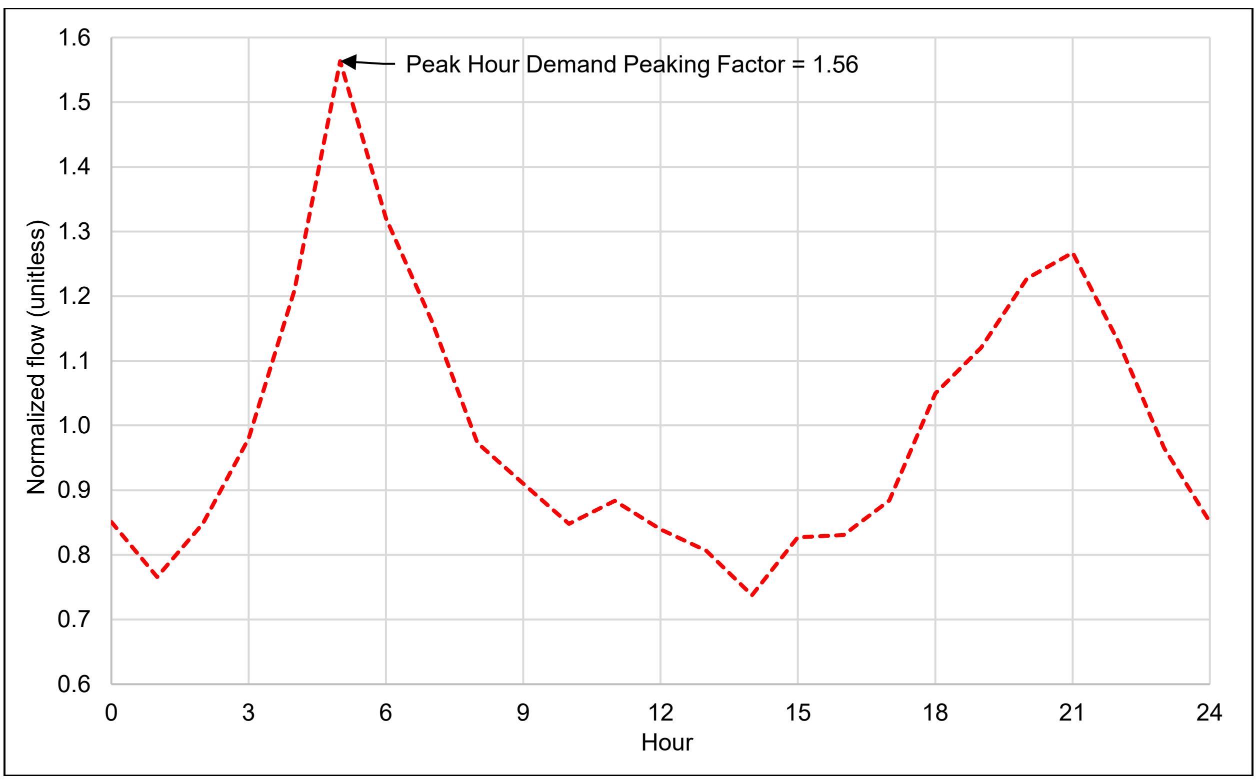


Figure 4-3: System Diurnal Pattern and PHD PF



4.1.2 Existing Land Use

For planning and modeling purposes, customer demands developed based on land use assume that users with the same, or similar, land use types will have similar water demand patterns. This enables the City to anticipate the water supply needs for these types of developments in the future and account for potential changes in land use that will impact water demand.

The meter billing data includes the following column titles representing different specificities of parcel utilization: *Account Type*, *Account Class*, *Property Class*, and *Zoning Class*. For this analysis, it was determined that *Account Class* was the most appropriate designation to use for land use as the categories in this column provide an appropriate level of accuracy and specificity.

To develop customer demands, each meter within the billing data was linked to its associated parcel in GIS based on the APN listed in the meter billing data, serving two purposes:

1. To link a land area to the billing data for unit factor development; and
4. To assign an *Account Class* – and ultimately a land use – to each existing water user in the City based on the billing data.

Where multiple water meters serve the same parcel, these meters were combined.

Some meters did not link to a corresponding parcel in GIS. These were investigated on a case-by-case basis and either manually assigned to the correct parcel or excluded from the unit demand analysis.

Additionally, some parcels within City limits did not have an associated water meter. These parcels were also investigated and fell into the following categories and received the following associated action:

- Parcels assumed to have no potable demand and removed from this analysis:
  - Parcels identified by the City as having no water accounts;
  - Parcels outside the extent of the existing water distribution system;
  - City parks that have private raw water wells for irrigation;
  - Underdeveloped or vacant parcels; and
- Meters that appeared to be linked to the incorrect parcel (e.g., a single meter that serves an entire residential complex was linked to a single unit in the complex, leaving the remaining units' parcels with no linked meter demand) – unlinked parcels manually assigned the correct land use.

Figure 4-4 displays the *Account Class* linked to each parcel within City limits.

For modeling purposes, land use types are grouped according to their anticipated water use pattern; *Account Classes* expected to generate similar water demands were consolidated into fewer land use categories to facilitate the water demand analysis and limit the level of complexity. There are 26 *Account Class* types that were consolidated into 12 land use categories based on expected similar demands as well as a preliminary look at the average unit demand for each *Account Class*. Some of the *Account Classes* had no demand in the billing data and thus were assigned no demand in the existing scenario.

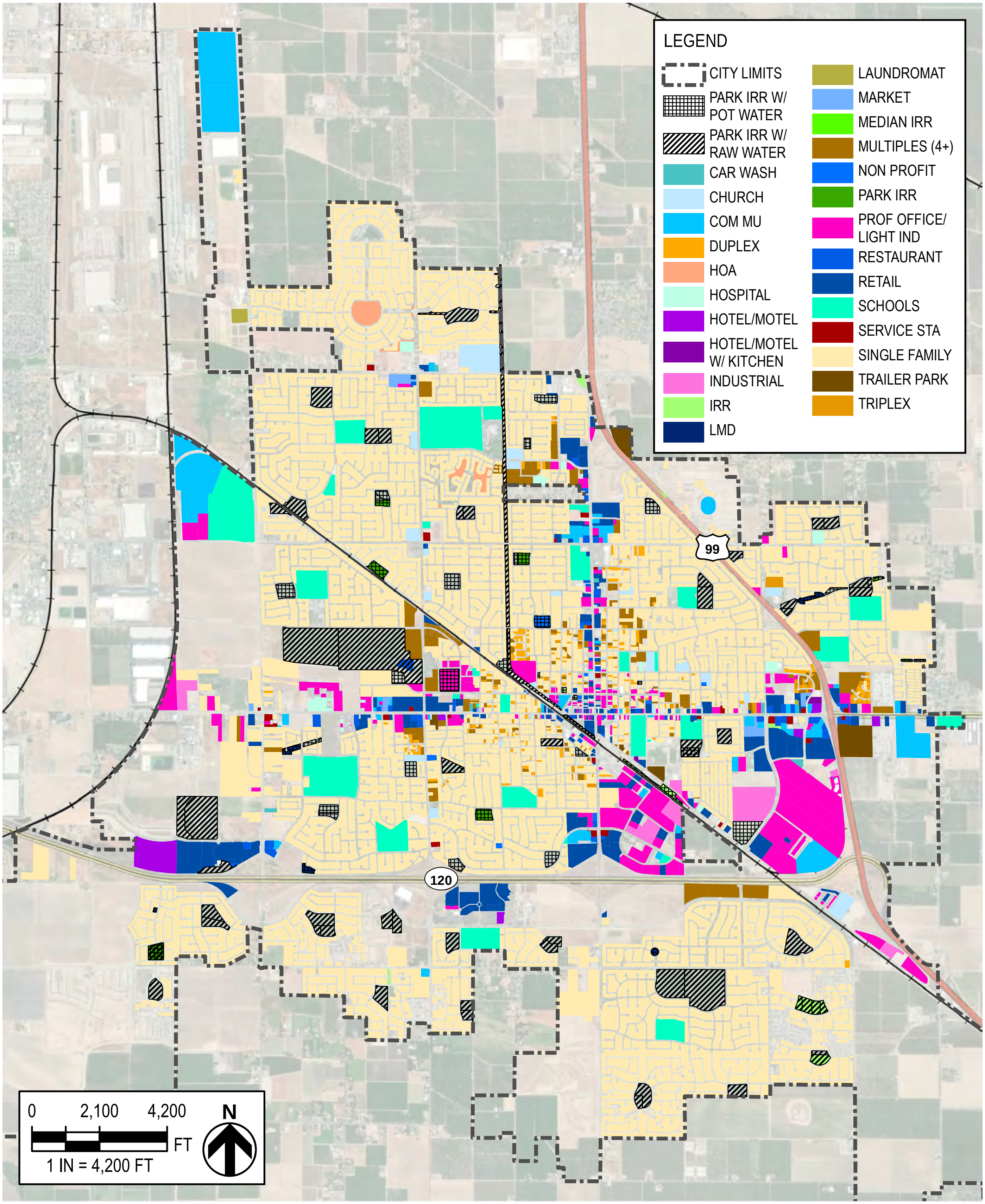


FIGURE **4-4**
CITY OF MANTECA
WATER MASTER PLAN
2021 ACCOUNT CLASS

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According to the City's GPA, the low density residential (LDR) designation allows for 2.1-8 dwelling units per acre (DUs/acre), while the very low density residential (VLDR) designation allows for up to 2 DUs/acre. Based on this, the "Single Family" *Account Class* was divided into LDR and VLDR land uses based on the area of each parcel: parcels with an area of 0.5 acres or less were assigned the LDR land use category, while those with a larger acreage were assigned the VLDR land use category. The land use consolidations are presented in **Table 4-3** and displayed in **Figure 4-5**.

In addition to the metered billing data, potable water consumption was also provided separately for parks irrigated with potable water that do not have automated meter reads and therefore, are read manually each month. Demands for these parks were not included in the calibration of unit water demand factors as they are not included in the meter billing data. Due to a number of inconsistencies in the meter data for the parks, each park was assigned a unit demand factor based on agronomic irrigation rates using local climatological data (precipitation and evapotranspiration rates). Typical monthly unit irrigation demands for turf grasses are calculated using the following formula:

$$ID = \frac{((ET_0 * k_c) - Pe_p)l_r}{e_i}$$

where:

ID = *Irrigation demand (inches)*

ET_0= *Normal year reference crop evapotranspiration rate for a given geographic location (inches)*

k_c = *Crop coefficient for turf grasses (DWR Leaflets), 0.80.*

P = *Average precipitation (inches)*

e_p = *Precipitation irrigation efficiency, 0.85. Assumes that approximately 15% of rainfall during growing season is lost to evaporation, runoff, etc.*

l_r = *Loss rate, 1.10. Assumes that approximately 10% of the applied water passes through the grass root zone and is lost.*

e_i = *Irrigation efficiency, typically varies throughout the year between 0.60 in the summer and 0.95 in the winter. Assumes that 5-40% of the applied irrigation water is lost to the environment. For planning purposes, an irrigation efficiency of 0.80 was used.*

The typical total annual unit irrigation demand for turf grasses in the City is estimated at 46.9 inches or 3.91 feet per acre. This translates to approximately 3,490 gpd/acre.

This calculated irrigation demand assumes that turf is irrigated at these agronomic rates during all months which is likely an overestimation given that the City does not allow watering on Mondays in addition to other likely general conservation practices. Additionally, parks that are irrigated often contain non-irrigated areas such as sidewalks, trails, parking lots, etc. For these reasons, the unit demand that was applied to park irrigation was reduced by 75% to account for acreage that is not irrigated. This resulted in a unit water demand for parks of 2,600 gpd/acre. These parks were manually selected and included in the existing demand scenario as identified in **Figure 4-5**.

Table 4-3: Consolidated Land Use Categories

Account Class	Consolidated Land Use	
Professional Office/Light Industrial	BIP	Business Industrial Park
Car Wash	C	Commercial
Laundromats	C	Commercial
Market	C	Commercial
Restaurants	C	Commercial
Service Station	C	Commercial
Commercial Mixed Use	CMU	Commercial Mixed Use
Retail	CMU	Commercial Mixed Use
Multiples (4 Plus)	HDR	High Density Residential
Hotel/Motel	HOTEL	Hotel/Motel
Hotel/Motel with Kitchen	HOTEL	Hotel/Motel
Industrial	I	Industrial
Single Family	LDR	Low Density Residential
Single Family	VLDR	Very Low Density Residential
Duplex	MDR	Medium Density Residential
Triplex	MDR	Medium Density Residential
Homeowners Associations	MDR	Medium Density Residential
Trailer Park	MOB	Mobile Home Parks
Irrigation	PARK	Park Irrigation
Churches	PQP	Public/Quasi-Public
Hospital	PQP	Public/Quasi-Public
Non Profit	PQP	Public/Quasi-Public
Schools	PQP	Public/Quasi-Public
Construction Water	Various[1]	
CFD (Community Facilities District)	No Demand	
Drinking Fountain	No Demand	
LMD (Landscape Maintenance District)	No Demand	
Median Irrigation	No Demand	
Mortuary	No Demand	
Park Irrigation	No Demand	
Rooming Houses	No Demand	
Sewer Lift Station	No Demand	
Wastewater	No Demand	

Notes:
1. Parcels with *Account Class* of “Construction Water” were manually checked and assigned an appropriate land use based on aerial imagery.

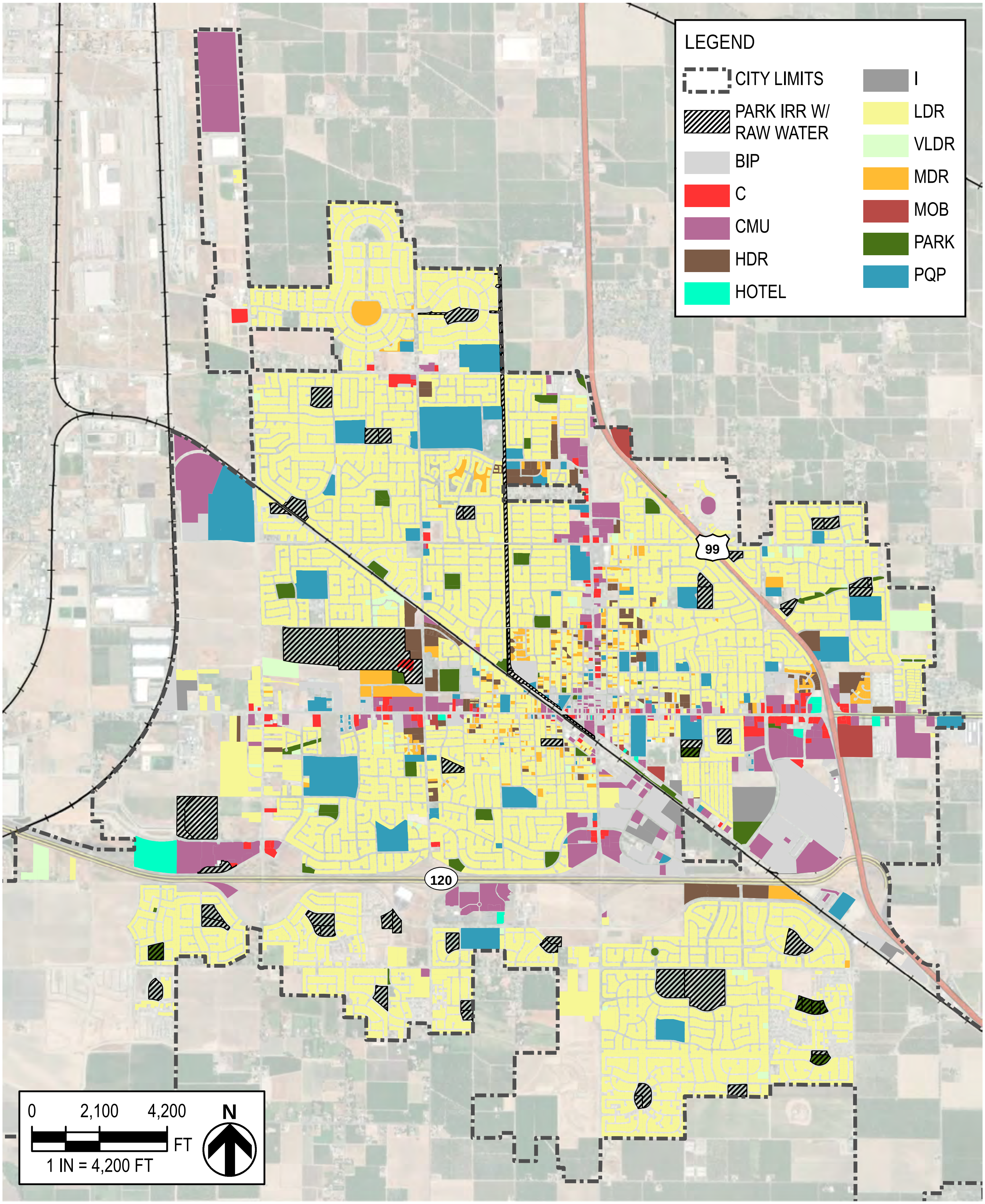

FIGURE **4-5**
CITY OF MANTECA
WATER MASTER PLAN
2021 CONSOLIDATED LAND USE CATEGORIES

HydroScience

4.1.3 Existing Unit Water Demand Factors

With meters linked to their corresponding parcels, an average daily water use per acre was developed for each parcel. The total annual consumption was grouped for each parcel and divided by the number of days listed in the meter billing data to estimate an average consumption in units of gpd for each parcel. That average consumption was then divided by the linked parcel area to obtain an average consumption in units of gpd/acre for each parcel.

For the LDR and VLDR land uses, unit demand factors were developed based on the average water use per account, resulting in a unit factor of gpd per dwelling unit (gpd/DU) assuming one dwelling unit per parcel (DU/parcel). For all other land use types, unit demand factors were developed in terms of gpd/acre.

An average water use factor was developed for each of the 12 consolidated land use categories presented in **Table 4-3**.

Unit factors were applied back to each parcel in the City except those identified as having no demand and iteratively adjusted until the City's total water demand calculated from the unit factors matched the expected ADD presented in **Table 4-1**; this calibration process includes only the metered billing data and excludes the parks irrigated with potable water for which data was provided separately as described above.

Unit factors were also compared with unit factors developed for cities in the surrounding region to ensure they were in-line with expected values. The resulting unit factors are presented in **Table 4-4**.

Table 4-4: Calibrated Unit Water Demand Factors

Consolidated Land Use Code	Unit Factor	Units
BIP	1,000	gpd/acre
C	1,600	gpd/acre
CMU	900	gpd/acre
HDR	3,300	gpd/acre
HOTEL	2,000	gpd/acre
I	550	gpd/acre
LDR	430	gpd/DU[1]
MDR	2,850	gpd/acre
MOB	1,000	gpd/acre
PARK	2,600	gpd/acre
PQP	1,200	gpd/acre
VLDR	700	gpd/DU[1]

Notes:
1. Assume one DU/parcel.

Large Water Users: For planning and modeling purposes, large water users are defined as customers that consume an unusually high volume of water for their use type and parcel area. Large users are typically identified and removed from the unit demand analysis to avoid skewing water use factors. Demands for large users are then manually added to the model to ensure their impacts to the water infrastructure are accurately represented.

For this analysis, the top 60 water users – in terms of average gpd/acre and excluding LDR and VLDR use types – from the 2020-2021 billing data were identified and reviewed. Each of these users were removed for the unit factor development described above and then manually included in the water demand totals and at their respective locations in the hydraulic model. The identified large water users are shown on **Figure 4-6**.

Water Demand Factor Calibration Results

Unit factors were applied to all existing parcels except those designated as large users which were manually assigned demands based on their individual billing data. The resulting ADD (excluding parks irrigated with potable water for which data was provided separately) using the calibrated unit water demand factors compared to the 2021 ADD is presented in **Table 4-5**. The calculated ADD is slightly larger than the metered 2021 ADD and is a conservative representation of the City's existing ADD based on the historical trends (see **Table 4-1**).

Table 4-5: ADD using Unit Factors vs. Metered ADD

ADD Basis	ADD (MGD)
Calculated using Unit Factors	12.3
From Meter Billing Data	12.1
% Difference	**+1.8%**

In addition to the calibration of the unit factors to the metered ADD as presented in **Table 4-5**, the total ADD (including the additional park irrigation data and water losses) was also compared to the City's total potable water production data as an additional check.

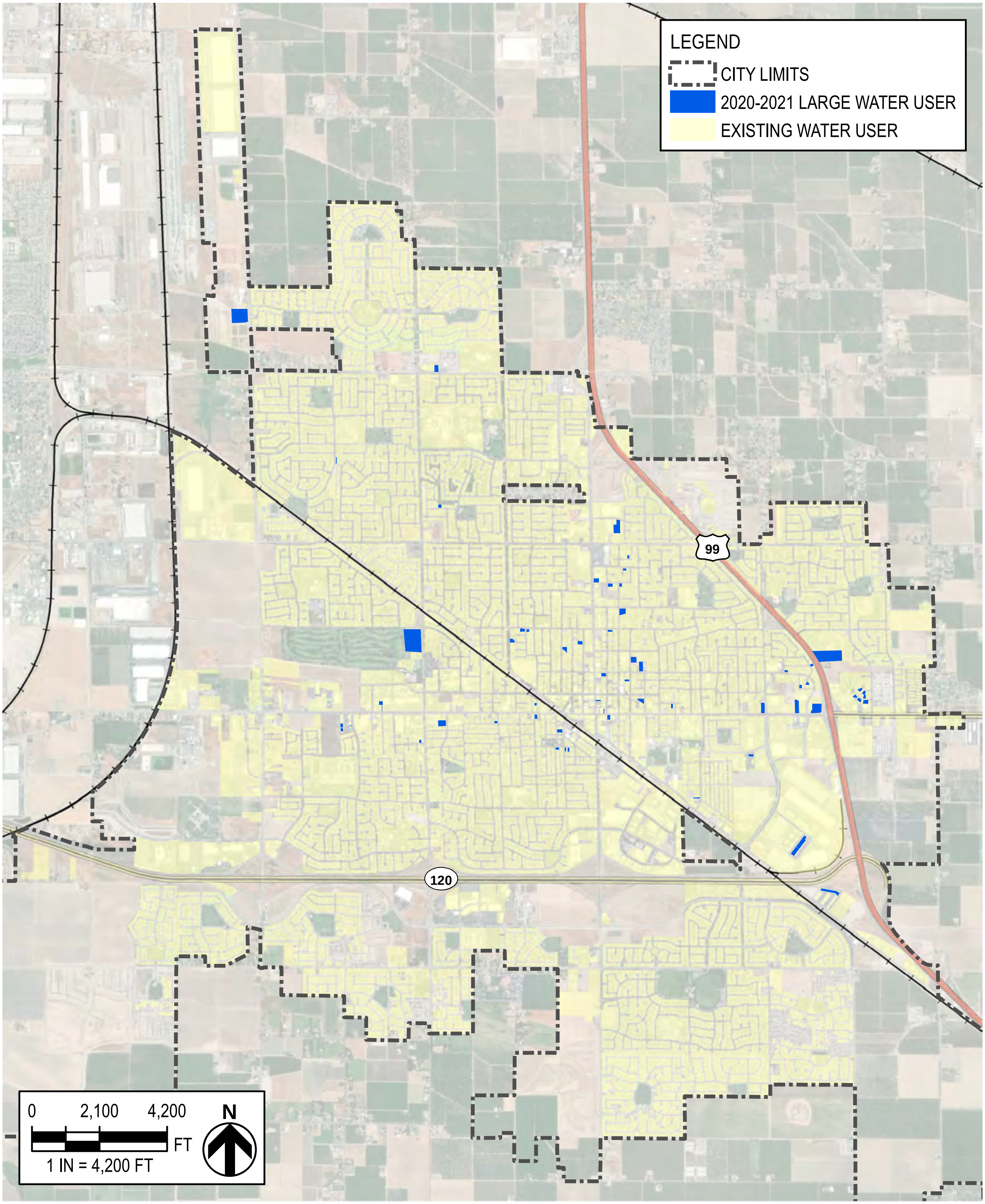

FIGURE **4-6**
CITY OF MANTECA
WATER MASTER PLAN
LARGE WATER USERS

HydroScience

4.1.4 Water Losses

Every water distribution system has some level of water loss which should be considered to accurately plan for future supply sources. Water losses are defined as the difference between annual water production and annual water sales. Water losses may be due to leaks, reservoir overflows, inaccurate meters, and/or other water used for operations such as system flushing and filter backwashing.

Beginning in 2016, water suppliers are required to report distribution system water losses annually using the American Water Works Association's (AWWA) Water Audit Software. **Table 4-6** presents the annual water losses calculated using the Water Audit Software.

Table 4-6: Annual Water Loss Reporting

Parameter	2016	2017	2018	2019	2020	2021
Water Loss[1] (MGD)	1.0	0.5	0.4	0.4	0.6	1.1
Water Loss[1] (AFY)	1,119	551	441	455	712	1,212
% of Total Water[2]	9.70%	4.28%	3.24%	3.42%	4.66%	8.39%

Notes:
1. Taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet.
2. Percentage of water losses out of total potable water supplied each year.

From 2017 through 2020, calculated water losses have averaged approximately 5.6% of the total potable water production for the City, and 5.2% when the highest and lowest values are excluded. For the purpose of estimating water loss in the development of water demands, a value of 5.2% was globally applied to all existing demands in the hydraulic model.

4.1.5 Comparison to UWMP

As part of the UWMP, suppliers are required to report their total potable water demand (including water losses) relative to their population in units of gallons per capita per day (gpcd). **Table 4-7** presents the population estimates for each of the past six years as estimated by the California Department of Finance (DOF) for the City of Manteca as well as the total potable water demands in terms of gpcd. This potable water demand, taken directly from the City's annual AWWA water audits, includes the ADD listed in **Table 4-1**, the City's estimate of unbilled and unmetered potable water, and potable water losses.

Table 4-7: Historical Potable Water Use

Parameter	2016	2017	2018	2019	2020
Potable Demand (MGD)	10.3	11.5	12.1	11.9	13.6
Potable Demand (AFY)	11,536	12,858	13,615	13,288	15,282
Population	76,752	78,784	80,762	83,323	84,842
Potable Demand (gpcd)	134	146	151	142	161

4.2 Growth and Development Analysis

This section presents the development of projected water demand based on both estimated population growth as well as anticipated City development.

4.2.1 Growth Projections

There are generally two methods that can reasonably be used to project a City's growth:

1. Population growth based on historical trends; and
2. City development rates based on land use.

For this Master Plan Study, unit water demands were developed for the City based on parcel land use designations, as detailed in **Section 4.1**. However, it is also important to ensure that demand projections based on land use agree with established City population projections. The following discussions present this analysis.

Population: In the year 1980, the City had a population of 24,925. Between 1980 and 2020, the City experienced an average annual growth rate of 3.1%, fluctuating between less than 1% and greater than 6% from year to year. For this analysis, the average growth rate between 2000 and 2020 of 2.8% is being utilized. Beginning with the City's documented 2020 population according to the 2020 Census, this annual growth rate was applied through 2045 and the resulting population projections are presented in **Table 4-8**.

Table 4-8: Population – Historical, Current, and Projected

	2020 [1]	2025	2030	2035	2040	2045
Estimated Population	84,842	97,404	111,826	128,383	147,392	169,215

Notes:
1. 2020 Census population for the City of Manteca.

According to the GPA, the City's buildout population is 206,381. Using the 2.8% annual growth rate, the City would reach this buildout population in the year 2053.

City Development: The following resources were provided by the City and utilized for the development of future development and land use projections:

- A table titled "*Finished, Entitled, and Pending Lots/Units*" as of May 1, 2022 with accompanying GIS shapefiles and a table titled "*City of Manteca Commercial Development Pipeline Report*" as of July 1, 2022 with an accompanying GIS shapefile; these two tables are included in **Appendix F**. According to City Staff, these documents represent the development expected to be completed within the next five to seven years (near-term development).
- A document titled "*Manteca Municipal Services Review*" (MSR) published in July 2022 which details the City's estimated 10-year and 30-year Sphere of Influence (SOI) areas.
- A shapefile including the GPA land uses for the entire City planning area.

For this analysis, the near-term development is assumed to be complete by 2030. Subsequently, it is assumed that all undeveloped land within the existing City limits as well as land designated as "SOI 10-Year" in the GPA land use shapefile and in the MSR will be developed by 2045. Based on the number of residential units, full development of these areas is consistent with the population growth presented in **Table 4-8**. Areas in the "SOI 30-Year" and "Area of Interest (AOI)" are assumed to be developed beyond 2045 and are excluded from this analysis.

On page 1-15 of the MSR, it states:

> *…not all of the land in the 10-year horizon will be completely built out within 10 years. Planning for future development and infrastructure provisions requires a long-term view…*

Figure 4-7 presents a map of the existing, 2030, and 2045 projected development areas.

4.2.2 Future Land Use

To develop projected water use based on City development, land uses need to be assigned to all future development areas ("2030" and "2045" areas as shown on **Figure 4-7**). This section details how future land uses were assigned to these areas.

It is assumed that all existing parcels with linked billing data ("Existing" areas as shown on **Figure 4-7**) will maintain the same land use designation unless specified otherwise by the planned near-term development.

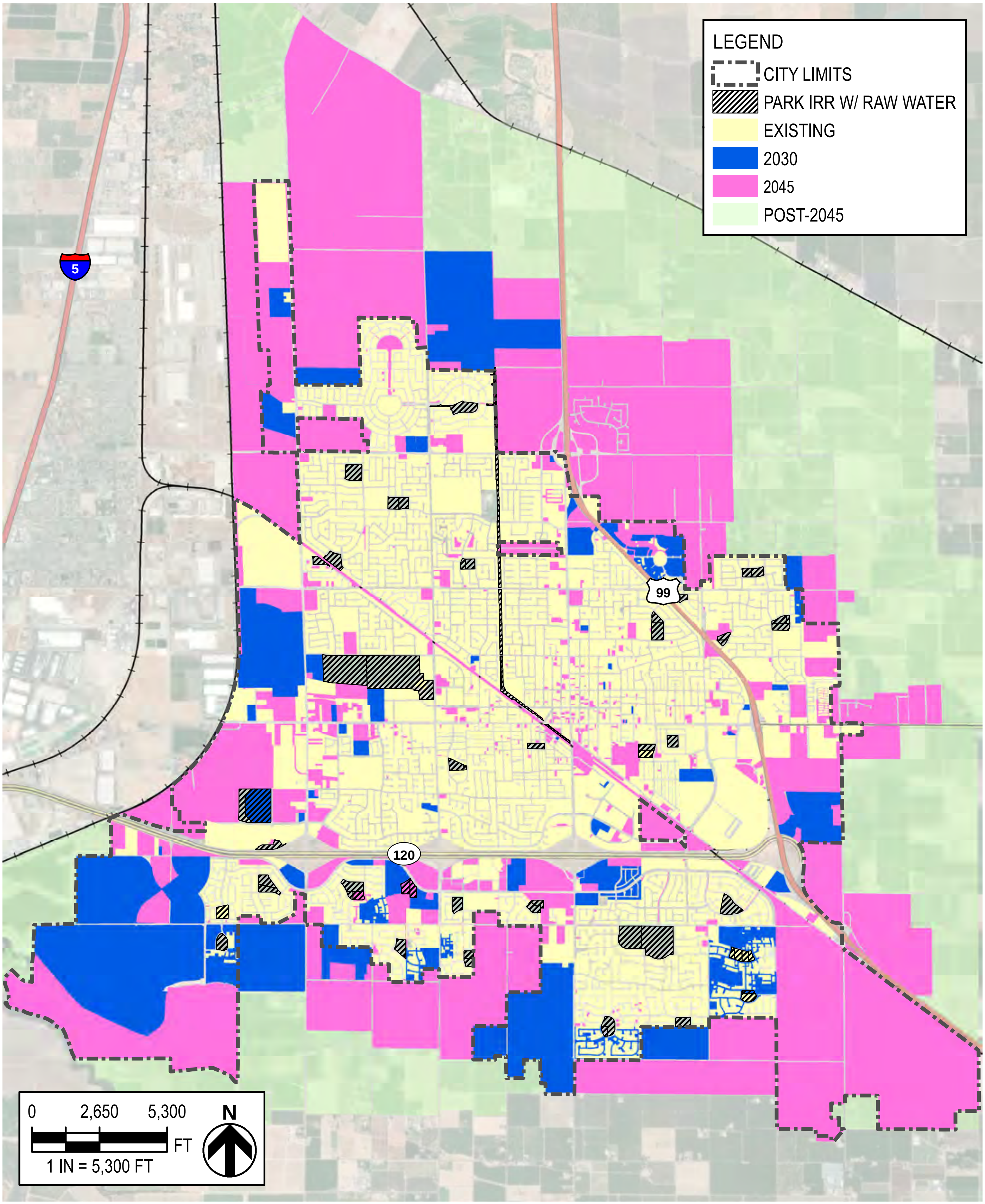

FIGURE **4-7**
CITY OF MANTECA
WATER MASTER PLAN
PROJECTION HORIZONS

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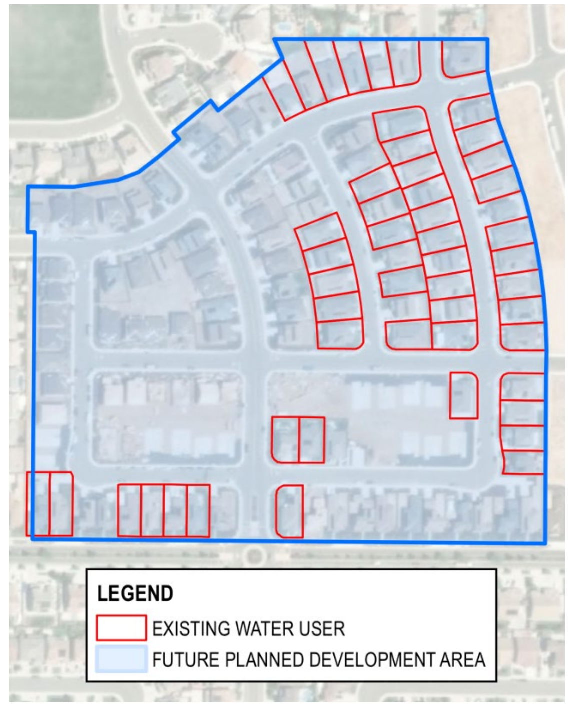
Near Term 2030: Within the near-term planned development locations, residential areas identified as "subdivisions" (see **Appendix F**) were assigned the LDR land use. Each subdivision had a specified number of planned units, which was used to calculate future demand. Residential areas identified as "lots" or "apartments" were assigned either the MDR or HDR land use based on the specified density (number of units per acre) and the following GPA land use definitions:

- Medium Density Residential: 8.1 to 15 DU/ac
- High Density Residential: 15.1 to 25 DU/ac

Figure 4-8: Overlapping Development Area



In some cases, the planned development areas overlap existing developed parcels, particularly in residential neighborhoods where some units in the neighborhood have been built and some lots are still vacant or partially developed. For future scenarios, the overlapping larger planned development area and respective density was used as the basis for estimating demand. This area accounts for the total planned number of units/total acreage in that area, which captures existing developed parcels. See **Figure 4-8** for an example of these overlapping areas. It is noted that in this figure, the aerial imagery reflects 2022 conditions, while the "Existing" parcel boundaries represent the 2021 condition to match metered water use data; houses seen in the aerial imagery built past 2021 will not show as an "Existing" parcel.

For the non-residential planned development, a consolidated land use category (see **Table 4-3**) was assigned based on the project description and the GPA land use description it is most closely aligned with.

Future 2045: All parcels within the 2045 projected area as identified in **Figure 4-7** were assigned their GPA land use. Similar to the process of relating billing account classes to a consolidated land use, each of the GPA land uses was correlated to the same list of consolidated land use categories (**Table 4-3**) with an associated calibrated unit demand factor (**Table 4-4**). These land use assignments are presented in **Table 4-9** and on **Figure 4-9**; for reference, **Table 4-9** also includes the existing *Account Class* consolidations.

There is a single parcel within the existing City limits designated as "AG – Agriculture" according to the GPA land use. This parcel appears, based on aerial imagery, to be an existing agricultural parcel that is not currently served by the City's distribution system. It is assumed that this agricultural parcel will continue to maintain its current source of water and will not have a demand on the City's potable water distribution system.

Table 4-9: Future Consolidated Land Use Categories

<table>
<tr><th>Account Class[1]</th><th colspan="2">Consolidated Land Use</th><th colspan="2">GPA Land Use</th></tr>
<tr><td>Professional Office/Light Industrial</td><td>BIP</td><td>Business Industrial Park</td><td>BIP</td><td>Business Industrial Park</td></tr>
<tr><td>Car Wash</td><td rowspan="5">C</td><td rowspan="5">Commercial</td><td rowspan="5">C</td><td rowspan="5">Commercial</td></tr>
<tr><td>Laundromats</td></tr>
<tr><td>Market</td></tr>
<tr><td>Restaurants</td></tr>
<tr><td>Service Station</td></tr>
<tr><td>Commercial Mixed Use</td><td rowspan="2">CMU</td><td rowspan="2">Commercial Mixed Use</td><td>CMU</td><td>Commercial Mixed Use</td></tr>
<tr><td>Retail</td><td>DW</td><td>Downtown</td></tr>
<tr><td>Multiples (4 Plus)</td><td>HDR</td><td>High Density Residential</td><td>HDR</td><td>High Density Residential</td></tr>
<tr><td>Hotel/Motel</td><td rowspan="2">HOTEL</td><td rowspan="2">Hotel/Motel</td><td rowspan="2">-</td><td rowspan="2">-</td></tr>
<tr><td>Hotel/Motel with Kitchen</td></tr>
<tr><td rowspan="2">Industrial</td><td rowspan="2">I</td><td rowspan="2">Industrial</td><td>AI</td><td>Agricultural Industrial</td></tr>
<tr><td>I</td><td>Industrial</td></tr>
<tr><td rowspan="2">Single Family</td><td>LDR</td><td>Low Density Residential</td><td>LDR</td><td>Low Density Residential</td></tr>
<tr><td>VLDR</td><td>Very Low Density Residential</td><td>VLDR</td><td>Very Low Density Residential</td></tr>
<tr><td>Duplex</td><td rowspan="3">MDR</td><td rowspan="3">Medium Density Residential</td><td rowspan="3">MDR</td><td rowspan="3">Medium Density Residential</td></tr>
<tr><td>Triplex</td></tr>
<tr><td>Homeowners Associations</td></tr>
<tr><td>Trailer Park</td><td>MOB</td><td>Mobile Home Parks</td><td>-</td><td>-</td></tr>
<tr><td>Irrigation</td><td>PARK</td><td>Park Irrigation</td><td>P</td><td>Park Irrigation</td></tr>
<tr><td>Churches</td><td rowspan="4">PQP</td><td rowspan="4">Public/Quasi-Public</td><td rowspan="4">PQP</td><td rowspan="4">Public/Quasi-Public</td></tr>
<tr><td>Hospital</td></tr>
<tr><td>Non Profit</td></tr>
<tr><td>Schools</td></tr>
<tr><td>CFD (community facilities district)</td><td rowspan="10" colspan="2">No Potable City Demand</td><td rowspan="2">AG</td><td rowspan="2">Agriculture</td></tr>
<tr><td>Drinking Fountain</td></tr>
<tr><td>LMD (landscape maintenance district)</td><td rowspan="2">OS</td><td rowspan="2">Open Space</td></tr>
<tr><td>Median Irrigation</td></tr>
<tr><td>Mortuary</td><td rowspan="2">ROW</td><td rowspan="2">Right of Way</td></tr>
<tr><td>Park Irrigation</td></tr>
<tr><td>Rooming Houses</td><td rowspan="3">Water</td><td rowspan="3">Water</td></tr>
<tr><td>Sewer Lift Station</td></tr>
<tr><td>Wastewater</td></tr>
</table>

Notes:
1. Presented previously in **Table 4-3** and repeated here for reference.

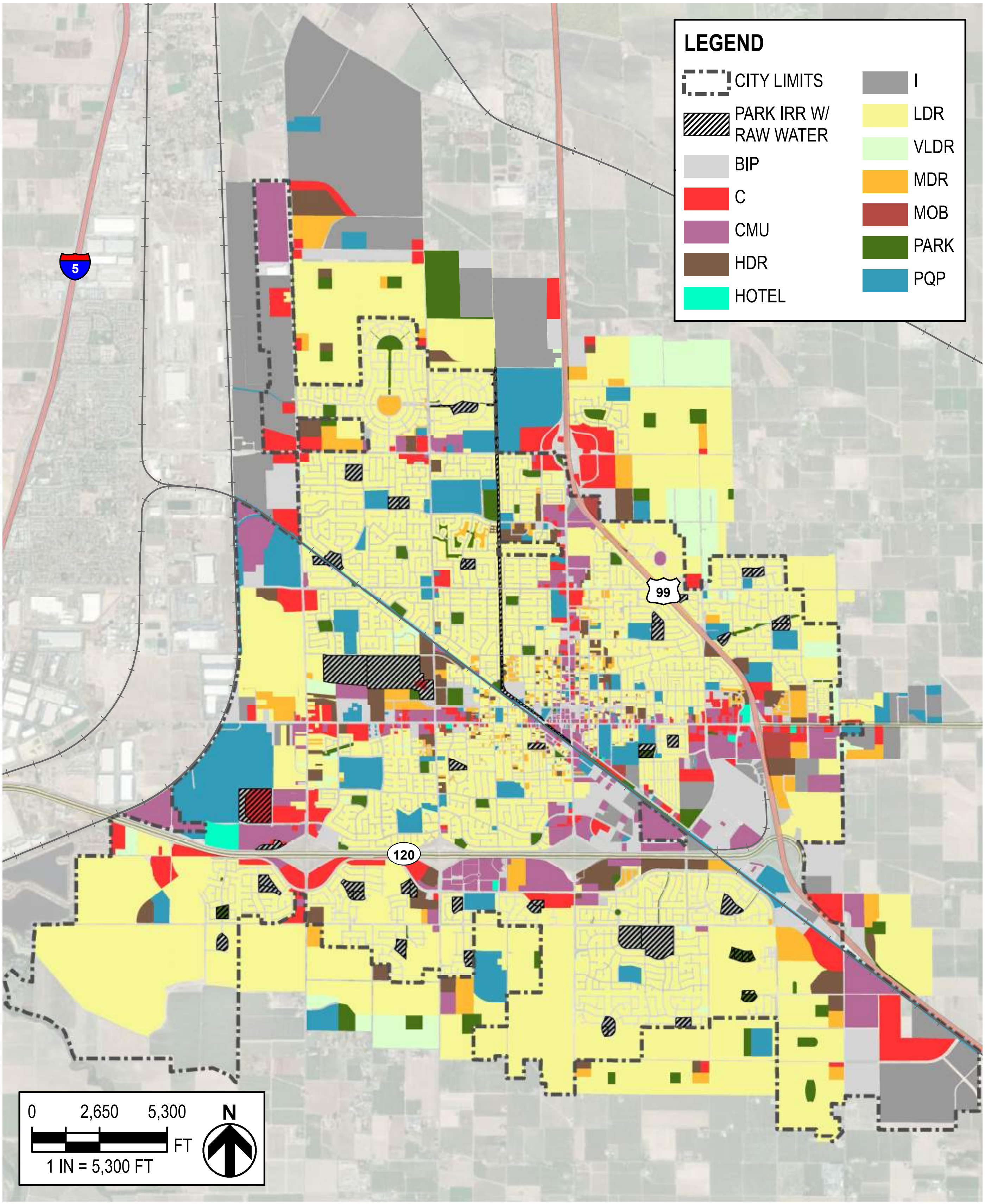


FIGURE 4-9
CITY OF MANTECA
WATER MASTER PLAN
FUTURE CONSOLIDATED LAND USE CATEGORIES

HydroScience

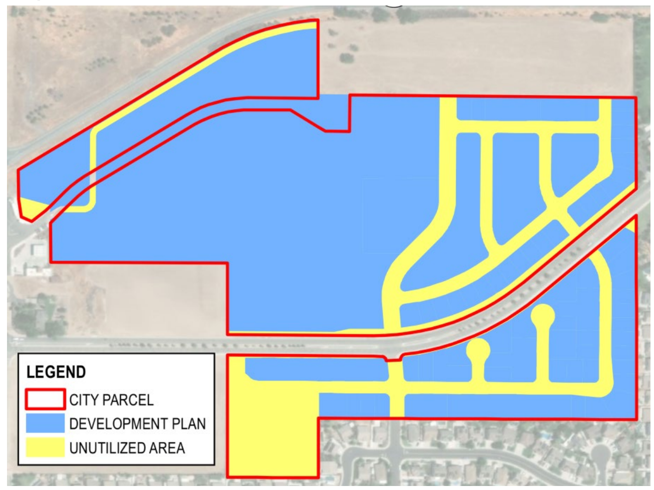
4.2.3 Future Unit Water Demand Factors

To establish future unit water demands and factors, the following assumptions were applied:

- **% Land Area Utilization:** Many of the future development areas outside of the existing water users (see **Figure 4-7**) do not account for area dedicated to right-of-way, open space, or non-water consuming lands between land uses.

  Figure 4-10 displays a planned development area in the southern part of the City. The red lines represent the undeveloped City parcel areas; the blue area is the developer's planned development; the yellow area is the unutilized area that will be public right-of-way and detention basin. The unutilized area accounts for about 20% of the larger designated area.

  Figure 4-10: Example of 80% Land Area Utilization

  To account for this, a utilization rate of 80% was applied to the areas of each of the future development areas assuming that approximately 20% will become right-of-way or other non-water consuming land; those are the areas used to calculate future water demands. The exception to this is the near-term residential developments that have a specified number of dwelling units (DUs) that are used to calculate future demands.

- **LDR and VLDR Number of DUs:** Many of the future LDR and VLDR development areas are identified as large areas and are not yet subdivided into individual parcels. Because the unit factors for LDR and VLDR are based on the number of DUs, the number of DUs for each large parcel needed to be estimated.

  To do this, an average density was calculated for all existing LDR and VLDR parcels; these densities are summarized in **Table 4-10**. These average densities were then applied to the future LDR and VLDR parcels. The number of DUs was rounded down to the nearest whole number with a minimum of one DU.

  Table 4-10: Average Densities

Land Use	Average Area (acres/DU)	Average Density (DUs/acre)
LDR	0.17	5.8
VLDR	1.26	0.8

- **Updated Future Residential Unit Demand Factors:** Newer residential developments are typically more water efficient than existing or older residences due to the default inclusion of more water efficient fixtures, such as low flow faucets, water efficient appliances, and landscaping complying with State Model Water Efficient Landscape Ordinance (MWELO) standards.

Published in November 2009, Senate Bill No. 7 (SB X7-7) required that by December 31, 2020, every water retailer in the State achieve a 20% reduction in urban per capita water use. This led to implementation of behavioral changes as well as incentive programs to replace old fixtures and appliances with newer more efficient alternatives, among other activities, to encourage water conservation and achieve this 20% reduction. These efficiencies are now standard practice and are expected to be fully incorporated into new developments for both indoor and outdoor water use.

For the future scenario, an average – across all existing and new development – of 15% overall reduction in water use by 2045 was assumed for residential unit factors. This is intended to take into consideration continued improvements to indoor and outdoor water efficiency for existing development and the requirements for new development. This reduction also agrees with continued per capita water use considering both future City development and population projections. These updated unit factors are presented in **Table 4-11**. Residential unit factors in the interim years are interpolated between the existing factors presented in **Table 4-4** and these future factors as the increased efficiency is expected to be gradual.

Table 4-11: Future Unit Water Demand Factors

Consolidated Land Use Code	Updated Unit Factor	Units
HDR	2,810	gpd/acre
LDR	370	gpd/DU
MDR	2,420	gpd/acre
VLDR	600	gpd/DU

- **Large Water Users:** For all future scenarios, large users are assumed to remain large users with their demands manually assigned based on the 2020-2021 billing data (see **Figure 4-6**) as none are identified as areas to be redeveloped.
- **Water Losses:** The water loss percentage of 5.2% was maintained and applied to all system demands for all future projected scenarios.

4.2.4 Projected Water Demands

Projected demands for 2030 and 2045 are based on the areas presented in **Figure 4-7**. It is difficult to predict the direction of spatial expansion for the interim years and thus, demands for 2025, 2035, and 2040 are numerically interpolated for supply and demand analysis purposes.

Using the projected development and City growth, coupled with the GPA land use and future unit demand factors detailed herein, the total projected ADD are presented in **Table 4-12**. Totals are also presented in terms of gpcd for purposes of comparing to the City's UWMP and assuring good correlation with population projections. These values also include parks irrigated with potable water and water losses and thus, represent total potable water production.

Table 4-12: Projected Potable Water Demands

Parameter	2021	2025	2030	2035	2040	2045
ADD (MGD)	13.2	15.2	17.9	20.2	22.8	25.7
ADD (AFY)	14,830	16,982	20,117	22,677	25,562	28,814
Population	87,218	97,404	111,826	128,383	147,392	169,215
ADD (gpcd)	152	156	160	158	155	152

It is noted that the total demand in terms of gpcd peaks in 2030 and can be attributed to a lag in population growth (which is estimated at a constant 2.8% annual) and the significant amount of projected development identified by the City by 2030. The gpcd tapers off between 2030 and 2045 as the population catches up with development.

The City's SB X7-7 2020 target per capita water use (2020 Target) – detailed in the City's 2015 UWMP – was 179 gpcd. The City successfully achieved this 20% reduction and is expected to maintain its per capita water use below this value into the future.

Figure 4-11 graphically depicts the City's historical and projected water usage along with population projections presented in **Table 4-12**, and **Figure 4-12** presents the same data presented in terms of gpcd. For reference, **Figure 4-12** also displays the 2020 Target as dictated by SB X7-7.

Figure 4-11: Historical, Current, and Projected Water Demands

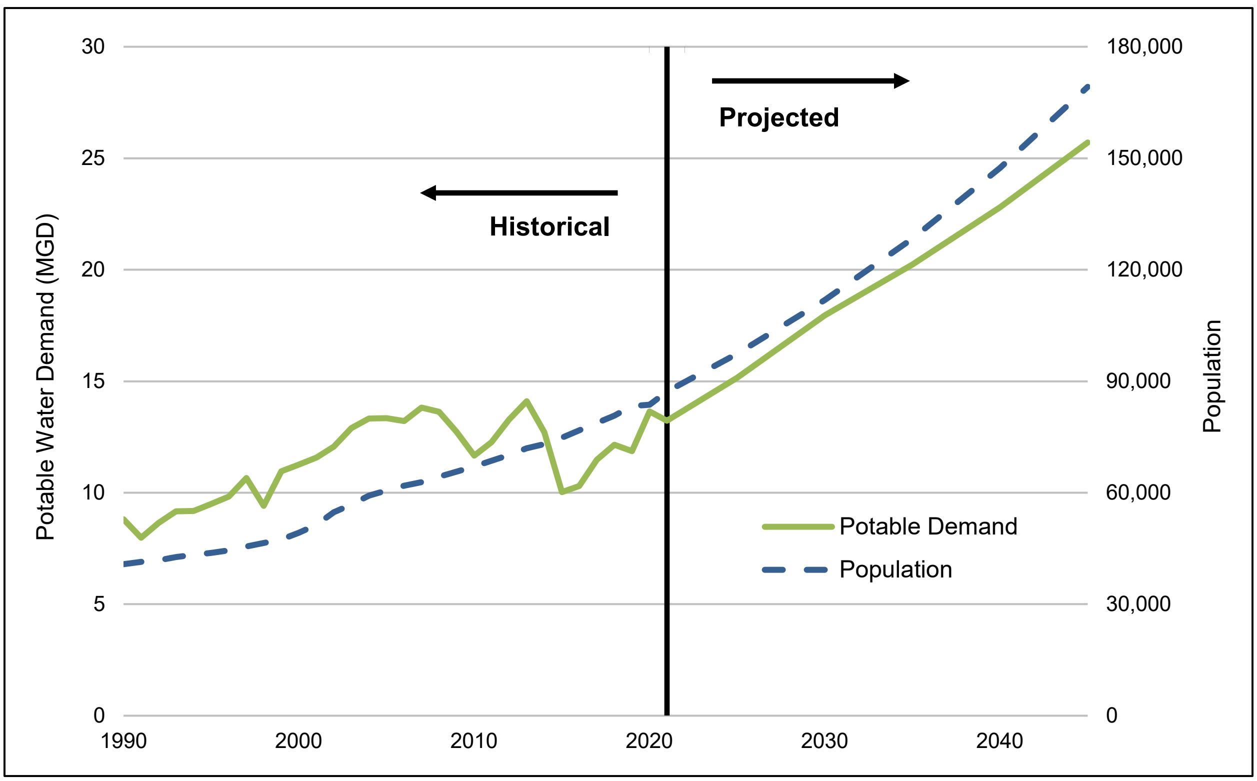
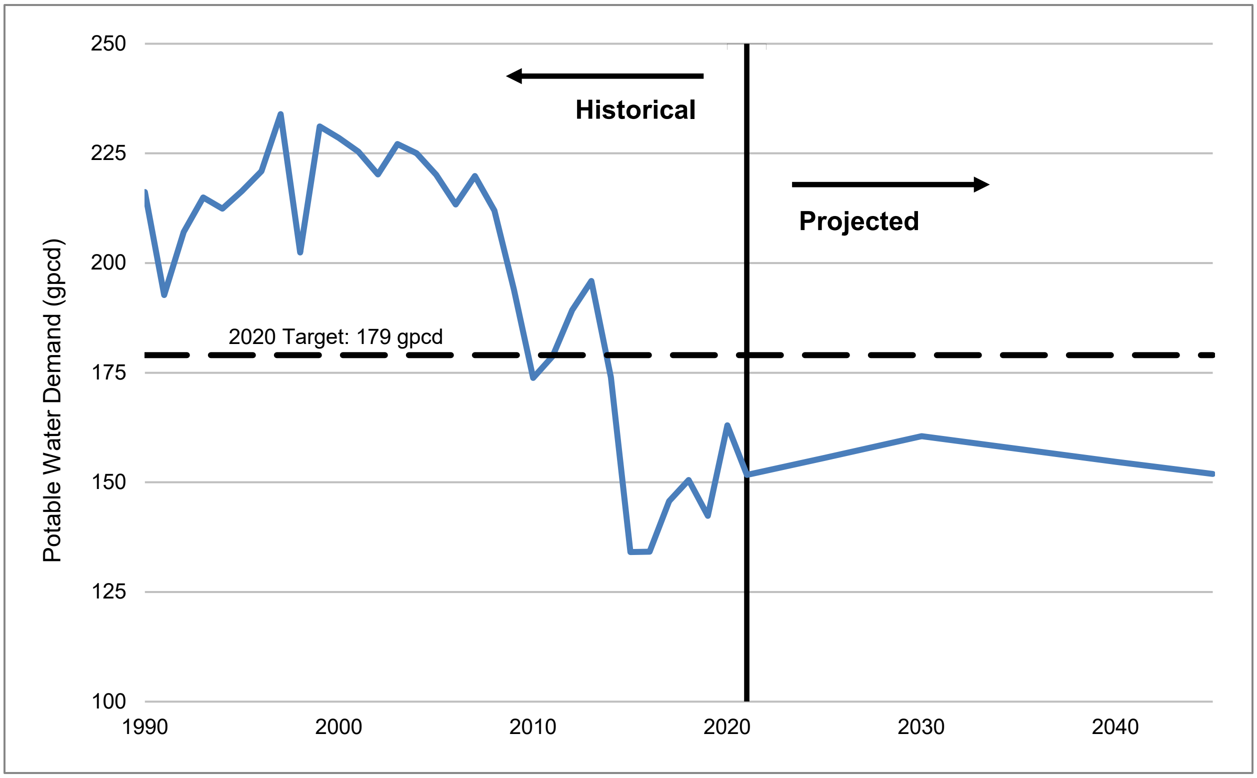


Figure 4-12: Historical, Current, and Projected Per Capita Water Demands



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SECTION 5 – SOURCE AND STORAGE CAPACITY ANALYSIS

When projecting future demands, it is crucial to also plan for the water supply to meet these projected demands. The City's existing potable water supply portfolio, as detailed in **SECTION 2**, is comprised of surface water from SSJID and local groundwater pumped from the ESJ Subbasin.

5.1 Future Storage/Supply Capacity

For the three demand scenarios (Existing, 2030, and 2045) the criteria for estimating the minimum required instantaneous flow capacity is the maximum of MDD plus fire flow [MDD+FF] or PHD on a maximum day. The largest required fire flow under any condition is 5,000 gpm for industrial land uses (see **Section 9.2.2**). **Table 5-1** presents the MDD+FF and PHD for each demand scenario. Under all demand scenarios, the PHD is the largest required instantaneous flow. **Table 5-1** also presents the net additional PHD flow need for future scenarios; this is the flow that will be met with future supply sources for each respective horizon.

Table 5-1: Maximum Flows Required

Demand Condition[1]	Existing (gpm)	2030 (gpm)	2045 (gpm)
MDD	13,965	18,945	27,135
Fire Flow[2]	5,000	5,000	5,000
MDD+FF	18,965	23,945	32,135
PHD[3]	21,786	29,554	42,330
Net Additional PHD[4]	-	7,768	12,777

Notes:
1. MDD = maximum day demand, FF = fire flow, PHD = peak hour demand
2. The largest required fire flow under any condition is 5,000 gpm for industrial land uses (detailed in **Section 9.2.2**).
3. PHD = MDD x 1.56
4. 2030 Net PHD = 2030 PHD – Existing PHD
   2045 Net PHD = 2045 PHD – 2030 PHD

Based on the net additional PHD presented in **Table 5-1**, the following assumptions were used to project the flow capacity required from surface water and groundwater for the purposes of this future source and storage capacity analysis:

- The required PHD listed in **Table 5-1** are assumed to occur during the summer months; demands typically peak during the warmer summer months when irrigation is at a maximum. In general, during the winter months when demands are lower due to minimal outdoor water use, the City's demands are met primarily with surface water. During the drier summer months as demands increase, surface water is supplemented with groundwater.

  For the purposes of this analysis, as a worst-case scenario, it is assumed that the City's future water supply will proportionally resemble its existing portfolio; i.e., surface water and groundwater will continue to meet all potable demands. Alternatives to offset potable water demands in order to increase supply reliability are discussed later in **Section 6.4**.

- On an annual basis, the City has a goal of maintaining a water supply ratio of 53% surface water to 47% groundwater. On average, the City's potable water supply is comprised of between 35% and 50% groundwater during the peak summer months. For this analysis, it is assumed that future PHD flows will be met with 50% groundwater and 50% surface water from SSJID turnouts.
- Because the City's existing facilities have proven to provide sufficient supply and pumping capacity to meet existing demands, it is assumed for the purposes of this analysis that existing demands will continue to be met with existing facilities.
- It is assumed that additional future demands will be met by expanding the capacity of existing turnouts and/or constructing new turnouts and constructing additional groundwater wells. This assumption means that any existing redundancy in the system will be maintained in all the future scenarios for system reliability. Existing well capacities should be reassessed to verify existing capacities and it is recommended that this analysis be periodically updated based on future well development and updated information.

Using these assumptions, **Table 5-2** lists the required flow capacity required from groundwater and surface water for 2030 and 2045.

Table 5-2: Required Additional Source Capacity

Parameter	2030	2045	Cumulative
Additional PHD (gpm)	7,768	12,777	20,545
Flow to be met with Surface Water (gpm)	3,884	6,388	10,272
Flow to be met with Groundwater (gpm)	3,884	6,389	10,273
Number of Additional Wells Required	3 [1]	3 [2]	6

Notes:
1. Includes the planned Well 30 providing 1,500 gpm and two additional future wells providing 2,000 gpm each.
2. Though three wells is 6,000 gpm, there is additional unused capacity from the three new wells for 2030 to supply the remaining flow.

Surface Water: City staff have communicated that their use of surface water from SSJID turnouts is limited by infrastructure constraints within the system. In order to receive more SSJID surface water to provide peak demand flows, the City will need to improve limiting infrastructure or construct a new turnout or storage facility to fully utilize the existing allocation of 11,500 AFY and to utilize the Phase II allotment of 18,500 AFY when it is available. For the purpose of this analysis, it is assumed that infrastructure improvements will be implemented in order to access the City's full allotment of surface water from SSJID.

Groundwater: The capacity of a well is dependent on many factors and is difficult to estimate until it is drilled and tested. The capacities of existing City wells range from approximately 500 gpm up to 2,500 gpm, as presented in **Table 3-2**. These capacities change over time as efficiency decreases and wells are impacted by other factors such as groundwater quality and local drawdown.

A new well (Well 30) in the southern part of the City is about to go into construction at the time of this Study and is expected to be online by December 2024, providing approximately 1,500 gpm of additional pumping capacity. For planning purposes, it is assumed that all other new future wells will have a pumping capacity of 2,000 gpm. Using these assumptions, **Table 5-2** also lists the number of wells required for each scenario to meet the estimated additional projected PHD.

As part of this analysis, a set of potential new well sites are identified. Potential new well sites are identified in conjunction with the hydraulic modeling detailed later in **SECTION 9** in order to consider the hydraulics of each location. **Figure 5-1** presents a total of 14 potential well sites. The factors considered in selecting potential new well sites include the following:

- **Land use** – All site locations are on parcels designated as existing or future parks to ensure City Staff will have access to the property.
- **Proximity to existing wells** – Locations were chosen to ensure good spatial coverage throughout the existing and future expanded distribution system.
- **System reliability and redundancy** – Due to the highways and the Union Pacific Railroad (UPRR) running through the City, some parts of the City are more isolated from each other; specifically, the areas east of CA-99 and south of CA-120. Though the City has ensured that there are multiple pipeline crossings to connect these areas to the rest of the system, they are inherently hydraulically isolated from the core of the City. Should one or multiple of these crossings be affected by an emergency, it is good practice for reliability of the system to ensure that these areas have sufficient water supply to maintain service.
- **Proximity to abandoned wells** – Well sites that were abandoned or destroyed due to water quality issues were taken into consideration to avoid similar water quality issues. This is assuming that the well would draw from a similar depth.
- **System hydraulics** – Multiple wells sites were tested in the hydraulic modeling of the future scenarios, as detailed in **SECTION 9**, to ensure the system still meets the pressure and velocity criteria for both PHD and MDD+FF.

The City has also identified two potential well locations to consider including one at LAPS and one at the Veterans Center near CATF. CATF currently has unused treatment capacity which could be utilized for an additional well.

A total of six future wells are required to meet 50% of future PHD flows (see **Table 5-2**). Additional sites are included as alternative locations which may be necessary for any of the following reasons:

- One or more existing well(s) may need to be decommissioned in the future due to facility deterioration and/or water quality issues.
- One of more of the potential well sites may, upon further investigation, be deemed unsuitable for reasons such as water quality, planned development, etc.
- One or more additional well(s) may be necessary to ensure sufficient flow capacity during an emergency scenario such as a power outage where SSJID facilities are offline, during standard maintenance on other wells, and/or for general system reliability and redundancy.

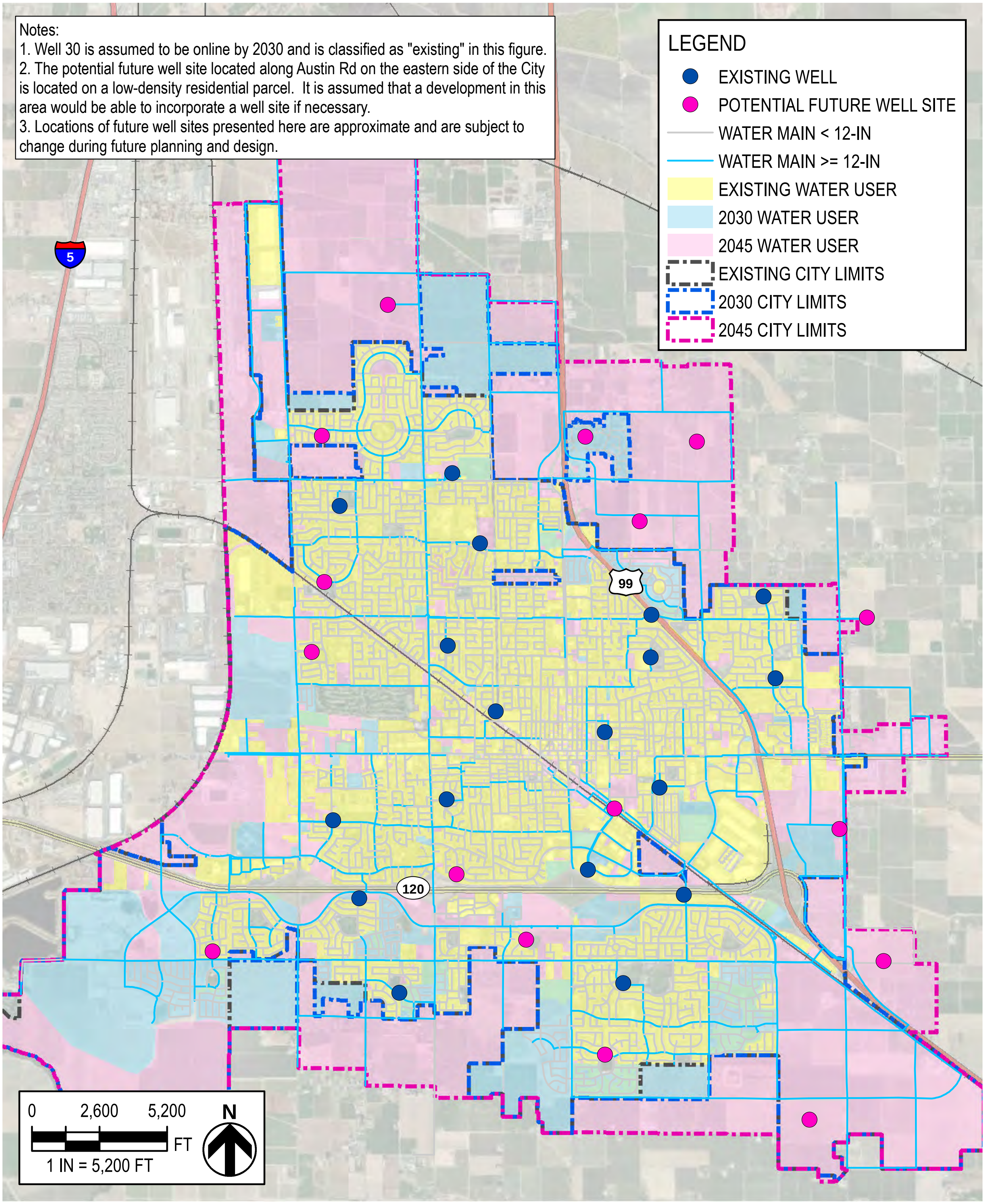


FIGURE 5-1
CITY OF MANTECA
WATER MASTER PLAN
POTENTIAL FUTURE POTABLE WELL SITES

HydroScience

5.1.1 Future Storage/Groundwater Supply Alternatives

Currently, the City operates with one 3.8-MG tank (Atherton Tank), in conjunction with VFD-operated pumps with onsite backup power at most of the wells, to meet peak demands throughout the year, meet daily fluctuations, and provide emergency storage.

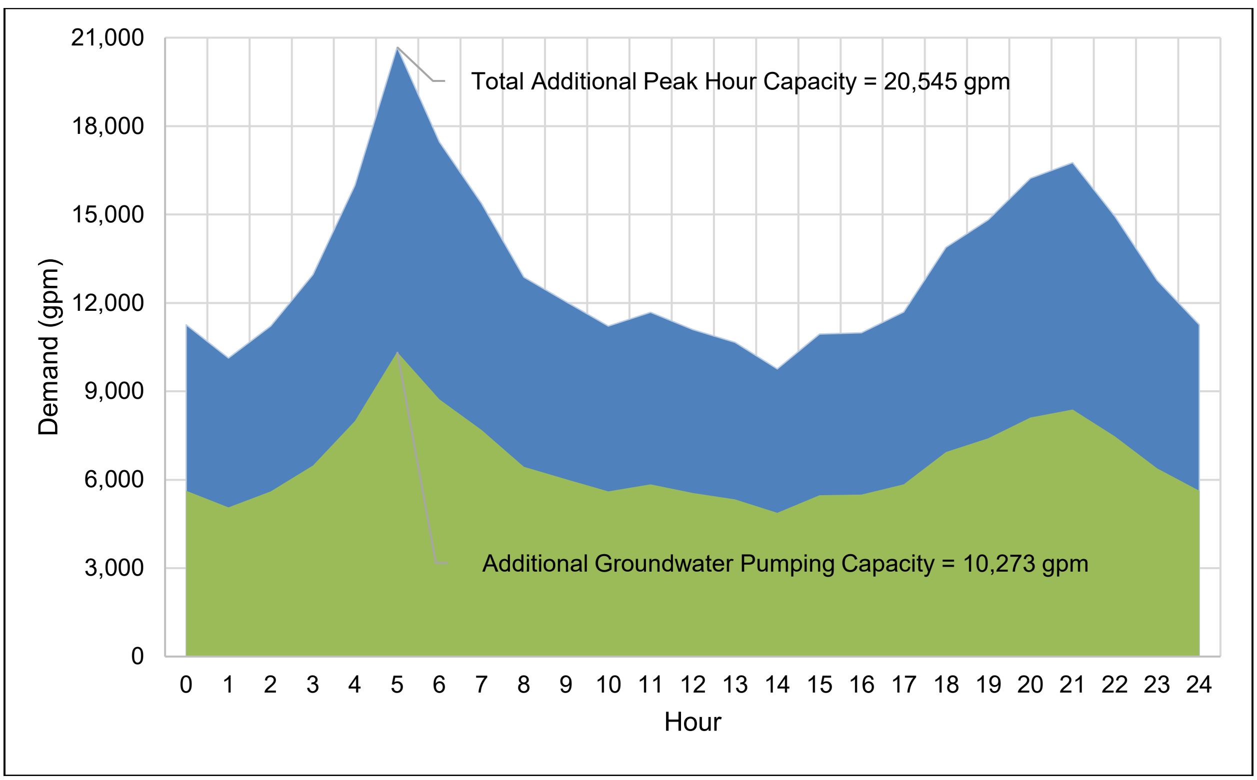
To meet future demand, the City will utilize their surface water allotment to the extent possible. The City must also augment this supply with groundwater to keep up with City growth and provide water supply reliability. While it is assumed that surface water facilities will be expanded to meet at least half of the City's demand (see **Table 5-2**), there are two main alternatives for groundwater development considered to meet future peak demands, each briefly detailed in this section:

1. Construct only new groundwater wells for future supplies; or
5. Construct a combination of groundwater wells and storage.

<u>Alternative 1 – Meet Future Peak Demands with Groundwater Wells</u>

This alternative includes the construction of at least 10,273 gpm of new groundwater supply to meet the 50% of instantaneous 2045 maximum day PHD assumed to be met with groundwater (see **Table 5-2**). **Figure 5-2** is a graphical representation of the total additional source water capacity required for this alternative, equivalent to the diurnal MDD. The required peak capacities labeled in this figure are the cumulative additional PHD between existing demands and 2045 projected demands as listed in **Table 5-2**.

Figure 5-2: Alternative 1 Required 2045 Pumping Capacity



With this alternative it is necessary for most wells to have VFDs in order to supply a range of flows from ADD to PHD as well as fire flow. It is also recommended that all new wells be equipped with backup power to ensure they are operable during an emergency scenario such as a power outage. To address water quality issues, it is assumed that all wells will need wellhead treatment which is typically designed to meet the capacity of the pumps.

Advantages:

- More efficient energy use

Disadvantages:

- Need more well capacity and consequently, higher wellhead treatment capacity
- Required to have onsite backup power at all well sites

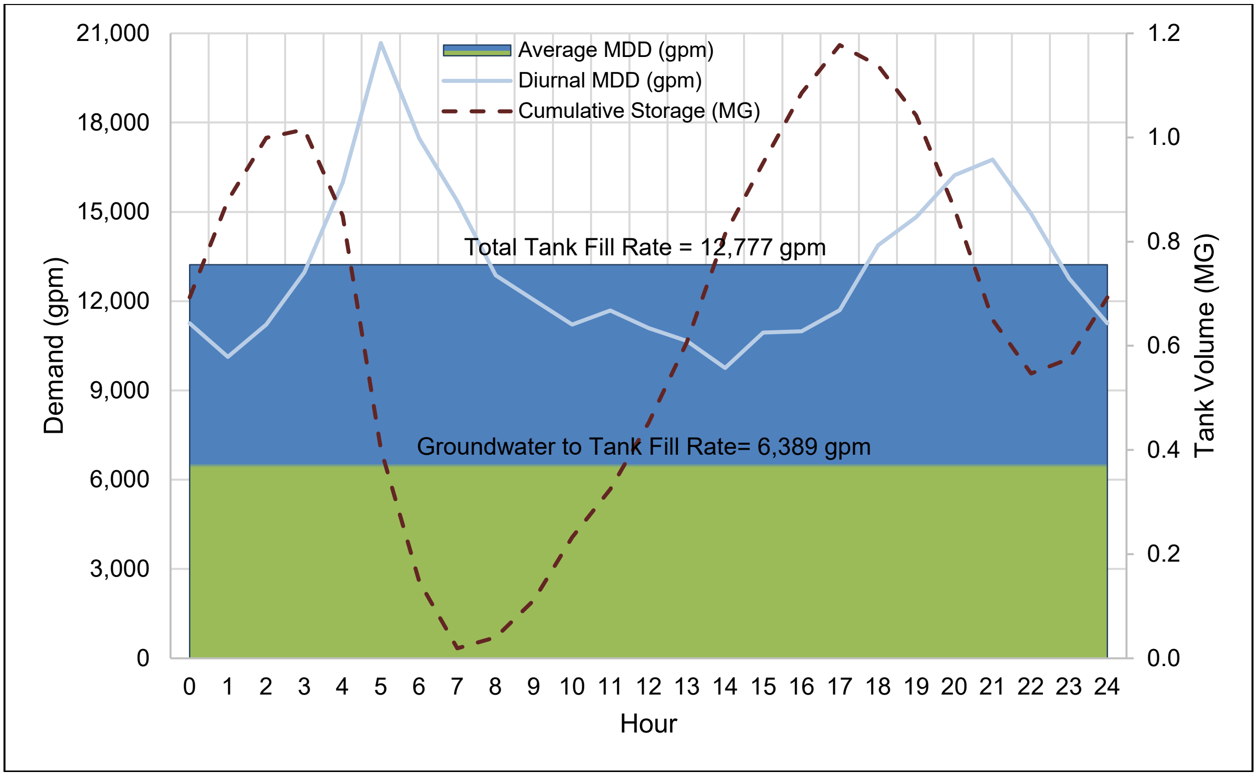
<u>Alternative 2 – Meet Future Peak Demands with Storage Tank(s)</u>

This alternative includes the construction of a storage facility that can be filled by wells and/or SSJID surface water. **Figure 5-3** is a graphical representation of the diurnal MDD overlaid with the average pumping rate flowing into the tank and the required storage volume over the course of a maximum day. This alternative assumes a constant fill rate throughout the day – the difference between the 2045 MDD (27,135 gpm) and the Existing MDD (13,965 gpm) listed in **Table 5-1**, which is equivalent to 13,170 gpm. A 50% split is also assumed for wells and surface water.

The change in storage volume in the tank for each hour is the difference between the fill rate and the hourly demand. Using the same assumption that half of the required pumping capacity will be met with surface water and half with groundwater, this alternative would require at least 6,389 gpm of instantaneous groundwater pumping capacity by 2045. Assuming 1,500 gpm of pumping capacity will be met by Well 30, this would necessitate 4,889 gpm of additional groundwater pumping capacity, and approximately 1.2 MG of storage.

It is noted that this storage volume is solely for operational equalization of diurnal demands on a maximum day. It is intended to shave down the peaks and moderate the groundwater well pumping capacity. The tank fill rate can be modified to run at a higher rate for fewer hours to achieve the same result. When sizing any storage facility, it should be determined what function it will serve and whether additional storage is required or desired for fire flow and/or emergency purposes as discussed in **Section 5.2**.

Figure 5-3: Alternative 2 Required 2045 Pumping and Storage Capacity



Storage can be implemented at a large scale to serve the City or can be used on a smaller scale for individual developments to manage peak demands and their impact on the City's infrastructure. It is noted that during the winter, tank turnover should be considered in the operational strategy to avoid stagnation and maintain water quality.

Advantages:

- Opportunities for centralized blending and/or treatment
- Simpler operation of single speed pumps at wells
- Need less well capacity and consequently, less treatment capacity because only need to meet MDD, not instantaneous PHD
- Only required to have onsite backup power at the tank site(s) for emergencies

Disadvantages:

- Construction of raw water pipelines required for centralized storage and blending and/or treatment
- Need to operate a booster pump station at the storage tank(s)
- Need to ensure sufficient turnover during winter months to prevent water quality issues
- More dependent on fewer wells
- Existing wells would be running harder for longer peaks

5.2 Emergency Supply

Drinking water retailers are responsible for providing a supply of safe and reliable drinking water supply to its customers. For water system operation, Waterworks Standards dictate that:

> *At all times, a public water system's water source(s) shall have the capacity to meet the system's MDD. …the system shall be able to meet four hours of PHD with source capacity, storage capacity, and/or emergency source connections.*
>
> *Both the MDD and PHD requirements shall be met in the system as a whole and in each individual pressure zone.*

Beyond this, it is recommended that the supplier is also prepared to handle a major fire. Per AWWA M31 – Distribution System Requirements for Fire Protection (AWWA M31), required fire flow refers to the rate of flow, at a residual pressure of 20 psi and for a specific duration, that is necessary to control a major fire. This requirement can be met by storage or supply capacity, and any additional available supply and storage capacity allows the system to operate during extended emergencies.

Groundwater wells account for the City's existing emergency supply. For groundwater wells to serve as emergency supply, they must be reliably accessible during a power outage (i.e., wells and associated blending and/or treatment facilities are equipped with onsite backup power) – see **Table 3-2**. It is recommended that all new wells are constructed with onsite backup power and to have sufficient wellhead treatment to provide treated water during an emergency.

SECTION 6 – WATER SUPPLY RELIABILITY ANALYSIS

One of the City's highest priorities as a water retailer is to ensure the reliability and sustainability of the local water supply to ensure safe and reliable drinking water is available to their customers. With the growth projected for the City, as presented in **Section 4.2**, it is prudent for the City to evaluate the projected availability of water supply as compared to projected demands into the future.

The State-mandated UWMP guides suppliers through a Water Supply Reliability Assessment under a normal year, a single dry year, and a multiple dry year sequence. In this assessment, future available water supplies are compared against projected demands, and supply surpluses and shortfalls are identified. The purpose of this analysis is to project if/when supply shortfalls will happen and encourage suppliers to consider and plan for these shortages.

As part of this Master Plan Study, the sustainability of the City's water supply was assessed and regulations identified that could potentially impact City water operations. TM #4 – attached as **Appendix C** – examined the reliability of the City's water supply sources and delivery allocations and identified ways to strengthen the City's future water supply and delivery reliability; TM #5 – attached as **Appendix D** – built on TM #4 and further evaluated the existing and potential State and/or Federal regulations and how they may affect the City's water supply and its ability to reliably meet future demands.

This section summarizes this collective supply reliability analysis, and **Appendices A** and **B** should be consulted for a more detailed presentation of this analysis.

6.1 Hydrologic Sustainability and Climate Change

Climate change can affect the water supply delivery stipulations – including timing of deliveries – based on agreements between wholesale and retail suppliers connected to California rivers, streams, reservoirs, lakes, and managed embayments. Multiple years of climate change-induced drought have the potential to reduce the assumed sustainable yield volumes, and ultimately, the established pumping allowance afforded to the City that are currently calculated based on recharge of the ESJ Subbasin as part of the GSP and the ongoing SGMA process.

In California and, more specifically the Sierra Nevada and southern Central Valley, changes are evidenced by the diminishing snowpack, earlier spring melt, a temporal shift in the rainfall/runoff relationships, increasingly frequent extreme events (e.g. drought and flood), and potentially hotter temperatures. While the accumulating climate change data is vast, the results can be just as diverse as considerable uncertainties remain in the specifics of the various modeling platforms.

6.2 Supply and Demand Outlook

Evaluation of the City's water supply versus demand balance is based on a series of factors, including:

- Historical water supply data – measured and estimated (see **SECTION 2**);
- Hydrologic assumptions;
- Engineering system assumptions;
- Historical demand analyses and water loss assumptions (**Section 4.1**); and
- Anticipated growth projections (**Section 4.2**).

Total City water supplies (both potable and non-potable) for 2020 are presented in **Figure 2-1**. Since the City began receiving surface water from the SSJID through the SCWSP in 2005, supply has remained below both the total surface water right from SSJID and the groundwater sustainable yield for the ESJ Subbasin.

To date, the City has successfully mitigated water shortage concerns during dry years with implementation of its WSCP to encourage and/or require City residents to conserve water. However, as the City continues to expand and develop, the margins will continue to decrease between City demands and supply, especially during dry years.

As part of the UWMP Water Supply Reliability Assessment, each of the City's supplies are assumed to be curtailed during dry years based on supply curtailments in the most extreme historical dry year sequence. Based on SSJID's 2020 UWMP, the greatest curtailment of SSJID supply based on historical records was 25%, and consistent with UWMP methodologies, groundwater pumping is assumed to be un-curtailed.

Though this is the DWR prescribed methodology for this assessment, there are many assumptions therein that may not account for potential supply limitations during sustained or repeat dry year conditions. During the 2012-2016 drought period, groundwater reliance increased to about 80% of total supply in the San Joaquin Valley as surface water supplies became increasingly strained. At that usage rate, successive drought years would conceivably impact and potentially decrease groundwater reserves. Thus, it is prudent to assume a reduction in the sustainable yield pumping rate of 1 AFY/Ac during a period of sequential drought years for two reasons:

1. To prepare for the possibility of a curtailment; and
2. To plan for the management of the ESJ Subbasin's sustainable yield under sustained drought conditions.

Using the prescribed methodology, there are water supply shortfalls identified in future years; precisely when shortfalls will begin occurring is difficult to pinpoint, but addressing these shortfalls is the focal point of this analysis. Most of these shortfalls will be sufficiently addressed by the City's WSCP as they have been in the past. However, as discussed herein, it is prudent for the City to consider more extreme conditions and further curtailments on both surface water and groundwater availability to be prepared for the unpredictable nature of water supply availability in the years to come; actual supply shortfalls may be more extreme than predicted using the DWR methodology.

Though not required by DWR, the following actions are recommended for the City when forecasting water supply and demand outlooks to ensure water supply reliability during drought years:

- Assume a worst-case delivery scenario for available water supply;
- Use climate-sensitized future hydrology projections; and
- Assume maximum curtailments – curtailments may be initiated by regulation despite SSJID's Pre-1914 Water Rights and/or SWRCB interests in maintaining Delta assets during droughts.

6.3 Future Water-Related Threats to the City

Future potential threats to the City's water supplies can be grouped into the following categories, each further detailed below:

1. Hydroclimatic change and uncertainty;
2. Existing surface water storage capacity limitations;
3. Regulatory impositions; and
4. Declining groundwater.

6.3.1 Hydroclimatic Change and Uncertainty

Planning for the future of water supply involves projecting into the future. This is accomplished using a variety of climate models, each with their own set of assumptions. The caveat is that there is uncertainty inherent in the phenomenon of climate change, that each climate model has a wide range of assumptions, and each can give vastly different results from another.

Though a considerable number of hydroclimatic uncertainties exist, the most glaring and consequential is precipitation. The most challenging part of studying patterns and identifying trends in precipitation is its inherent variability which makes it difficult for water planners to discern what changes are the result of climatic volatility induced by climate change or are embedded as part of natural variability. For example, the interannual range of expected precipitation in the San Joaquin Valley has ranged between 15 inches (Water Year [WY] 1976-77) and 77 inches (WY 1982-83) with an annual average of 40 inches. WY 2021-22 saw a total of 25.3 inches, significantly below average.

One distinct observed effect of climate change is the change in precipitation timing patterns throughout the year. Hydroclimate trends for the San Joaquin Valley and the Stanislaus River watershed indicate an increase in October to March runoff as a result of increasingly less snowfall and a more direct rainfall-runoff response. The high spring flows in April to July that have become such a characteristic part of the Sierra Nevada hydrology are expected to steadily decline with snowmelt occurring earlier and earlier.

6.3.2 Existing Surface Water Storage Capacity Limitations

The ongoing surface water storage issue is the result of limited reservoir storage capacity across the system relied upon by SSJID and the City. Since all reservoirs have a maximum storage capacity less than the unimpaired yield of the draining watersheds above it, careful management of storage volumes/water levels is necessary to ensure that all primary functions of the facility – flood control, water supply, hydropower generation, instream flow releases, recreational flows, etc. – are adequately accommodated. This operational balancing act is further challenged by the fact that these reservoirs are operating in a Mediterranean, semi-arid climate where the annual rainy season is limited to four or five winter and spring months. All existing facilities, particularly dams/reservoirs were designed based on assumptions that are now growing increasingly outdated.

During the wet season, dams and reservoirs are managed for flood control. Often, releases are made in anticipation of a forecasted rainstorm to avoid breaching of the dam; then, a few months later, water conservation efforts are required in the summer as reservoir storage dwindles. The precarious nature of reservoir storage operations, including those of New Melones Reservoir, drive the need for two continual improvements:

1. Improved hydroclimatic forecasting with more advanced hydrometric instrumentation; and
2. Additional reservoir storage, whether at existing reservoirs or new sites.

6.3.3 Regulatory Impositions

Regulations, particularly as they relate to surface water operations of the primary water regulators in the State, are of notable interest to the City. The City's surface water supplies are generated in the headwaters of the Stanislaus River in the central Sierra Nevada. Operationally, that runoff is controlled by the United States Bureau of Reclamation's (USBR's) Central Valley Project (CVP) through the Tri-Dams Project, New Melones Reservoir, and downstream at Tulloch, Goodwin, and Woodward reservoirs. The City's contracted surface water allotment with SSJID both now and in the future is dependent on the hydrology of the Stanislaus River system meeting the instream flow requirements of the river and, more importantly, meeting all the flow, water quality/salinity, and flow/habitat requirements of the Bay-Delta. The federal agencies through the USBR, U.S. Fish & Wildlife Service, and EPA can, and do, impose restrictions on diversions from the Stanislaus River system. State agencies, primarily the SWRCB, California DWR, California Department of Fish & Wildlife (CDFW) can also impose restrictions on any water diversions hydrologically connected to the Bay-Delta; this includes the entire Stanislaus River watershed from which SSJID holds pre-1914 water rights. The regulations and their potential impacts to the City's water supply are discussed in additional detail in TM #5, included as **Appendix D**. Below are brief summaries of the regulations discussed:

- **Groundwater Regulation and SGMA:** The passage of SGMA almost ten years ago was a way for the State to provide a framework at the local level for managing and ultimately reversing the effects of extensive groundwater pumping on the State's aquifers. In 2016, the City of Manteca became a GSA, and in 2017, the City along with 16 other GSAs, formed the Eastern San Joaquin Groundwater Authority. Their mission was to ensure initial and ongoing SGMA compliance within the Basin. Its primary purpose is to develop, adopt and implement a legally sufficient GSP that covers portions of the subbasin within the jurisdictional boundaries; and satisfy SGMA's requirements for coordination among the GSAs.

- **AB 2201:** Permits for new wells are determined by county governments, which, before the passing of AB 2201, were not required to consider groundwater sustainability when granting them. The passing of AB 2201 requires San Joaquin County to forward groundwater well permit applications, within the City's jurisdiction, to the City to review for conformity with the GSP. With the passing of AB 2201, GSAs, such as the City, are required to confirm that all well-drilling permit applications align with the GSP for their respective basin. Applicants for permits must provide a report demonstrating that their wells will not harm communities before they are approved.
- **Bay-Delta-Related Curtailments:** In 2022, the Stanislaus River system was affected by curtailments imposed by the State with numerous water right entitlement holders facing unprecedented curtailments. SSJID, the City's primary surface water retail water purveyor was curtailed of their 1921 priority appropriative right (A002524). Curtailments to SSJID have direct effects on the City's water supply. Any curtailments imposed upon SSJID are propagated down, directly affecting water retailers, including the City.
- **State Water Rights Petitions:** An important monitoring priority for water utilities diverting from the larger Bay-Delta watershed involves the water right permit actions of others. The Bay-Delta, as a collective river system, is dependent on the cumulative hydrology of the basin. If Bay-Delta inflows are reduced, then the demands placed on others, like SSJID, to meet existing Bay-Delta water quality thresholds becomes that much more important. As such, water purveyors, such as the City, typically monitor the water right petition activities of other water utilities.
- **Bay-Delta and Water Quality Flow Objectives:** The SWRCB is responsible for adopting and updating the Bay-Delta Plan which establishes water quality control measures and flow requirements needed to provide reasonable protection of beneficial uses in the watershed. The new flow objectives under the Bay-Delta Plan will affect the future reliability of water supplies, significantly reducing the volume of water available for diversion by SSJID in dry and critically dry years and reducing the water supply available to growers. Impacts to SSJID diversions directly impact the City.
- **Potable Water Use:** Late in 2021, DWR and the SWRCB submitted a report to the Legislature recommending that urban water suppliers achieve an indoor water use efficiency standard of 55 gpcd by 2023, declining to 47 gpcd by 2025, and 42 gpcd by 2030 and beyond. If adopted by the Legislature, the standards recommended by DWR and the SWRCB would be implemented at the water supplier level and would not apply to individual customers. Thus, the City would be responsible for achieving compliance with these standards.
- **Salt and Nitrate Control Program:** Reduction in urban water use standards has the adverse effect of increasing salt and nitrate concentrations in wastewater by reducing the volume of water available for dilution. This in turn makes it more challenging for the City to meet future discharge limitations at the WQCF.
- **Drinking Water Quality:** Water quality constituents are regulated as either primary or secondary drinking water standards under Title 22. Primary standards protect public health by limiting the levels of contaminants in drinking water. Secondary standards may have cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color issues) in drinking water. The City provides treatment at most wells and thus retains a T3 treatment classification. As discussed in **Section 2.2.3**, recent and upcoming changes to standards for perchlorate, PFAS, hexavalent chromium, manganese, arsenic, PFOA, PFOS, and NDMA may have the potential to affect City operations and treatment needs.

- **Federal Protection of Fish and Wildlife:** The protection of endangered species drives reservoir releases to downstream rivers during dry and critically dry periods in order to maintain flow for anadromous fish species. These releases can affect available storage and flow for water rights holders including SSJID and the City. The CVP Improvement Act (CVPIA) mandates changes in management of the CVP, particularly for the protection, restoration, and enhancement of fish and wildlife by assuring 800,000 AF of water dedicated to fish and wildlife annually, among other requirements.

Continued degradation of local drinking water aquifers and the regulation of new constituents that are threatening to impair water quality will continue to increase the cost to water purveyors to provide safe drinking water throughout the Central Valley, potentially reducing the availability of groundwater.

6.3.4 Declining Groundwater

The groundwater challenges for the City are consistent with what the United States Geological Survey (USGS) – the primary federal regulatory and management agency for groundwater – has identified. These challenges form a foundational basis for many SGMA objectives and include the following:

- Recharging, discharging, and managing change in storage response to climate variability on interannual to multidecadal timescales and climate change from human activities in the principal aquifers of the United States.
- Identifying how much hydrologic response is caused by natural variability and how much is caused by human activities with respect to future climate change.
- Identifying potential need for time-varying groundwater management strategies, such as artificial storage and recovery efforts due to climate variability.
- Identifying whether certain principal aquifers are more, or less, susceptible to changes in storage caused by climate variability and change.
- Identifying whether trends in groundwater quality can be linked to climate variability and change.
- Identifying what strategic role groundwater storage will play in adapting to climate change.

According to the American Geophysical Union, California has a less than one in five chance of recovering from groundwater overdraft over the 20-year period following a drought based on the expectations of a drier climate in the immediate future. Given that drought frequencies in California are easily within 20-year timeframes, full groundwater recovery is unlikely.

With declining groundwater, the other major concern is land subsidence. Since the 1920s, excessive pumping of groundwater at thousands of wells caused land to subside, or sink, by as much as 8.5 meters (28 ft) in some sections of the Central Valley; if groundwater levels continue to decrease, subsidence will continue to occur. Continued subsidence reduces the groundwater basin's physical capacity to store water.

6.4 Alternative Water Supply Analysis

Based on the growing scarcity and uncertainty of surface water and groundwater – the two water sources the City primarily relies on – as described herein, it is recommended that water purveyors diversify their supply portfolios and ideally invest in and pursue resources that they can maximize influence and control over. This section presents the potential water supply alternatives, developed in conjunction with City Staff, to expand the City's water supply portfolio to meet future demands and increase the reliability of the supply portfolio in the face of increased threats from climate change and other regulatory concerns.

6.4.1 Reclaimed Water

In January 2023, the City finalized its RWFMP which includes a recommended plan to systematically expand the use of reclaimed water from the WQCF with phased development/implementation over the next 20-25 years based on an in-depth cost/benefit analysis.

Potential expanded reclaimed water uses include irrigation of City parks, public areas, Manteca Park Golf Course, and other irrigation uses. Currently, the Manteca Park Golf Course irrigates its 115 acres with an average of approximately 1,000 AFY of raw groundwater. Other potential reclaimed water uses include WQCF equipment washdown, cleaning of sanitary sewer lines, and consolidating backfill in trenches. The utilization of reclaimed water for these uses could shift demand from potable water sources including SSJID surface water and local groundwater.

The RWFMP evaluates many potential reclaimed water options on a cost per volume basis of reclaimed water delivered. The alternatives evaluated include:

- Local alternatives, including all demands within City limits as well as different combinations of City demands;
- Regional alternatives including partnering with SSJID, delivering to agricultural users outside the City, transfer of water to the CVP, and transfer of water rights to the Mountain House Irrigation District; and
- Groundwater recharge in agricultural areas northeast of City limits.

After a full analysis of each alternative and comparison of each on both a monetary and non-economic basis, the local alternative to serve as many customers as economically feasible was chosen as the recommended alternative. This alternative includes repurposing two existing wastewater force mains that have been recently decommissioned into reclaimed water force mains to form the backbone of the expanded distribution system along the western and southern portions of the City.

6.4.2 Stormwater

Stormwater as a supply source has many advantages including the following:

- It is not controlled by State or federal regulators;
- It has no effect on State water quality or endangered species;
- It has no effect on any other water purveyor's claimed water entitlements, so there can be no injury claims made against it;
- It cannot be curtailed, even under the worst drought conditions;
- Existing infrastructure required for conveyance/collection already exists to some degree; and
- It is a free resource.

Stormwater capture, storage, and utilization is the most overlooked water supply asset in California water resources management today. Average annual precipitation within the ESJ Subbasin ranges from about 11 inches in the southeast to about 25 inches in the northeast, though there is significant interannual variability as shifting hydroclimatic trends continue to force water managers to recalibrate assumptions on water yield based on these emerging and intensifying climatic patterns.

While the City's 2015 UWMP acknowledges utilization of stormwater as a potential water supply source, it has not yet been studied in detail. However, the City owns existing infrastructure to store and treat stormwater runoff. Existing stormwater runoff is conveyed through City infrastructure into SSJID drains and laterals and is ultimately discharged to the San Joaquin River. This drainage infrastructure could serve as the vital backbone of any new stormwater retention or enhanced water supply program that the City might decide to pursue, though it is likely that the City would have to build its own storage/retention basins to utilize stormwater capture as a reliable resource.

To quantify the amount of stormwater potentially available within the City for reuse, a rough estimate is provided in **Table 6-1**.

Table 6-1: Stormwater Supply Opportunity Estimates

Parameter	2016	2017	2018	2019	2020	2021
Total Q1 & Q4 Precipitation (in)[1]	13.58	7.91	10.14	10.48	4.65	10.11
City Area (acres)	6,400					
Potential Stormwater Capture (AFY)	3,621	2,109	2,704	2,795	1,240	2,696
Potential Stormwater Capture (MGD)	3.2	1.9	2.4	2.5	1.1	2.4

Notes:
1. Source: CIMIS data for Station No. 70 (http://www.cimis.water.ca.gov).

These volumes are based on multiple assumptions, including that infrastructure was implemented to capture, treat, and/or distribute stormwater. It is noted that not all stormwater can be captured as a portion of it percolates directly into the subsurface. This volume would be based on many factors including soil type, saturation, and other site-specific conditions such as permeable area, hardscaping, and landscaping. For the purposes of this analysis, the volumes presented here are rough estimates developed for the sake of discussion of the potential benefits that stormwater could have on the City's water supply portfolio.

For this calculation, local climatological data was obtained from the California Irrigation Management Information System (CIMIS) website (http://www.cimis.water.ca.gov) for Station No. 70 located just north of City limits. During summer months, a majority of the rainfall in the City is likely meeting irrigation demand with very little percolates deep into the soil to recharge the shallow groundwater aquifer. During the winter months, as the subsurface becomes saturated, the excess rainfall runs off and is discharged to the stormwater collection system and ultimately to the San Joaquin River; this runoff would be most accessible for capture and reuse. Precipitation from calendar quarters one and four (Q1 and Q4), the winter wet months, were used to estimate the quantity of stormwater potentially available for capture. **Table 6-1** presents the total precipitation for Q1 and Q4 for each of the previous six years.

To calculate the volume of water, the total depth of precipitation is multiplied by the surface area of the land that it is falling on. For estimation purposes, it is assumed that the developed parcels within the City (i.e. existing water customers) are served by the storm drain collection system and thus would contribute to the volume of potential capture. Undeveloped areas were assumed to contribute a less significant amount of potential storm water for reuse due to less hardscaping and more significant percolation. **Table 6-1** lists the area of the existing water customers.

Assuming approximately 50% of the City area is permeable and the other 50% is impermeable and can generate stormwater runoff, **Table 6-1** presents the approximate quantities of stormwater over the past six years that could have potentially been available for capture and reuse with the appropriate infrastructure.

In theory, stormwater appears as a simple solution to the City's (and the State's) water supply problems. In practice, though, there are many logistical factors to consider:

- Stormwater is a clean resource until it hits the ground and interacts with pollutants on streets such as volatile organic compounds (VOCs) from vehicles. It is likely that even for non-potable uses, some level of treatment would be necessary. In some cases the stormwater quality is inferior to the existing drinking water aquifer quality and while percolating to the shallow aquifer for non-potable use may be appropriate, injecting stormwater to recharge the drinking water aquifer could adversely affect drinking water quality. Similar to reclaimed water, treatment and proof of attenuation would be required prior to injection.
- A majority of the City's stormwater drainage infrastructure is owned and operated by SSJID (see **Section 2.4**); the City does not have full operational control over these portions of the infrastructure and thus, negotiation with SSJID would be necessary if the City intended to use any of the dual infrastructure as part of a stormwater capture and reuse system.
- As mentioned previously, stormwater that is most valuable to capture occurs during the winter months, and this water is most needed during the summer months. Thus, it would likely be necessary to build storage to capture the water in the winter to distribute during the summer.
- If stormwater is considered for non-potable reuse, due to the distributed nature of parks and open space throughout the City, it is likely that some form of a new distribution system would be necessary to convey captured stormwater. Similar to a reclaimed water distribution system, this would include pipelines, pump stations, and other appurtenances.

It is recommended that the City perform a feasibility study to evaluate the water rights implications, practicality, treatment requirements, and cost effectiveness of implementing a stormwater capture and reuse system as well as managed aquifer recharge (MAR) – the purposeful recharge of water to aquifers for subsequent recovery or for environmental benefit – utilizing stormwater; this could be done in the form of an update to the City's 2013 SDMP or as a standalone analysis. Specifically, this option should be evaluated relative to the costs and benefits of expanding reclaimed water use from the WQCF, a resource which is already available and will likely generate more reliable quantities from year-to-year. As part of this feasibility study, it is recommended that the following considerations be evaluated:

- Determine if the City is entitled to divert stormwater from the SSJID-owned pipelines or if City stormwater capture needs to take place prior to flowing into SSJID-owned infrastructure.
- Determine the locations throughout the City that could utilize captured stormwater, such as parks and open space that can be irrigated with non-potable water.
- Identify ideal locations for MAR.
- Obtain and analyze water quality data to determine the level of treatment required to reuse the stormwater. This will depend on the intended purpose (i.e., potable or non-potable).
- Perform flow monitoring and/or evaluate existing flow monitoring data to determine more precisely the potential quantities available for capture and reuse as well as the most effective locations for potential capture relative to the flows and locations of storage and/or distribution.
- Develop capital and operations and maintenance (O&M) cost estimates for construction and maintenance of:
  - Distribution pipelines;
  - Storage facilities (if needed);
  - Pumps and/or pump stations;
  - Stormwater treatment facilities (if needed); and
  - Personnel and equipment needs.

SECTION 7 – DESKTOP CONDITION ASSESSMENT

A desktop condition assessment was conducted to evaluate and identify pipelines with the highest probability of failure to drive recommendations for the City's planned system maintenance program and prioritization of all recommended projects – both capacity and condition related. This analysis considers four different factors to assess the risk and likelihood of failure for each pipeline. The results of this assessment were incorporated into the CIP recommendations presented in **SECTION 10**. This section details the criteria and analysis used to prioritize the pipelines for replacement.

7.1 Criteria

This analysis considers the following four factors, each briefly described below, to determine each pipeline's likelihood and risk of failure:

- **Pipeline Age** – In general, as a pipeline ages, the likelihood of failure increases.
- **Pipeline Diameter** – In the older part of the City, many pipelines are smaller than 8-in which provides insufficient capacity for large demands including fire flows (see **Section 9.1**).
- **Soil Type** – The expansion and contraction of certain soil types can, over time, affect smaller pipes of brittle material.
- **Proximity to Major Transportation Corridors** – Pipelines crossing under or located near CA-120, CA-99, and/or the UPRR are more difficult to replace or repair in an emergency due to construction and permitting limitations.

A rating system was applied to each criterion from 0 to 4 representing low to high risk of failure.

Pipeline Age: A pipeline's expected useful life is a difficult attribute to quantify as it is based on many factors such as pipe material, soil conditions, water quality, proper maintenance, etc. In ideal conditions with thorough maintenance, pipes can reliably serve a water system for up to 100 years or more.

For this criterion, pipelines were assigned a rating based on the decade in which they were installed according to **Table 7-1**. While other factors affect useful life, the criterion assumes no significant adverse condition. Other factors that contribute to the expected useful life are considered in the other criteria for this analysis (i.e. diameter, material, soil type, and proximity to transportation corridors).

The City's GIS database contained installation dates for approximately 95% of the system's pipelines. Where there was no installation data available, pipelines were assigned the average installation date for that material. Where both installation date and material were unavailable, pipes were labeled as unknown.

A map of the pipeline ratings according to pipeline age is included in **Appendix G**.

Table 7-1: Pipeline Ratings Based on Pipeline Age

Decade Installed	Pipeline Age Rating
1900 – 1929	4
1930 – 1959	3
1960 – 1979 [1]	2
1980 – 1999	1
2000 – present	0

Notes:
1. Pipelines with unknown installation dates and unknown materials were assigned an average rating of 2.

Pipeline Diameter: When the City was first incorporated, development began in the central part of the existing City limits. This portion of the City contains the majority of the oldest pipelines, which also tend to be smaller in diameter. Today, potable water distribution system best practices indicate that all new pipelines installed should be 8-in or larger in diameter to provide sufficient fire flow within typical pressure and velocity criteria. While most of the City's system meets this standard, 16% of the City's distribution system is 6-in pipe and 4% is smaller than 6-in. Ratings were applied to pipelines based on their diameter to prioritize these small pipelines for replacement according to **Table 7-2**. A map of the pipeline ratings based on diameter is included in **Appendix G**.

Table 7-2: Pipeline Ratings Based on Pipeline Diameter

Diameter	Pipeline Diameter Rating
< 6-in	4
6-in[1]	2
> 6-in	0

Notes:
1. Pipelines with unknown diameters were assigned an average rating of 2.

Soil Type: The composition of the soil surrounding a pipeline can affect the useful life of certain pipe materials in the distribution system. Both cast iron pipe (CIP) and asbestos cement pipe (ACP) are susceptible to breakage and/or failure in areas that contain alluvial/clay soils due to the expansive properties of the soil. CIP and ACP are brittle pipe materials that are sensitive to the cycles of soil expansion and contraction in the wet and dry seasons, respectively. More specifically, smaller diameter pipes are the most vulnerable.

According to the California Geologic Survey (https://maps.conservation.ca.gov/cgs/DataViewer/), there is a single soil type that underlies the entire City and surrounding area: Q – alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated; mostly nonmarine but includes marine deposits near the coast. For this assessment, each pipeline was assigned a soil type rating based on the pipeline material and diameter according to **Table 7-3**. A map of the pipeline ratings based on material and size for this soil type is included in **Appendix G**.

Table 7-3: Pipeline Ratings Based on Soil Type

Material	Diameter	Soil Type Rating
ACP, CIP[1,2]	< 6-in	4
	6-in	3
	8-in	2
	> 8-in	1
All other materials	All diameters	0

Notes:
1. ACP = asbestos cement pipe
CIP = cast iron pipe
2. Pipelines with unknown materials were assumed to be in the ACP, CIP category.

Proximity to Major Transportation Corridors: A pipe failure under a freeway or railroad will have a higher consequence such as higher costs and permitting impacts than those in an accessible neighborhood street. Within City limits, the UPRR runs from the northwest corner to the southeast corner, and CA-99 and CA-120 run north-south and east-west, respectively. Pipelines within 50 ft of these major highways and railroads were assigned a rating according to **Table 7-4**, and a map of the pipelines ratings based on proximity to these major transportation corridors is included in **Appendix G**.

Table 7-4: Pipeline Ratings Based on Proximity to Major Transportation Corridors

Criteria	Major Transportation Corridors Rating
Within 50 ft of highway or UPRR	4
Not within 50 ft of highway or UPRR	0

7.2 Pipeline Replacement Prioritization

With each pipeline assigned a rating for each of the four criteria described above, the sum of the ratings provided each pipeline's overall score ranging from 0 to 12. **Table 7-5** summarizes which pipe characteristics dominate each score range, and scores are presented in **Figure 7-1**. The range represents lowest to highest risk of failure and directly correlates with lowest to highest priority for replacement.

Table 7-5: Prioritization Scores

Score	Priority	Notes
11-12	Very High	Small diameter (6-in and smaller) ACP installed between the 1910s and 1950s
9-10	High	Mostly 4-in and 6-in diameter ACP installed in the 1910s, 1960s, and 1970s
8	Moderately High	Mostly 2-in and 6-in diameter ACP installed in the 1910s, 1940s, and 1950s
7	Moderate	Mostly 6-in diameter ACP installed in the 1960s and 1970s
4-6	Low	Mostly 6-in to 12-in diameter ACP and PVC installed between the 1910s and 2000s
0-3	Very Low	Mostly larger diameter (8-in and larger) PVC installed since the 1980s

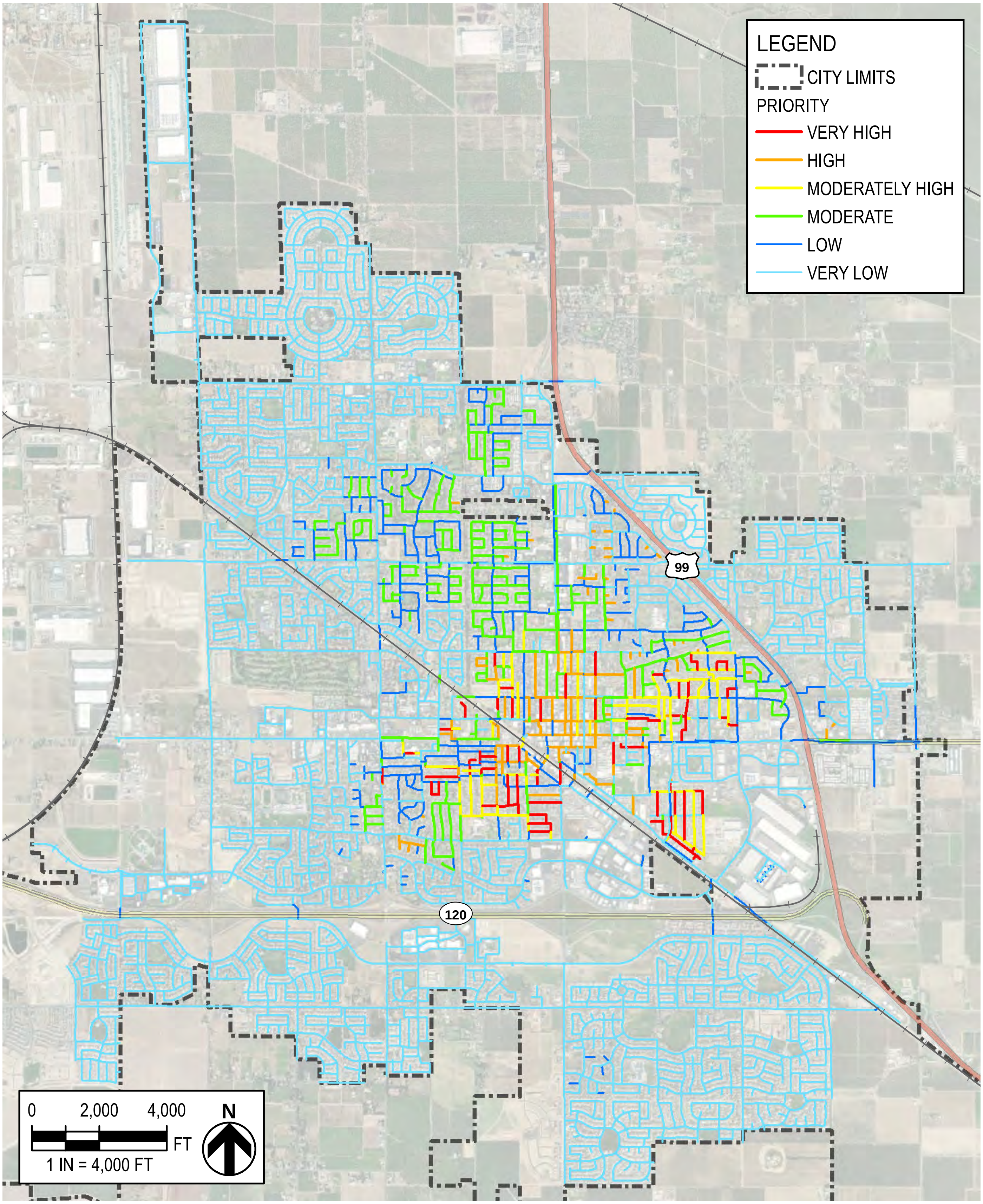


FIGURE 7-1
CITY OF MANTECA
WATER MASTER PLAN
OVERALL PRIORITIZATION

HydroScience

SECTION 8 – HYDRAULIC MODEL BUILDING AND CALIBRATION

As part of the City's past water master planning efforts, the City developed and updated a hydraulic model. Originally created in KYPIPE in 1985, the model was converted to Cybernet 2.0 in 1994 and to WaterCAD for Windows in 1997. The City's 2005 WMP updated and analyzed the hydraulic model in Haestad Methods WaterCAD for Windows software.

For this analysis, the existing hydraulic model was not available, and thus, a new potable water hydraulic model was built and calibrated using WaterGEMS, a successor of Bentley's original water hydraulic analysis software WaterCAD. WaterGEMS includes the ability to conduct fire flow analyses, water quality simulations, and criticality and energy cost analyses with a rich scenario management system that allows the user to create child scenarios that inherit all data from the parent.

The City's GIS records were used to build the hydraulic model, while SCADA data and field data from system-wide pressure monitoring and hydrant testing were used to calibrate the model once it was built. The pressure monitoring and hydrant testing sites are presented in **Figure 8-1**, and the model building and calibration processes are detailed in this section.

8.1 Model Building Process – Existing Scenario

Before the model import process began, a comprehensive review was completed of as-built drawings for each water supply facility (wells, treatment facilities, turnouts, tanks, and pump stations) where as-builts were available. Any updates made relative to the City's GIS were noted in the attribute tables in the final model.

Below are the details of the import process and data analysis for each aspect of the City's distribution system infrastructure. Regional DEM data, along with the *TRex* elevation extraction tool in WaterGEMS, was used to obtain elevations for pumps, tanks, valves, junctions, and hydrants; elevations of wells were set based on the surface elevation at the well minus the static water level below ground surface.

Turnouts and Wells: The City's distribution system contains four turnouts and 15 active plus two standby potable water wells. Non-potable wells were not included in the hydraulic model as they are not connected to the distribution system. Each of the turnouts and wells are represented as constant-head reservoirs in WaterGEMS. A reservoir in the hydraulic model represents an infinite source.

Pumps: The City's geodatabase did not contain each pump in the system, rather, they were manually added to the model at each supply source location. Pump definitions were created for each pump using available data such as pump curves, pump test data, and SCADA data as available, and these pump definitions were adjusted during the calibration process, as detailed later in this section.

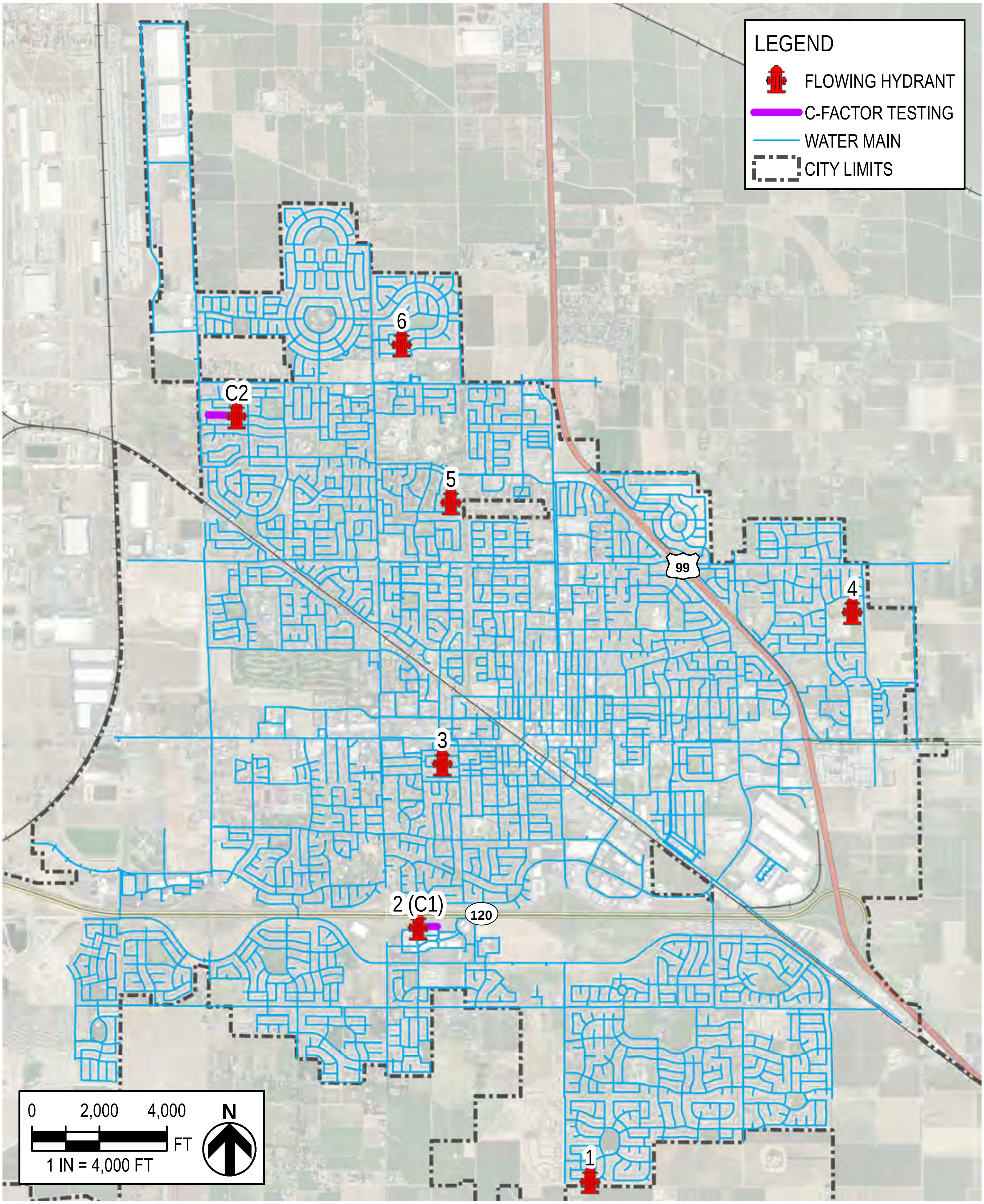


FIGURE **8-1**
CITY OF MANTECA
WATER MASTER PLAN
MONITORING AND TESTING SITES

HydroScience

Tanks: The three tanks located within the City's distribution system were imported to the model and dimensions were specified where information was available.

Valves: Where identified in available as-built drawings, PRVs, PSVs, and flow control valves (FCVs), were included in the model with the appropriate settings based on information from City Operations Staff and/or SCADA data.

Pipelines and Junctions: The model is limited to City-maintained and owned facilities and excludes SSJID surface water pipelines, private water lines, and service water lines. The pipeline feature classes included in this hydraulic model are:

- Surface Water Pipes (WSURF)
- Non-Potable Water Mains (WMNP)
- Water Mains (WMAIN)

The City has a naming convention for each of the feature classes (identified in parentheses in the list above) to identify which layer they belong to (e.g., "WMAIN-####"). During the review of as-builts for the existing supply source facilities, any pipes added were labeled to match this naming convention with an "H" preceding the number to identify that it was added by HydroScience (e.g., "WMAIN-H####"). Where the layer appeared to be misidentified, the label was updated and this change was noted.

The following pipelines attributes were imported into the model:

- Pipe ID (Label)
- Diameter
- Material
- Install Date
- HydroScience Notes

Upon import, WaterGEMS automatically creates a junction at each end of every imported pipe. These junctions are assigned by WaterGEMS with the naming convention "J-####." A manual review was conducted of the pipelines to ensure connectivity of pipelines where they intersect. In locations where intersecting pipelines were not actually connected, the pipes were selected and split using the *Batch Pipe Split* tool in WaterGEMS. Upon splitting of pipes, WaterGEMS maintains the pipe labels, and automatically adds a "(1)" or "(2)" to the end of the label.

There were 17 pipe segments with unknown diameters according to the City's GIS. Diameters of these segments were manually interpolated based on the surrounding pipelines, and "INT_DIAM" was added to the "Notes" column of the model. Many of these segments were short (< 20 ft) pipelines that appear to be services or stubs. In these cases, diameters of similar nearby stubs were used to interpolate.

C-Factors

The City conducted C-factor testing for 8-in PVC in two locations (C1 and C2) as identified on **Figure 8-1**. This pipe diameter and material are the most commonly found within the City's distribution system (see **Table 3-5** and **Table 3-6**). C-factor testing sites were selected where there are two or three hydrants on a single stretch of long pipe without any tees or turns in between.

Site C1 (hydrant test Site 2) includes data logger data for use in calculating the C-factor. Site C2 was used only for C-factor testing and therefore has pressure gauge readings for static and residual pressure but does not have corresponding data logger data. As noted above, the pressure gauge provides slightly less accurate data compared to the data loggers.

During testing, adjacent valves were closed to ensure unidirectional flow only, and the distance between the flowing hydrant and the residual hydrant was measured in the field. Resulting flow and pressure readings for C-factor testing are provided in **Table 8-1**.

Table 8-1: C-Factor Testing Data

Site No.	Pipe Diam (in)	Pipe Material	Pipe Install Date	Flowing Hydrant	Residual Hydrant	Estimated Flow (gpm)	Static Pressure (psi)[1]	Residual Pressure (psi)[1]
C1	8	PVC	2009	169-062	169-060	1,138	54.9	50.7
C2	8	PVC	1999	056-021	056-019	1,087	56.0	50.0

Using the Hazen-Williams friction equation, the headloss due to friction in a pipe flowing full can be calculated as:

$$h_f = 0.2083 * \left(\frac{100}{C}\right)^{1.852} * \frac{q^{1.852}}{{d_h}^{4.8655}}$$

where,

h_f = headloss due to friction (ft),

C = C-factor (unitless),

q = flow (gpm), and

d_h = pipe diameter (in).

Rearranged to solve for C, this equation can be written as:

$$C = \frac{42.9 * q}{{d_h}^{2.628} * {h_{100ft}}^{0.54}}$$

where,

h_f = ft headloss per 100 ft (unitless).

Using the C-factor testing data collected in the field and presented in **Table 8-1**, the C-factor for each testing site was calculated based on the equation above. For this analysis, it is assumed that the difference between static head and residual head is due only to friction headloss. **Table 8-2** presents the C-factor calculations and results for each location.

Table 8-2: C-Factor Testing Results

Site No.	Pipe Type	Headloss (psi)	Distance b/w Hydrants (ft)	Headloss (ft/100 ft)	Calculated C-Factor
C1	8-in PVC	4.2	557	1.7	**154**
C2	8-in PVC	6.0	845	1.6	**151**

The results of this C-factor testing were incorporated into the model by applying the average of these two calculated C-factors (152.5) to all PVC pipes. C-factors for the remaining pipe materials in the City's distribution system were developed based on industry standards. All relevant pipe materials and corresponding C-factors used in the hydraulic model are presented in **Table 8-3**.

Table 8-3: C-Factors Based on Pipe Material

Pipe Material[1]	C-Factor
ACP, Steel	140
CIP, DIP, Unknown	130
PVC	152.5
RCP	110
WIP	100

Notes:
1. ACP = asbestos cement pipe
   CIP = cast iron pipe
   DIP = ductile iron pipe
   PVC = polyvinyl chloride
   RCP = reinforced concrete pipe
   WIP = wrought iron pipe

Hydrants: The fire hydrant GIS feature class provided by the City was manipulated to transfer the hydrants from the end of the hydrant service line to the point where the hydrant service connects to the main pipeline. This was done to reduce the complexity of the model by importing the hydrants directly onto the main pipelines. These adjusted hydrants were imported into the model with their hydrant ID labels, and pipes were split at the location of each hydrant using the *Batch Pipe Split* tool in WaterGEMS. A small percentage of hydrants were not located adjacent to a City Main and did not get linked to a model pipeline; these hydrants were excluded from this analysis.

Customer Demands: As detailed in **SECTION 4**, existing customer meters were linked to their corresponding City parcel based on the APN listed in the customer meter data. To include these demands in the model, parcels were converted to points using GIS and were imported as customer meters. During the import process, the following attributes were included in the model:

- APN (Label)
- Parcel Area (acres)
- Customer Meter *Account Class*
- HydroScience Land Use Category
- Horizon (Existing)

Once imported, the *Load Builder* tool was used to assign the customer meters to the nearest pipe which then assigns the demand proportionally to the nodes at each end of that pipe based on spatial proximity.

SCADA Data: SCADA data was processed and used for the following purposes:

- Develop an average day diurnal pattern (see **Section 4.1.1**);
- Understand supply operations;
- Understand tank fill and drain cycles;
- Identify which water supply sources were active during the monitoring period and hydrant testing; and
- Compare to modeled flows for calibration of the hydraulic model.

The SCADA data provided by the City included flows and pressures for each pump and turnout as well as inflow, outflow, and levels for each tank. **Table 8-6** lists the water supply sources that supplied the system during each day of the monitoring period and the corresponding flow ranges for each facility.

Operating ranges for each of the three storage tanks during the monitoring period are listed in **Table 8-4**.

Table 8-4: Storage Tank Operating Range during Monitoring Period

Tank	Tank Level Range (ft)
Atherton Tank	19.1 – 25.9
M2 Tank	14.0 – 14.4
M3 Tank	14.3 – 14.8

As detailed in **Section 4.1.1**, a mass balance water compiled to calculate flows during each day of the monitoring period. **Figure 4-2** presents the hourly flows for each day of the monitoring period, and **Table 8-5** summarizes the same data in terms of average daily demand.

Table 8-5: Average Daily Demands during Monitoring Period

	Monday 10/25/21 [1]	Tuesday 10/26/21	Wednesday 10/27/21	Thursday 10/28/21	Friday 10/29/21	Saturday 10/30/21	Sunday 10/31/21
Average Demand (gpm)	6,641	7,330	7,409	7,511	7,641	7,851	7,788

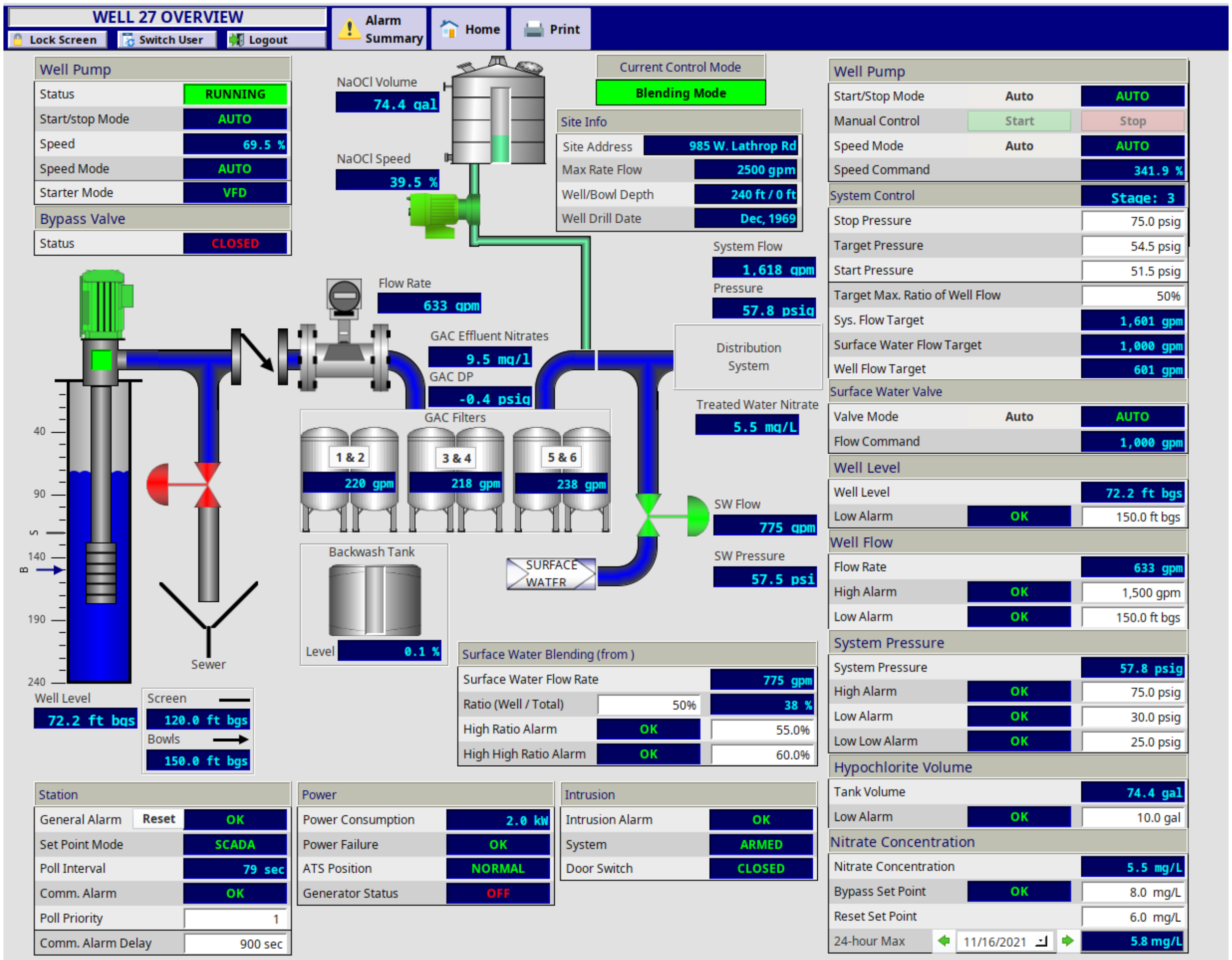
Notes:
1. Mondays are no-watering days in the City.

Table 8-6: Supply Sources Flowing During the Calibration Period

Supply Source	Monday 10/25/21	Tuesday 10/26/21	Wednesday 10/27/21	Thursday 10/28/21	Friday 10/29/21	Saturday 10/30/21	Sunday 10/31/21	Minimum Flow (gpm)	Maximum Flow (gpm)
WELL 12	✓	✓	✓	✓	-	✓	✓	14	318
WELL 12 SW	-	-	-	-	-	-	-	-	-
WELL 13	✓	✓	✓	✓	✓	✓	✓	0	708
WELL 14	✓	✓	✓	✓	✓	✓	✓	0	1,153
WELL 15	✓	✓	-	✓	✓	✓	✓	0	479
WELL 15 SW	✓	✓	✓	✓	✓	✓	✓	43	986
WELL 16	✓	✓	✓	✓	✓	✓	✓	0	616
WELL 16 SW	✓	✓	✓	✓	✓	✓	✓	239	1,124
WELL 17	✓	✓	✓	✓	✓	✓	✓	0	1,078
WELL 18	-	-	-	-	-	-	-	-	-
WELL 19	✓	✓	✓	✓	✓	✓	✓	0	1,481
WELL 20	-	-	-	-	-	-	-	-	-
WELL 21	✓	✓	-	✓	-	-	-	0	405
WELL 22	✓	-	-	-	-	-	-	0	377
WELL 22 SW	✓	✓	✓	✓	✓	✓	✓	615	877
WELL 23	✓	✓	✓	✓	✓	✓	✓	0	612
WELL 23 SW	✓	✓	✓	✓	✓	✓	✓	75	1,109
WELL 24	✓	✓	✓	✓	✓	✓	✓	0	1,060
WELL 25	✓	✓	✓	✓	✓	✓	✓	0	1,769
WELL 27	✓	✓	✓	✓	✓	✓	✓	0	853
WELL 27 SW	✓	✓	✓	✓	✓	✓	✓	64	1,204
WELL 28	-	✓	-	✓	-	-	✓	0	932
WELL 29	✓	✓	✓	✓	✓	✓	✓	0	706
ATPS	✓	✓	✓	✓	✓	✓	✓	1,477	3,419
LAPS 16-in	✓	✓	✓	✓	✓	✓	✓	0	2,889

In addition to the flow and pressure data, City Operations Staff also provided screenshots of the live SCADA interface at each facility to aid in the understanding of system operations. **Figure 8-2** presents a sample SCADA screenshot.

Figure 8-2: SCADA Screenshot Sample



8.2 Model Calibration

To calibrate the hydraulic model, it is necessary to compare model operations to field data to understand how the system operates. The field data used for this process was the system-wide pressure monitoring, hydrant flow testing, and SCADA data.

The City conducted hydrant flow testing during the monitoring period on October 27, 2021 at six hydrants located adjacent to the six data logger sites (see **Figure 8-1**), allowing the data loggers to capture the system response during hydrant flow. Residual pressures were also captured and manually recorded using a pressure gauge on the next adjacent hydrant for an additional data point. Pressure gauge accuracy is approximately ±2.0 psi while the datalogger accuracy is within ±0.25%.

Hydrant flow was measured using a handheld pitot tube. The accuracy of the pitot tube is +/- 25 gpm. Thus, there is an inherent level of error in flow and pressure readings for hydrant testing that is considered during the calibration process. Hydrant testing data was used for steady-state (SS) model calibration.

Two different types of calibration are utilized to calibrate the hydraulic model to the City's existing system operation, each detailed below.

SS Calibration: SS calibration is intended to ensure that the hydraulic model is accurately capturing the system's response to hydrant flow testing. The intent was to recreate field demands and operations such that the modeled results mimic those observed during testing. During hydrant testing, two pressure conditions were documented for each site:

1. Static system pressures prior to hydrant flow testing; and
6. Residual pressures during hydrant flow testing.

Thus, each hydrant test had a corresponding static and residual modeled scenario. In total, 12 SS scenarios were created to represent each of the tests conducted in the field. Manually and electronically recorded flow and pressure readings are provided in **Table 8-7**.

Table 8-7: Hydrant Flow Testing Data

Site No.	Pipe Diam (in)	Pipe Material	Flowing Hydrant	Residual Hydrant	Measured Flow (gpm)	Static Pressure (psi)[1]	Residual Pressure (psi)[1]
1	8	PVC	180-074	180-073	1,087	51.9	46.0
2	8	PVC	169-062	169-060	1,186	54.4	50.6
3	4	ACP	022-013	022-019	978	53.9	46.6
4	8	PVC	033-013	033-021	1,087	48.3	45.7
5	6	ACP	043-017	043-018	1,007	53.9	50.0
6	8	ACP	126-050	126-049	1,186	55.5	50.0

Notes:
2. Field static and residual pressures are the average of data logger pressure readings over one minute prior to and during the flow test, respectively.

System demands for each of the SS scenarios were calculated by processing the SCADA data at the time which correlated to static and residual pressure readings. Demands for each scenario were adjusted to match the SCADA data during each test.

Additionally, well operation was adjusted to reflect the configuration of active wells during the respective field test, and tank levels were updated to reflect SCADA levels at the time of each hydrant flow test. The field data presented in **Table 8-7** was used for calibration of each of the 12 SS scenarios.

EPS Calibration: EPS calibration analyzes system operation under an extended timeframe and models system responses to hourly diurnal demand variations.

Normal operating conditions were modeled using a single-day EPS. System-wide pressure data captured by the data loggers as well as flows, pressures, and levels for turnouts, groundwater wells, and tanks documented in the SCADA data were used to calibrate the EPS scenarios.

Figure 4-2 presents the average hourly flows for each day during the monitoring period and as discussed in **Section 4.1.1**, Thursday, October 28, 2021 was selected as the representative day for the diurnal pattern and subsequently was used to calibrate the hydraulic model. This is referred to herein as the "calibration day."

A single EPS scenario was created to represent the 24-hour condition observed during the calibration day. The average demand for the calibration day (7,511 gpm) was applied to the scenario along with the diurnal pattern to fluctuate demands over 24 hours. The following operational settings were modified to match SCADA data for the calibration day:

- Supply source status;
- Valve settings; and
- Reservoir starting levels.

Initial controls and logical rules were set for all pumps in the system based on targets and on/off set points as provided by City Staff. Controls and logical rules within WaterGEMS allow pumps to turn on or off depending on a specific condition such as system pressure, time of day, or reservoir level. Only the logical rules for those facilities active on the calibration day were active in the EPS scenario.

8.2.1 Calibration Results

Through an iterative approach, adjustments were made to the SS and EPS scenarios; modeled pressures were compared to data logger pressures at each of the calibration points, and modeled pressures, flows, and tank levels were compared to SCADA data at each of the supply sources.

The strategy during the calibration was to establish known variables and iteratively adjust the unknown variables within the range of estimated operating parameters. System pressures are largely a function of demands and supplies; system demands are a known variable and are fixed, leaving supplies to be adjusted to calibrate system pressures. The unknown supply variables are summarized as follows:

- VFD pump curve and pump speed data;
- Pump efficiency data;
- Target set points;
- On/off set points for each supply source;
- Operating parameters for valves throughout the system; and
- Hydraulic grade line (HGL) information and pump operation information at SSJID turnouts.

For the SS calibration, the static pressure scenarios were developed and run first. Once modeled static pressures were within 5-10% of field results, the hydrant flow scenarios were tested. The pressures of concern are the residual pressures read by the data loggers as well as the pressure drops (static pressure minus residual pressure).

The following adjustments were made in the model during the calibration process:

- Adjusted pump efficiencies as needed to approximate supply ratios documented by SCADA.

- Created pump curves where pump curves were not available or data provided was conflicting. The curves were created from SCADA data during the monitoring period and iteratively adjusted to calibrate model flows and pressures to observed flows and pressures.
- Pump target pressures provided by the City ranged by up to 9 psi between different wells. When there are multiple pumps operating in a single pressure zone with varying target pressures, the pump with the higher target pressure is going to consistently dominate. As a result of this large range, the model experienced instability and inaccurate results. Target pressures were iteratively adjusted based on SCADA data and data logger pressure readings until pumps were operating well in conjunction, the model was stable, and pump discharge pressures were within expected results.
- Set well timers for multiple sources based on SCADA data and communication with City Staff.
- On/off pressure settings provided by the City (see **Appendix E**) conflicted with SCADA data provided for the monitoring period. On/off pump pressures were iteratively adjusted in the model based on SCADA data until pump operations closely resembled field data.
- In the field, the Atherton Tank fill rate is controlled by an automatic sleeve valve and City Staff manually controls when the fill may occur. To mimic this operation, flow control valves operated with timers were added to the model at the upstream end of Atherton Tank to mimic fill operations observed in SCADA data.
- Per conversations with City Staff, storage tanks M2 and M3 each drain and fill simultaneously, essentially operating as large pipes. To improve model stability, M2 and M3 turnouts were modeled to bypass their respective tanks and flow directly to the distribution system.
- Wells 13, 19, and 21 were not operating at the rates observed in the SCADA data based on the on/off pressures provided for the testing period (see **Appendix E**). Model on/off pressures were adjusted to reflect SCADA data and logical controls were created to mirror the sequence outlined in the SCADA data.
- To improve model stability, the combined surface water and groundwater flows at Wells 12, 15, 22, and 27 – which all blend with M2 – were represented as a single source rather than competing sources; PRVs were added at the blending locations of each well and were modeled to mirror the blended flows observed in the SCADA data.

  Similarly, Well 23 and M4 flows and Well 16 and M4 flows were modeled as single sources at the respective blending locations. Pump curves were created to mirror the blended flows observed in the SCADA data.

During this process, system operations were confirmed with City operations personnel.

Iterations were repeated until modeled flows, pressures, and tank levels matched those observed in the field at each calibration point reasonably well. For the SS scenarios, all static pressures are within 2% of field pressure, and residual pressure within 10% of field results. SS calibration results are presented in **Table 8-8**.

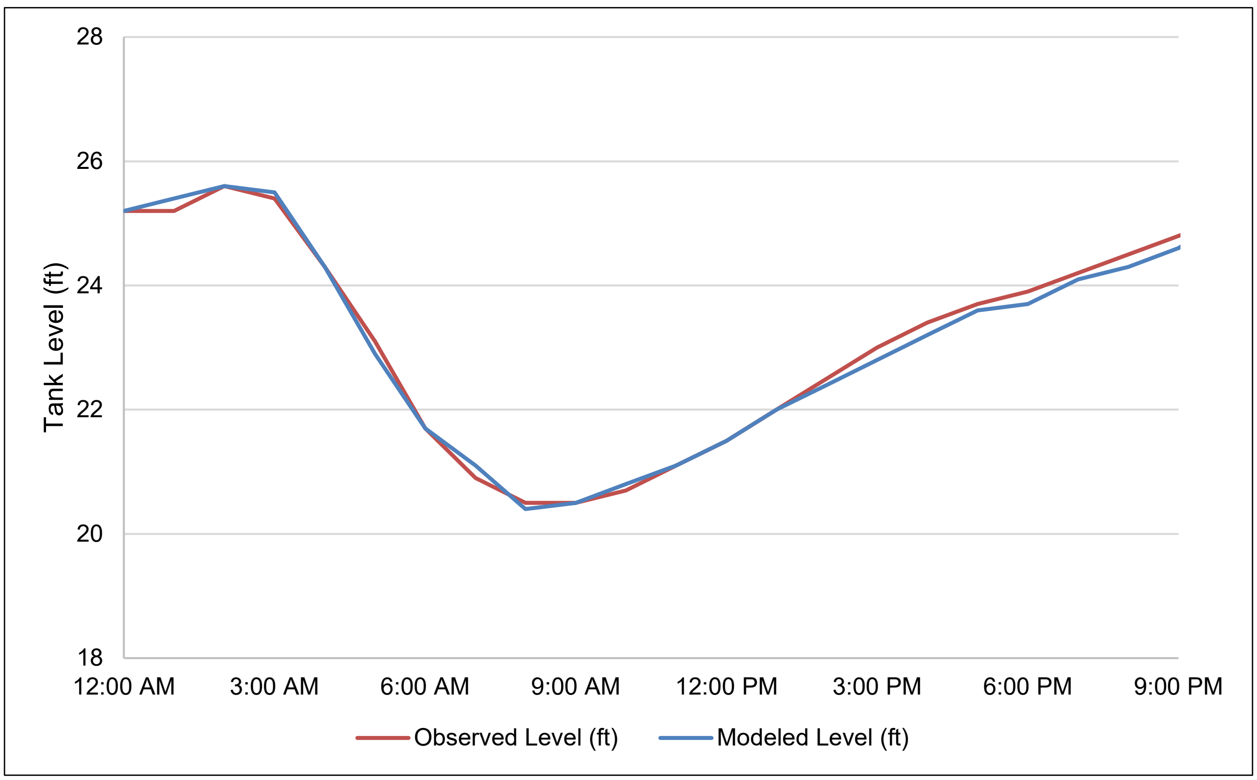
Table 8-8: Steady-State Calibration Results

Site No.	Flowing Hydrant	Residual Hydrant	Static Pressure (psi)		% Diff.	Residual Pressure (psi)		% Diff.
			Field	Model		Field	Model	
1	180-073	180-074	51.9	51.4	1.0%	46.0	47.9	-4.1%
2	169-060	169-062	54.4	54.6	-0.4%	50.6	51.2	-1.2%
3	022-019	022-013	53.9	53.5	0.7%	46.6	12.9	72.3%[1]
4	033-021	033-013	48.3	47.5	1.7%	45.7	44.3	3.1%
5	043-018	043-017	53.9	53.5	0.7%	50.0	47.9	0.7%
6	126-049	126-050	55.5	54.4	2.0%	50.0	51.0	-2.0%

Note:
1. It is noted that the pressures recorded during hydrant testing at Site 3 did not align with modeled hydraulics. According to the City's GIS, the flowing hydrant (022-019) is located on a 2-in pipeline. Given that flows of approximately 1,000 gpm were observed during hydrant testing, it is unlikely that this is a 2-in pipeline. It is assumed that the pipe configuration in this area is misrepresented and thus, was unable to be accurately calibrated. For this reason, Site 3 was not used as a calibration point for SS calibration.

All hourly EPS model results are within 10% of field results. **Figure 8-3** presents SCADA data tank levels for Atherton Tank during the calibration day along with the modeled Atherton Tank levels. The full EPS calibration results are included in **Appendix H**. Figures show modeled and measured pressures at each calibration site and include a 5% margin of error for reference.

Figure 8-3: Observed and Modeled Atherton Tank Levels



SECTION 9 – HYDRAULIC ANALYSES

Once calibrated, the hydraulic model was used to analyze the City's distribution system infrastructure under Existing, 2030, and 2045 buildout demand scenarios as detailed in **SECTION 4**. The Existing scenario was built to represent 2021 system demands and operations. All three flow scenarios were modeled under ADD, MDD, and PHD conditions utilizing the peaking factors also detailed in **SECTION 4**; fire flows were then analyzed during MDD and PHD conditions.

This section presents the hydraulic model performance criteria, analysis, and all identified hydraulic deficiencies.

9.1 Modeling and Performance Criteria

The following criteria were established and used for evaluation of the water system and are intended to ensure that the system can accommodate peak demands while maintaining residual system pressure and without excessive wear or energy usage:

- **Pressure Criteria** – Maintaining minimum system pressure ensures that water quality is maintained to prevent the entrance of pathogens or constituents into the distribution system and to ensure that customers have adequate pressure at the tap, preventing the opportunity for backflow. Conversely, operating at higher pressures increases the potential for water loss in the system due to leaks and main breaks and generally increases wear and tear on the infrastructure. Minimum and maximum pressures are set to provide an operating range that balances these factors.
- **Velocity Criteria** – Maintaining minimum system velocities ensures that there is adequate turnover in a pipeline to avoid stagnation and related water quality issues, including nitrification. Conversely, operating at high velocities can lead to scouring of pipelines and can potentially damage the cement mortar lining of ductile iron pipe, though it is acceptable for short periods of time in the event of an emergency (i.e., fire) as it is expected that these flows would be for emergencies only and short in duration; sizing a pipeline based on lower allowable pipe velocities during fire events can lead to oversizing of facilities, contributing to long-term water quality issues. Maximum velocities for fire flow differ for utilities based on system condition; for a well-maintained system, it is acceptable to allow a higher maximum velocity during fire events.

  Headloss gradient and velocity are evaluated simultaneously to provide a stronger analysis than considering them separately; this ensures adequate flow rates while limiting excessive wear on the system or energy usage.

Table 9-1 presents a summary of the criteria used to evaluate the performance of the City's water distribution system.

Table 9-1: Distribution System Performance Criteria

Criteria		Value
Minimum pressure at PHD[1]		40 psi
Maximum pressure at all times[2]		70 psi
Maximum velocity at all times excluding fire flow[3]		7 ft/s
Maximum headloss gradient[3]		0.015 ft/ft
During fire flow	Minimum residual pressure[1,4]	20 psi
	Maximum velocity[3]	15 ft/s

Notes:
1. California DDW Waterworks Standards Article 8 Section 64602.
2. Maximum operating pressure identified by City Operations Staff in source main pipelines.
3. Industry standards: 7 ft/s is common in the industry although it can vary by water utility.
4. AWWA M31: Distribution System Requirements for Fire Protection.

To ensure sufficient available flow during a fire event, fire flow criteria are established on a land use basis and assigned to each hydrant in the model. Fire flow duration criteria are also established for storage analysis to ensure sufficient storage to provide for a fire flow event.

Fire flow requirements from the 2005 Master Plan as well as for surrounding cities were reviewed for consideration in this analysis. Developed in conjunction with City Staff and the City Fire Marshal, the fire flow criteria used for this analysis are provided in **Table 9-2**.

Table 9-2: Fire Flow Criteria

Land Use	Required Fire Flow (gpm)	Duration (hours)
Single-Family Residential	1,500	2
Multi-Family Residential	2,500	2
Public/Schools	3,500	4
Business and Commercial	3,500	4
Industrial[1]	3,500 – 5,000	4

Notes:
1. Actual required fire flow and duration for industrial depends on the size of parcel and type of facility.

9.2 Scenario Development

A total of 15 scenarios were developed and modeled for this analysis: three demand scenarios each evaluated under five peaking conditions. This section details the scenarios and conditions, and the process of building each.

The distribution system was analyzed under the following demand scenarios:

- **Existing:** Existing modeled conditions capture the system as it is at the time of the Master Plan development. This includes capital improvement projects that have been constructed to date in the distribution system. The system demands are also representative of analyzed metered water use data.
- **2030:** This scenario captures projected demands for 2030 as presented in **Table 4-12**. It includes an expanded skeletonized distribution system to provide potable water to these new customers and three new wells as presented in **Table 5-2**.
- **2045:** This scenario captures future 2045 demands as presented in **Table 4-12**, additional skeletonized infrastructure to reach these expanded areas, and three additional new wells beyond those from 2030 (total six new wells).

Each demand scenario was modeled under the following conditions:

- **Average Day Demand (ADD):** This condition establishes the base demands for the system during normal operation. Water demands in the system are escalated from the ADD condition to evaluate peak conditions in the system. The scenarios are not evaluated under this condition for deficiencies as its primary functions is the baseline for scaling MDD and PHD conditions.
- **Maximum Day Demand (MDD):** For this condition, the MDD peaking factor and system diurnal pattern are applied to all customers in the hydraulic model and the scenarios are run as both SS and EPS. The SS scenario identifies deficiencies in the system representative of average demand over the course of a maximum day. The EPS scenario represents the maximum day including hourly demand and operations fluctuations according to the diurnal pattern.
- **Peak Hourly Demand (PHD):** The PHD is run as SS scenarios at the peak of the MDD diurnal pattern. This is represented by a snapshot of the MDD EPS scenario at time 5:00 AM. This scenario identifies deficiencies in the system during the peak hour on a maximum day.
- **Maximum Day Demand + Fire Flow (MDD+FF):** This scenario applies a specified fire flow to each hydrant in the system during MDD conditions based on the most conservative land use surrounding the hydrant and the corresponding fire flow criteria listed in **Table 9-2**. Per industry standard, this analysis identifies deficiencies within the system associated with a fire flow event on a maximum day.
- **Peak Hour Demand + Fire Flow (PHD+FF):** This scenario duplicates the MDD+FF scenario except that it is run on the peak hour during MDD conditions. This scenario uses the same fire flow for each hydrant and the same fire flow criteria as used in the MDD+FF scenario.

9.2.1 Model Building Process – Future Scenarios

The City's growth is mostly outward expansion from the City center with some planned infill development. With this growth, the City's distribution system will need to expand to reach these new areas as they are developed. For the purposes of modeling this future expansion, a skeletonized system – a simplified version of the system typically representing only the larger diameter pipelines – was developed based on the spatial expansion areas presented in **Figure 4-7**. The intent is to ensure that the system can provide sufficient flow and pressure to the expansion areas and to analyze any impacts of the expansion on the existing system. It is acknowledged that expansion areas will be planned and designed as development occurs and may not reflect the skeletonized system developed herein; however, the future impacts to the existing system would be captured in this analysis.

Figure 9-1 presents the pipelines and wells added to the model for the 2030 and 2045 model scenarios, and below are the details of the future scenario model building process for each aspect of the system's infrastructure. As in the existing scenario, the regional DEM data was used to obtain surface elevations for all future infrastructure. It is noted that the model did not consider restriction or expansion of turnout capacity and for modeling purposes it was assumed that adequate flow would be available even though City Staff indicated that infrastructure limitations have prevented the City from taking their full allocation.

Wells: Based on the analysis presented in **SECTION 5** and the results of this analysis presented in **Table 5-2**, three new wells were added to the 2030 scenario, including Well 30, and three additional wells were added to the 2045 scenario. The locations of the wells were initially based on spatial distribution and coverage of both the existing and future expansion areas; the locations were also adjusted during the modeling process based on the hydraulics of the future expanded system.

Pumps: Pump curves were created and added to the model at each of the new wells with a maximum flow of 2,000 gpm (1,500 gpm for Well 30) and total dynamic head (TDH) corresponding to the head of the nearest point in the existing system during MDD to maintain existing system pressures.

Pipelines and Junctions: For the 2030 and 2045 scenarios, a skeletonized set of transmission main was added to the model to reach the expanded service areas displayed in **Figure 4-7**. This includes currently planned pipelines in areas of upcoming development. The transmission main follow the general pattern of a 12-in to 16-in looped system with 8-in pipes in between. These pipelines were iteratively adjusted during the modeling process to ensure sufficient velocity and pressure availability. The following items are noted about the expansion areas:

- The expansion area to the south of E. Yosemite Ave, east of CA-120, and north of CA-99 is largely hydraulically isolated from the existing system. A new highway crossing in the vicinity of Austin Rd and CA-99 is recommended to provide multiple points of connection to this area.
- The expansion area along E. Yosemite Ave east of Austin Rd creates a dead end in the system which inherently provides fire flow deficiencies in the system due to the industrial land use in the area requiring 5,000 gpm of fire flow. Multiple points of connection to the existing infrastructure are recommended in this area to loop the system and ensure sufficient fire flow.

All future transmission mains were assumed to be PVC pipe with a C-factor of 152.5 (see **Table 8-3**).

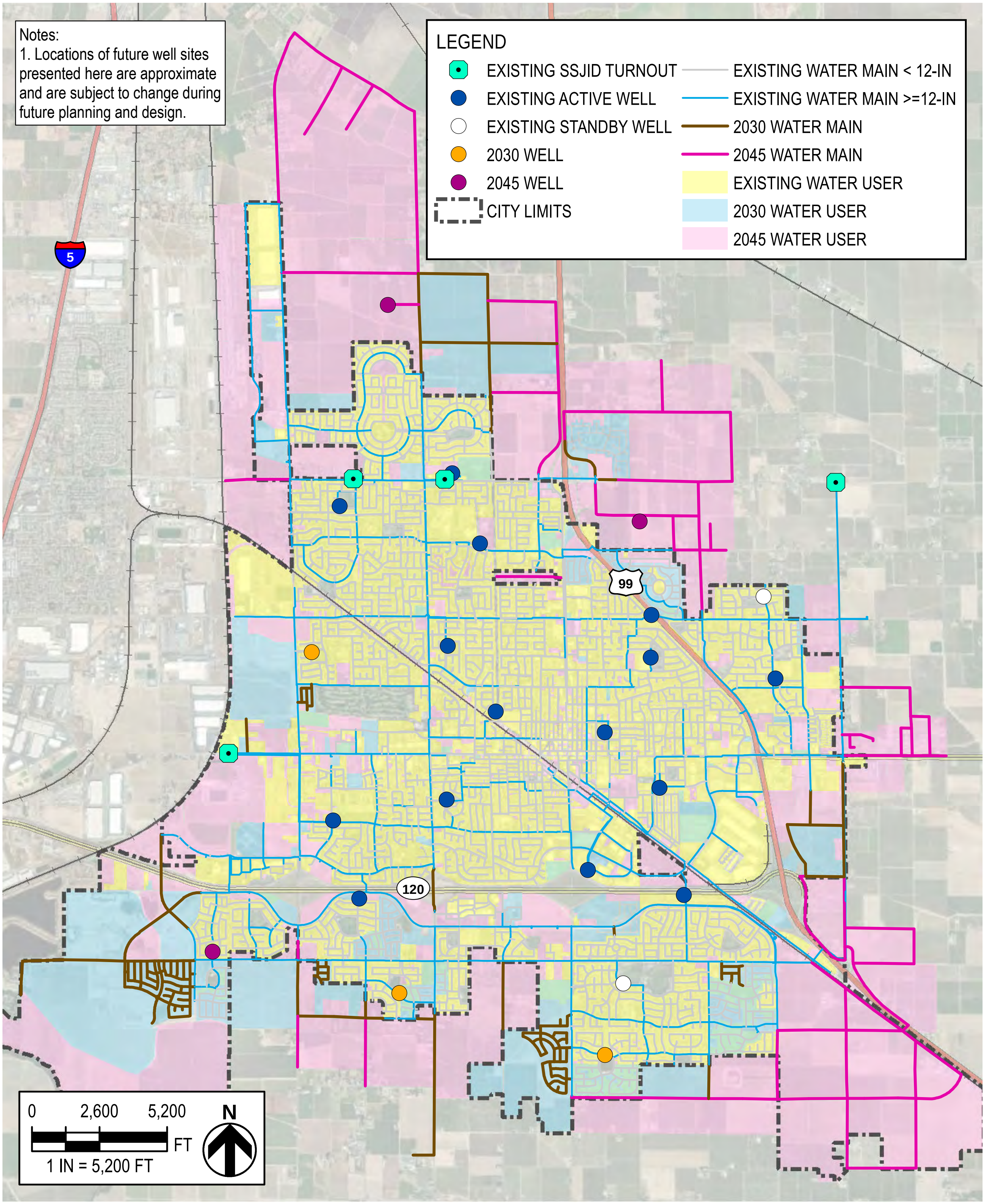


FIGURE 9-1
CITY OF MANTECA
WATER MASTER PLAN
MODEL INFRASTRUCTURE - FUTURE SCENARIOS

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Hydrants: Hydrants were added to the future infrastructure at each junction and at the midpoint of most pipelines to ensure that all land uses were captured in the expansion areas.

Customer Demands: Similar to the customer demand import process for the Existing scenario detailed in **Section 8.1**, GPA parcels for the 2030 and 2045 horizons were converted to points using GIS and imported as customer meters and the *Load Builder* tool was used to assign each customer meter to the nearest pipe. During the import process, the following attributes were imported into the model:

- APN/Unique Identifier (Label)
- Parcel Area (acres)
- GPA Land Use
- Consolidated Land Use Category
- Horizon (2030/2045)

9.2.2 Assigning Fire Flows

To model fire flow conditions, each hydrant must be assigned a land use and corresponding associated fire flow. This process was completed by linking each customer meter to the closest hydrant. Each hydrant was ultimately assigned the land use with the highest fire flow based on the customer meters that were linked to it.

This process was completed for the Existing, 2030, and 2045 scenarios chronologically to capture locations where fire flow requirements might change in the future due to new development. The hydrant Flex Table in the model contains the Existing, 2030, and 2045 land use for each hydrant.

9.3 Hydraulic Modeling Results

The entire service area was modeled and evaluated based on the velocity, pressure, and headloss performance criteria presented in **Table 9-1**. It is noted that the City's distribution system operation is highly variable – target flows and pressures are manually adjusted throughout the year based on observed system demands. The configuration and operation of supplies running in the hydraulic model is based on the configuration and operation which occurred during the monitoring period. The results for each flow condition under all four demand scenarios are discussed below and are included in **Appendix I**.

9.3.1 Maximum Day Demand (MDD)

Under MDD conditions, the distribution system can meet all performance criteria. **Table 9-3** presents the minimum and maximum pressures, and maximum velocities during MDD for each scenario.

Table 9-3: Results – MDD

	Existing	2030	2045
Minimum Pressure (psi)	43.2	43.2	42.8
Maximum Pressure (psi)	59.9	57.5	66.1
Maximum Velocity (ft/s)	5.3	5.2	5.2

System pressures for Existing, 2030, and 2045 under MDD conditions are presented in **Figure 9-2**, **Figure 9-3**, and **Figure 9-4**, respectively. A table of the MDD model outputs for all scenarios is in **Appendix I** including pipes, junctions, and hydrants.

9.3.2 Peak Hour Demand (PHD)

During PHD conditions, the system continues to meet all performance criteria under Existing and 2030 conditions. During 2045 conditions, multiple junctions in the eastern part of the service area were below the minimum pressure criteria of 40 psi. These low pressures could be improved with increased flows from the surface water turnouts. **Table 9-4** presents the minimum and maximum pressures, and maximum velocities during PHD for each scenario.

Table 9-4: Results – PHD

	Existing	2030	2045
Minimum Pressure (psi)	42.6	41.0	40.5
Maximum Pressure (psi)	57.4	53.7	57.7
Maximum Velocity (ft/s)	2.3	6.8	6.8

System pressures for Existing, 2030, and 2045 PHD conditions are presented in **Figure 9-5**, **Figure 9-6**, and **Figure 9-7**, respectively. A table of the PHD model outputs for all scenarios is included in **Appendix I**.

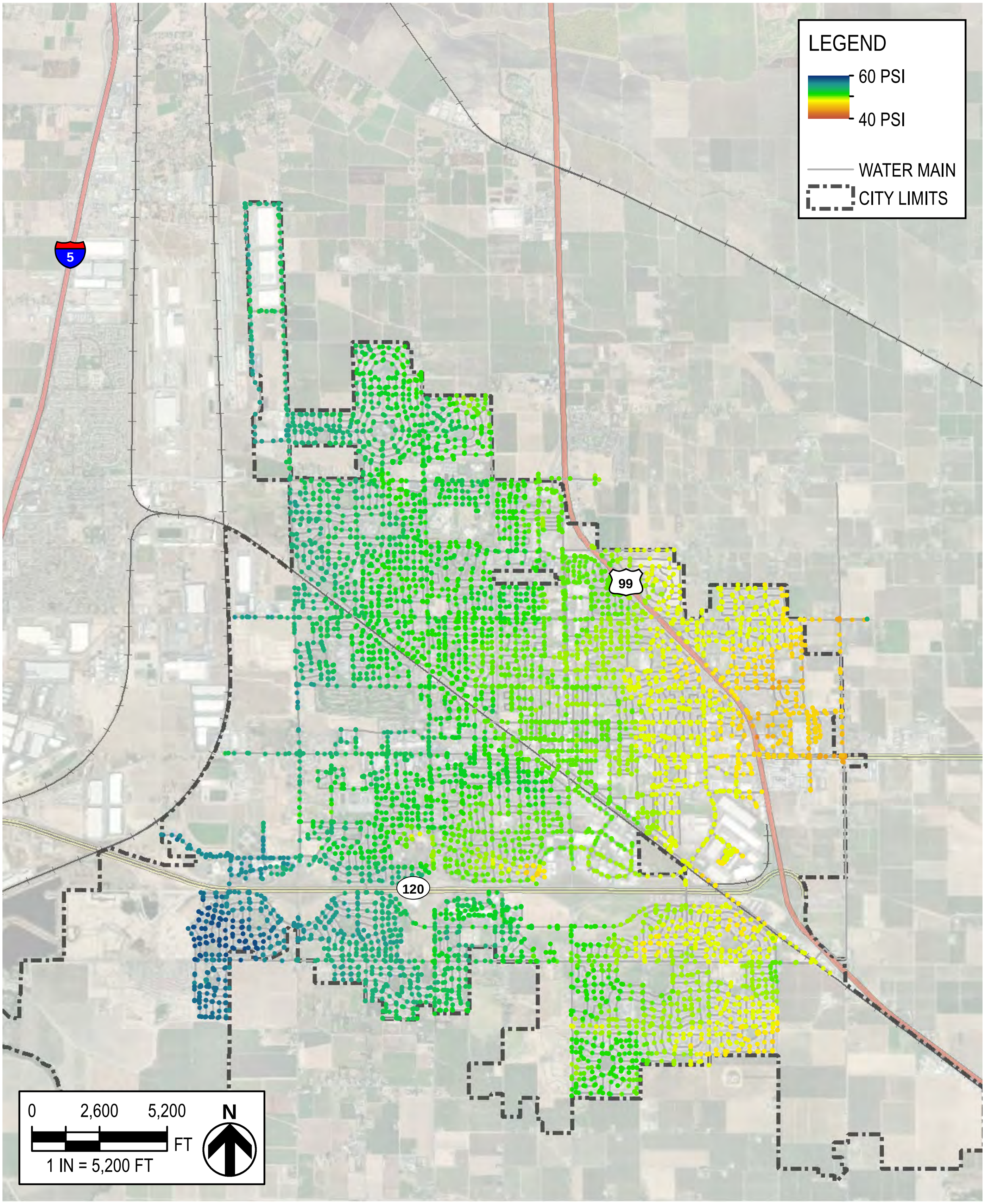

FIGURE 9-2
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - EXISTING MDD

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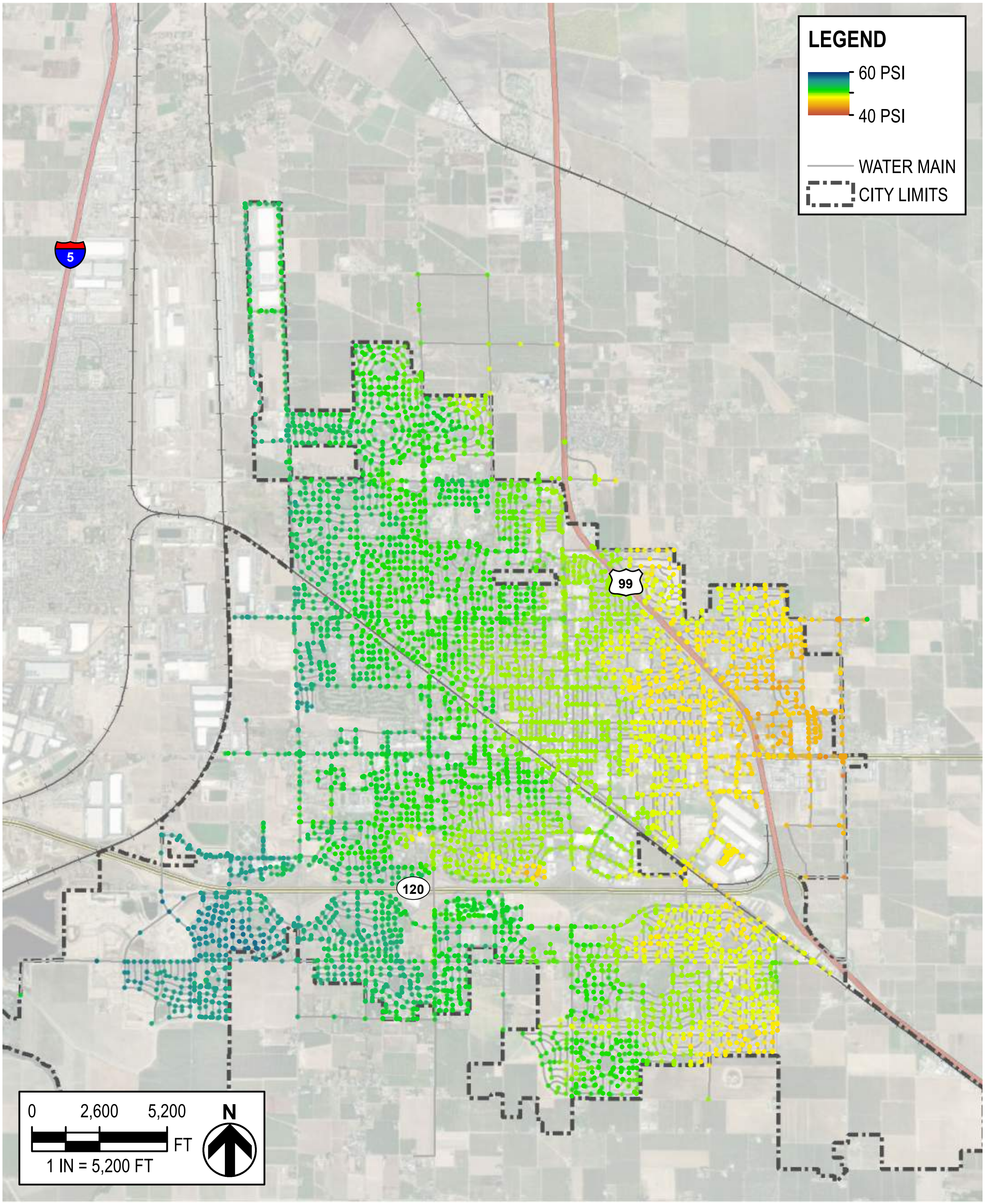

FIGURE 9-3
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - 2030 MDD

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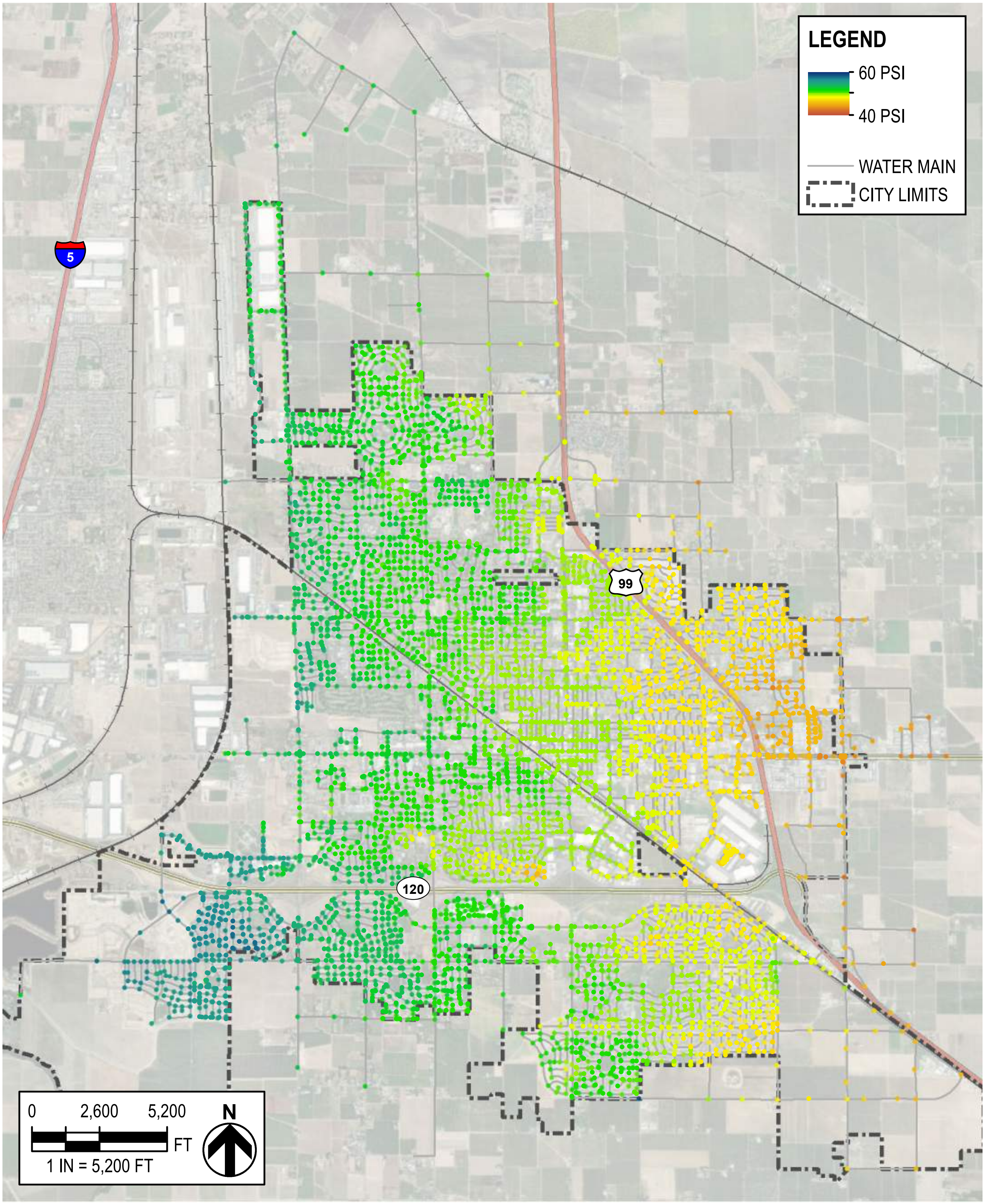

FIGURE 9-4
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - 2045 MDD

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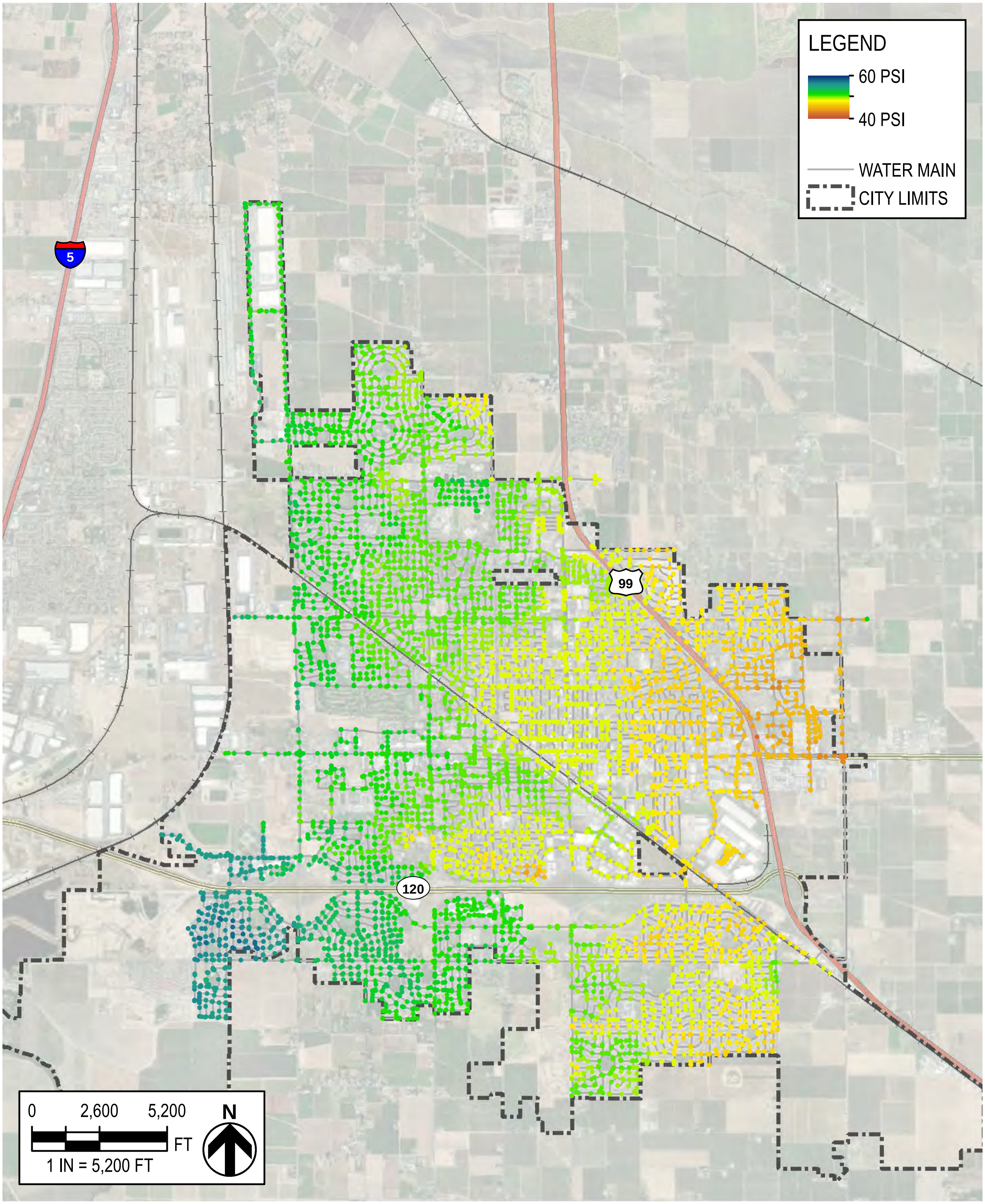

FIGURE 9-5
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - EXISTING PHD

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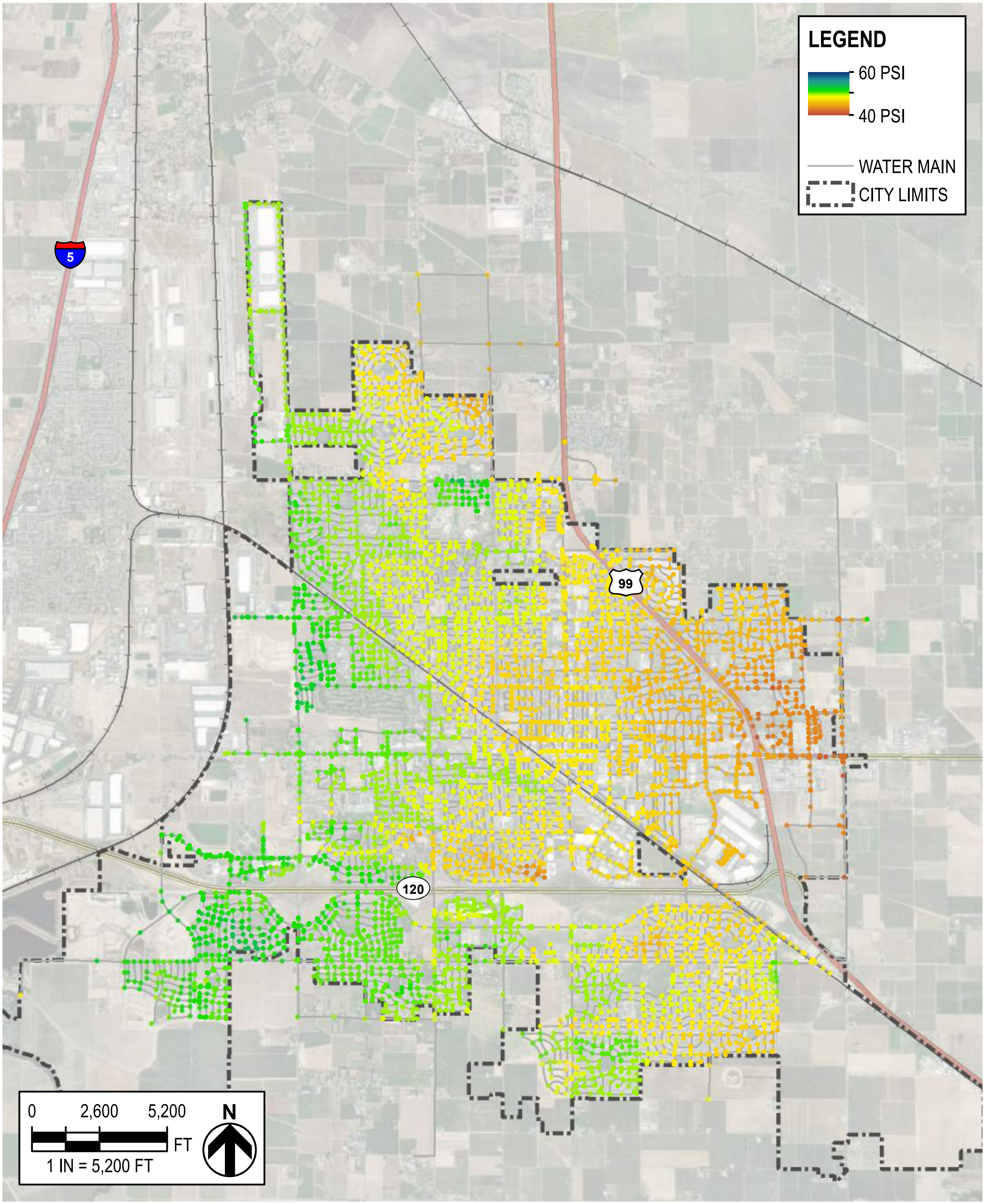

FIGURE 9-6
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - 2030 PHD

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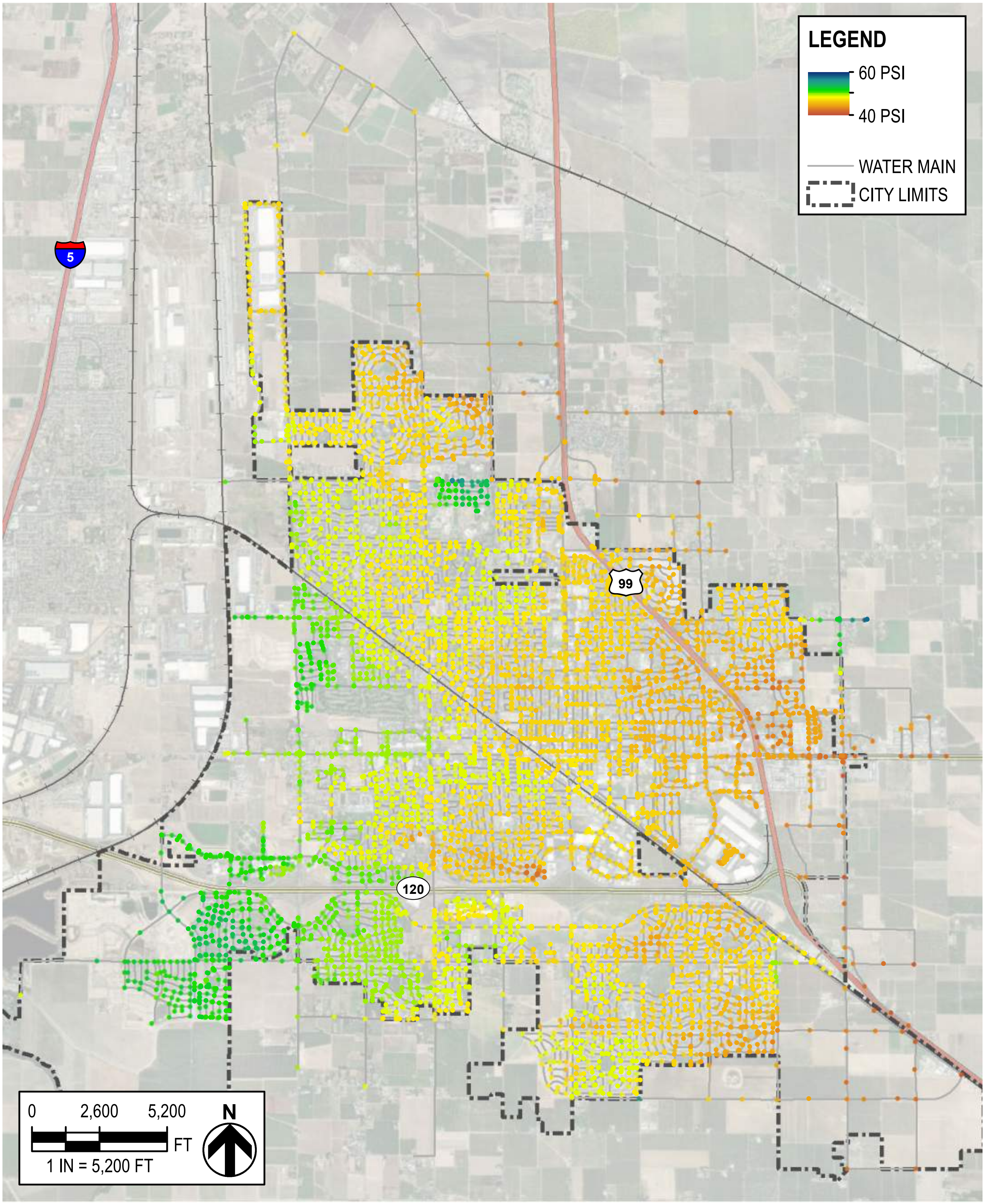

FIGURE 9-7
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - 2045 PHD

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9.3.3 Maximum Day Demand plus Fire Flow (MDD+FF)

MDD+FF deficiencies occur when a hydrant is unable to meet the fire flow requirements presented in **Table 9-2** while maintaining hydrant residual pressure above the minimum criteria of 20 psi and/or system pipeline velocity below the maximum criteria of 15 ft/s (see **Table 9-1**). Each hydrant deficiency was grouped into the following categories:

- **Within 5%:** If a hydrant flow causes residual pressure to drop below minimum criteria or a pipeline to exceed the maximum velocity criteria, the hydraulic model presents the amount of available fire flow at the criteria limits. If the available fire flow is within 5% of the needed fire flow, this was assumed to be within the acceptable margin of error, and these hydrants were not considered to cause a deficiency for this analysis.
- **Multiple Hydrants:** In many cases – particularly surrounding larger commercial or industrial properties which also require higher fire flow – there are two or more hydrants available to meet the required fire flow. These hydrants were not considered to cause a deficiency.
- **System Dead-End:** Deficiencies were triggered in cul-de-sacs or other areas where system dead-ends occur. These are often limited by velocity constraints in the pipelines leading to the dead-end. It is noted the maximum flow rate through a 6-in pipeline at 15 ft/s is 1,320 gpm; thus any greater flow through a 6-in pipeline will cause velocities to exceed the maximum criteria, which is common in multi-family residential cul-de-sacs where fire flow demand is 2,500 gpm. The maximum flowrate through an 8-in pipeline at 15 ft/s is 2,350 gpm, which is 6% less than the required fire flow for multi-family homes (2,500 gpm).

  This is not to say that fire flow is not available, but instead that velocities would be outside of the preferred criteria, which may lead to excessive wear and tear. It is also noted that actual flows at hydrants can vary based on pipe roughness and hydrant nozzles/features. While upsizing the pipelines will resolve the fire flow deficiencies, it can promote water quality issues caused by stagnant water, particularly in non-residential areas where water use may decrease on the weekends when businesses are closed.

  Some of these deficiencies were in areas of newer development and pipeline installation and it is feasible that these customers are equipped with fire sprinklers, reducing the required fire flow in accordance with the 2022 California Fire Code: Title 24, Part 9, Appendix B – Fire-Flow Requirements for Building. It is recommended that the City confirm fire flow requirements for these customers prior to implementing improvements.
- **Hydrant Relocation:** Several hydrants that caused deficiencies are located on small diameter pipes (6-in and 8-in) that are near/adjacent to larger diameter pipelines with a greater capacity. If the hydrant services were reconnected to the larger diameter pipes, these deficiencies would be resolved.
- **Insufficient Pressure/Flow:** The remaining deficiencies that were not addressed by any of the above categories were evaluated and projects were developed to address each of these deficiencies. The major cause for deficiencies is small diameter pipes (4-, 6-, and 8-in).

Each of these categories are identified for the MDD+FF condition on **Figure 9-8**, **Figure 9-9**, and **Figure 9-10** under Existing, 2030, and 2045 demand scenarios, respectively. A table of the MDD+FF hydrant model outputs for all scenarios is included in **Appendix I**.

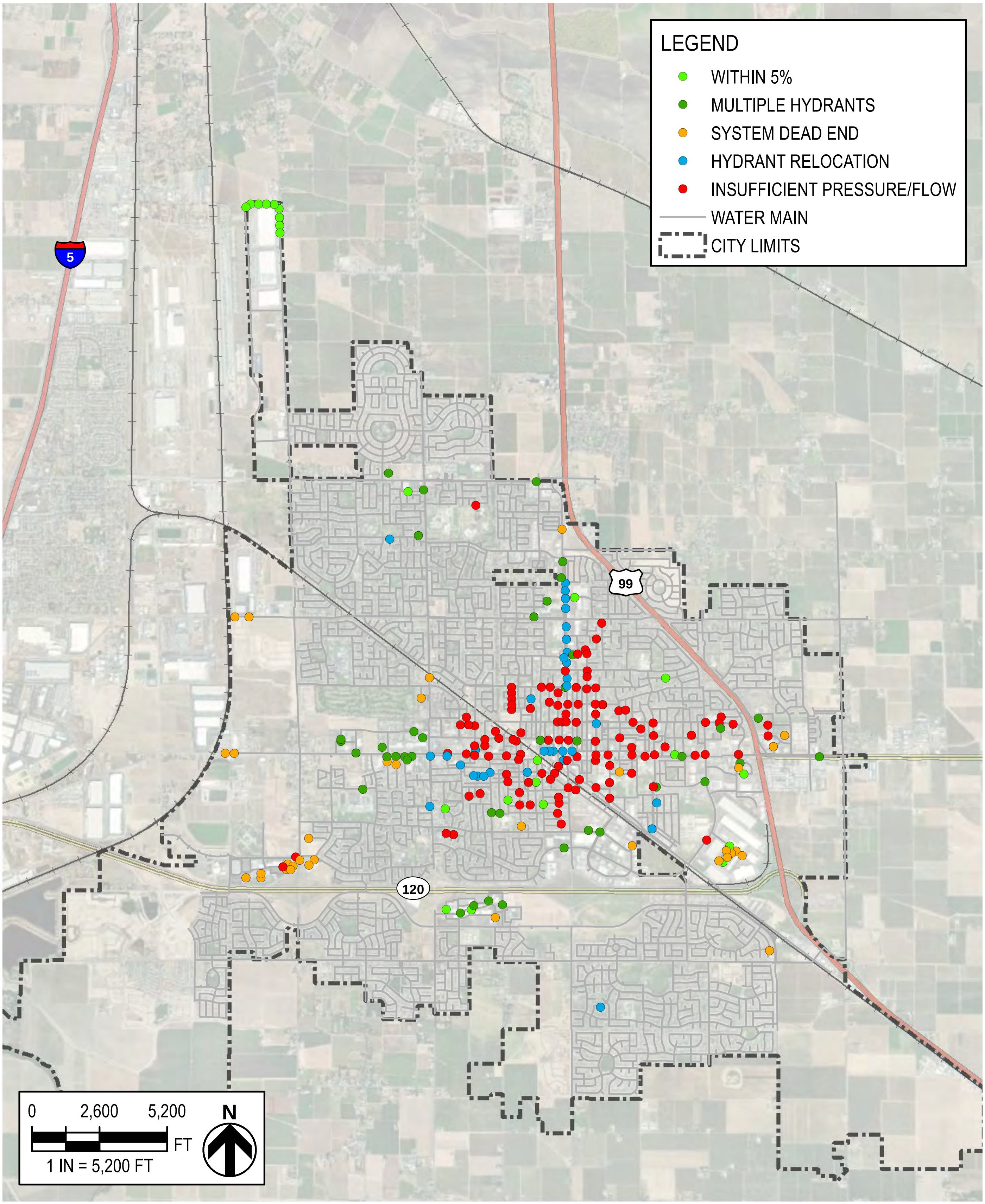

FIGURE 9-8
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - EXISTING MDD+FF

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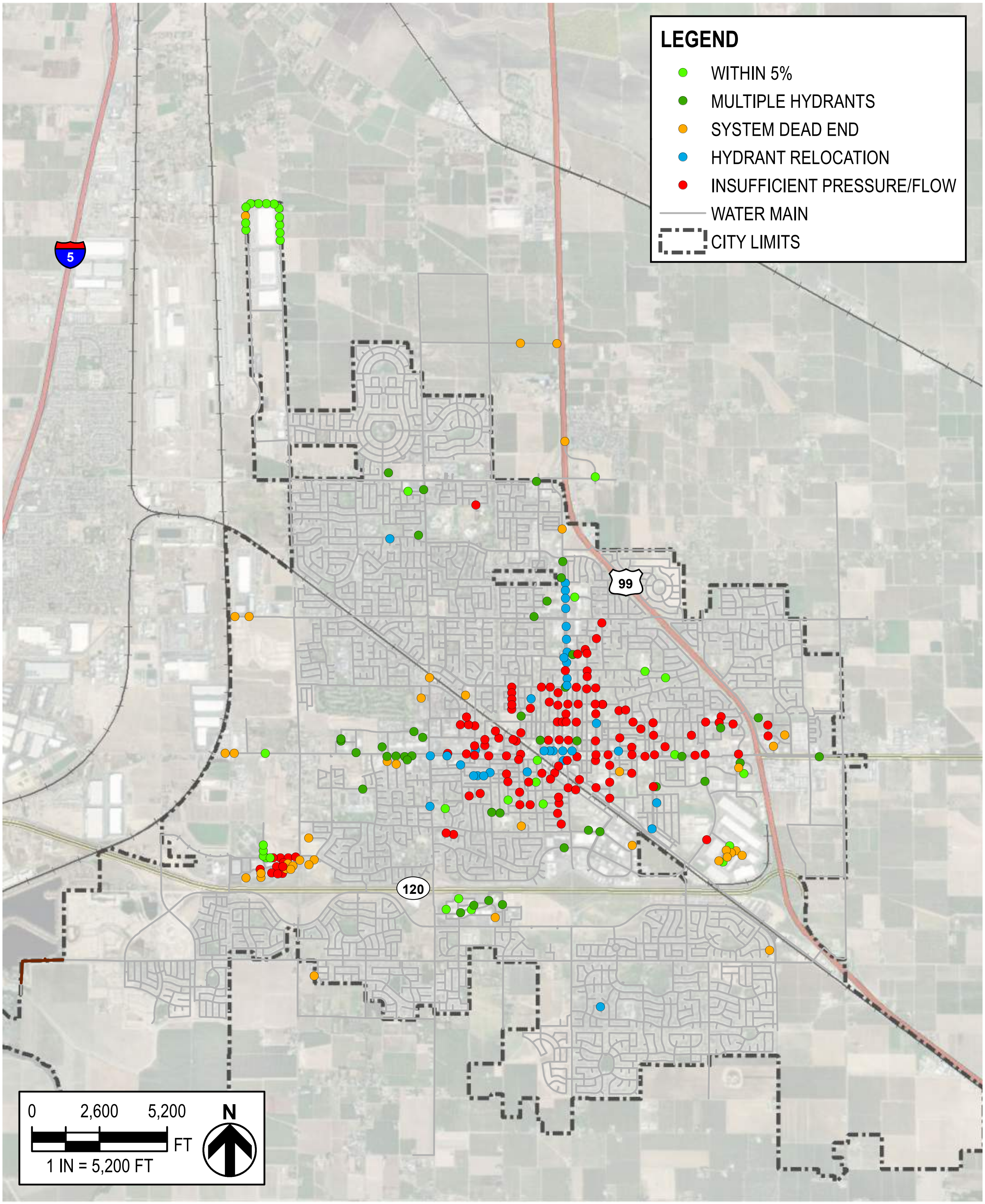

FIGURE 9-9
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - 2030 MDD+FF

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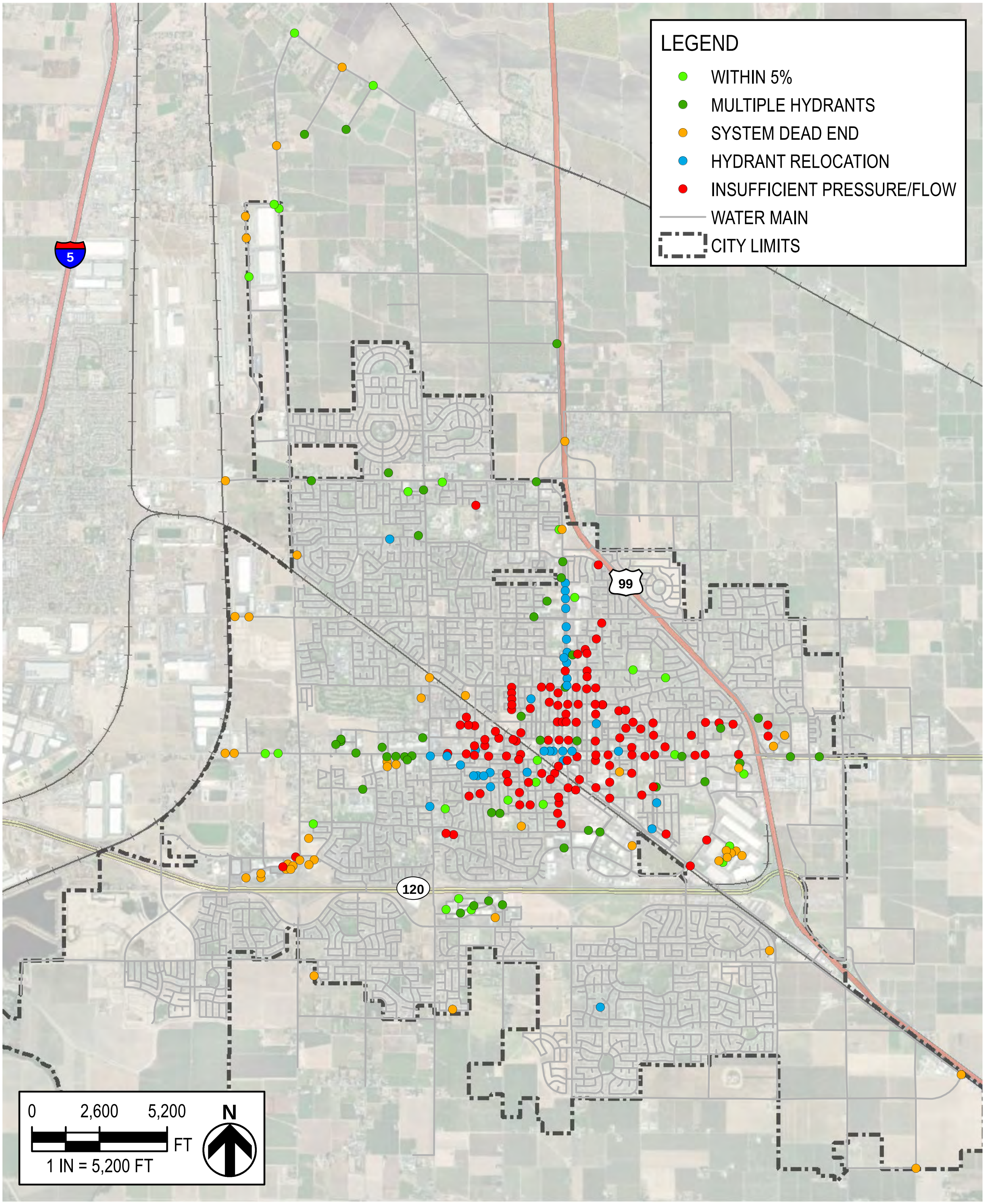

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FIGURE 9-10
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - 2045 MDD+FF

9.3.4 Peak Hour Demand plus Fire Flow (PHD+FF)

As an additional check, fire flow was also analyzed under PHD conditions (PHD+FF) in the 2045 scenario. Deficiencies triggered in the PHD+FF scenario are very similar to those identified in the MDD+FF scenario. Because fire flow is the major trigger of the deficiencies, the increase in demand at each hydrant caused by the peaking of MDD to PHD is largely negligible in comparison to the fire flow demand.

In the 2045 scenario, there are 34 hydrants that meet all criteria for sufficient fire flow under MDD+FF conditions but have insufficient fire flow under PHD+FF conditions. These additional deficiencies are detailed as follows:

- Nineteen of these hydrants fall into the “Within 5%” category described above and are thus not classified as deficiencies for this analysis.
- One hydrant is 6% deficient and falls into the “Multiple Hydrants” category described above and thus is not classified as deficient for this analysis.
- Three are located in the parking lot of the shopping center just south of Big League Dreams. These are addressed by recommended CIP Project #41.
- Four are located in the industrial area in the northwestern corner of the existing City limits, bordered by Airport Way to the east, E Roth Rd to the north, and Intermodal Way to the west. Multiple hydrants on this loop were also deficient in the MDD+FF scenario and were categorized at system dead-ends due to the nature of this loop. It is recommended that this loop be analyzed wholistically as the area is developed to determine if upgrades are necessary. There may be fire flow exceptions for buildings in this area if they are equipped with fire sprinklers. Also, it is important to balance the need for sufficient fire flow and sufficient turnover to prevent water quality issues; this loop services mostly industrial land uses which typically do not use water consistently every day of the week.
- The remaining seven are located within the new skeletonized infrastructure in the expansion area north of the existing City limits. These do not have an effect on the existing infrastructure and it is assumed that the expanded infrastructure will be designed to adequately handle demands in these areas during development and expansion of the distribution system network.

Figure 9-11 presents the PHD+FF results for the 2045 scenario. To underscore the difference between MDD+FF and PHD+FF results, this figure only displays the additional deficiencies triggered by PHD+FF. A table of the PHD+FF hydrant model outputs for 2045 is included in **Appendix I**.

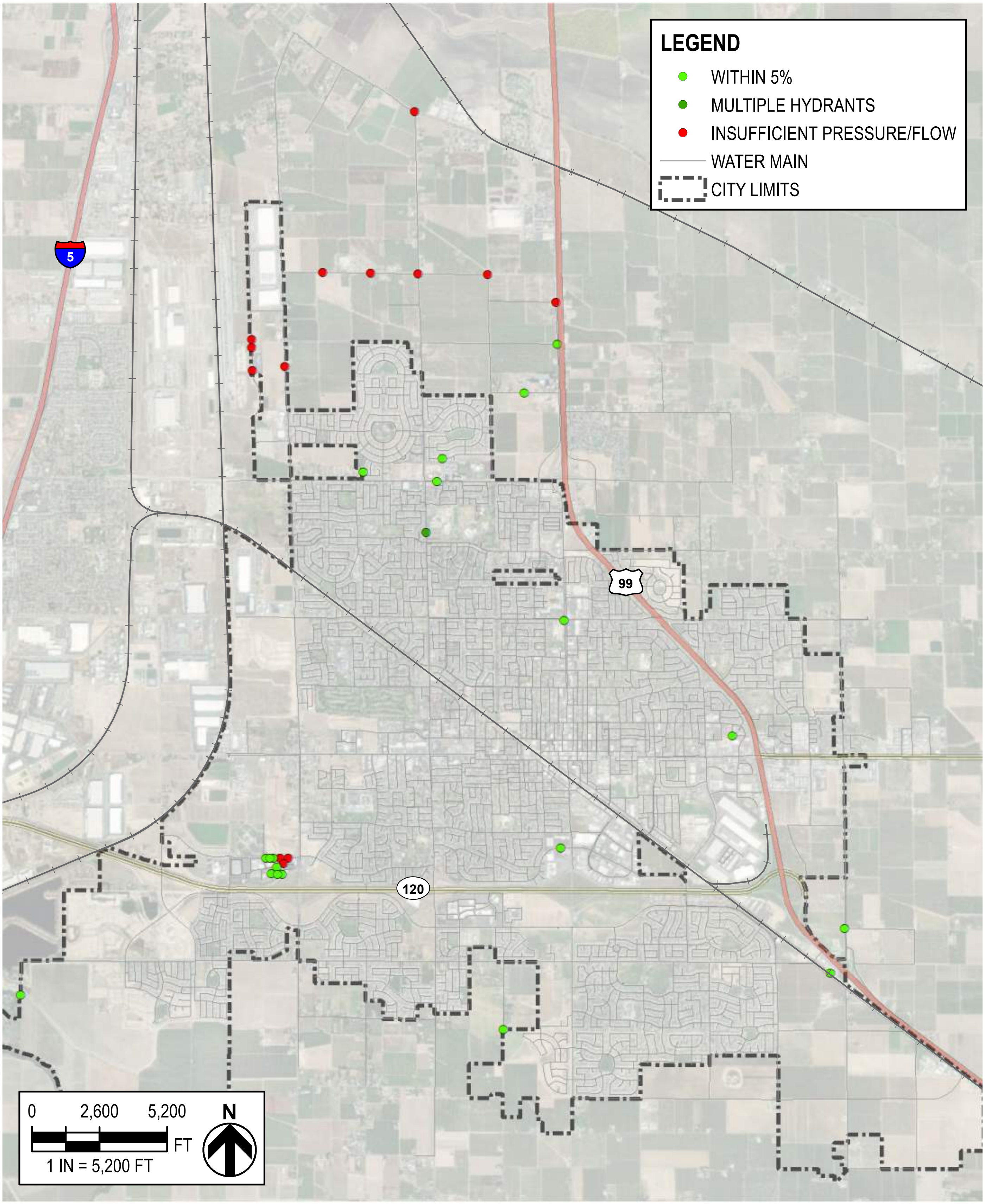

FIGURE 9-11
CITY OF MANTECA
WATER MASTER PLAN
RESULTS - 2045 PHD+FF

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SECTION 10 – CAPITAL IMPROVEMENT PLAN (CIP)

As detailed in **Section 9.3**, all scenarios were evaluated for deficiencies based on the performance criteria presented in **Section 9.1**; most deficiencies are triggered during the MDD+FF scenarios and thus this is the focus of the CIP project development. When evaluating these deficiencies, the approach is to review both the existing and future scenarios in parallel to identify improvements needed to meet long-term needs while also considering the timing and urgency of those improvements if the deficiency is triggered by a change in the way water is used. Each deficiency was evaluated and recommended improvements were developed to address each one.

This section presents the projects proposed to continue to ensure the reliable and safe delivery of water to the City's customers and the estimated costs and schedule for implementation of the CIP. Projects are designed to improve water quality, provide redundancy where there is none, and/or meet the performance criteria. In general, the purpose of a water system CIP is to:

- Maintain and enhance water infrastructure to continue to maintain a high level of service to the community;
- Prioritize and address preventive maintenance, infrastructure replacement at the end of useful life or at risk of failure, regulatory requirements, and safety; and,
- Develop and implement projects to ensure continued and reliable delivery of safe and high-quality drinking water to all customers.

Provided in the following sections is a brief description of the recommended CIP projects and their associated planning-level cost estimates. Detailed cost estimates for each recommended project are included in **Appendix J**.

10.1 Cost Basis

The purpose of approximating the cost of construction is to appropriate a conservative level of funding for each project. This section describes the basis for development of the unit costs and other associated costs and presents a summary of the total costs for each project.

10.1.1 Pipeline Construction Unit Costs

Unit costs for pipelines, mechanical equipment, and appurtenances were estimated based on recent project bid tabulation for similar Capital Improvement Projects and experience estimating the cost of similar local projects. Pipeline installation projects are estimated using a loaded construction cost estimate per foot of pipeline installed.

Table 10-1 provides a summary of the parameters used for estimating construction costs for conceptual planning and cost comparisons of pipeline projects.

Table 10-1: Construction Unit Cost Estimating Parameters

Cost Parameter	Unit Cost	Applied to:
Mobilization/Demobilization	7%	Construction Subtotal
8-in PVC Pipe Replacement	$270 per foot	Pipeline Length
10-in PVC Pipe Replacement	$305 per foot	Pipeline Length
12-in PVC Pipe Replacement	$340 per foot	Pipeline Length
8-in PVC New Pipe	$250 per foot	Pipeline Length
10-in PVC New Pipe	$285 per foot	Pipeline Length
12-in PVC New Pipe	$320 per foot	Pipeline Length
8-in Gate Valve[1]	$5,000 ea	Each
10-in Gate Valve[1]	$6,500 ea	Each
12-in Gate Valve[1]	$8,000 ea	Each
Bore and Jack Trenchless (12-inch pipe+carrier)	$1,000 per foot	Pipeline Length
Excavation Pits	$60,000 ea	Each
Move Services	$9,000 per service	Each
New Hydrant/Hydrant Service Relocation	$17,000 per hydrant	Each
Abandon Pipe[2]	$8 per foot	Pipeline Length
Reconnect Services and Abandon Pipe	$32 per foot	Pipeline Length
Service Connections & Meter Box	$24 per service	Each
Water Main Tie-In	$10,000 per tie-in	Each
Piping Appurtenances	10%	Pipeline Cost
Street Overlay[3]	$15 per sf	Pipeline Length
Traffic Control During Construction[4]	2% - 8%	Cost of Construction Subtotal

Notes:
1. Assumed one valve per 500 ft of pipeline.
2. For planning level cost estimating purposes, it is assumed that abandoned pipes are abandoned in place. During preliminary design, it should be determined whether pipelines will be abandoned in place or removed and disposed.
3. Street overlay assumes a 3 ft trench width and 9-in depth.
4. Traffic control is generally higher for projects on major streets and increases by length of project.

10.1.2 Pipeline Construction Soft Costs

Soft costs are additional project costs that are not considered to be contractor construction costs. These costs include engineering design, permitting, construction administration, and construction management. Typical soft costs include:

- **Engineering Design and Permitting:** These costs are expected to also address California Environmental Quality Act (CEQA) requirements to identify significant environmental impacts including handling of ACP, if any;
- **Administrative and Construction Management:** These costs are associated with the administration of the contract, Engineering Services during Construction (ESDC), and management and inspection for project construction; and,

- **Contingency:** The construction and market contingency provides an allotment of funds designated for unexpected issues, including site specific and economic issues, that can change the scope of the project.

Table 10-2 provides a summary of the soft costs which were globally applied to all pipeline projects.

Table 10-2: Soft Cost Estimating Parameters

Cost Parameter	Cost	Applied to:
Engineering Design, Consulting, and Environmental Permitting Services	17.5%	Construction Subtotal
Engineering Services during Construction (ESDC), Construction Management, and Inspection Services	20%	Construction Subtotal
Construction Cost and Market Contingency	30%	Construction Subtotal

10.1.3 Groundwater Well Construction Costs

Costs for drilling and equipping of a new groundwater well, including basic arsenic removal, as well as the design and construction of wellhead TCP treatment are provided based on the recent construction of Well 29. For planning level cost estimating purposes, it is assumed that all new wells in the City will require some level of wellhead treatment based on the history of water quality issues in the City's groundwater.

Table 10-3 provides a summary of the estimated costs for the design and construction of a new groundwater well and associated wellhead treatment. These costs include all associated soft costs and contingencies and are based on the assumption that future wells will have a similar capacity to the City's existing wells (i.e., up to 2,000 gpm). The cost basis details are provided in **Appendix J**.

Table 10-3: Groundwater Well Construction Cost Estimating Parameters

Cost Parameter	Cost
Well Drilling, Equipping, and Wellhead Arsenic Treatment	$6.7M
Wellhead TCP Treatment	$5.3M

10.2 CIP Project Development Considerations and Methodology

Pipeline Projects: Using the hydraulic model, pipeline improvements projects were developed to address each of the hydraulic deficiencies identified in **Section 9.3**. Projects were then grouped based on proximity, severity, and project type; pipelines requiring improvements in the same area or on the same street were grouped for efficiency of design and construction. Once hydraulic deficiencies were addressed, pipelines prioritized for replacement based on condition (see **Figure 7-1**) in the vicinity of hydraulic deficiency projects were also incorporated to take advantage of economies of scale to address both issues together.

For velocity deficiencies, pipelines are recommended for upsize to accommodate the required fire flow. Per industry standards for a distribution system of this size, a minimum diameter of 8-in is recommended, and where necessary to meet higher fire flow demands, larger diameters are recommended as dictated by the hydraulic model and estimated flow requirements.

When the City was first incorporated, many small diameter water distribution pipelines were installed in alleyways and residential back yards with limited access for maintenance. As improvements have been made to the system, there has been little urgency to transfer the services from these older and smaller pipelines to the new pipelines. Maintaining operation of these smaller pipelines was initially not a significant expense; however, as the pipes approach the end of their useful life, the repair costs will exceed the expense of a systematic planned maintenance approach to replace the pipes. **Figure 10-1** presents a map of all the pipelines in the City that are not located within the City right-of-way (ROW).

Where there were deficiencies, pipelines outside the City ROW were not recommended for improvement; these were generally recommended for abandonment. In some cases, abandonment can be achieved by reconnecting all the relevant services to existing adjacent City pipelines; in other cases, construction of a new pipeline is required within the City ROW adjacent to these pipelines to be able to reconnect the services and abandon these pipelines, wherever possible.

Where these pipelines outside the ROW were not triggering any hydraulic deficiencies and the pipes did not have high priority ratings, no projects are recommended at this time. However, as funding is available, it is recommended that the City continue to install pipelines within the ROW in order to abandon these pipelines over time.

Groundwater Well Projects: For planning level cost estimating purposes, Alternative 1 (see **Section 5.1.1**) of the Storage/Groundwater Supply Analysis is assumed, i.e. peak hour demands will be met with turnout capacity and groundwater pumping capacity without the use of any additional storage. The timing of City development and expansion will dictate the need for construction of new groundwater wells; the budgeting of well construction herein is based on the timing of the growth projections presented in **Table 4-12**. Well 30 is not included in the CIP cost estimates because the construction of this well is already in progress and it is assumed that the budget is already accounted for.

Surface Water Projects: In addition to new groundwater wells, the City will also need to make infrastructure updates to expand the system's capacity to accept water from the existing SSJID turnouts. As Phase II of the SCWSP is implemented, it will also likely be necessary for the City to construct at least one new turnout with associated appurtenances and pipeline requirements. Alternatively, the installation of a storage tank at the M1 turnout would increase the City's capacity to receive surface water by mitigating pressure concerns within the SSJID pipeline.

For budgeting purposes, $5M is allocated in the recommended CIP for expansion of existing turnout capacity, construction of a new SSJID turnout, and/or construction of a new City storage tank at the existing M1 turnout. Timing of implementation is such that the City will be able to take their current and future allotment as necessary to meet anticipated demand.

Other Projects: In addition to the projects developed solely for the potable water distribution system, $10M is budgeted for the Water Fund for its share of the new Utilities Building to be built at the WQCF.

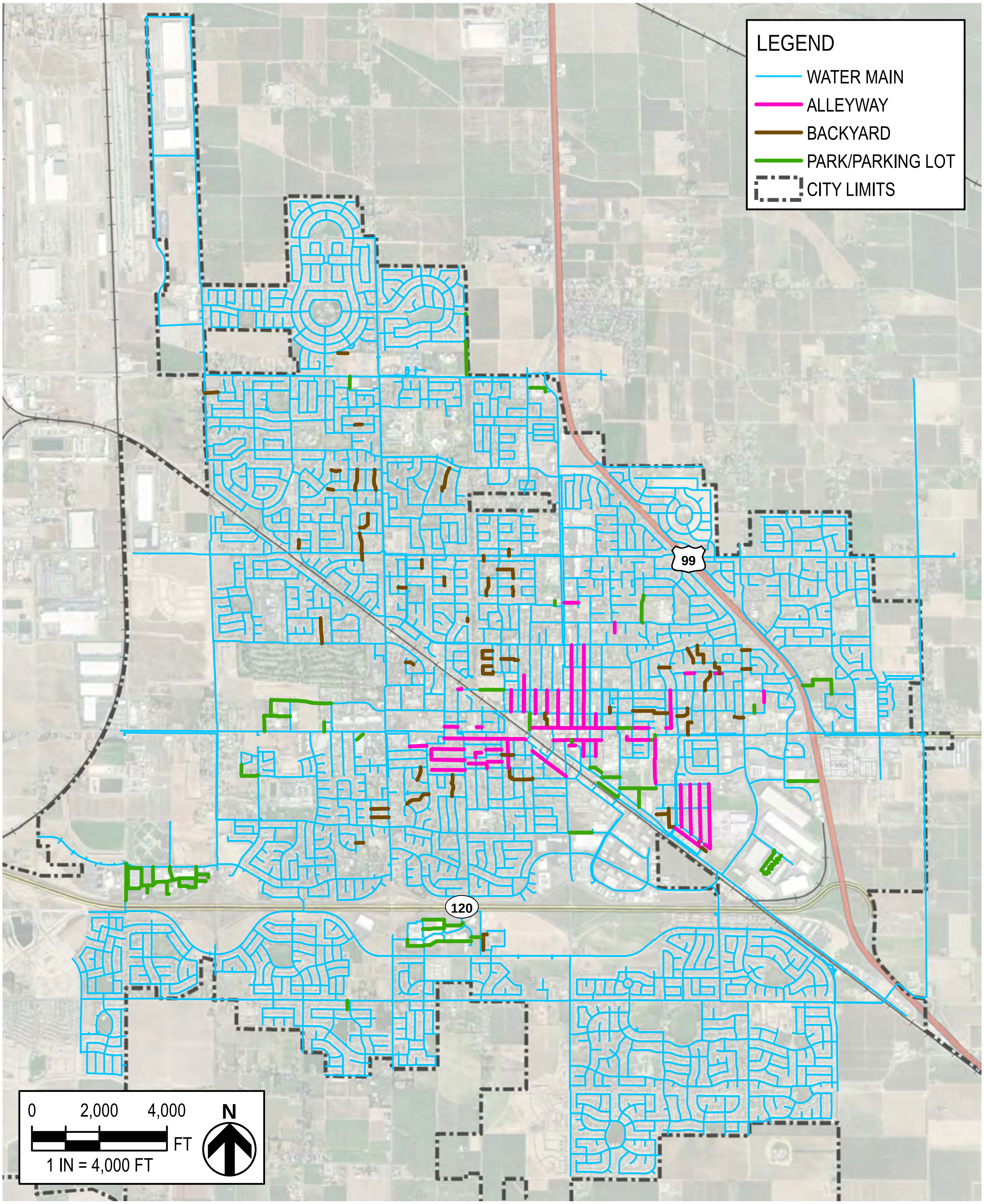

FIGURE **10-1**
CITY OF MANTECA
WATER MASTER PLAN
PIPES OUTSIDE CITY RIGHT-OF-WAY

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10.3 Proposed CIP Pipeline Projects

This section presents the water distribution system CIP projects proposed to address the City's infrastructure improvement needs within the next 20-year period. The proposed CIP includes all projects developed to address the identified deficiencies in the system along with projects to improve system reliability.

Each project includes some or all of the following components:

- Pipe replacement;
- Pipe replacement with upsize;
- New pipe construction;
- Pipe abandonment and reconnection of all accompanying services; and
- Hydrant relocation.

Once the projects were developed, they were placed in order of relative priority. Each was identified as addressing:

1. Hydraulic deficiencies (see Section 9.3); and/or
2. High priority pipe replacement based on overall prioritization scores (see **Section 7.2**).

The project schedule was determined by the severity of the hydraulic deficiencies within each project where % deficiency (i.e. available fire flow ÷ required fire flow) was prioritized followed by the pipeline replacement priority (**Figure 7-1**). Once placed in order of relative priority, the projects were further divided into phases for budgeting purposes. This section presents the four phases of recommended CIP pipeline projects. Phases 1 and 2 are focused in the downtown area, in the oldest part of the City, while Phases 3 and 4 extend beyond the downtown core.

It is noted that all of the projects in Phases 1 and 2 are high priority and should be addressed in any order where the City can complete the projects effectively, i.e., if there are other surface or subsurface improvement projects slated for construction in the area of any of the projects presented herein, of any phase, it is recommended that they be combined to take advantage of economies of scale.

Detailed cost estimates and figures for each project are provided in **Appendix J**.

10.3.1 Phase 1

The following projects are budgeted for implementation in the next five years. A summary of the costs for each phase is provided in **Table 10-4** and detailed cost estimates and figures for each project are provided in **Appendix J**.

Table 10-4: CIP Phase 1 Estimate of Costs (2025-2029)

Project #	Action	Diameter (in)	Quantity	Unit	Total Cost
1	Pipe Replacement w/ Upsize	8	2,292	ft	$2,432,000
	New Pipe Construction	8	1,150	ft	
	Reconnect Services & Abandon	-	1,920	ft	
	Hydrant Relocation	-	2	ea	
	New Hydrant	-	1	ea	
2	Pipe Replacement w/ Upsize	8	546	ft	$1,611,000
	Pipe Replacement w/ Upsize	10	1,120	ft	
	New Pipe Construction	8	388	ft	
	Reconnect Services & Abandon	-	1,545	ft	
	Hydrant Relocation	-	1	ea	
	New Hydrant	-	2	ea	
3	Pipe Replacement w/ Upsize	8	1,866	ft	$1,597,000
	Pipe Replacement w/ Upsize	12	8	ft	
	New Pipe Construction	8	388	ft	
	Reconnect Services & Abandon	-	973	ft	
	Hydrant Relocation	-	1	ea	
	New Hydrant	-	1	ea	
4	Pipe Replacement	8	25	ft	$1,820,000
	Pipe Replacement w/ Upsize	8	2,064	ft	
	New Pipe Construction	8	513	ft	
	Reconnect Services & Abandon	-	1,588	ft	
	New Hydrant	-	1	ea	
5	Pipe Replacement w/ Upsize	8	4,011	ft	$3,282,000
	Pipe Replacement w/ Upsize	12	832	ft	
6	Pipe Replacement w/ Upsize	8	605	ft	$1,004,000
	New Pipe Construction	8	561	ft	
	Reconnect Services & Abandon	-	2,877	ft	
	Abandon	-	688	ft	
	Hydrant Relocation	-	1	ea	
7	Pipe Replacement w/ Upsize	8	614	ft	$712,000
	New Pipe Construction	8	452	ft	
	Reconnect Services & Abandon	-	491	ft	
8	Pipe Replacement w/ Upsize	8	1,839	ft	$1,200,000
9	Pipe Replacement w/ Upsize	8	2,033	ft	$1,323,000
			Total		**$14,981,000**

10.3.2 Phase 2

These improvements are budgeted for implementation in the 6- to 10-year timeframe. A summary of the costs for this phase of the CIP is provided in **Table 10-5** and detailed cost estimates and figures for each project are provided in **Appendix J**.

Table 10-5: CIP Phase 2 Estimate of Costs (2030-2034)

Project #	Action	Diameter (in)	Quantity	Unit	Total Cost
10	New Pipe Construction	8	1,975	ft	$3,100,000
	New Pipe Construction	12	1,571	ft	
	Reconnect Services & Abandon	-	5,199	ft	
	Hydrant Relocation	-	6	ea	
	New Hydrant	-	4	ea	
11	Pipe Replacement w/ Upsize	8	268	ft	$1,558,000
	Pipe Replacement w/ Upsize	12	1,145	ft	
	New Pipe Construction	8	61	ft	
	Reconnect Services & Abandon	-	1,151	ft	
	Hydrant Relocation	-	11	ea	
12	Pipe Replacement w/ Upsize	12	1,485	ft	$3,966,000
	New Pipe Construction	12	2,630	ft	
	Abandon	-	568	ft	
	Bore and Jack Trenchless	-	250	ft	
	Excavation Pits	-	2	ea	
	Hydrant Relocation	-	3	ea	
13	Pipe Replacement w/ Upsize	8	184	ft	$1,899,000
	Pipe Replacement w/ Upsize	12	1,771	ft	
	New Pipe Construction	8	160	ft	
	Reconnect Services & Abandon	-	2,944	ft	
	Hydrant Relocation	-	1	ea	
14	Pipe Replacement w/ Upsize	8	2,614	ft	$1,791,000
	New Hydrant	-	3	ea	
15	Pipe Replacement w/ Upsize	8	495	ft	$1,098,000
	New Pipe Construction	8	1,260	ft	
16	Pipe Replacement w/ Upsize	8	1,179	ft	$937,000
	Pipe Replacement w/ Upsize	10	104	ft	
	Reconnect Services & Abandon	-	506	ft	
	Hydrant Relocation	-	2	ea	
17	Pipe Replacement	8	54	ft	$897,000
	Pipe Replacement w/ Upsize	8	962	ft	
	Pipe Replacement w/ Upsize	10	24	ft	
	New Pipe Construction	8	301	ft	
	New Hydrant	-	1	ea	
18	Pipe Replacement w/ Upsize	8	1,843	ft	$4,957,000
	New Pipe Construction	8	4,780	ft	
	Reconnect Services & Abandon	-	8,249	ft	
	Hydrant Relocation	-	7	ea	
			Total		**$20,203,000**

10.3.3 Phase 3

These improvements are budgeted for implementation in the 11- to 15-year timeframe. A summary of the costs for this phase of the CIP is provided in **Table 10-6** and detailed cost estimates and figures for each project are provided in **Appendix J**.

Table 10-6: CIP Phase 3 Estimate of Costs (2035-2039)

Project #	Action	Diameter (in)	Quantity	Unit	Total Cost
19	Pipe Replacement w/ Upsize	8	1,799	ft	$1,854,000
	New Pipe Construction	8	691	ft	
	Reconnect Services & Abandon	-	2,671	ft	
	New Hydrant	-	2	ea	
20	Pipe Replacement w/ Upsize	8	1,412	ft	$1,195,000
	Pipe Replacement w/ Upsize	10	373	ft	
21	Pipe Replacement w/ Upsize	8	248	ft	$442,000
	New Pipe Construction	8	420	ft	
	Reconnect Services & Abandon	-	346	ft	
22	Pipe Replacement w/ Upsize	8	3,405	ft	$2,220,000
23	New Pipe Construction	8	2,665	ft	$2,067,000
	Reconnect Services & Abandon	-	4,211	ft	
	Hydrant Relocation	-	4	ea	
24	Pipe Replacement w/ Upsize	8	4,979	ft	$3,361,000
	New Hydrant	-	4	ea	
25	Pipe Replacement w/ Upsize	8	668	ft	$504,000
	New Pipe Construction	8	10	ft	
	Reconnect Services & Abandon	-	467	ft	
	Hydrant Relocation	-	1	ea	
26	Pipe Replacement w/ Upsize	8	1,444	ft	$1,193,000
	Pipe Replacement w/ Upsize	10	341	ft	
27	Pipe Replacement w/ Upsize	10	795	ft	$645,000
	Reconnect Services & Abandon	-	818	ft	
28	Pipe Replacement w/ Upsize	8	1,254	ft	$821,000
29	Pipe Replacement w/ Upsize	8	1,220	ft	$970,000
	New Pipe Construction	8	252	ft	
	Reconnect Services & Abandon	-	268	ft	
30	Pipe Replacement w/ Upsize	8	1,780	ft	$1,195,000
	Hydrant Relocation	-	1	ea	
			Total		**$16,467,000**

10.3.4 Phase 4

These improvements are budgeted for implementation in the 15- to 20-year timeframe. A summary of the costs for this phase of the CIP is provided in **Table 10-7** and detailed cost estimates and figures for each project are provided in **Appendix J**.

Table 10-7: CIP Phase 4 Estimate of Costs (2040-2044)

Project #	Action	Diameter (in)	Quantity	Unit	Total Cost
31	Pipe Replacement w/ Upsize	8	3,318	ft	$2,188,000
	Pipe Replacement w/ Upsize	10	35	ft	
32	Pipe Replacement w/ Upsize	8	3,570	ft	$2,358,000
	Reconnect Services & Abandon	-	484	ft	
33	Pipe Replacement w/ Upsize	8	1,019	ft	$1,117,000
	Pipe Replacement w/ Upsize	12	328	ft	
	New Pipe Construction	12	192	ft	
	Reconnect Services & Abandon	-	189	ft	
	New Hydrant	-	1	ea	
34	Pipe Replacement w/ Upsize	8	1,021	ft	$664,000
35	Pipe Replacement w/ Upsize	8	216	ft	$137,000
36	Pipe Replacement w/ Upsize	8	2,002	ft	$1,312,000
	Pipe Replacement w/ Upsize	12	10	ea	
37	Pipe Replacement w/ Upsize	8	1,195	ft	$916,000
	New Pipe Construction	8	198	ft	
	Abandon	-	467	ft	
38	Pipe Replacement w/ Upsize	12	3,986	ft	$3,191,000
39	Pipe Replacement w/ Upsize	8	809	ft	$530,000
40	Pipe Replacement w/ Upsize	8	342	ft	$227,000
41	Pipe Replacement w/ Upsize	12	427	ft	$345,000
42	Pipe Replacement w/ Upsize	8	1,339	ft	$2,915,000
	New Pipe Construction	8	2,077	ft	
	Reconnect Services & Abandon	-	5,402	ea	
	New Hydrant	-	12	ea	
43	Hydrant Relocation	-	5	ea	$157,000
			Total		**$16,057,000**

10.3.5 New Development Transmission Mains 2030 and 2045

As new developments are implemented throughout the City and beyond the current City boundaries, transmission mains will be extended to serve those new developments. The City requested inclusion of a skeletonized transmission network to extend potable water service to potential new developments throughout the buildout of the General Plan. The proposed pipelines are shown in **Figure 10-2** and summarized in **Table 10-8**. **Figure 10-2** distinguishes between the planned transmission mains to serve “near-term” development through 2030 (as defined in **Section 4.2.1**) and separately that skeletonized network of transmission mains that were modeled to serve potential development beyond 2030 through 2045. Over 12 miles of transmission main is planned for construction through 2030 and over 30 miles of the skeletonized network is included to accommodate supply to potential future development through 2045.

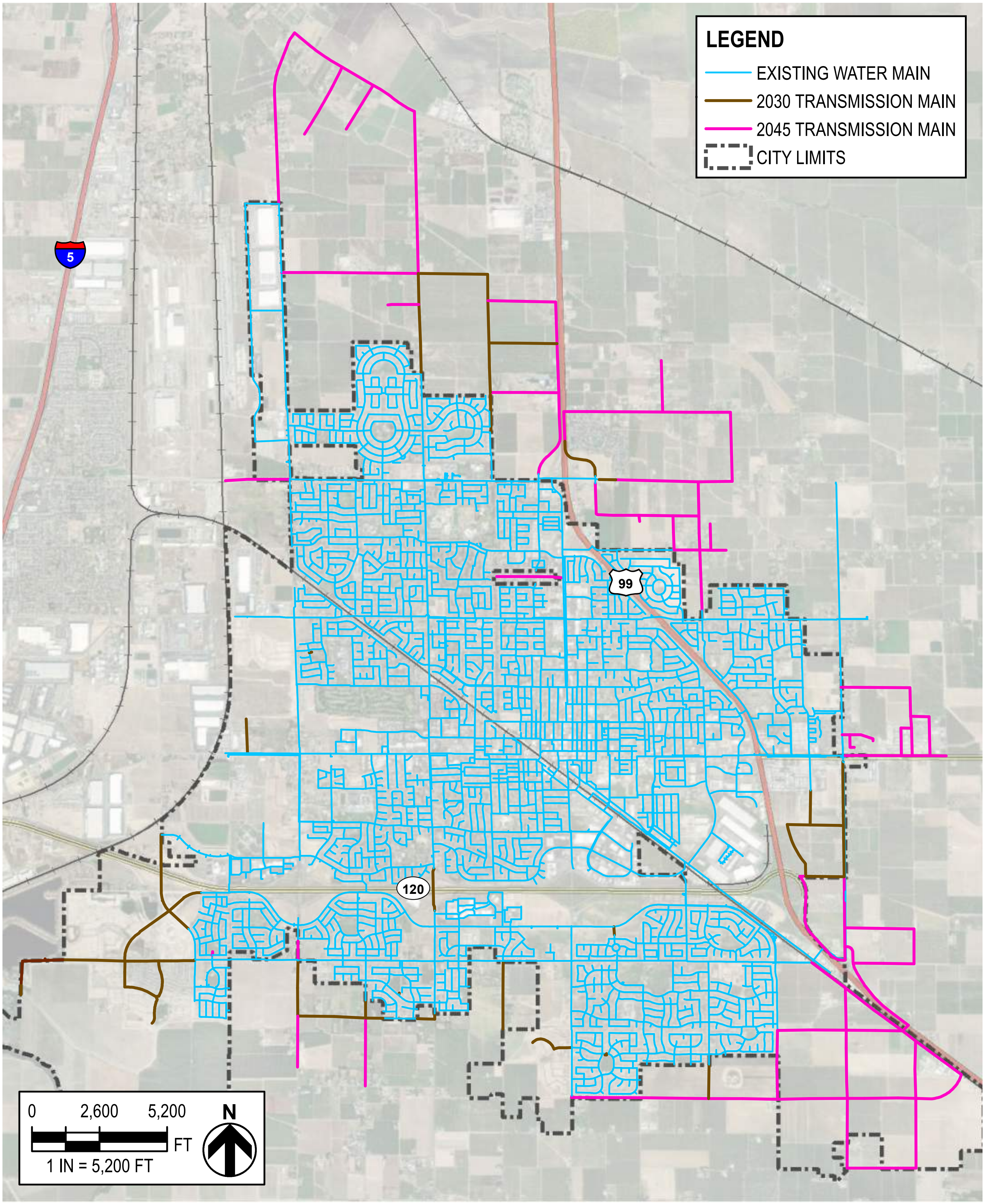

FIGURE 10-2
CITY OF MANTECA
WATER MASTER PLAN
NEW DEVELOPMENT TRANSMISSION MAIN

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Table 10-8: Transmission Main Estimate of Costs through 2045

Project #	Action	Diameter (in)	Quantity	Unit	Total Cost
2030	New Pipe Construction	12	63,072	ft	$52,987,000
	New Pipe Construction	16	1,190	ft	
2045[1]	New Pipe Construction	8	14,132	ft	$131,159,000
	New Pipe Construction	12	143,520	ft	
	New Pipe Construction	16	3,849	ft	

Notes:
1. Timing and related costs for future transmission main beyond 2030 will depend upon timing of planned development.

The skeletonized network is sized to accommodate fire flow according to the proposed land uses for undeveloped land. The timing and sequence of these developments have yet to be determined. Pipeline sizes and locations would be confirmed when designing the planned expansion. The actual cost and phasing of these transmission mains are outside of the control of the City. For the purposes of this analysis, estimated costs for each project have been included in the CIP. These could be funded by developers, the City, or others. The detailed cost estimates are provided in **Appendix J**.

10.4 Proposed CIP Summary and Schedule

Table 10-9 presents a summary of the proposed improvement projects in five-year increments, and **Figure 10-3** displays each of the phases of pipeline projects spatially throughout the City.

Table 10-9: Summary of CIP Schedule

Category	Phase 1 2025-2029	Phase 2 2030-2034	Phase 3 2035-2039	Phase 4 2040-2044
Estimated Pipeline Cost	$14,981,000	$20,203,000	$16,467,000	$16,057,000
Estimated Groundwater Well Cost[1]	$6,700,000	$13,400,000	$6,700,000	$6,700,000
Budgeted SSJID Capacity Expansion/ Storage Cost	$5,000,000	--	--	--
New Utilities Building at WQCF	$10,000,000	--	--	--
Total CIP	**$36,681,000**	**$33,603,000**	**$23,167,000**	**$22,757,000**
New Development Transmission Main[2]	$52,987,000	$131,159,000		

Notes:
1. The cost for groundwater well construction is highly dependent on water quality. Cost provided is assuming treatment for arsenic. Additional cost for TCP treatment based on recent implementation is estimated to be $5.3M (see **Table 10-3**).
2. Timing and related costs for future transmission main beyond 2030 will depend upon timing of planned development.

10.5 Other Recommendations

Provided below are other recommendations for implementation by the City:

- Significant updates and detail were incorporated into the hydraulic model making it a valuable tool for the City's ongoing use. The model should be updated periodically as new infrastructure is built to ensure the accuracy of the model and to aid in future pipeline, well, and general system design. In addition, it is recommended that the following information is collected and incorporated into the hydraulic model to continue to improve its accuracy:
  - Pump performance curves and pump speed data;
  - Pump efficiency data;
  - Target and on/off set points for each supply source and related operating conditions (i.e. seasonal operation);
  - Operating parameters for valves throughout the system; and
  - HGL information and pump operation information at SSJID turnouts.
- During MDD+FF conditions, the distribution system exhibited some deficiencies in cul-de-sacs where system dead-ends occur (see **Figure 9-8**, **Figure 9-9**, and **Figure 9-10**). These deficiencies are typically the result of velocity constraints in the pipelines leading to the dead-end. While upsizing the pipelines will resolve the fire flow deficiency, it can result in water quality issues. These areas should be reviewed for availability of fire sprinklers and possible exceptions to fire flow requirements on a case-by-case basis.
- Perform a condition assessment of the water distribution system facilities, including turnouts, wells, pump stations, tanks, and treatment facilities.
- Prepare an update to the Water Master Plan in ten years in order to capture the significant amount of planned growth and development that is expected to occur in the near term.

The following recommendations are based on observations made by City Staff in the ongoing operation of the existing potable water distribution system:

- Move the SCADA server from Well 19 to a more secure location.
- Evaluate conversion of the SCWSP to an uninterruptible water supply as the City's reliance on surface water increases with population growth.
- Convert all existing well site RTU communication systems to communicate via a fiber system to increase reliability.
- Install backup generators at LAPS and CATF to maintain their operation in the event of a power outage. Currently, LAPS would not be able to operate the booster pumps during a power outage, leaving only pressure head differential to drive water from M1 turnout; Wells 13,19, and 21 have backup power but CATF does not, deeming them unusable during a power outage.
- Construct a new bulk sodium hypochlorite storage facility with a 5,000-gal capacity and the option to expand up to 7,500 gal for easy access for bulk delivery tankers. Include built-in containment, indoor storage for two City delivery trucks, and a truck wash out area.
- Perform an in-depth analysis/study to consider additional storage and pumping to manage peak demands and operational needs as desired, including the following:

  - Consider an elevated storage tank to assist system pressures during peak demands.
  - Consider a storage tank located in the northeast area of the City.
  - Water quality in the southwest part of the City is poor; consider a tank in this area to manage demands in this rapidly growing area.
  - Determine the size of any storage facilit(y/ies) during the planning and design of the facility based on the City's desire to cover operational, peaking, emergency, etc. storage.
  - Consider a storage tank at the M1 turnout as the existing SSJID pipeline direct tap does not conform to SCWSP contract. A storage tank would mitigate pressure issues on the SCWSP pipeline.
  - Consider construction of a new booster pump station and additional storage at the WTP to improve SCWSP transmission pipeline pressure.
- There are pipe friction limits on the surface water line from M2 turnout that blends with Wells 27, 12, 15, and 22 (see **Figure 3-1**). Currently, Wells 15 and 22 operate at lower production rates than they are able to due to pipe friction in the blending line. Each of these wells has the capacity to produce an additional 1,500 gpm if the friction in the blending line were mitigated. Consider adding wellhead treatment at Well 22 for arsenic removal rather than relying on blending to ensure high water quality. Well 15 could continue current operation with surface water blending, and with construction of wellhead treatment at Well 22, the existing surface water blending line connecting Well 22 to Well 15 could be used to carry water from Well 15 to Well 22 for wellhead treatment during an emergency such as surface water curtailment, surface water pipeline break, etc.

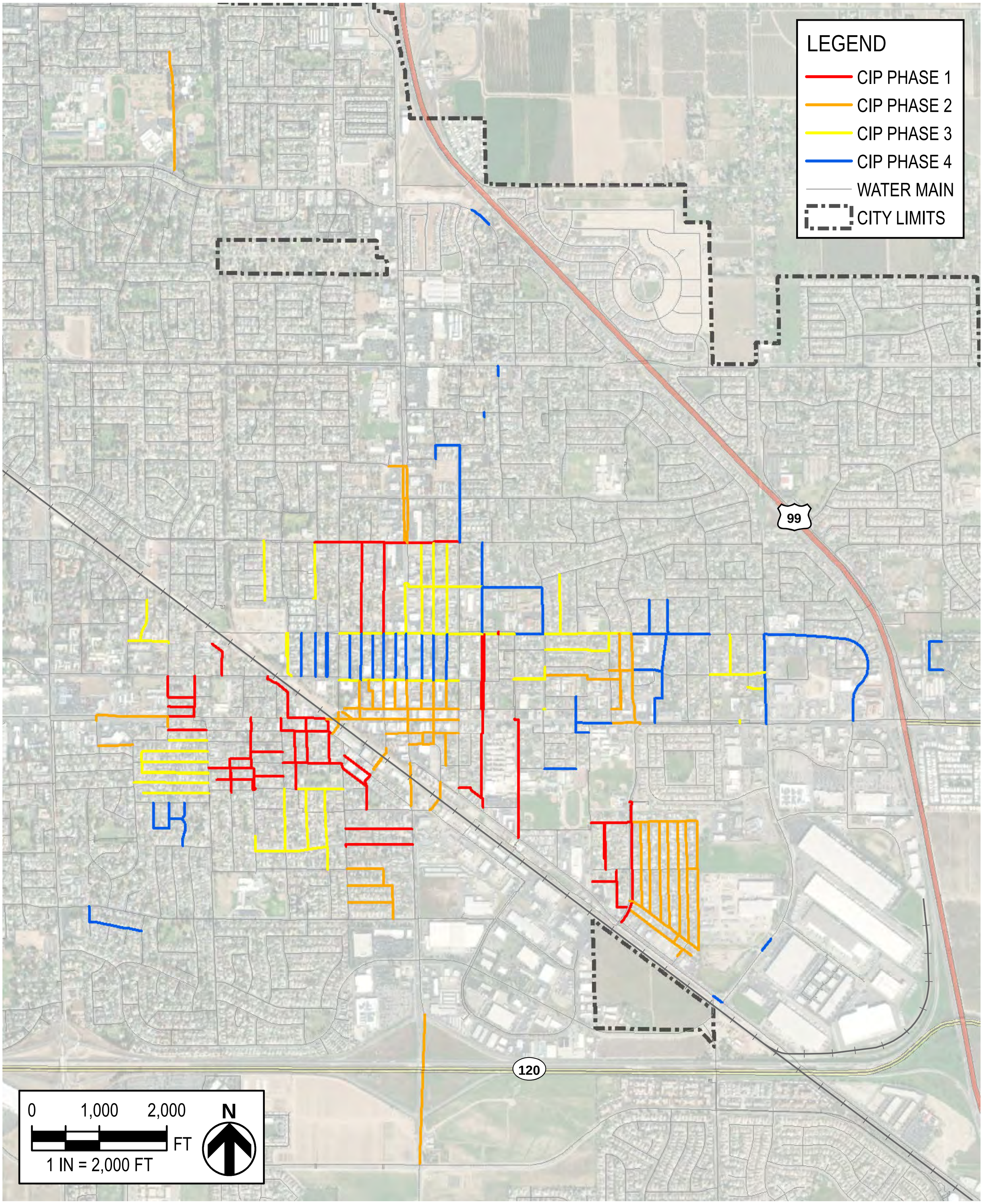

FIGURE 10-**3**
CITY OF MANTECA
WATER MASTER PLAN
CIP PROJECT PHASES

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10.6 Funding for CIP Projects

The City uses enterprise funds to account for City operations that are financed and operated like private business enterprises. The City's enterprise utility funds are fully funded by the rates charged to customers. Use of this type of fund permits user charges to finance or recover the cost of providing the City's services to customers on a continuing basis.

The water funds account for activities associated with providing water services including construction and maintenance of the water distribution systems.

The *Water Maintenance and Operations* fund accounts for the day-to-day operations, including water pumping and deliveries, billing, collections and system maintenance. These activities are funded through the monthly service fees collected from water service customers.

The *Water Fee Improvement and Public Facilities Implementation Plan* funds account for the capital improvements necessary to maintain and expand the system, including water main construction and rehabilitation and well construction and rehabilitation. These activities are funded through fees imposed on new development.

Other funding sources may include grant and loan programs for both water system reliability and improvements, as well as reclaimed water projects. Funding may be in the form of grants or loans. Notable programs that the City may qualify for include:

- **California Department of Housing and Community Development (HCD)**
  - *Community Development Block Grant (CDBG):* Eligible applicants include non-entitled cities or counties that do not receive funding from the U.S. Department of Housing and Urban Development's (HUD's) CDBG entitlement program. Water projects must principally benefit low/moderate income persons/households. Eligible projects may include feasibility studies, final plans and specs, site acquisition and construction, grant administration costs, repair or new construction of town's water tank, assessment fees for low-income families, installation of private laterals and hook-up fees for low-income families under housing rehabilitation activity. For 2022 and 2023, HCD will not be accepting new construction applications. Available funding will be used to fund the waiting list from the 19/20 Notice of Funding Availability.
- **California Infrastructure and Economic Development Bank**
  - *Public Agency Revenue Bonds:* Bond financings for various state and local government agencies for various public or economic development projects.
  - *Infrastructure State Revolving Loan Fund (ISRF):* The ISRF Program provides low-cost, direct loans to local governments for a wide variety of public infrastructure and economic expansion projects that improve and sustain communities. ISRF financing is available in amounts ranging from $1 million to $65 million with loan terms for the useful life of the project up to a maximum of 30 years. Eligible ISRF applicants include any subdivision of a local government, including cities, counties, special districts, assessment districts, joint powers authorities, and eligible nonprofit corporations.

- **California Governor's Office of Emergency Services (Cal OES)**
  - *Building Resilient Infrastructure and Communities (BRICs):* BRIC implements a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding in future disasters. Eligible subapplicants with projects that mitigate risk to public infrastructure, include innovative partnerships, mitigate risk to one or more lifelines, incorporate nature-based solutions, or incentivize adoption and enforcement of modern building codes are especially encouraged to apply. The funding cycle for BRIC begins with the Federal Emergency Management Acts's (FEMA) release of the notice of funding opportunity (NOFO), typically mid-to-late summer, and sub-applications are due to Cal OES in November.
- **State Water Resources Control Board (SWRCB)**
  - *Drinking Water State Revolving Fund:* This program provides low-interest loans and grants for planning and construction projects that support public water systems in meeting compliance with drinking water standards. Eligible projects include planning/design and construction of drinking water infrastructure projects including: consolidation; water meters; water storage; treatment systems; replacement of aged water transmission or distribution mains, groundwater wells, or other infrastructure; private services; interconnections; pipeline extensions.
  - *Groundwater Site Cleanup Subaccount Program (SCAP):* SCAP issues grants for projects that remediate the harm or threat of harm to human health, safety, or the environment caused by existing or threatened surface water or groundwater contamination. Eligible projects include remediating the harm or threat of harm to human health, safety, and the environment from surface water or groundwater contamination; human-made contaminates (i.e., tetrachloroethylene, trichloroethylene, perchlorate, and hexavalent chromium); a regulatory agency that issues a directive (unless this is infeasible); a responsible party that lacks financial resources. Projects may include site characterization, source identification, or implementation of cleanup.
  - *Water Recycling Funding Program:* This program promotes use of treated municipal wastewater to augment or offset State/local fresh water supplies. Eligible projects include reclaimed water treatment; reclaimed water storage, distribution, and pumping; groundwater recharge; indirect potable reuse; and surface water augmentation.
- **Federal Bipartisan Infrastructure Law:** The legislation's $55 billion investment represents the largest investment in drinking water, wastewater, water reuse, conveyance and water storage infrastructure in American history, including dedicated funding to replace lead service lines and address the dangerous chemical PFAS. This funding falls into seven major programs covered under this section – (1) the Drinking Water and Clean Water State Revolving Funds ($23.43 billion), (2) Lead Service Lines ($15 billion), (3) PFAS and Emerging Contaminants ($10 billion), (4) Indian Water Rights ($2.5 billion), (5) Indian Health Service Sanitation Facilities Construction ($3.5 billion), (6) Water and Sewer Tax ($1.25 billion), (7) Western Water including Rural Water ($8.3 billion). The majority of the water funding will move through the State Revolving Fund programs.

- **United States Bureau of Reclamation (USBR)**
    - *Sustain and Manage America's Resources for Tomorrow (WaterSMART):* The USBR sponsors a number of funding opportunities through the WaterSMART program including projects that address water and energy efficiency, drought response, water recycling (Title XVI), water marketing, water conservation, desalination, and water resources. Projects are selected through a competitive process and the focus is on projects that can be completed within two or three years. Funding opportunities and cycles can be found on the USBR WaterSMART website at https://www.usbr.gov/watersmart/.

The scope of the project will dictate funding qualification. As projects are defined, an inquiry can be submitted to the California Financing Coordinating Committee (CFCC) to determine program qualification. **Appendix K** includes a copy of the CFCC Common Funding Inquiry Form. Additionally, the California State Library has created the *California Grants Portal*, a website (www.grants.ca.gov/) that provides a centralized location to find State grant opportunities. Grant seekers are now able to see all current grant and loan opportunities that are offered on a competitive or first-come basis and can search and filter their results.

Additionally, the City is performing a Water Rate Study based on this Master Plan.

SECTION 11 – WATER GROUP STAFFING PLAN

As part of this Master Plan Study, a Staffing Plan was compiled to aid the City in determining the appropriate current and future staffing levels for the Water Group to meet existing operational needs, future demand as detailed in **SECTION 4**, projected regulatory requirements as described in **SECTION 6**, and implementation of the CIP projects presented in **SECTION 10**.

The objective of the Water Group Staffing Plan is to:

- Determine the appropriate level of current and future staffing needs;
- Ensure service levels will be met in consideration of a more stringent regulatory environment, aging infrastructure, and customer base growth;
- Support succession planning efforts and prepare for the retirement of key personnel; and
- Adequately staff the City to allow for planning functions while meeting day-to-day responsibilities.

Overall, the intent of this Staffing Plan is to ensure the Water Group is adequately staffed for both current and future needs, to cost-effectively provide the services required to support water system operations utilizing existing highly skilled staff and continue to meet emerging regulatory drinking water and reclaimed water service objectives.

Recommendations presented herein are based on the findings from City-specific considerations and strategic objectives. Performance indicators from the 2022 AWWA Utility Benchmarking: Performance Management for Water and Wastewater (AWWA Utility Benchmarking) were used as the basis of comparison herein.

11.1 Existing City Organization and Staffing

This section presents an overview of the current organization, training, and certification of staff in the Water Group. Information about existing City staffing levels were provided by the City and obtained from the FY 2022-2023 Adopted Budget (FY 22-23 Adopted Budget).

11.1.1 City Organization

The City is governed by a five-member City Council consisting of the Mayor, Vice-Mayor, and three council members. The Executive Team of 12 includes the City Manager who is appointed as chief administrative officer. Under the City's Council-Manager form of government, the City Manager, along with the executive leadership team and staff, implement City Council's policies and pursue its objectives. The City Manager's Office provides information and recommendations to the City Council, implements City Council policy direction, directs the delivery of municipal services, and oversees accomplishment of City objectives and capital projects specializing in economic development, media relations, community relations, and special projects. The City currently has a total of 467 full-time employee/equivalent (FTE) positions, based on the operating budget published in the FY 22-23 Adopted Budget, page FS-29.

Water Group: For the purposes of this Staffing Plan, the collection of relevant City staff positions considered will be referred to as the Water Group; FTE numbers are for the Water Group only. This collection of positions includes the water treatment, water distribution, water facilities maintenance, water meter services, and water regulatory compliance branches of the Water Division in the Department of Public Works and the Water Infrastructure Division of the Department of Engineering.

Department of Public Works: The Department of Public Works is comprised of nine divisions: Water, Sewer, Transit, Administration, Parks, Fleet, Building Maintenance, Streets, and Solid Waste.

The Water Division is responsible for emergency water line repairs; distribution system maintenance; monitoring and maintenance of water wells; testing and disinfection of the municipal water supply; marking water line locations for construction; installation, repair, and maintenance of water meters; and monthly water meter reading.

Department of Engineering: The Department of Engineering – comprised of the Infrastructure and Development Divisions – oversees planning, design, and construction for new water treatment and distribution, wastewater collection and treatment, drainage and stormwater control, traffic and transportation, and other infrastructure projects. It administers the subdivision review process, participates in site plan review, and manages the City's CIP. **Figure 11-1** shows the portions of the Public Works and Engineering Departments that comprises the Water Group, including the FY 2022-2023 City staffing numbers.

Staff Responsibilities: Responsibilities of staff in the specific job functions are described below. There are different levels within the job functions based on years of experience and certification.

<u>Water Meter Services:</u> upload, download and troubleshoot meter data; water meter installation, inspection and maintenance; respond to citizens' complaints and answer questions from the public; and ensure accurate billing to accounts.

<u>Water System Maintenance Worker:</u> assist in the installation, maintenance and repair of water meters and related service lines; inspect meters and service lines for leaks and malfunctions; install and repair meter boxes, fire hydrants and sidewalks; service equipment with oil and grease or replacing filters; perform traffic control; identify water line locations for underground excavations and assist with trenching and refilling of trenches; and investigate and respond to public service complaints and emergencies.

<u>Water Distribution Operator:</u> inspect meters and service lines for leaks, malfunctions, and high usage; initiating and discontinuing service monitoring meter readings; monitor of chemical dosages and adjusting water quality parameters; and investigate and respond to public service complaints and emergencies.

<u>Water Treatment Operator:</u> operate water wells, water connections, water treatment facilities, pumping equipment, piping systems and related components within the City's potable water system; monitor and adjust chemical dosages/blend ratios.

<u>Well Mechanic/ Operator:</u> operate and maintain water wells, pumping equipment, piping systems and related components within the City's potable water system; monitor chemical dosages to assure adequate and safe drinking water; operate, service, and repair the standby generators at the well sites.

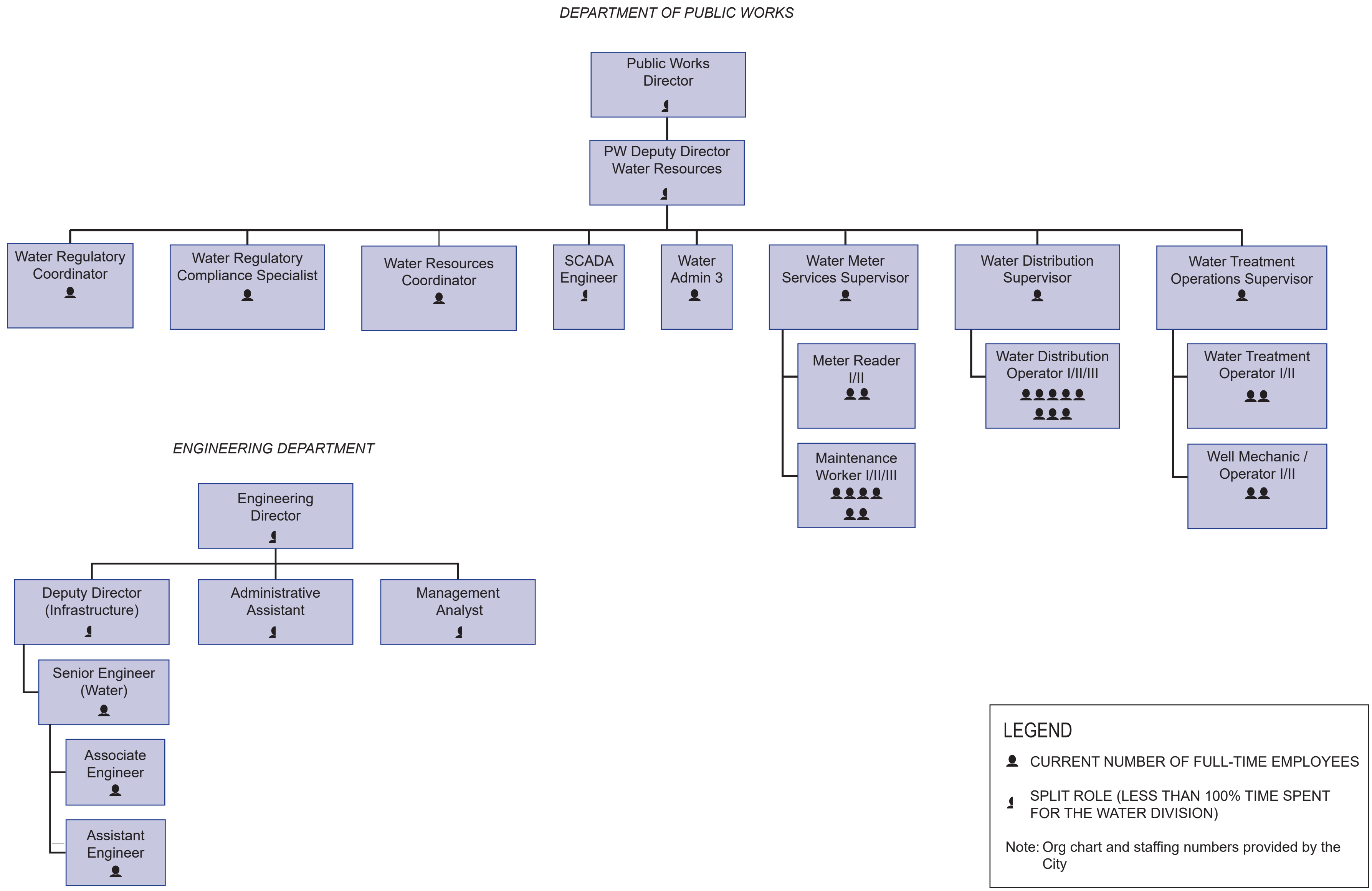

FIGURE 11-1
CITY OF MANTECA
WATER MASTER PLAN
WATER GROUP STAFFING AS OF DECEMBER 2023

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Water Regulatory Compliance Specialist: respond to customer service requests; ensure water conservation and backflow prevention compliance; ensure the City's programs and operations comply with state and federal regulations; and prepare a variety of technical reports for submission to regulatory agencies.

Water Resources Coordinator: coordinate, implement, and promote water conservation; assist in activities required to ensure regulatory compliance for water resources; conduct research and prepare written reports, correspondence and promotional materials; serve as water resources liaison; coordinate and implement public outreach and education efforts; perform grant writing; and coordinate with enforcement efforts.

Water Regulatory Coordinator: monitor water regulatory compliance and related programs and priorities; ensure compliance; direct the review and analysis of new and changing regulations; interpret Federal and State regulations related to drinking water quality and environmental aspects of water operations to ensure compliance; and develop and update City ordinances.

SCADA Engineer: ensure proper operation of the water system through observing control data; and designing, installing, programming, and monitoring of control systems at the wells and distribution system.

Assistant/Associate/Senior Engineer: plan, organize and manage assigned capital improvement projects for the Engineering department; and perform technical engineering duties and coordination for the planning, design, construction, budgeting, bidding and analysis of capital improvement projects.

Management: manage staff; ensure adequate staffing; implement procedures for reliable operations of the water system; and recommends new capital improvements projects.

11.1.2 Water Distribution and Treatment Certification and Training

The SWRCB's DDW District Offices and Local Primacy Agencies classify water treatment facilities and distribution systems statewide in accordance with CCR, Title 22, Sections 64413.1 and 64413.3, respectively. The SWRCB uses a five-level classification system, established in regulations for water distribution systems, water treatment facilities, and certified operators. Water distribution systems are classified into classes D1 through D5, according to population served and the complexity of the distribution system. Water treatment facilities are classified into classes T1 through T5, using a point system based upon source water characteristics, maximum capacity, and treatment techniques utilized.

The City's water system is classified as a T3 treatment and a D5 distribution system. As such, the Chief Treatment Operator must possess a T3 certification, and the Chief Distribution Operator must possess a D5 certification at minimum. All other operating personnel making process control/ system integrity decisions about water quality or quantity that affect public health must have some level of certification as well depending upon the type of work being performed. Certification is obtained from SWRCB by passing an exam and having a minimum level of experience per level of certification. Certification renewal is required every three years. Renewal requires a minimum amount of training/contact hours approved by SWRCB. The amount of training needed depends on the level of certification being renewed.

11.1.3 Staffing Levels

A summary of FTE positions is provided in **Table 11-1**. This table presents the Water Group positions displayed in **Figure 11-1** which are grouped into job categories aligning with the AWWA Utility Benchmarking for analysis herein. This information represents staffing count as of December 2023 as provided by the City.

In some cases, employees may have responsibilities across multiple branches and split their time between roles; a decimal representation of FTEs is provided for estimation if an employee's time is split between the water, wastewater, and/or stormwater branches.

Table 11-1: Water Group FTE Positions

Category	FTEs in 2023
Department of Public Works – Water Division[1]	**28.9**
Water System Maintenance Worker	6
Water Treatment Operator/ Well Mechanic	5
Water Distribution Operator	8
Water Meter Services	3
Management, SCADA, Water Regulatory Compliance, Water Resources Coordination	4.9
Department of Engineering – Infrastructure Division[1]	**3.6**
Engineering	3.6

Notes:
1. Source: Provided by City Staff.

11.1.4 Vacancies

The City as well as other water agencies have had challenges in recruiting operators and maintenance workers due to the lack of available certified operators and civil engineers. In addition, demand for certified operators have increased as water quality regulations become more stringent and additional water treatment is needed. Water reuse has also increased the need for certified water treatment operators and as development continues to grow so does water distribution systems and the need for additional maintenance workers. Some agencies have turned to vendors or contract operators and/or staff augmentation using consultants or contract employees till vacancies can be filled.

For example, the City and County of San Diego has a rotating consultant list to provide environmental services, staff augmentation, construction management, in addition to specific design projects. For the construction of the Echo Water Project for SacSewer, formerly Regional Sanitation, project management and construction management services were provided by different design engineers. Operations partners such as Veolia Water and Fluid Resources Management provide staff for operations, mechanical repair, controls, and regulatory compliance.

11.1.5 Overtime and Temporary Staffing

The City's stance on overtime is that it should be used only when necessary and when other alternatives are not feasible or cost effective. Currently, most positions within the Water Group are working overtime. The City can also use temporary staffing or contractors to meet peak workload requirements in the short-term. The City Manager and Department Managers encourage the use of temporary rather than regular employees to meet peak workload requirements, fill interim vacancies, and accomplish tasks where less than full-time, year-round staffing is required. Contract employees are generally used for medium-term projects, programs, or activities requiring specialized or augmented levels of staffing for a specific period, generally between six months and two years. Temporary staff and contractors are not included in the FTE count in this analysis.

11.1.6 Succession Planning

The City is currently taking several actions for implementation of a succession plan for all management positions to ensure that employees are sufficiently trained or cross-trained in multiple positions with the goal to fill critical vacant positions with qualified personnel. For the Water Group, implementation of the succession planning program continues to be an objective for FY 2023-2024.

In addition, the City currently has a Flexible Staffing Policy, where any water group employee in the maintenance worker or operator series can be promoted with the correct certification and years of service to a higher position in either of these series.

Succession planning is a process for identifying and developing staff with the potential to fill critical roles. Succession planning includes all of these key steps: identification of critical positions; defining competencies required to undertake these roles; assessing people for such competencies; identifying talented people who can perform highly in these key roles; and developing employees to be ready for advancement in these key roles. Key skills include technical knowledge, procedural best practices, and leadership skills. Some municipalities have also developed other strategies to aid in succession planning. The Metropolitan Water District of Southern California has developed a two-prong approach that focuses on workforce development and on the on-boarding process. Workforce development included a focus on clarifying department goals, assessing gaps in skill sets, providing cross-training, providing mentoring and leadership development, and organizing a monthly brown bag to discuss initiatives or key issues. Energy Services in southern Florida has developed a program to reward employees who give more than normal notice about their retirement plans. Fairfax County in the DC Metro area in Virginia has developed a Deferred Retirement Option Program where the retiree can work for up to an additional three years with the intent to retire and invest additional funds for their pension. During that time, a replacement overlaps with the retiree to learn key skills for the position.

11.2 Considerations for Staffing Levels

Recommended staffing levels are based on changes in regulatory requirements, CIP needs, growth in the system, and the performance indicators identified in the 2022 AWWA Utility Benchmarking, detailed in this section.

11.2.1 Changing Near-Term Regulatory Monitoring

In the near-term, legislation is requiring changes to monitoring and reporting which may require additional staffing or contract resources. Legislation packages will require water utilities to track and report annual water use & water loss and cross connection control.

Urban Water Use Objective Calculation

Water use and loss reporting is anticipated with the passage of 2018 Legislation Senate Bill 606. Assembly Bill 1414 requires analysis of the FY 2022-2023 annual water use with a report due by January 1, 2024. The system specific water loss audit would include development and operations to perform leak detection. Reports would be sent annually to the Department of Water Resources to compile a record of annual system water losses. The regulation would also require the City to establish a volumetric water loss standard (such as five gallons per connection) and maintain this water loss standard by 2028. The water loss staff's time would involve setting this standard, tracking water losses, and reporting annually. If the volumetric water losses are too high, the staff would also need to alarm the distribution operators. A timeline of implementation is as follows:

- Submit questionnaires and data about metering and meter testing practices by January 1, 2023;
- Submit feasibility of pressure by July 1, 2023 and update July 1, 2026;
- Submit feasibility of asset management by July 1, 2024 and update July 1, 2027
- Calculation and compliance with leakage reduction with individual volumetric standards by January 1, 2028.

Cross Connection Control Program Revision

The Cross Connection Control program requirements were revised on December 19, 2023 to include four additional components in addition to six existing components. The added components include:

- Use of certified backflow prevention assembly testers and cross control specialists;
- Backflow incident response, reporting, and notification;
- Public outreach and education; and
- Local entity coordination.

These added components would increase the tasks currently undertaken by the cross-connection control specialists and additional staffing is needed to ensure compliance and coordinate within the City. While certified backflow prevention assembly testers can be contracted through agencies within California, an operator or compliance specialist would still need to manage the reporting and verify certification. Additionally, the specialist is required to be contacted within an hour to respond to cross-connection incidents or hazard analysis under the Cross-Connection Control Program.

For water meter staff, at least one staff is recommended to receive certification for performing water loss audits and for cross-connection control, each. As more meters become automated, response to water leaks and cross-connections and reporting will be tasks that water meter staff would need to handle.

11.2.2 Changing Regulatory Compliance

There are two consequences impacting staffing based on future water related threats to the City as discussed in in **Section 6.3** that may impact staffing requirements.

- Imported water restrictions and curtailments depending on time of the year resulting in increasing need for groundwater during peak times; and
- Declining groundwater quality requiring more wellhead treatment.

Currently, City operators are required to have T3 treatment operator certification or D5 distribution operator certification. The D5 distribution system is the highest within the classification. An increase of population or distribution pipeline length would not impact the certification needed. The treatment certification system also ranges from 1-5 and is based on regulatory limits.

The City's treatment certification level can go higher if there is an increase in the point system on the following factors related to groundwater treatment as described in CCR, Title 22, Section 64413.1:

- Average turbidity,
- Average levels of perchlorate, nitrate, and nitrite that exceed the MCLs,
- If the levels for each of the inorganic contaminants, organic contaminants, and radionuclides based on monitoring are below the MCL, are greater than the MCL, or exceed five times greater than the MCL.

Additional wells and additional population are not expected to push the City to higher certification requirements as currently treatment is provided for nitrate, arsenic, manganese, and TCP (as summarized in **Table 2-2**). If new MCLs are established for PFOA, PFOS, and NDMA, and if exceedances are considered in future water treatment certification, then this may increase the certification level requirement for the current City staff.

11.2.3 Modifications based on CIP Projects

As the City embarks on implementing the Capital Improvements Program, increased staffing will be needed in the Engineering Department to account for the administration of capital improvements projects as well as to account for asset management of existing assets as they age. The CIP Program is anticipated to administer 10-14 projects within a 4-year window from planning, design, bid, and construction, while coordinating within internal departments and external regulatory agencies. It is recommended for three engineers to be added and then an additional engineer by 2030.

If the City chooses to handle design services or construction management in-house rather than contracting with consulting firms, it is recommended that the City hire additional staff more than is presented in **Table 11-2**.

Table 11-2: Recommended Additional Engineering Staff for CIP Administration

Parameter	Phase 1 2025-2029	Phase 2 2030-2034	Phase 3 2035-2039	Phase 4 2040-2044
Number of Pipeline Projects	9	9	12	13
Estimated Pipeline Construction Cost	$14,981,000	$20,203,000	$16,467,000	$16,057,000
Estimated Groundwater Well Cost	$6,700,000	$13,400,000	$6,700,000	$6,700,000
Total Miles of Transmission Main in the City[1]	317.1	344.9		
Number of New Wells	1	2	1	1
Total Number of Wells	17	19	20	21
Recommended Number of Engineering Staff for the CIP[2]	3	4	4	4

Notes:
1. Timing of transmission main construction beyond 2030 is dependent upon timing of development and City annexation of parcels outside of the current City limits.
2. One Engineering Staff FTE is added between 2030 and 2045 to account for the transmission main expansion assuming the pace of development is relatively consistent over that time frame.

11.2.4 Modifications based on Long-term Asset Planning

Long-term asset planning through preventative maintenance and asset management will need to be prioritized in the Water Group as pipelines and facilities continue to age. Roughly one quarter of the existing pipelines are past a 40-year life expectancy based on **Table 3-7** and 33% of wells are past a life expectancy of 35 years based on **Table 3-2**. This job duty is recommended to be separated out within the infrastructure division of the engineering department so that there is a capital improvements branch and operations and maintenance branch. Within the operations and maintenance branch, a GIS technician is also recommended to track existing facilities, work orders, and preventative maintenance.

11.2.5 Increasing Water Production

Additional staffing is required as the City increases annual water production. Estimates for the quantity of staffing are based on the AWWA Utility Benchmarking Program. AWWA began development of a utility benchmarking program in 1995 with the goal of providing water, wastewater, and combined utilities with performance measurements for internal tracking and external comparisons. The basis for performance benchmarking is a system of well-defined and time-tested performance indicators specific to the water sector. These indicators were designed to help utilities improve their operational efficiency and managerial effectiveness. For the 2022 publication, 168 municipalities from the USA and Canada contributed to benchmark data from 2021. Municipalities are identified as providing services for:

- Water utilities;
- Wastewater utilities; or
- Combined utilities offering both water and wastewater services.

Performance indicators reported in the AWWA Utility Benchmarking report include:

- Staffing levels
  - Total FTEs
  - FTEs by job category
- Water produced per employee (MGD per employee)

The AWWA Utility Benchmarking survey collected responses from utilities to the following question: "Record the number of FTEs working on water services at your utility during the reporting period." Based on the survey responses, quartile values were recorded. The following analysis utilizes the median or 50th percentile of the survey respondents.

11.3 Recommended Staffing Projections

Staffing projections follow the water demand projections (**Section 4.2.4**) and proposed CIP Projects (**SECTION 10**) developed as part of this Master Plan Study through 2045.

11.3.1 Recommended City Water Group Staffing for 2025

The AWWA Utility Benchmarking provides indicators for the entire sample set as well as subsets of utilities broken down based on similar characteristics (i.e., types of services offered, population served, region, etc.). Further, the number of FTEs is calculated using varying metrics (i.e., number of accounts per employee, quantity of water produced per employee, etc.). For this analysis, a range of staffing levels recommended for the City's Water Group was calculated based on water produced per employee as described in **SECTION 4** for the entire sample set and subset if information was provided. An outline of relevant metrics with units and subsets is below:

- Water produced per employee (MGD water supplied/ FTE)
  - Entire sample set: combined utility (water operations and water only utility). This is inclusive of all utilities offering water services whether or not they offer another service such as wastewater.
  - Subset by combined utility – water operations. The sample size is 97 utilities.
  - Subset by region. The sample size is 35 utilities.

The AWWA Utility Benchmark includes multiple job categories; some that do not apply to the Water Group as these job functions are performed outside of the Water Group, but within the larger City workforce, such as human resources, information technology, finance, and service calls. An estimated 71% of the job categories included in the AWWA Utility Benchmark are included in the City of Manteca Water Group. As such, the AWWA comparison factors or performance indicators were multiplied by 0.71 to account for the job categories included in the Water Group only.

A range of recommended staffing numbers for the City based on these performance indicators are presented in **Table 11-3**. The recommended total number of City FTEs is calculated by:

$$\frac{(Amount\ of\ Water\ Produced\ MGD)\ x\ 0.71}{AWWA\ Median\ Value\ of\ Water\ Produced\ /\ FTE} = 2025\ Recommended\ No.\ of\ City\ FTEs$$

Using the water demands and the AWWA indicator value for combined utilities-water and combined utilities in Region V which includes California, the recommended number of total City Staff in FY 2025 based on water production projections is 47 FTEs.

Table 11-3: Range of Total Staffing Using AWWA Indicators

AWWA Metric	AWWA Benchmark Reference[1]	AWWA Median Value of Water Produced / FTE	2025 Water Produced	2025 Recommended No. of FTEs[2]
Water Produced Per Employee				
Combined Utilities - Water Operations	Table 4-2	0.23 MGD/FTE	15.2 MGD	47
Subset: Region V	Appendix C, p. 219	0.23 MGD/FTE	15.2 MGD	47
			Recommended	**47**

Notes:
1. The AWWA Benchmark Reference locates the table number or page number within the AWWA Utility Benchmarking publication.
2. A ratio of 0.71 is used to compare job categories included in the City Water Group compared to all of the job categories listed in the AWWA Utility Benchmarking publication.

Table 11-4 presents a comparison of the City's current staffing levels in each of the City's job categories compared to the recommended number of FTEs calculated, 47 FTEs, plus the 3 engineers for CIP Project administration as discussed in **Section 11.2.3**. The resulting organization chart is shown on **Figure 11-2** for the Water Group.

The City's Water Group currently employs 32.5 FTEs which is considerably less than the recommended 50 FTEs.

Table 11-4: City Actual Staffing Compared to Recommended Staffing for 2025

Job Category	City Actual Staff in FTEs (FY 2022-2023)	AWWA Recommended Staff FTEs (FY 2024-2025)
Water System Maintenance Worker	6	6
Water Treatment Operator/Well Mechanic	5	10
Water Distribution Operator	10	16
Water Meter Services	3	4
Other/Management	5	6
Engineering	3.6	5
Engineering - CIP	0	3
Total	**32.5**	**50**

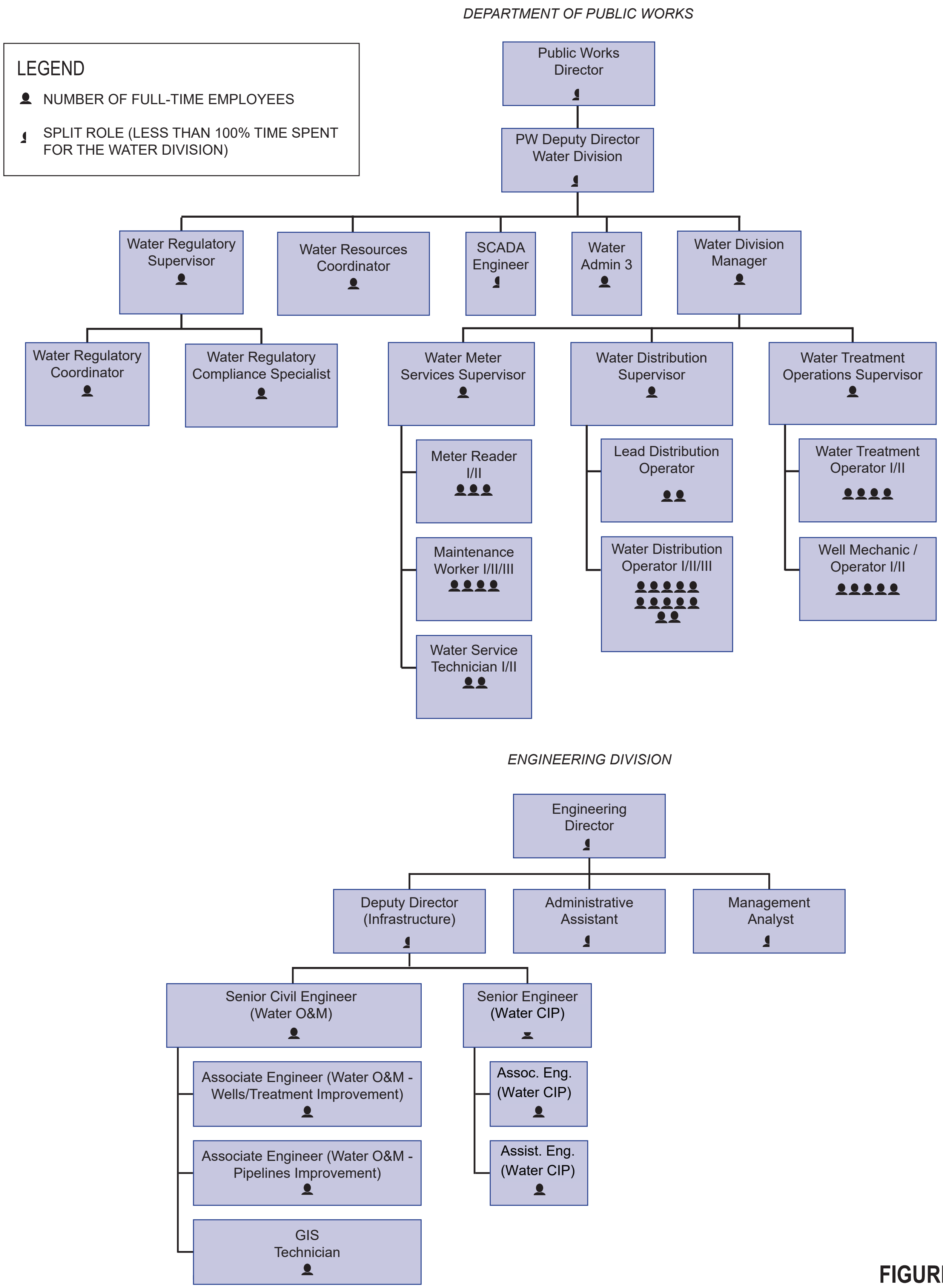


FIGURE 11-2
CITY OF MANTECA
WATER MASTER PLAN
RECOMMENDED WATER GROUP STAFFING FOR 2025

11.3.2 Recommended City Water Group Staffing for 2045

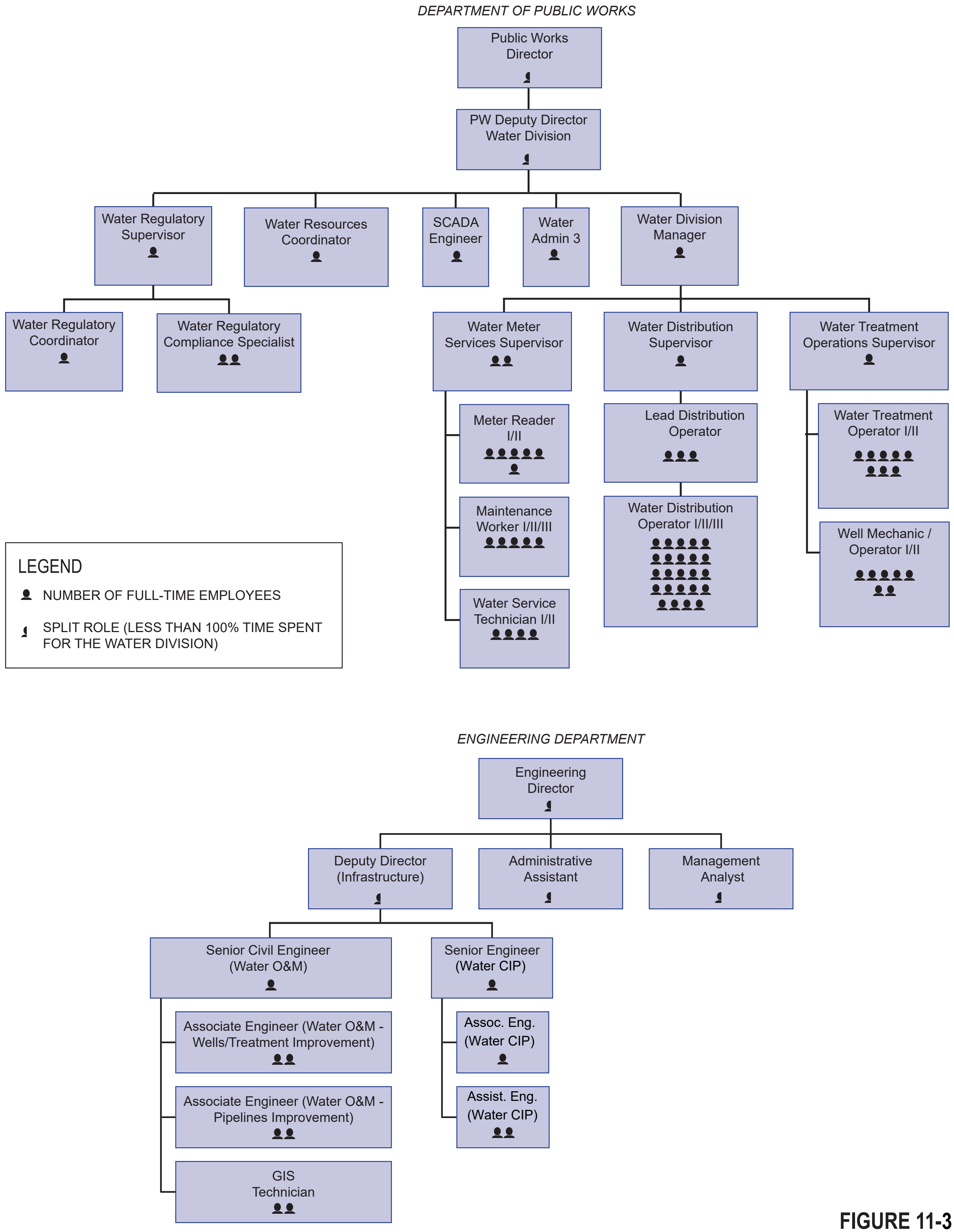
Using the same procedure described in **Section 11.3.1**, the number of future total FTEs was estimated based on the projected average annual demand as listed in **Table 4-12**. The number of Water Group FTEs was then calculated using the 0.71 ratio of Water Group staff to total staff as detailed in **Section 11.3.1.**

Table 11-5 presents the projected City staff FTE recommendations based on this procedure. In 2045, it is recommended that the City employ a Water Group staff comprised of 83 FTEs by 2045. The resulting organization chart is shown on **Figure 11-3** for the Recommended Water Group in 2045.

Table 11-5: Projected FTEs based on Water Demand and Percentage in Job Category

Parameter	Existing	Recommended				
	2023	2025	2030	2035	2040	2045
ADD (MGD)[1]	13.2	15.2	17.9	20.2	22.8	25.7
ADD (AFY)[1]	14,830	16,982	20,117	22,677	25,562	28,814
Population[1]	87,218	97,404	111,826	128,383	147,392	169,215
Recommended Water Group FTEs[2]	32.5	50	59	66	74	83
Job Category						
Water System Maintenance Worker	6	6	6	7	8	9
Water Treatment Operator/Well Mechanic	5	10	12	13	15	17
Water Distribution Operator	10	16	20	22	25	28
Water Meter Services	3	4	5	6	7	8
Other/Management	4.9	6	7	8	8	9
Engineering	3.6	5	5	6	7	8
Additional Engineering Staff for CIP[3]	--	3	4	4	4	4

Notes:
1. Duplicated from **Table 4-12** for reference.
2. Calculated as ADD (MGD) divided by the recommended ratio of 0.23 MGD/FTE as detailed in **Section 11.3.1**, using a 0.71 ratio of Water Group also detailed in **Section 11.3.1**, and adding additional engineering staff recommended for CIP administration .
3. Additional engineering staff recommended for CIP administration as described in Table 11-2.



HydroScience

FIGURE 11-3
CITY OF MANTECA
WATER MASTER PLAN
RECOMMENDED WATER GROUP STAFFING FOR 2045

11.3.3 Future Staffing Needs Considerations

The Water Group staff of 83 FTEs is recommended for 2045.

Factors that would increase the need for additional staff include:

- The City performing engineering services during construction or construction management;
- MCLs adopted for contaminants that would require the City to increase water treatment operator certification; and
- Increased reliance on both groundwater and imported water as a supply source due to availability limitations requiring development of infrastructure for both supply sources.

Mitigation measures include:

- Cross-training and cross-certification of City staff to fill vacant and promotional opportunities or providing training as a group for certification;
- Using continuing education and training requirements to encourage cross-certification;
- Reliance on alternative water sources to offset peaks and reduce the rate of requiring new infrastructure as described in **Section 6.4**; and
- Contracting for operators to supplement City staff.
- Splitting recommended positions such as GIS technician and water regulatory compliance specialist with other underground utilities such as stormwater, recycled water, and wastewater divisions in the engineering department.
- Alternatively, the GIS technician could be cross-trained to also use maintenance planning software to track assets and maintenance work orders.

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SECTION 12 – REFERENCES

Provided are a list of sources used in the development of the Master Plan. These documents are incorporated herein by reference.

2019 SGMA Basin Prioritization, Appendix 1 published by DWR

American Water Works Association, Manual of Water Supply Practices M31: Distribution System Requirements for Fire Protection

American Water Works Association, Manual of Water Supply Practices M32: Computer Modeling of Water Distribution Systems

American Water Works Association, Utility Benchmarking: Performance Management for Water and Wastewater 2022

California Regional Water Quality Control Board – Central Valley Region, National Pollutant Discharge Elimination System (NPDES) CA0081558 Order R5-2021-0003, February 18, 2021

California Code of Regulations Titles 22 and 24

City of Manteca, Water Loss Audit Reports, 2016-2020

ESJ Integrated Regional Water Management Plan 2014 Update

ESJ Subbasin GSP November 2019, revised June 2022

City of Manteca, 2005 Water Master Plan

City of Manteca, 2013 Storm Drain Master Plan (SDMP)

City of Manteca, 2015 Urban Water Management Plan, September 2016

City of Manteca, Adopted Budget, Fiscal Year 2022-2023

City of Manteca, General Plan Amendment (GPA) published in January 2024

City of Manteca, Reclaimed Water Facilities Master Plan (RWFMP)

Department of Water Resources, California's Critically Overdrafted Groundwater Basins, January 2020

Manteca Municipal Services Review (MSR) published in July 2022

South San Joaquin Irrigation District, 2020 Agricultural Water Management Plan, Adopted March 23, 2021

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