VOLUME II

WATER AND WASTEWATER MASTER PLAN

Prepared for

Town of Buckeye, Arizona

February 18, 2011

WATER AND WASTEWATER MASTER PLAN

Prepared for
Town of Buckeye, Arizona

VOLUME II
of the
TOWN OF BUCKEYE
INTEGRATED WATER RESOURCES PLAN

February 18, 2011

Brown and Caldwell Project No.: 135867

Expires 9/30/12

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LIST OF ACRONYMS/ABBREVIATIONS

A.A.C.	Arizona Administrative Code
ADC	Arizona Department of Commerce
ADD	Average Day Demand
ADWR	Arizona Department of Water Resources
AMA	Active Management Area
ASPC	Arizona State Prison Complex
AWWA	American Water Works Association
CAD	computer aided design
CCI	construction cost index
CCTV	closed-circuit television
CIP	Capital Improvement Plan
DAWS	Designation of Assured Water Supply
d/D	depth to diameter ratio
ENR	Engineering News-Record
FCV	flow control valve
FF	fire flow
ft/s	feet per second
GIS	Geographic Information System
gpd	gallons per day
gpcd	gallons per capita per day
gpm	gallons per minute
HARN	high accuracy reference network
HDPE	high-density polyethylene
HGL	hydraulic grade line
I/I	inflow and infiltration
ISDS	individual sewage disposal system
MAG	Maricopa Association of Governments
MDD	Maximum Day Demand
MG	million gallons
MGD	million gallons per day
MPA	Municipal Planning Area
MPC	Master Planned Community
NAD	North American Datum
NED	National Elevation Dataset
PHD	Peak Hour Demand
PRV	pressure reducing valve
psi	pounds per square inch
QA/QC	Quality Assurance/Quality Control
RID	Roosevelt Irrigation District

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LIST OF ACRONYMS/ABBREVIATIONS (continued)

SCADA	supervisory control and data acquisition
SBR	Sequencing Batch Reactor
SEBIS	Southeast Buckeye Interceptor Sewer
Town	Town of Buckeye
USGS	United States Geological Survey
UV	ultraviolet
VFD	variable frequency drive
WRF	water reclamation facility
WSRV	West Salt River Valley
WWTP	wastewater treatment plant

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1. INTRODUCTION

The Town of Buckeye (the Town) is located near the far western boundary of Maricopa County, in south central Arizona. Its history as a center of agriculture dates back to the late 1800s, and it was incorporated in 1929 as a 440-acre town centered on what is now the downtown area. Until the 1990s, the Town's growth had been modest, consistent with a small, rural community profile. In the last decade, however, agricultural and native desert lands have been transformed into residential developments and commercial businesses at a rapid pace, and the Town's future planning includes the possibility of becoming an international trade and logistics center.

The unprecedented growth patterns of the last five to ten years have had significant impacts on the Town. The Municipal Planning Area (MPA) now encompasses 600 square miles (approximately 380,000 acres), straddles the Phoenix Active Management Area (AMA) boundary, and includes portions of four separate but interconnected groundwater basins: West Salt River Valley (WSRV), Lower Hassayampa, Gila Bend, and Rainbow Valley Basins (Figure 1-1). Not only is the Town faced with the challenge of managing diverse and separate groundwater resources, but the rules and regulations are vastly different for areas within versus outside of the AMA.

Interstate 10 (I-10) roughly bisects the MPA. South of I-10 the predominant land use is still agricultural, as shown on the aerial map on Figure 1-1, although residential, industrial, and commercial land uses are intermixed with irrigated acreage. North of I-10 within the MPA boundary, the land is largely native desert interspersed with the early stages of development to the west and northwest of the White Tank Mountains. The property boundaries for Master Planned Communities (MPCs) and developments within and adjacent to the Town's MPA provide an indication of the changes that will occur in the future (Figure 1-2).

The timing and growth rate of the Town's MPCs and developments vary widely, and the majority of the development plans submitted to the Town are focused solely on the demands within each development footprint. A unified planning effort is needed to ensure that the water resources infrastructure, although initially comprised of disparate systems, will become a unified operation meeting the ultimate goal of interconnection.

1.1 Purpose and Goals

The purpose of the Integrated Water Resources Plan project is to develop a cohesive plan for moving forward, a starting point that serves as a repository for new and updated information. The underlying goals of the project are to facilitate the process of managing the growth in a consistent, unified way and to develop water management guidance documents for Town staff, developers, and residents.

Prior to this project, a compilation of the planning data had not been done, nor had hydraulic modeling been performed to assess the integration of neighboring systems. Several studies considered the management of multiple developments under a single, sub-regional plan; however, this project provides the Town with a starting point for eventually combining all development data and plans in a single repository. Moving forward, as changes and revisions to existing development plans are submitted, and as the Town signs new development agreements, the data will be incorporated into the framework developed in this Plan.

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Specific goals and objectives of the Integrated Water Resources Plan were defined in conjunction with Town staff and include the following:

- Assess water resources in the context of long-term sustainability;
- Develop a management tool to plan for future water and wastewater service, with a specific focus on planning and development in the Central Buckeye region;
- Develop Capital Improvements Plans (CIPs) for water and wastewater to identify critical infrastructure needs in the Central Buckeye region; and
- Provide basic planning documents that will support the Town's efforts to secure a Designation of Assured Water Supply (DAWS) from the Arizona Department of Water Resources (ADWR).

The Town submitted a DAWS application in December of 2008. The application is currently under review by ADWR, with approval of the application anticipated in 2011. The Integrated Water Resources Plan is a key planning element that will support future modifications to the DAWS.

1.2 Scope of Work

The Town developed separate scopes of work for a Water Master Plan and a Wastewater Master Plan in 2008, both of which included elements of water resources planning. Brown and Caldwell was selected to develop both plans, and began a 6-month collaboration process with Town staff to combine the scopes of work into an Integrated Water Resources Plan that included three distinct planning elements: a Water Resources Plan, a Water Master Plan, and a Wastewater Master Plan. Through this process, a sequence of tasks was defined for the project; the flowchart is provided as Chart 1 at the end of this section.

The scope of work for the Integrated Water Resources Plan is provided as Appendix A. As the project progressed, adjustments to scope items were made to address issues and data gaps as necessary; these revisions are reflected in the scope of work in Appendix A.

The Water and Wastewater Master Plans were similar in methodology and scope, and were therefore combined into a single document; the different purpose, study area, and goals of the Water Resources Plan were better served in a separate report:

- Volume I Water Resources Plan
- Volume II Water and Wastewater Master Plan

1.3 Data Sources

Initial data collection was performed during the first six months of the project, from July through December of 2008. All planning documents were provided by Town staff in electronic format, if available, or in hard copy or scanned hard copy format otherwise. The data collection task was extended to address issues of data compatibility, and to allow for mapping and digitization of key infrastructure elements. This process was largely completed by Town staff using a Geographic Information System (GIS), following industry-accepted protocols and data standards. Brown and Caldwell provided Quality Assurance/Quality Control (QA/QC) on the work product.

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Water, wastewater, reclaimed water, and water resources plans for the MPCs and developments within the Buckeye MPA were provided by the Town. The most recent versions of the plans and documents available in early 2009 were utilized for the project, whereas more recent submittals to the Town will not be reflected in this work. In addition, the project relied heavily on key planning documents for the region, including:

- 2007 Town of Buckeye General Plan Update (Adopted January 18, 2008);
- Town of Buckeye Water Conservation Plan (June 2, 2009);
- Maricopa Association of Governments (MAG) 208 Water Quality Management Plan - Comprehensive Amendment for the Town of Buckeye (October, 2007);
- Buckeye Parks, Open Space, and Trails Plan (November, 2005);
- Land Use Plan from the Buckeye General Plan (Figure 1-2);
- MAG Transportation Systems Modeling for Buckeye Region (Procured November 2009); and
- Economic Development Fact Book, Town of Buckeye, Arizona (Revised 09-2008).

1.4 Approach

The scope initially developed for the project in early 2008 preceded a nationwide economic recession by several months. When the notice to proceed was issued in July 2008, all projections (for future population growth, development, and land use) were predicated upon the assumption of a continuation of the tremendous growth that had previously characterized the region. During the course of this project, radical changes in population growth and development trends have occurred that generate uncertainty as to the timing and the magnitude of future growth. To the extent possible, the scope of work for this project has been adapted to address changing economic conditions and to provide the Town with a suitable starting point to manage their current and future water, wastewater, and water resources.

The original scope specified four planning horizons for water and wastewater hydraulic modeling – 2007, 2010, 2020 and buildout – and a 100-year timeline for water resources modeling (consistent with ADWR Assured Water Supply regulations). These planning horizons were adjusted during the course of the project as the interim projections were no longer deemed to be realistic. Planning horizon data for 2007 were used to represent the present-day planning horizon, and were augmented with 2008 data where feasible. Planning for 2010 and 2020 was eliminated because MAG population projections and the associated spatial distribution of growth for these periods were too out-of-date to warrant a separate planning horizon. Buildout planning assumptions remained unchanged as they are on a sliding scale and are not tied to a specific year. The timeline for the Water/Wastewater Master Plan therefore focused on present-day and buildout horizons.

Study areas for each of the three components of the Integrated Water Resources Plan (water resources, water infrastructure, and wastewater infrastructure) were varied to address the key areas and issues. The water and wastewater components were focused on the central Buckeye region, between I-10 and the Gila River, while the water resources component was broader based, covering the majority of the Buckeye MPA and excluding only the Verrado region and locations south of the Buckeye Hills. In this manner, the most immediate infrastructure needs in central Buckeye were evaluated, and long-term water resources planning encompassed the bulk of the groundwater aquifer system most crucial for the Town's future water supply portfolio.

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Both Volumes I and II of the Integrated Water Resources Plan are intended to be updated on a periodic basis. They are evolving documents and their value is dependent upon up-to-date assumptions, inputs, and planning. Typically, 5-year intervals are recommended for water and wastewater master plans; however given the fluctuations in the current economic climate, an update within the next 3 years would be advised. The Water Resources Plan will require an update within the same timeline.

Electronic files of the report text, figures, appendices, GIS files and model files are provided as Appendix F.

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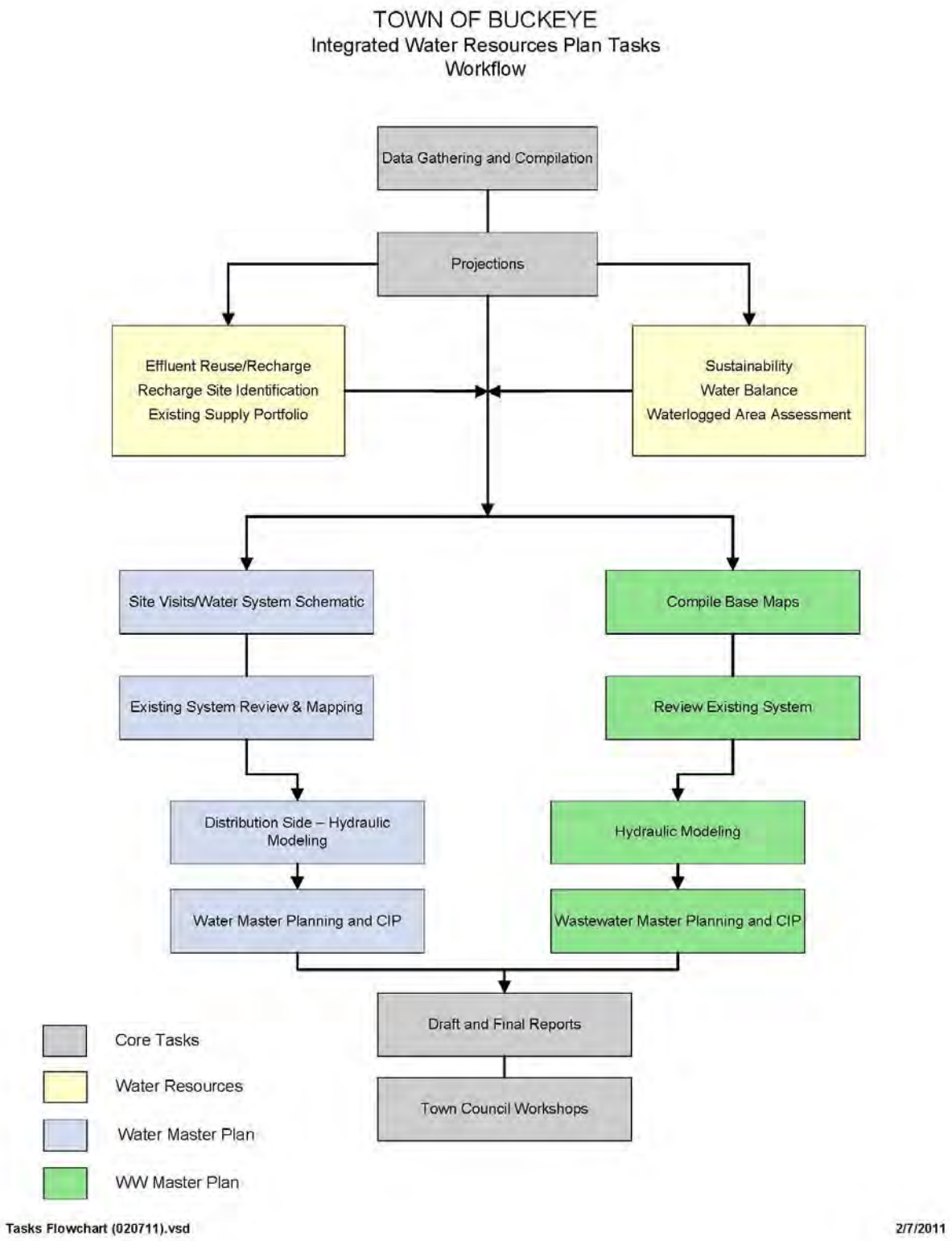

Chart 1. Integrated Water Resources Plan Flowchart

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1.5 Modeled Areas

The modeling focus in this Water and Wastewater Master Plan (Plan) encompasses the region of the Town MPA south of I-10 and north of the Gila River. The boundaries of the modeled areas were defined in conjunction with Town staff during the scoping phase of the project. Figure 1-3 shows the modeled areas for water and wastewater, which are slightly different to conform to existing Town and development plans. The modeled area for water does not include the Valencia service area of Global Water because that area is not served by the Town. The wastewater model area excludes the Sundance and Cipriani service areas in accordance with the scope of work (Appendix A).

1.6 Master Plans

The Town provided master plans for MPCs and developments which were used as the basis for future planning. Figure 1-4 shows the MPCs and development areas incorporated into this Plan. In the cases where multiple development plans overlapped, the most current or most comprehensive document or model was used for future planning. Existing master plans for individual developments that had not received final approval from the Town Engineer prior to the end of the data collection phase for this Water and Wastewater Master Plan were not included. However, these individual master plans can be included when the Water and Wastewater Master Plan is updated in the future.

Planned water and/or wastewater piping and facility information (pumps, tanks, manholes, etc.) was available for many of the developments and was added to the water or wastewater models. This information was available in electronic (GIS, computer aided design [CAD], model files) and non-electronic (paper map) formats. The non-electronic information was converted to an electronic format by digitizing the mapping and the facility information was imported into the model.

Tables 1-1 and 1-2 list the water and wastewater planning documents provided by the Town, respectively. For developments within the modeled area shown on Figure 1-4, the piping and facilities were activated in the model and checked to confirm the data were valid. For developments outside of the modeled region, the piping and facilities were added to the model, but were not active.

The tables list the source of information for the pipe diameters used in the model, but the diameter information was not always from the same source as the piping layout information. For example, in some cases piping was available in a CAD format but pipe diameters were not shown on the CAD drawing. For the wastewater plans, pipe invert elevations were not added to smaller diameter piping (usually less than 12 or 15 inches) in the model if the data were not available in a CAD or GIS format.

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Table 1-1. Water Master Plans

Development	Master Plan Document Name	Master Plan Date	Within Model Area	Source of Facilities Added to Model	Pipe Diameter Source	Comments
Anthem Sun Valley	Village 3 of Sun Valley South and Planning Unit 1 of Village 3 at Sun Valley South Volume 2A	February 2007	No	GIS data	N/A	
Bella Vagare	Water Master Plan Bella Vagare	July 2006	Yes	Scanned map	From scan	
Cipriani	Master Water Report from Cipriani	October 2006	Yes	N/A	N/A	Included in West Buckeye plan
Cottonwood	Cottonwood Water and Wastewater Master Plan Update	January 2007	Yes	Water model	From model	
Douglas Ranch	Master Water Study – Douglas Ranch Master Planned Community	May 2007	No	Scanned map	From scan	
Elianto	Elianto Water Master Plan	May 2007	No	Scanned map	From scan	
Entrada	TriMark Development Entrada Water Master Plan	June 2006	Yes	Scanned map	From scan	
Farallon	Farallon (A.K.A. Buckeye 240) Water Master Plan	December 2005	Yes	N/A	N/A	Included in West Buckeye plan
Festival Ranch/Festival Foothills	Festival Ranch Planning Unit One Domestic Water Plan & Update to Master Domestic Water Plan	November 2003	No	Scanned map	From scan	
Henry Park	Henry Park Water Exhibit	March 2006	Yes	Scanned map	From scan	
Lower Buckeye	Lower Buckeye Water Supply Study and Water Campus Master Plan	February 2006	Yes	Scanned map	From scan	
MC 85	MC 85 Water Group- Master Water Study	July 2008	Yes	CAD drawing	From scan	
Monte Verde	Monte Verde Water Master Plan	May 2007	No	Scanned map	From scan	
Montiere	N/A	N/A	No	Water model	N/A	
Mountain View Business Park	Mountain View Business Park I-10 and Dean Road in Buckeye, AZ	March 2008	Yes	Scanned map	From scan	
Mystic Vista	Water Distribution System Basis of Design Report- Mystic Vista	January 2006	No	Scanned map	From scan	
North Airport Road	North Airport Road Water Master Plan	July 2006	Yes	N/A	N/A	Included in Mountain View plan
San Madera	Water & Sewer Design Report for San Madera	August 2007	No	Scanned map	From scan	
Southwest Ranch	Water Master Plan for Southwest Ranch	March 2004	Yes	Scanned map	From scan	
Southwest Ranch Supply	Water Master Plan for Southwest Ranch	March 2004	Yes	Scanned map	From scan	

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Table 1-1. Water Master Plans

Development	Master Plan Document Name	Master Plan Date	Within Model Area	Source of Facilities Added to Model	Pipe Diameter Source	Comments
Spurlock	Master Water Report Amendment for Spurlock Ranch	March 2007	No	GIS data	N/A	
SR 85	SR-85 Improvement District	October 2008	Yes	Water model	From model	Included in West Buckeye plan
Tartesso	Water and Wastewater Master Plan Tartesso Amendment #2	July 2008	No	CAD drawing	From CAD	
The Reserve	The Reserve Final Water System Design Report	May 2007	Yes	Scanned map	From scan	
Trillium	N/A	N/A	No	Water model	From model	
Valle Del Sol	N/A	N/A	No	Water model	From model	
Ventana Ranch	Ventana Ranch Water Campus Service Area Water Master Plan	March 2007	Yes	CAD drawing	N/A	Included in Lower Buckeye plan
West Buckeye	Regional Water Master Plan for West Buckeye, AZ	September 2006	Yes	Water model	From model	This plan covers several other developments in the western portion of the modeled area and was used in the model instead of those other plans. This plan incorporated facility and piping plans from those other developments.
Westpark	Water Master Plan for West Park Phase 2 Service Area	February 2006	Yes	Scanned map	From scan	
Wingate	N/A	N/A	Yes	CAD drawing	N/A	

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Table 1-2. Wastewater Master Plans

Development	Master Plan Document Name	Master Plan Date	Within Model Area	Source of Facilities Added to Model	Invert Elevation Source	Comments
Anthem Sun Valley	Master Wastewater Report for Village 3 of Sun Valley South and Planning Unit 1 of Village 3 at Sun Valley South	October 2006	No	GIS data, possibly from a model	N/A	
Bella Vagare	Bella Vagare Sewer Master Plan	July 2006	Yes	Scanned map	From report	
Blue Hills	N/A	N/A	Yes	Scanned map	As-built drawings	
Buckeye Municipal Airport	Buckeye Municipal Airport Drainage and Utilities Study	May 2008	Yes	Scanned map	From report	
Cipriani	Master Wastewater and Reuse Repot for Cipriani	October 2006	No	GIS data, possibly from a model	N/A	
Cottonwood	Cottonwood Water and Wastewater Master Plan Update	January 2007	Yes	N/A	N/A	Included in SEBIS plan
Desert Creek	Sewer Master Plan Desert Creek	April 2007	No	N/A	N/A	
Douglas Ranch	Master Wastewater Study Douglas Ranch	August 2008	No	CAD drawing, possibly from a model	N/A	
East Buckeye (Sundance Portion)	East Buckeye Wastewater Master Plan	May 2004	No	Sewer model	From model	The Sundance portion of the plan was added to the model. The area within the SEBIS plan was not added.
Entrada	N/A	N/A	Yes	N/A	N/A	Included in SR85 plan
Farallon	Farallon Wastewater Master Plan	June 2005	Yes	Scanned map	From report	
Henry Park	Preliminary Engineering Report for Henry Park	March 2006	Yes	Scanned map	From report	
Monte Verde	Monte Verde Wastewater Master Plan	May 2007	Yes	Scanned map	From report	
Montiere	N/A	N/A	No	Sewer model	From model	
Mountain View Business Park	Conceptual Master Wastewater Report Mountain View Business Park I-10 and Dean Road in Buckeye, Arizona	March 2008	No	Scanned map	From scan	

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Table 1-2. Wastewater Master Plans

Development	Master Plan Document Name	Master Plan Date	Within Model Area	Source of Facilities Added to Model	Invert Elevation Source	Comments
Mystic Vista	Mystic Vista Sewer Analysis	October 2007	Yes	Scanned map	From report	
Palm Valley Church	Palm Valley Church Sewer Master Plan	March 2008	No	Scanned map	N/A	
Portico	Portico Sewer Master Plan	June 2006	Yes	Scanned map	From report	
San Madera	Water & Sewer Design Report for San Madera	August 2007	Yes	Scanned map	N/A	
SEBIS	Southeast Buckeye Interceptor Sewer	Memo dated January 2007	Yes	Sewer model	From model	
Southwest Ranch	Sewer Master Plan for Southwest Ranch	March 2004	Yes	N/A	N/A	Included in SEBIS plan
Spurlock	Master Wastewater Report Amendment for Spurlock Ranch	March 2007	No	GIS data, possibly from a model	N/A	
SR85	Wastewater Master Plan SR85 Service Area	October 2008	Yes	Sewer model	From model	
Sun City Festival/ Festival Ranch	N/A	N/A	No	Scanned map	N/A	
Tartesso	Water and Wastewater Master Plan Tartesso Amendment #2	July 2008	No	Sewer model	From model	
The Reserve	The Reserve Final Wastewater Design Report	May 2007	Yes	Scanned map	N/A	
Valle Del Sol	N/A	N/A	No	Sewer model	From model	
Ventana Ranch	Ventana Ranch – Units I & II Final Sewer Report	December 2006	Yes	CAD drawing	N/A (there were some inverts in report, but they did not match CAD drawing)	
Watson Road	Watson Road Community Facilities District Sewer Mains Conceptual Plan	December 2005	Yes	As-built drawings	As-built drawings	
Westpark	Sewer Master Plan for Westpark	May 2004	Yes	N/A	N/A	
Wingate	N/A	N/A	Yes	CAD drawing	N/A	

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2. EXISTING WATER SYSTEM

The Town owns and operates the water distribution facilities that serve most of the residential, commercial, and industrial customers within the Town limits. Figure 2-1 shows the general location of the areas served by the Town. Several private water companies also provide service within the Town's limits. The larger service providers include: Arizona American Water, serving Verrado; Global Water, serving the Valencia service area, an area north of the Historic Buckeye service area; and Arizona Water Company, serving the White Tank Water System located east of the Sundance service area. Figure 2-1 shows the service areas of these water companies as well as the service area of the smaller providers. This section discusses only the water distribution facilities within the areas currently served by the Town.

2.1 Service Areas

The Town's existing water system consists of five main service areas which are operated as independent systems. They are Historic Buckeye, Airport, Sundance, Tartesso, and Festival Ranch as shown on Figure 2-1. Figure 2-2 shows a hydraulic schematic of the Town's water system which illustrates the relationship between the pressure zones, tanks, and pump stations for each of these five systems. Figures 2-3 through 2-6 show detailed views of the Historic Buckeye, Sundance, Tartesso, and Festival Ranch systems. All piping shown in the figures is based on the City's GIS piping as of August 2009.

The Historic Buckeye water system is the oldest infrastructure within the Town's water system, with pipes dating back to the 1950s. Over the years, the other service areas were added as new developments were built within the Town limits. Each service area includes a separate booster pump station, storage tanks, supply wells, and a pipe network. Table 2-1 describes each service area and lists the pressure zones within each service area. The pressure zones are discussed in more detail in Section 2.3.

Table 2-1. Service Areas

Service Area	Pressure Zones	Service Area Description
Historic Buckeye	Zone 1	Oldest water infrastructure in the system, dating back to the 1950s. This area was formerly connected to the Global Water private system at Apache Road to the north.
Sundance	Zones 2 and 3	Water system serves the Sundance MPC and Rancho Sunora, and is connected to the North Airport Road Booster Pump Station.
Tartesso	Zone 3	Water system serves the Tartesso MPC.
Festival Ranch	Zone 7	Water system serves the Festival Ranch MPC which consists of primarily single family residential dwellings in the Festival Foothills development and the age-restricted Sun City Festival development.
Airport	Zone 2	The Buckeye Airport includes four hangers that are operated by independent businesses. This area is slated for development by the Town of Buckeye and a new water system will be needed to serve that development. It is expected that the existing facilities will be abandoned.

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In addition to the pressure zones listed in Table 2-1, there is also a very small pressure zone served by the Christmas Well. This small pressure zone was not analyzed because it only serves three residences and is outside of the modeled area. The Christmas Well is located 2 miles north of the Sundance booster pump station and pumps water to a storage tank and booster pump that serves the three residences.

2.2 Water Supply

The Town's water system is supplied by groundwater wells. Each separate service area has a network of wells that, in all but one location, connects directly to a storage tank. The Historic Buckeye service area is the only exception to this with a single well (Church Well) that pumps directly into the water distribution system. Table C-1 (Appendix C) of Volume I (Water Resources Plan) lists the details about each well within the Town's water system.

2.3 Pressure Zones

The Town established pressure zone boundaries at 130-foot elevation intervals. This equates to a 57 pounds per square inch (psi) range of static pressures across each zone. This Plan uses ground elevations to designate these pressure zone boundaries. However, elevations within a pressure zone may be slightly higher or lower than the specified elevation interval because of local topography or other conflicts. Table 3-5 of the System Design and Evaluation Criteria memorandum in Appendix B lists the existing and future pressure zone numbering and high/low elevations for each zone. The pressure zone boundaries used in this Plan are shown on Figure 2-7.

2.3.1 Pressure Zone Valves

Pressure reducing valves (PRVs) reduce the pressure of water transferred from a higher pressure zone to a lower pressure zone. For the most part, the Town does not exchange water between pressure zones under normal operations and water is usually supplied to each zone from pumped storage. However, there are a few PRVs that allow water to be shared between pressure zones in the Sundance service area (Table 2-2). There are no PRVs within Historic Buckeye and PRV information was unavailable for the other service areas.

Table 2-2. Town Pressure Reducing Valves

Valve	Setting (psi)[1]	Number of Valves	Location
Watson Road PRV Station	60	2	Sundance, from Zone 3 to Zone 2
Sun Valley Parkway PRV Station	56	2	Sundance, from Zone 3 to Zone 2
Sunora PRV Station	50	2	Sundance, from Zone 2 to Sunora Pressure Zone, a small pressure zone with reduced pressures due to older, lower pressure piping

1. Recorded during field testing in October 2008.
2. psi = pounds per square inch

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2.4 Storage Tanks

Each service area within the Town's water system is served by one or two adjacent storage tanks. The tanks are cylindrical, welded steel tanks built at or slightly below ground level and are filled by wells or the distribution system. Pumps then deliver water from the tanks into the distribution system. Table 2-3 lists details about each existing storage tank within the Town's water system. Note that the Historic Buckeye tanks are over 30 feet tall. The Town has not generally allowed tanks of this height except in industrial areas.

Table 2-3. Storage Tank Summary

Tank	Approximate Capacity (gallons)	Floor Elevation (feet)	Tank Height (feet)	Approximate Diameter (feet)	Pressure Zone Served
Historic Buckeye 1	700,000	885	35	60	Historic Buckeye Zone 1
Historic Buckeye 2	750,000	885	36	60	Historic Buckeye Zone 1
Sundance 1	2,600,000	1,080	16	175	Sundance Zones 2 and 3
Sundance 2	1,500,000	1,080	16	130	Sundance Zones 2 and 3
North Airport Road 1	1,000,000	1,037	16	105	Sundance Zone 3
North Airport Road 2	1,000,000	1,037	16	105	Sundance Zone 3
Tartesso	2,000,000	1,220	16	155	Tartesso Zone 3
Festival Ranch	1,200,000	1,595	16	116	Festival Ranch Zone 7
Airport	10,000	1,020	16	10	Airport Zone

Table 2-4 summarizes tank operation by service area and includes a picture of a representative storage tank. Tank operational information was not available for the Airport tank.

Table 2-4. Storage Tank Summary

Service Area	Storage Tank Description	Storage Tank Photograph
Historic Buckeye	The two storage tanks are both located at 615 Arizona Eastern Avenue. The tanks are filled from Wells 12 and 14 and Farallon Well 2 using an altitude valve on the tank inlet pipes which allows water to enter the tanks to a specified level. The photograph at the right shows one of the two tanks.	

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Table 2-4. Storage Tank Summary		
Service Area	Storage Tank Description	Storage Tank Photograph
Sundance	The Sundance service area has four storage tanks: two at the Sundance Water Campus and two at the North Airport Road Water Campus. The Sundance storage tanks are located on Yuma Road, just south of I-10. The photograph at the right shows one of the two Sundance tanks. Sundance Wells 1, 2, 3, 4, 7 and 8 pump directly into the Sundance storage tanks through dedicated well piping. Sundance Wells 5 and 9 are not yet connected; there is no Well 6. The well pumping is controlled by SCADA, which turns wells on and off to control the levels in the tanks. The water from the tanks is then pumped into the system based on system pressure. The North Airport Road storage tanks are located east of Airport Road and north of Van Buren Street. North Airport Road Wells 1 and 2 pump directly into the North Airport Road storage tanks through dedicated piping.	
Tartesso	The storage tank is located at 4023 296th Avenue. The tank is supplied by Tartesso Wells 1 and 2. Tartesso Well 3 is not yet connected. The water from the tank is pumped into the system based on system pressure.	

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Table 2-4. Storage Tank Summary		
Service Area	Storage Tank Description	Storage Tank Photograph
Festival Ranch	The storage tank is located on Beardsley Parkway. The tank is supplied by Sun City Festival Wells 1 and 2. Sun City Festival Well 3 is not yet connected. The water from the tank is pumped into the system based on system pressure.	

2.5 Pump Stations

There are seven pump stations in the Town's water system. Each pump station, with the exception of the Airport system, contains multiple booster pumps. The pumps boost water from ground level storage directly into their respective distribution systems. Variable frequency drives (VFDs) at each pump station maintain a constant discharge pressure. Pertinent design details for each of the pump stations in the Town's water system are summarized in Table 2-5. Figures 2-8 and 2-9 show the booster pumps at the Historic Buckeye Site, and the Zone 2 and Zone 3 booster pumps at Sundance.

Table 2-5. Pump Station Summary

Service Area - Zone	Pump Number	Horsepower	Design Head (feet)	Design Flow (gpm)	Notes
Historic Buckeye	1	75	155	1,250	The pump station was upgraded in 2006 with new pumps and is located next to the Historic Buckeye storage tanks.
	2	75	155	1,250	
	3	75	155	1,250	
Sundance Zone 2	1	50	120	1,000	The pump station has been in service since 2003 and is located next to the Sundance storage tanks. There is a slot for a sixth pump.
	2	50	120	1,000	
	3	50	120	1,000	
	4	25	120	500	
	5	50	120	500	

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Table 2-5. Pump Station Summary					
Service Area - Zone	Pump Number	Horsepower	Design Head (feet)	Design Flow (gpm)	Notes
Sundance Zone 3	1	75	200	1,000	The pump station has been in service since 2003 and is located next to the Sundance storage tanks.
	2	75	200	1,000	
	3	75	200	1,000	
	4	75	200	1,000	
	5	125	200	2,000	
	6	125	200	2,000	
Sundance Zone 3 (North Airport Road BPS)	1	125	228	1,300	The North Airport Road pump station is not currently in service.
	2	125	228	1,300	
	3	125	228	1,300	
	4	125	228	1,300	
	5	125	228	1,300	
	6	125	228	1,300	
Tartesso	1	100	165	1,350	The pump station has been in service since 2006. The pump station is located in Zone 4 but the pump discharge head is significantly less than the desired HGL for Zone 4.
	2	100	165	1,350	
	3	125	165	2,155	
	4	125	165	2,155	
	5	125	165	2,155	
Festival Ranch	1	200	226	2,125	The pump station has been in service since 2006.
	2	200	226	2,125	
	3	200	226	2,500	
	4	40	226	475	
Airport	1	5	Not available	< 100	

gpm = gallons per minute
HGL = hydraulic grade line

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Figure 2-8. Historic Buckeye Booster Pumps

Figure 2-9. Sundance Booster Pumps

2.6 Pipe Network

The Town's existing distribution system (which delivers water to customers) consists of pipes ranging in diameter from 0.75 to 24 inches. Each service area is relatively isolated and the supply is provided locally, with the exception of Wells 12 and 14 which are located outside of the Historic Service Area but provide a portion of the supply to the area. Table 2-6 lists the length of distribution piping by diameter for each service area. Pipe material information was not available for the majority of the distribution piping and is therefore not listed.

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Table 2-6. Length of Water Distribution Piping by Diameter

Pipe Diameter (inches)	Length of Pipe (feet)					
	Historic Buckeye	Sundance	Tartesso	Festival Ranch	Airport	Total
0.75	222	0	0	0	0	222
1	1,464	0	27	0	0	1,491
1.5	2,450	0	0	0	0	2,450
2	26,799	1,262	0	16	6,012	34,090
2.5	975	15	0	0	0	990
3	3,392	0	0	0	0	3,392
4	21,773	4,507	0	0	0	26,280
6	43,452	62,456	518	46	0	106,471
8	74,912	280,045	160,609	32,544	0	548,111
10	6,885	803	28	0	0	7,716
12	89,679	71,395	14,337	0	0	175,410
16	41,095	41,499	22,072	0	0	104,666
18	302	17	0	0	0	319
20	0	12,722	5,034	27,837	0	45,594
24	0	9,517	4,415	0	0	13,932
Total	313,400	484,238	207,040	60,443	6,012	1,071,134

The Town's existing well transmission piping (from supply wells to the distribution system) consists of pipe ranging in diameter from 4 to 36 inches. Table 2-7 lists the length of well transmission piping by diameter for the Historic Buckeye, Sundance, and Tartesso service areas. Wells 12 and 14 pump to the storage tanks at the Historic Buckeye booster pump station via an approximately 14-mile pipeline. Along this route, pumped water is directly delivered to one location. This pipeline is included in the water transmission piping summary. Information was not available for well supply piping at the Airport and Festival Ranch. Pipe material information was not available for the majority of the transmission piping and is therefore not listed.

Table 2-7. Length of Water Transmission Piping by Diameter

Pipe Diameter (inches)	Length of Pipe (feet)			
	Historic Buckeye	Sundance	Tartesso	Total
4	272	0	138	410
6	1,358	0	0	1,358
8	4,214	147	0	4,361
12	40,028	8,287	6	48,321
16	31,690	9,688	5,368	46,746

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Table 2-7. Length of Water Transmission Piping by Diameter

Pipe Diameter (inches)	Length of Pipe (feet)			
	Historic Buckeye	Sundance	Tartesso	Total
20	0	2745	8,613	11,358
24	0	3925	21	3,946
36	0	0	5,510	5,510
Total	77,562	24,792	19,656	122,010

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3. EXISTING WASTEWATER SYSTEM

This section includes a description of the Town's wastewater system, including wastewater treatment plants/water reclamation facilities (WWTP/WRF) and their corresponding collection areas. Figure 3-1 shows the location of the existing WWTPs, their collection areas, and the existing collection system piping as well as planned WWTPs.

3.1 Wastewater Treatment Plants

The Buckeye wastewater system consists of six WWTPs and their corresponding collection areas. The Town owns and operates only four of the treatment plants: Central Buckeye WWTP, Sundance WWTP, Festival Ranch WRF, and Tartesso West WRF. The Arizona Department of Corrections operates the Arizona State Prison Complex-Lewis (ASPC-Lewis) WWTP which serves the state prison complex, and Arizona American Water Company owns and operates the Verrado WRF. Table 3-1 presents capacity, treatment process, and effluent disposal details for each of the existing WWTPs within the Town's MPA. The basic information in the table was taken from the MAG 208 Water Quality Management Plan, Comprehensive Amendment (MAG 208 Plan) (CMX, 2007). Effluent disposal and plant capacities have been updated with current operational information.

Table 3-1. Treatment Plant Summary

Treatment Plant	Plant Capacity (MGD)		Location and Treatment Process	Plant Effluent
	Existing	Ultimate Proposed		
ASPC - Lewis WWTP	0.75	0[1]	Located in the southern part of Buckeye, north of Patterson Road and west of US Highway 85. Serves the Arizona State Prison Complex-Lewis (ASPC-Lewis). Utilizes an extended aeration, activated sludge process.	Produces B+ effluent that is used for turf irrigation within the prison property.
Central Buckeye WWTP	3.0 (additional 1.5 MGD under construction)	45.8	Located on 7th Street, south of Beloat Road. Treatment includes influent pumping, mechanically and manually cleaned bar screens, grit removal, secondary treatment, secondary clarification, tertiary filtration, and chlorination/dechlorination.	Produces A+ effluent which is reused by the Town or discharged to the Arlington Canal for use by downstream irrigators. If not used for irrigation the water eventually discharges to the Gila River.
Festival Ranch WRF	1.0	17.3	Located along Wagner Wash near Sun Valley Parkway. Treatment includes fine screens, Sequencing Batch Reactor (SBR) for secondary treatment, tertiary filtration, and ultraviolet (UV) disinfection.	Produces A+ effluent that is used for golf course irrigation. Excess effluent is discharged to Wagner Wash.

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Table 3-1. Treatment Plant Summary

Treatment Plant	Plant Capacity (MGD)		Location and Treatment Process	Plant Effluent
	Existing	Ultimate Proposed		
Sundance WWTP	2.4	13.9	Located just east of Dean Road and north of the Roosevelt Irrigation District (RID) canal. The existing treatment plant (Phase 1) has a capacity of 1.2 MGD. The Town is currently adding a Phase 2 expansion for a total plant capacity of 2.4 MGD. The current phase includes biological processes, nitrification, denitrification, aerobic sludge digestion, sludge dewatering, disposal processes, and ultraviolet (UV) disinfection.	Produces A+ effluent that is used for golf course irrigation. Excess effluent is discharged to the Buckeye Canal via a 20-inch low pressure effluent line.
Tartesso West WRF	1.2	24.2	Located near the intersection of 319th Avenue and McDowell Road. Treatment includes an activated sludge process within hybrid SBRs for secondary removal of organics and nutrients. Primary treatment includes headworks with screening and grit removal. The facility is also equipped with tertiary treatment facilities including a surge basin, filtration, and UV disinfection with backup chlorination.	Produces A+ effluent that is recharged at their nearby basin infiltration recharge facility.
Verrado WRF	0.45	3.6	Located along McDowell Road just west of Tuthill Road. The plant operates as a SBR treatment facility with screening, secondary treatment with biological nitrogen removal, and chlorination.	Produces Class B+ (ultimately to be A+) effluent which is used for golf course irrigation and recharge.

1. The ASPC-Lewis WWTP will ultimately be phased out of service and the area currently served by the WWTP will be served by the Gila Rainbow WRF.

2. MGD = million gallons per day

3. Ultimate proposed plant capacities are based on the MAG 208 Water Quality Management Plan - Comprehensive Amendment for the Town of Buckeye (October, 2007) and are not based on population projections from land use in the Town of Buckeye General Plan Update (Adopted January 18, 2008)

3.2 Piping

Collection system piping throughout the Town ranges from 4 to 66 inches. Table 3-2 lists the length of pipe in feet by diameter for each collection system service area based on the Town's GIS. Piping for the Verrado and ASPC-Lewis collection systems, which are not operated by the Town, are not reflected in this summary. Pipe material information was not available for the majority of the pipe network and is therefore not included.

Table 3-2. Length of Wastewater System Piping by Diameter

Pipe Diameter (inches)	Length of Pipe (feet)				
	Central Buckeye	Sundance	Tartesso West	Festival Ranch	Total
4	2,212	269	0	0	2,481
6	41,586	0	643	0	42,229
8	245,629	256,497	137,262	39,906	679,294
10	40,347	15,789	2,703	0	58,839
12	36,560	16,913	5,852	0	59,325
15	37,159	7,246	0	2,106	46,511

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Table 3-2. Length of Wastewater System Piping by Diameter

Pipe Diameter (inches)	Length of Pipe (feet)				
	Central Buckeye	Sundance	Tartesso West	Festival Ranch	Total
18	16,514	15,990	1,356	0	33,860
21	0	5,088	0	0	5,088
24	21,701	4,161	0	0	25,862
27	0	3,362	0	0	3,362
30	3,897	8,716	14,768	24,629	52,010
36	4,548	0	0	0	4,548
42	732	0	0	0	732
48	0	0	922	0	922
60	2,628	0	8,323	0	10,951
66	1,337	0	0	0	1,337
Unknown	9,406	10,506	9,145	5,567	34,624
Total	464,256	344,537	180,974	72,208	1,061,975

3.3 Lift Stations

There are three lift stations within the wastewater service areas operated by the Town: the Central Buckeye collection system has one lift station, and the other two are located within the Sundance collection system. Details of each lift station are listed in Table 3-3.

Table 3-3. Lift Stations

Name	Collection System	Lift Station Location	Discharge Location	Pumping Capacity	Force Main Size (inches)
Broadway and Miller Road Lift Station	Central Buckeye	Broadway and Miller Road	Broadway and Apache Road manhole	720 gpm (Two 1.9-HP pumps) Model: Not Available	Not a force main. Pumps into an overflow into a gravity flow sewer.
Parcel 7 Lift Station	Sundance	Van Buren Street, east of Watson Road	Van Buren St. and Watson Road manhole	240 gpm (Two 6-HP pumps) Model: FLYGT MP3102-212	Two 4-inch pipes
Blue Horizon Lift Station	Sundance	Northeast corner of RID Canal and Yuma Road	Sundance WWTP	4,252 gpm (Two 70-HP Pumps) Model: FLYGT NP3301.180	16-inch

gpm = gallons per minute

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3.4 Individual Sewage Disposal System

Buckeye has a number of areas, mostly within the Central Buckeye Planning area, that use septic systems or individual sewage disposal systems (ISDSs). While most of these areas are Maricopa County land (one major exception is the incorporated portion of the Rancho Sunora development), they could eventually be connected to the Town's wastewater system. It is assumed that these areas will contribute flow into the collection system in the future. Some of the areas which rely on septic systems are within the Historic Buckeye water service area, while others are in the Sundance water service area.

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4. POPULATION AND FLOW PROJECTIONS

The Town of Buckeye has grown dramatically in areal extent and population since its incorporation as a 440-acre community in 1929, with the majority of this growth occurring in the last 10 years. Until recently, future growth was projected to follow the trends over this last decade, culminating in an ultimate population between 1.5 and 2.0 million people (2007 General Plan Update; 2007 MAG 208 Plan Amendment).

Population projections are a crucial element for master planning. Projected growth rates and the buildout population are the basis for wastewater flow projections, water demand, and ultimate capacity planning. In this section, historic population and growth are presented, and the changes in recent trends are discussed. Buildout population projections are compared to MAG population projections through 2030 to evaluate and modify the original planning horizons defined in the scope of work (Appendix A).

4.1 Historic Population and Growth Rates

Table 4-1 presents census population from 1970 through 2005 and the acreage of the Town's annexations for the same period. Between 1970 and 2000, the population growth rate ranged from 3 to 5 percent per year. This tripled to over 9 percent per year between 1990 and 2000.

Growth in the 5-year period from 2000 to 2005 increased dramatically to approximately 58 percent per year. While an impressive increase, this does include the impacts of the expansion of the Town's annexed boundary, which almost doubled in size. The current Town boundary encompasses over 238,000 acres (Figure 1-1).

Table 4-1. Town of Buckeye Census Population and Annexations 1970-2005

Year	Population	Percent Growth for the Period	Average Population Growth Per Year	Town Boundary (Total Annexed Acres)
1970	2,599	--	--	n/a
1980	3,434	32%	3%	n/a
1990	5,038	47%	5%	11,904
2000	6,537	30%	3%	81,344
2005*	25,406	289%	58%	142,719
2010**	--			238,651

*Sources: U.S. 1970, 1980, 1990 and 2000 Census Population; *Town of Buckeye Economic Development Fact Sheet; **Town of Buckeye GIS Database June 2009*

Yearly population estimates from 2001 through 2009 from the Arizona Department of Commerce (ADC) are presented in Table 4-2. The 2005 population estimate compares very well to the census data for 2005. The 2009 estimate from ADC reflects the current economic recession but still

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projects a slight increase in population relative to the 2008 estimate. Economic indicators from the Town suggest that population has dropped since late 2008; current population is assumed to be at or near the 2007 level of 40,467 residents.

Table 4-2. Town of Buckeye Population Estimates 2001-2009

Year	Population	Percent Growth per Year
2001	10,650	25%
2002	11,955	12%
2003	13,065	9%
2004	14,540	11%
2005	23,955	65%
2006	31,745	33%
2007	40,467	27%
2008	50,143	24%
2009	52,764	5%

Source: Arizona Department of Commerce, 2010

The databases used in support of this Plan reflect 2007 and 2008 groundwater pumping, land use, billing, water use, and wastewater flows. For consistency, the 2007 population estimate of 40,467 was used as a basis for calculations and assumptions, representing both 2007 and 2008 population. Until 2010 census data are available, this estimate is considered to be a rough approximation of present-day population.

4.2 Land Use Plan and Population Projections

Buckeye's General Plan (Town of Buckeye, 2007) included population projections based on the buildout land use, acreage within each land use category, and assumptions regarding population density. The areal distribution of each land use category is shown on Figure 1-2. The land use acreages were updated for this project to reflect revisions to the MPA boundary and land uses that post-date the General Plan (Table 4-3). The location for all future schools, parks, and development common areas are not specified in the General Plan. Therefore, the acreage for schools, parks, and development common areas is not available separately.

Table 4-3. Total Acreage in the Buckeye Municipal Planning Area by Land Use Category

Land Use Category	Acres
Very Low Density Residential	29,739
Low Density Residential	64,392
Medium Density Residential	85,061
Medium High Density Residential	9,904
High Density Residential	4,370

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Table 4-3. Total Acreage in the Buckeye Municipal Planning Area by Land Use Category	
Land Use Category	Acres
Mixed Use	14,449
Verrado - Master Planned Community	8,795
Festival Ranch - Master Planned Community	10,407
City Center	1,151
Regional Commercial	15,309
Professional Office Employment	3,075
Open Space	102,761
Military	1,438
Industrial	11,114
Government Center	56
Community Commercial	2,658
Business Park	14,107
TOTAL	378,786

Based on the updated acreage from Table 4-3 and assumptions regarding percent of developable acres, density, and persons per household from the General Plan, an updated buildout population was calculated (Table 4-4). Where there was a range given for the density of a residential land use type in the General Plan, the midpoint of the range was used for this calculation. Total buildout population for the Town of Buckeye based on these assumptions is 1,847,516 residents.

Table 4-4. Land Use Categories and Projected Population at Buildout

Land Use Category	Acres	Percent Developed	Density (Dwelling Units/Acre)*	People/ Household	Buildout Population
Very Low Density Residential	29,739	80%	0.5	2.7	32,118
Low Density Residential	64,392	80%	2.0	2.7	278,173
Medium Density Residential	85,061	80%	4.5	2.7	826,788
Medium High Density Residential	9,904	80%	8.0	2.7	171,135
High Density Residential	4,370	80%	12.5	2.7	117,986
Mixed Use	14,449	80%	10.0	2.7	312,106
Verrado - Master Planned Community	8,795	80%	1.6	2.7	30,396
Festival Ranch - Master Planned Community	10,407	80%	2.4	2.7	53,952
City Center	1,151	100%	8.0	2.7	24,862
TOTAL	228,268	--	--	--	1,847,516

**Density used for population calculation is the midpoint of ranges cited in the Town of Buckeye General Plan (2007)*

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4.3 Planning Horizons

The original scope of work specified four planning horizons for water and wastewater hydraulic modeling: 2007, 2010, 2020, and buildout. For water resources modeling, a 100-year timeline was specified, which is consistent with the current regulatory framework. These planning horizons were adjusted during the course of the project to capture more recent trends not yet reflected in published population projections from MAG, which publishes every 5 years. The most recent MAG projections were published in 2007, compiled during the prior year, and thus assumed rapid growth patterns that were in keeping with trends from that time period (Table 4-5). Those rapid growth trends are no longer viable predictors for the Town's planning horizons. Alternative approaches were therefore utilized for this project, including the Town's most recent population projections from the 2008 DAWS application and buildout population projections from the Town's General Plan.

Table 4-5. Comparison of Population Projections 2010-2030

Year	2008 DAWS Application Population	MAG Population	Percent Difference MAG versus DAWS Population
2010	50,000	95,695	+91%
2020	225,000	275,674	+25%
2030	375,000	537,490	+43%

DAWS = Designation of Assured Water Supply, December 2008

MAG = Maricopa Association of Governments

The Town's Water Resources Department developed population projections in support of their DAWS application submitted in December 2008. These datasets were compiled less than two years after the 2007 MAG projections, but a comparison of MAG estimates with the more recent data from the Town (Table 4-5) reflects the significant changes that have occurred during this period. The 2010 projection from MAG is almost double the more current estimate derived by the Town. Based on changes in occupancy rates since 2008, the DAWS estimate of 50,000 residents is still an over-estimate. The difference in 2030 population projections is not as significant but there is again a substantial divergence between these two sources.

Recovery from the economic recession and a return to a more stable economy is predicted for Arizona (Vest, 2010), although a more conservative growth pattern relative to the previous decade is anticipated. The explosive rate of construction and home sales of the last 10 years should not be projected into the future for planning purposes when the reality is a trend toward downsizing buildout densities and population estimates.

The original planning horizons of 2007, 2010, 2020, and buildout were therefore revised for the water/wastewater hydraulic modeling and CIP to account for slower growth and uncertainty associated with population projections. The 2007 population data were used to represent the present-day planning horizon and were augmented with 2008 data where feasible. Planning for 2010 and 2020 was eliminated because MAG population projections and the associated spatial

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distribution of growth for these periods were too out-of-date to warrant a separate planning horizon. The planning horizons for the hydraulic modeling and CIP planning are therefore focused on present-day and buildout.

4.3.1 Buildout Projections

The buildout planning horizon is a relative timeframe and is not tied to a specific year. It is, however, the most crucial planning horizon, as all interim year planning and the CIP are dependent upon the ultimate buildout infrastructure requirements. Land use from the 2007 General Plan incorporates planning documents from individual developments and MPCs, to the extent feasible. The land use data, although generalized, are the best spatial representation of the long-term distribution and magnitude of residential properties for the Town. However, the population projections based on the land use categories assumes maximum usage of acreage within each residential category (Table 4-4). In many cases, these population projections are higher than individual development plans.

As the most comprehensive future planning tool, General Plan population projections were utilized for water and wastewater hydraulic modeling in this Plan. The hydraulic modeling and CIP were restricted to that portion of the MPA south of I-10 and north of the Gila River, and were designed with the flexibility to easily revise or scale back the population and model demands in the future. It is anticipated that developments north of I-10 will be incorporated into these models as new and revised plans are submitted to the Town in the future.

The Water Resources Plan contains a Sustainability Assessment which compares the projected available groundwater supply with the projected buildout population. Based on the Sustainability Assessment, the sustainable buildout population is 970,073, which is close to 50 percent of the buildout population of 1,847,516 from the General Plan. After discussions with the Town, it was decided that for this first iteration of the Plan the entire buildout population would be used for the modeled areas. In the future, the Town will need to decide where reductions in the buildout population are feasible and/or identify additional sources of water supply.

4.4 Water and Wastewater Flows

Water demands and wastewater flows were calculated based on the land use and population projections for existing (2007-2008) conditions and for buildout. This section describes the development of the water and wastewater flows.

4.4.1 Water Demands

Water demands were calculated for the two service areas within the modeled area: Historic Buckeye and Sundance. This section describes the basis and assumptions for the water demand calculations.

Existing Water Use

Existing water system demands were calculated from water billing and water production data for Historic Buckeye and Sundance. The Town provided daily supply well logs with total daily flow from which the Maximum Day Demand (MDD) was calculated for both modeled service areas. Table 4-6 lists the system demands for the existing water systems. There were insufficient data to

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calculate the Average Day Demand (ADD). At least a year of daily production data is required to calculate the ADD, but only 3 months of data were available for Sundance and 9 months were available for Historic Buckeye.

Table 4-6. Maximum Day Demand

Area	Maximum Day Demand (MGD)	Comment
Historic Buckeye	0.92	Calculated from daily water production data for January through September 2008. The raw production data varied greatly from day to day (such as 0.38 MGD one day and 2.0 MGD the next day in April). Therefore, a trend line was plotted through the data and 0.92 MGD was selected as the maximum point on the trend.
Sundance	3.38	Calculated from daily water production data for July through September 2008.

MGD = million gallons per day

Water Peaking Factors

The daily water use pattern, or diurnal pattern, represents the fluctuation in demand over a given day. Diurnal patterns were calculated from the supervisory control and data acquisition (SCADA) for Sundance for the maximum water use week of 2008 (July 2 through 8). A diurnal pattern representative of that week was selected (July 8, 2008). There were not sufficient data to calculate diurnal patterns for the Town's other service areas. Figure 4-1 shows the Sundance diurnal pattern.

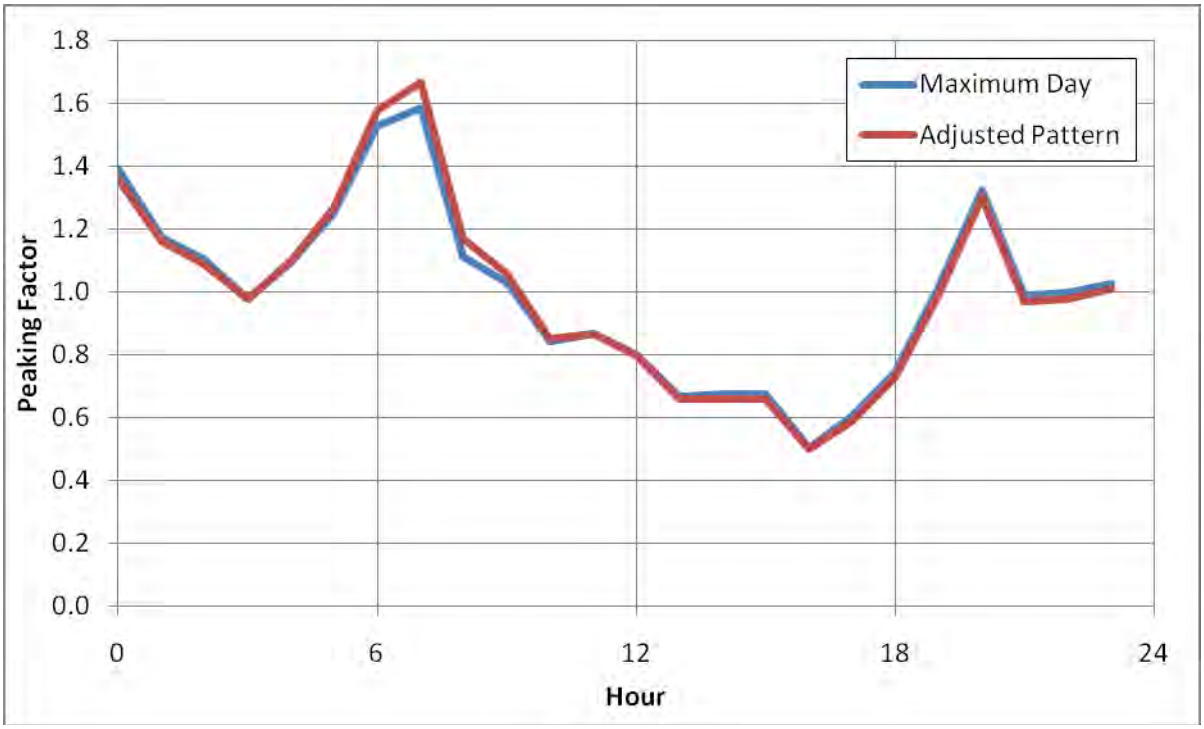

Figure 4-1. Maximum Day Diurnal Patterns - Sundance

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The Town requires a MDD peaking factor of 1.8 times ADD and a Peak Hour Demand (PHD) peaking factor of 3.0 times ADD (or 1.67 times MDD). The highest hourly peaking factor for July 8 was 1.59, which is slightly below the desired PHD of 1.67 times MDD. The diurnal pattern was therefore adjusted upward to give a PHD of 1.67 (Figure 4-1).

Table 4-7 lists the maximum day hourly peaking factors shown on Figure 4-1. The Sundance Diurnal in the table is the Maximum Day pattern shown in the figure. The Adjusted Peak Diurnal is the Adjusted Pattern shown in the figure. The average of the hourly factors is 1.0, which means that over an entire day, the water use equals MDD.

Table 4-7. Diurnal Pattern Peaking Factors

Hour	Sundance Diurnal	Adjusted Peak Diurnal
0	1.39	1.36
1	1.17	1.16
2	1.10	1.09
3	0.98	0.98
4	1.10	1.10
5	1.25	1.27
6	1.53	1.58
7	1.59	1.67
8	1.11	1.17
9	1.03	1.06
10	0.84	0.85
11	0.87	0.87
12	0.80	0.80
13	0.67	0.66
14	0.68	0.66
15	0.68	0.66
16	0.51	0.50
17	0.61	0.59
18	0.75	0.73
19	1.01	0.99
20	1.32	1.30
21	0.99	0.97
22	1.00	0.98
23	1.03	1.01

4.4.2 Wastewater Flows

Wastewater flows were calculated for the Central Buckeye collection system, which is the only existing system within the modeled area. This section describes the calculations performed to assign existing wastewater flows to the model.

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Existing WWTP Flows

Existing wastewater flows were analyzed using daily records from the Central Buckeye WWTP (Table 4-8). Figure 4-2 shows the daily trends at the Central Buckeye WWTP from June 2004 through December 2008, and reflects a relatively steady growth rate of 46 percent per year.

Table 4-8. Existing Wastewater Flow for Central Buckeye WWTP

Year	Average Annual Flow (MGD)	Peak Wet Weather Daily Flow (MGD)
2005	0.55	1.66
2006	0.76	1.21
2007	1.00	1.43
2008	1.16	1.44

MGD = million gallons per day

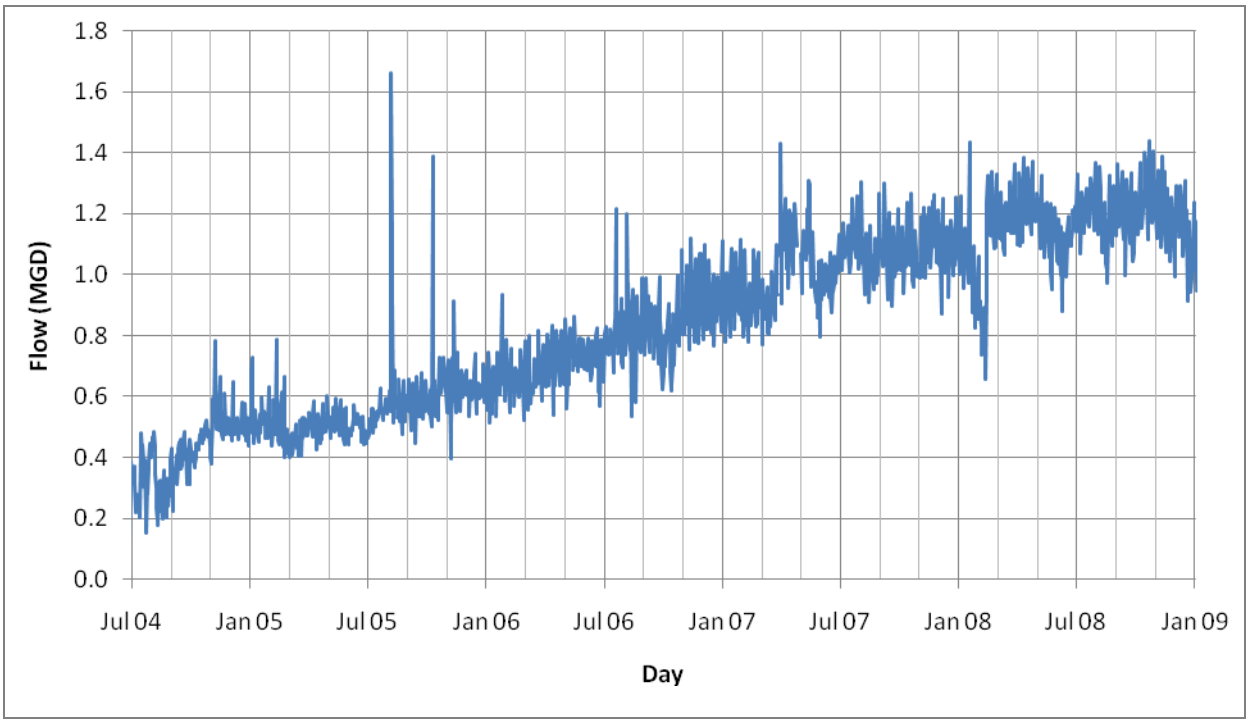

Figure 4-2. Daily Flows at Central Buckeye WWTP

Wastewater Flow Monitoring

A wastewater flow monitoring program was conducted during the two week period from December 28, 2008 to January 11, 2009. The purpose of the monitoring was to collect wastewater flow data at several locations within the current Central Buckeye collection system to develop flow peaking information. B&F Contracting, Inc. performed flow monitoring at four locations using Teledyne ISCO 2150 area/velocity meters to collect continuous velocity, depth, and flow. The flow

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monitoring sites were selected to capture the flow of the drainage basins within the Central Buckeye WWTP's existing service area. Appendix C contains the report from the flow monitoring subcontractor. Figure 4-3 shows the location of the sites. The sites included:

- Meter 1 – The meter was placed in the 66-inch Hobas (fiberglass reinforced polymer mortar) pipe upstream of the Central Buckeye WWTP. The meter captured the influent to the WWTP.
- Meter 2 – The meter was placed in a 24-inch concrete pipe on Apache Road, south of Baseline Road. The meter captured flow from the Central-East Drainage Basin.
- Meter 3 – The meter was placed in a 24-inch corrugated high-density polyethylene (HDPE) pipe on 1st Avenue, north of the Buckeye Canal. The meter captured flow from the Central-West Drainage Basin.
- Meter 4 – The meter was placed in a 42-inch corrugated HDPE pipe on Beloat Road, west of 1st Avenue. The meter captured flow from the West Drainage Basin.

During the flow monitoring, the flow monitoring subcontractor observed groundwater inflow through the 66-inch pipe fitting upstream of Meter 1. This leak was brought to the Town's attention and has since been repaired.

Existing Collection System Flows

The daily WWTP influent data and flow metering records discussed above provide flows at only a few locations in the collection system. To calculate flow where it enters the system at individual service locations, more detailed information is needed. Typically, flows throughout a collection system can be calculated using a combination of the WWTP flows, flow metering data, and billed water use. Winter-time billed water use gives a good approximation of where wastewater flows enter the collection system. Water used by residents and businesses in the winter closely approximates their wastewater flows because much of the water used during the winter ends up in the wastewater system, compared to other times of the year when the water use increases greatly for irrigation. Because some irrigation occurs during the winter, there is some error in using winter water data, but this was found to have less error than using population data. The estimated population data for the Central Buckeye area available from the MAG is grouped into large regions and does not sufficiently distribute the population to a level needed for this calculation.

The winter-time water billing data was collected from the Town and from Global Water for the Valencia area and was geographically located based on the billed address. The average water use for this Plan was calculated based on actual average monthly water use for January to February 2006, December 2006 to February 2007, and December 2007 to February 2008. See Section 6 (Table 6-1) for a detailed discussion of the meter results compared to the winter water use.

Wastewater Peaking Factors

Peaking factors are used to calculate peak flow from average dry weather flow. The Town uses a peaking factor curve from the Arizona Administrative Code (A.A.C.) which gives the peak flow for a specified population. The A.A.C. curve was converted from population to average flow versus peak flow for this project. See Appendix B for the A.A.C. peaking curve information.

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As a comparison to the A.A.C. peaking factor curve, peaking factors were calculated for each of the four flow meters. The peaking factors were calculated by dividing the peak 5-minute flow recorded during the two week metering period by the average flow. The peaking factors calculated from the flow monitoring are compared to the A.A.C. peaking curve on Figure 4-4.

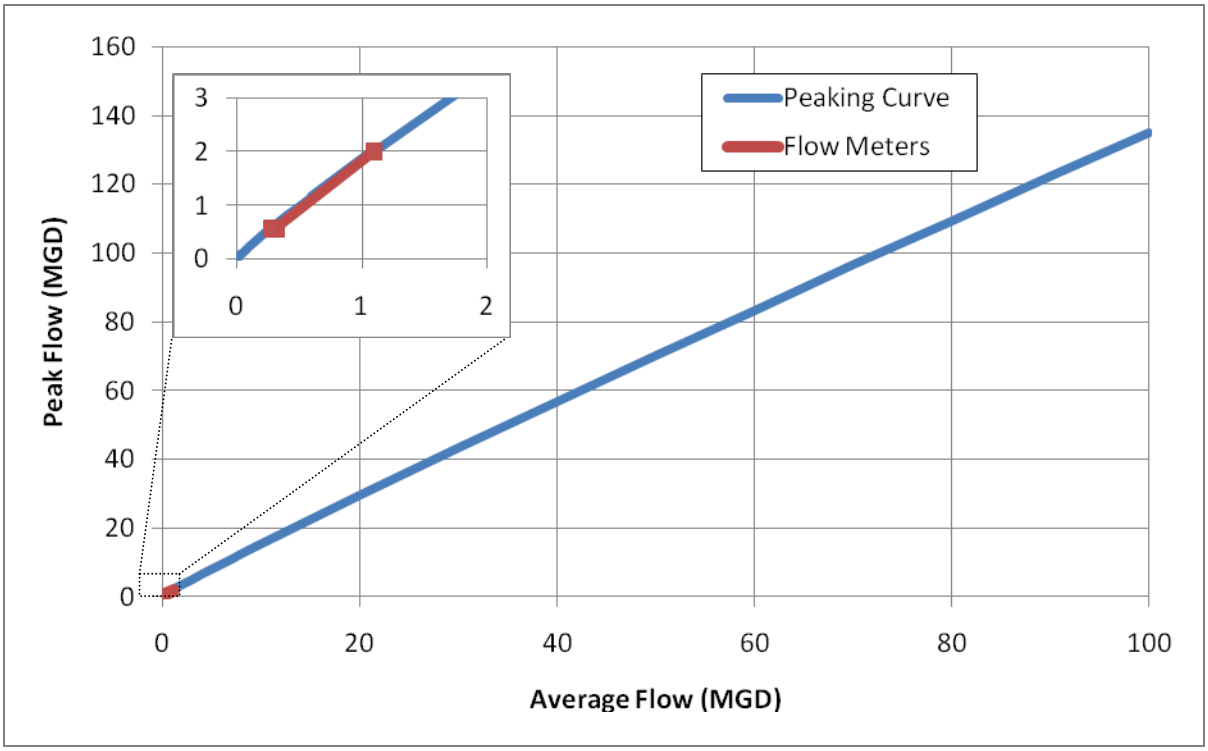

Figure 4-4. Average vs. Peak Flow Peaking Curve

As shown in the Figure 4-4, the curve calculated from the meters closely matches the A.A.C.curve, which helps to confirm that the A.A.C.curve is appropriate for the Central Buckeye system. However, the flow metering data is only available for a two-week period. Because long-term flow metering data is not available for time increments of less than an hour, which shows the true peak flows, the peaking factor curve could not be further confirmed.

Peak flows usually occur during wet weather events. During precipitation events, flows increase in the collection system from inflow and infiltration (I/I). I/I can enter the collection system through manhole covers, pipe joints, and cracks in pipes and manholes as direct inflow or through groundwater infiltrating through the soil. For example, the flows at Meter Station 1 were higher than expected due to groundwater inflow during the flow metering as mentioned above. A detailed I/I study with closed-circuit television (CCTV) and flow metering can identify the locations of high I/I to assist in I/I reduction.

In the A.A.C., the curve is labeled as a dry weather peaking curve. To account for higher flows due to wet weather I/I, the unit flow per person was increased as described in the next section.

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Wastewater Unit Flows

Water billing data from Section 4.4.1 was analyzed to estimate the average daily wastewater flow per person, or unit flow. To calculate the unit flow, water billing data was summed for the entire Central Buckeye WWTP service area, which includes residential, commercial, and industrial areas. As mentioned above, winter water use can be close to wastewater flows because much of the water used during the winter ends up in the wastewater system. The winter water billing data was summed inside of the Central Buckeye WWTP service area (including both Central Buckeye and Valencia). As a comparison, billing data was summed inside the Sundance WWTP service areas. For the residential billing addresses, the average winter water use was 143 gallons per day (gpd) per unit for Central Buckeye and 148 gpd/unit for Sundance. Using the General Plan value of 2.7 residents per unit, the water use per person was 53 gallons per capita per day (gpcd) for Central Buckeye and 55 gpcd for Sundance. Because there is some irrigation during the winter months and because not all billed water enters the wastewater collection system, the current wastewater unit flow could be less than 50 gpcd. This value does not include dry or wet weather I/I.

The Town requires an average daily wastewater flow of 100 gpcd for wastewater infrastructure design (Appendix B). Therefore, the 100 gpcd value used by the Town has a factor of safety that takes into account peak wet weather flows. However, as the Town's collection system grows and wet weather flow is recorded over a larger area, it is recommended that a more detailed analysis be done to refine the wet weather peaking factor.

4.5 Demands and Flow Projections

Future water demands and wastewater flows were calculated based on residential acreage and densities from the land use data in the Town's General Plan. The System Design and Evaluation Criteria Memorandum in Appendix B describes the development of the water demand and wastewater unit flows, or the flow rate per acre of land use type. Based on these criteria, the residential water demand per person (including water use inside and outside the home) was calculated to be 172 gpd/person and 108 gpd/person for wastewater flows. The non-residential water demands range from 2,009 to 2,232 gpd/acre and are 1,500 gpd/acre for wastewater flows. These unit water demands and flow rates were multiplied by the area of each land use polygon to give a total flow. The buildout projections were calculated for the model and MPA regions. The 2010 flows were calculated by scaling back the 2010 projections to match the 2010 population projections provided by the Town. Table 4-9 lists the total projected water demands and wastewater flows for each land use type.

Table 4-9. Demand and Flow Projections

Land Use Code - Description	Water Demands (MGD)				Wastewater Flows (MGD)			
	2010		Buildout		2010		Buildout	
	Model[1]	MPA[2]	Model	MPA	Model	MPA	Model	MPA
BP - Business Park	0.12	0.13	17.73	25.19	0.04	0.09	9.65	16.93
CMP - Master Planned Community	0.01	2.12	0.05	20.66	-	0.92	-	9.11
DO - City Center	1.75	1.75	3.45	4.65	1.01	1.01	2.69	2.69
GC - Government Center	-	-	0.09	0.09	-	-	0.07	0.07

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Table 4-9. Demand and Flow Projections

Land Use Code - Description	Water Demands (MGD)				Wastewater Flows (MGD)			
	2010		Buildout		2010		Buildout	
	Model[1]	MPA[2]	Model	MPA	Model	MPA	Model	MPA
HDR - High Density Residential	-	0.06	6.15	21.69	-	0.04	2.09	12.74
I - Industrial	0.01	0.29	10.51	17.86	0.01	0.21	8.57	13.34
LDR - Low Density Residential	0.20	0.33	8.20	68.48	0.04	0.15	3.32	30.04
MDR - Medium Density Residential	3.66	5.55	36.79	169.47	1.09	2.92	19.76	89.29
MHD - Medium High Density Residential	-	0.07	7.55	32.61	-	0.04	0.76	18.48
Military[3]	-	-	-	2.31	-	-	-	1.73
NC - Community Commercial	0.04	0.38	1.78	4.27	-	0.28	0.89	3.19
OFF - Professional Office Employment	0.04	0.04	3.48	4.94	0.03	0.03	1.72	3.69
OS - Open Space	-	-	-	-	-	-	-	-
RC - Regional Commercial	0.60	0.72	7.11	24.60	0.19	0.54	4.72	18.37
VCMU - Mixed Use	0.45	0.68	16.90	46.13	0.28	0.44	9.78	27.16
VLDR - Very Low Density Residential	0.00	-	0.94	15.06	-	-	0.30	3.47
Total	6.88	12.13	120.73	458.02	2.69	6.67	64.33	250.29

1. Model refers to the respective modeled areas for water and wastewater (Figure 1-3)
2. MPA = Municipal Planning Area
3. MGD = million gallons per day
3. It is assumed that military land will continue to use septic systems for wastewater

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5. WATER MODEL DEVELOPMENT

A hydraulic computer model of the Town's water distribution system was developed as a tool for evaluating the existing system and to establish future planning needs. This section describes the development of the model.

5.1 Computer Model Software

The Town's water system was modeled using H2OMAP Water, GIS-based modeling software. H2OMAP Water can analyze steady-state or extended period simulations. The model was created in the North American Datum (NAD) 1983 high accuracy reference network (HARN) State Plane Arizona Central (International Feet) coordinate system to be consistent with the Town's GIS database.

The model for this project was created as an extended period simulation. Although the original scope specified a steady-state model, which simulates a snapshot in time, the dynamic model was considered the better tool for two reasons. One reason is that the model must be analyzed for MDD and PHD conditions. A single dynamic model scenario can be used to analyze both of these demand conditions instead of two scenarios (MDD and PHD) required for steady-state models. The second reason is that as the Town grows to the north, storage could be constructed on elevated ground, which cannot be accurately analyzed using a steady-state model. This is because a steady-state model is a snapshot and does not represent water filling and emptying from a tank, which is very important when designing elevated storage.

5.2 Model Scenarios

Model scenarios were set up to simulate the existing system and expected future conditions. In accordance with the Scope of Work, only the distribution system was modeled and this Plan assumed that there is adequate supply. The following model scenarios were created:

- Existing (2007-2008) – This scenario includes existing facilities within Historic Buckeye and Sundance.
- 2010 – This is the same as the Existing scenario plus future facilities to serve projected 2010 demands for the areas south of I-10 and north of the Gila River. Although 2010 is included in the model, results were not evaluated in the context of the CIP.
- Buildout – This is the same as the Existing scenario plus future facilities to serve projected buildout demands for the area south of I-10 and north of the Gila River.

5.3 Model Facilities

A water model consists of junctions, pipes, valves, tanks, reservoirs, and pumps. Figure 5-1 shows how these facilities relate to each other. This section describes how the model facilities were created. Appendix D gives details for the model attributes assigned to each facility.

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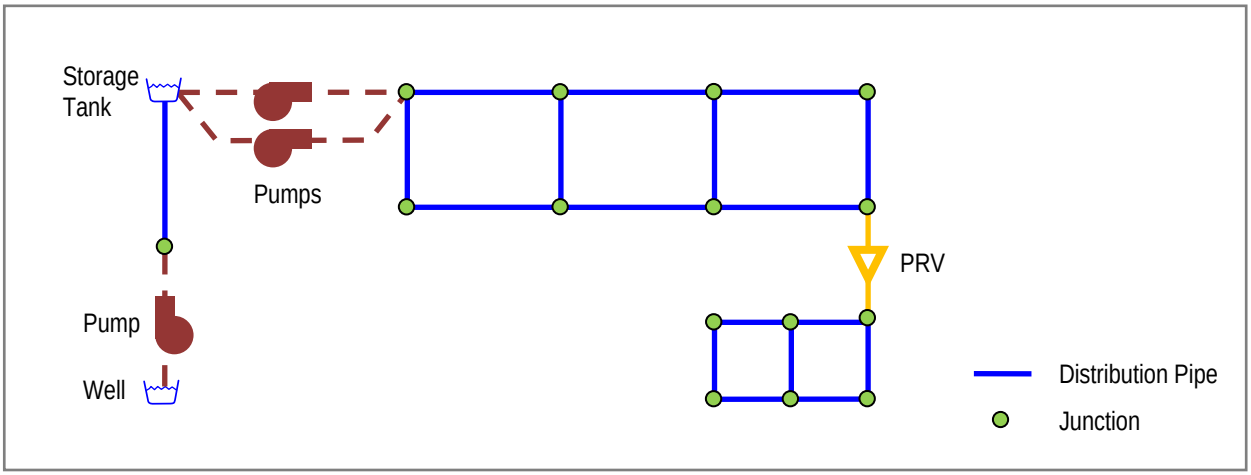

Figure 5-1. Water Model Facilities

5.3.1 Junctions

Junctions were created automatically by the model at the ends of each pipe segment, including at piping intersections, dead ends, changes in diameter, and hydrant locations. Hydrant locations were provided by the Town in a GIS hydrant layer. Junction elevations were interpolated from a 2-foot line contour layer provided by the Town, which covered most of the Town south of I-10 and north of the Gila River. For the areas outside of the 2-foot contour layer, elevations were interpolated from the National Elevation Dataset (NED), elevation data produced by the United States Geological Survey (USGS). The NED data consists of a grid of points every 10 meters. Demands were also added to junctions. The assignment of the demands is described in Section 5.4.

5.3.2 Pipes

The model pipe network was built using multiple sources. The Town created a GIS piping layer for existing piping which provided the location of the piping, pipe diameters, and pipe material for some pipes. Future planned piping was compiled from developer Master Plans as described in Section 1. After the piping was compiled, H2OMAP Water tools were used to clean up the piping, such as fixing overlapping pipes and identifying locations where the piping did not connect at intersections. Hazen-Williams C factors were added to pipes based on pipe material. For those pipes without a material in the GIS, a C factor of 130 was used based on discussions with the Town about common pipe materials in the water system.

5.3.3 Wells

Most of the Town's existing wells pump directly into storage tanks through dedicated well piping. The exception is the Church Well, which pumps directly into the Historic Buckeye distribution system. Future wells were not added to the model because locating future wells was outside of the scope of this project. Future wells were assumed to pump directly into existing or future storage tanks. It was assumed that there will be sufficient supply for the future demands discussed in Section 4.

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5.3.4 Tanks

Tanks were added to the model from the Town's GIS and from developer Master Plans. Dimensions and elevations for existing tanks were added to the model based on data obtained from the Town. Dimensions for future tanks were based on developer Master Plans and from planning done during this project. Existing and future tanks were modeled as fixed head reservoirs, meaning that the tank level does not vary but remains at a single level in the tank. This was done because future supply into the tanks was not modeled and it was assumed that there will be sufficient supply to keep the tanks full. Modeling the tanks as fixed head reservoirs does not affect operations in the model because water from the tanks is pumped into the system, and a water level difference of a few feet in the tanks does not affect how the pumps operate in the model. If tanks are planned for elevated ground where the tank floats off of the system hydraulic grade, it would be important to model the tanks with a defined volume.

5.3.5 Pumps

Pumps were added at booster stations and at modeled wells. Actual pump curves were entered into the model for several of the existing pumps. For the rest of the existing pumps, pump curves were not available so a design head vs. flow was added to the model based on available pump information. Future pumps were modeled with planned head vs. flow points.

5.3.6 Valves

The Town's existing and planned water system includes isolation valves, altitude valves, flow control valves (FCVs), and PRVs. Only FCVs and PRVs were modeled as valves. Isolation valves are not explicitly modeled, but a closed isolation valve is modeled by closing a model pipe. Altitude valves are modeled by adding controls to pipes in the model to open or close a pipe based on a tank level. Model PRVs were also used at pump stations to represent VFD on pumps. VFDs are used to maintain a constant discharge pressure at pump stations. The PRVs were added in the model to the discharge side of pumps and set to the desired discharge pressure.

5.4 Model Demands

The existing and future demands described in Section 4 of this report were allocated in the model as described below. The adjusted diurnal pattern calculated in Section 4 was then applied to the model demands.

5.4.1 Existing System Demand Allocation

Monthly water demands were calculated for each customer for 2006 through 2008 from the Town's water billing database. Total metered consumption is typically less than total system demand as calculated from water production records, which is primarily due to unaccounted-for water losses in the system. Individual customer demands were scaled up to distribute the unaccounted-for water proportionally throughout the system. The customer demands were assigned as model demands to the model junction located nearest to the customer address listed in the water billing database. The following steps describe how the existing system demands were assigned to the model. Figure 5-2 illustrates the process.

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1. Obtain billing data including addresses for each customer and calculate the MDD of each customer.
2. Geocode (locate geographically) the customers by matching the customer address to a parcel.
3. Flag each junction in the model as a demand junction or non-demand junction. Non-demand junctions, such as junctions on a transmission pipeline or at a pump station or storage tank, will not have a demand.
4. Create Thiessen polygons around each demand junction and calculate the area of each polygon. Thiessen polygons define the area of influence around each demand junction.
5. Calculate the total demand at each demand junction as the sum of the demand inside of the corresponding demand polygon.

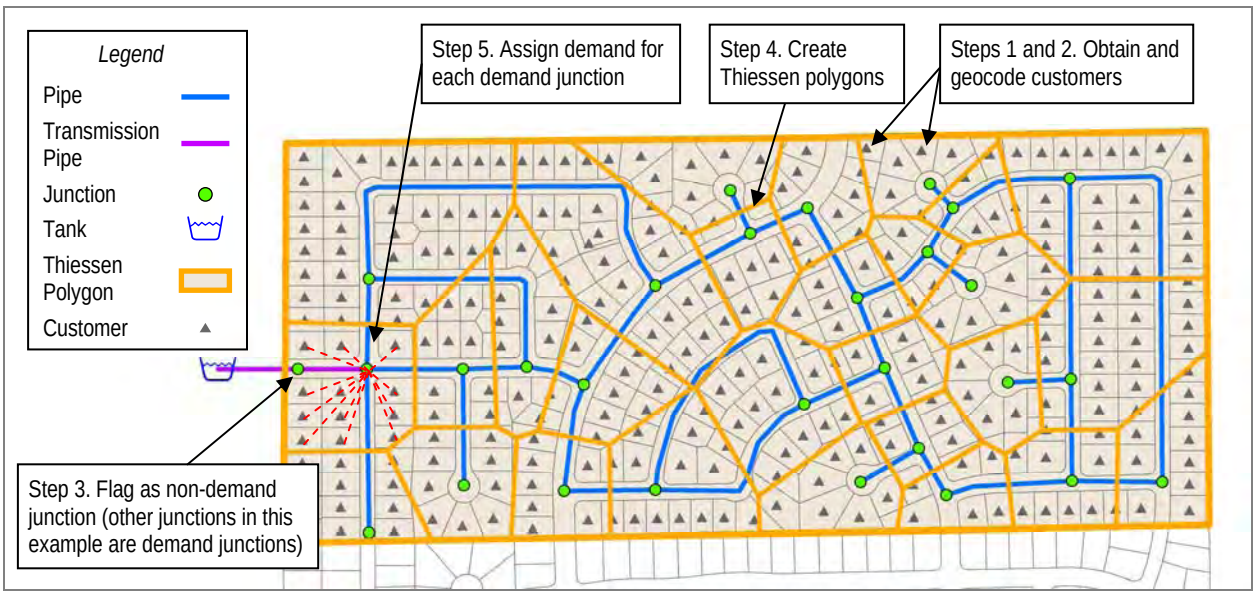

Figure 5-2. Existing Demand Allocation from Billing Data

5.4.2 Future System Demand Allocation

Future system demand allocation involves distributing the projected future system demands to the appropriate nodes in the computer model. The following steps describe how the future system demands were assigned to the model. Figure 5-3 illustrates the process.

1. Obtain general land use plan and develop unit-use rates for each land use category.
2. Flag each junction in the model as a demand junction or non-demand junction. Non-demand junctions will not have a demand, such as junctions on a transmission pipeline or at a pump station.
3. Create Thiessen polygons around each demand junction and calculate the area of each polygon. Thiessen polygons define the area of influence around each demand junction.
4. Calculate the total demand for a junction by multiplying the area of each land use category that falls within the junction's Thiessen polygon by the corresponding unit-use rates.

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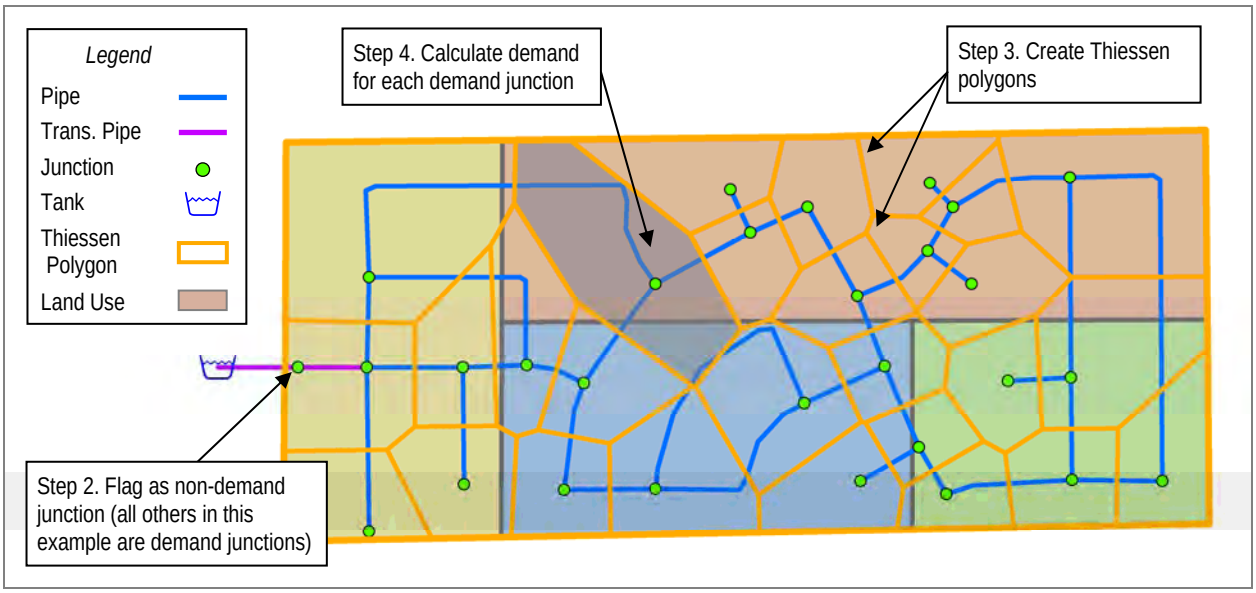

Figure 5-3. Future Demand Allocation from Land Use Data

5.4.3 Fire Flow Demand Allocation

Fire flow sets were created for the fire flow evaluation of the existing and future system. Fire flow requirements were established by land use as listed in Appendix B. For the existing system, each model junction that represents a hydrant was assigned the highest fire flow of the land use surrounding the hydrant. For the future system, each distribution junction (not including transmission or pump station piping) was assigned the highest fire flow of the land use surrounding the junction.

5.5 Model Calibration

The model was calibrated to ensure that model results for the existing system are representative of actual system operations. Model calibration involves adjusting model parameters until model results match field test data. Field test data was collected on August 30 and September 1, 2008 by representatives from Brown and Caldwell and the Town. Seven field tests were conducted in Sundance and four tests were conducted in Historic Buckeye. The field tests included flowing a hydrant and recording the pressure at a nearby hydrant before and after the test. Flowing a hydrant stresses the water system and causes a recordable pressure drop. When the field test is replicated in the model, it is then easier to identify issues such as potentially closed valves or incorrect PRV settings. Appendix E contains the calibration testing plan, which has maps showing the location of each test.

The eleven field tests were simulated in the model and the model was adjusted to better match field results. Inflows into the system were simulated at the Sundance and Historic Buckeye booster stations. Flows into Sundance were available from the Town's SCADA system, which includes tank levels, well flows, and booster pump flows. SCADA data is not available for the Historic Buckeye system, so the status of well and booster pumps was set in the model based on discussions with

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Town staff on the day of the testing. Well 12 was the only well in operation in Historic Buckeye at the time of the testing and this well was also simulated in the model. The primary model settings that were adjusted were pump settings and PRV pressures. Pump settings were verified and adjusted in both Historic Buckeye and Sundance while Sundance also required slight modifications to the pressure settings for the three PRVs to better match the field results. Although the PRV settings were measured in the field, pressure gage readings can often be off by a couple of psi and the exact elevation of the PRVs inside the PRV vaults was not measured.

Table 5-1 lists the calibration results. Overall, the model matched the field results well. Seven of the eleven tests matched within 6 psi. With regard to the other four tests, one test had unusual pressures at the pump station (Sundance Test 1), invalidating the results. The data and results for this test are included in Table 5-1 for completeness. The table gives possible reasons that the other three tests were not matched in the model. Additional field investigations would be necessary to obtain a better match for those three tests and is outside the scope of this Plan.

Table 5-1. Water Model Calibration Results

Test	Flow Hydrant Location	Field Test Pressure (psi)		Model Pressure (psi)		Pressure Difference (psi)		Comments
		Static	Residual	Static	Residual	Static	Residual	
Sundance								
1	Lasso and 239th	78	52	74	68	-4	16	Sundance Zone 3 pump discharge pressure in SCADA dropped suddenly for an unknown reason at time of test, so test could not be replicated in model.
2	Shadow and 232nd	70	60	66	63	-4	3	
3	Gardenia and 228th	64	50	58	51	-6	1	
4	221st and Near Solano	80	73	67	62	-13	-11	Either the model elevations extracted from the contour data are wrong or the pressures were measured incorrectly in the field. Otherwise, the field results are not possible because the HGL at the test location would be higher than the HGL at the pump station based on the pump station SCADA discharge pressure.
5	233rd and Ashleigh	69	54	57	54	-12	0	Same reasons as those listed in Test 4 above.
6	Gibson Road	56	40	56	43	0	3	
7	Cocopah at 219th	67	61	65	58	-2	-4	

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Table 5-1. Water Model Calibration Results								
Test	Flow Hydrant Location	Field Test Pressure (psi)		Model Pressure (psi)		Pressure Difference (psi)		Comments
		Static	Residual	Static	Residual	Static	Residual	
Historic Buckeye								
1	4th Street and Edison	50	42	49	47	-1	5	
2	Parkside Lane	60	41	61	53	1	12	Possibly incorrect diameters for model piping near this test. The initial pressures match well, but during the test, there is more headloss in the field than that predicted by the model, which could be due to pipe diameters that are too large in the model (or unknown closed valves).
3	6th Street and Clanton Ave	58	45	52	46	-6	1	
4	Ash Street by Park	55	30	50	34	-5	4	

HGL = hydraulic grade line
psi = pounds per square inch
SCADA = supervisory control and data acquisition

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6. WASTEWATER MODEL DEVELOPMENT

A hydraulic computer model of the Town's wastewater collection system was developed as a tool for evaluating the existing system and to establish future planning needs. This section describes the development of the model.

6.1 Computer Model Software

The Town's wastewater collection system was modeled using H2OMAP Sewer, GIS-based modeling software. H2OMAP Sewer can analyze steady-state or extended period simulations. This model was created as a steady-state simulation. An extended period simulation was not created because there was not enough sub-hourly flow metering data to accurately calculate daily diurnal flow variations. The model was created in the NAD 1983 HARN State Plane Arizona Central (International Feet) coordinate system to be consistent with the Town's GIS database.

6.2 Model Scenarios

Model scenarios were set up to model the existing system and expected future conditions. The following model scenarios were created:

- Existing (2007-2008) – This scenario includes the existing collection system that drains to the Central Buckeye WWTP. Piping greater than or equal to 12 inches and important smaller diameter piping was modeled. Existing piping outside of the modeled area was inactivated, such as for the Sundance WWTP service area. Much of the smaller diameter piping in the Central Buckeye WWTP service area was inactivated in the model because invert elevation data was not available for that piping.
- 2010 – This is the same as the Existing scenario plus future facilities to serve projected 2010 flows for the area south of I-10 and north of the Gila River. Although 2010 is included in the model, results were not evaluated in the context of the CIP.
- Buildout – This is the same as the Existing scenario plus future facilities to serve projected buildout flows for the area south of I-10 and north of the Gila River.

6.3 Model Facilities

A wastewater model consists of manholes, pipes, wet wells, lift stations, outfalls, and sub-basins. Figure 6-1 shows how the facilities relate to each other. This section describes how the model facilities were created. Appendix D gives details for the model attributes assigned to each facility.

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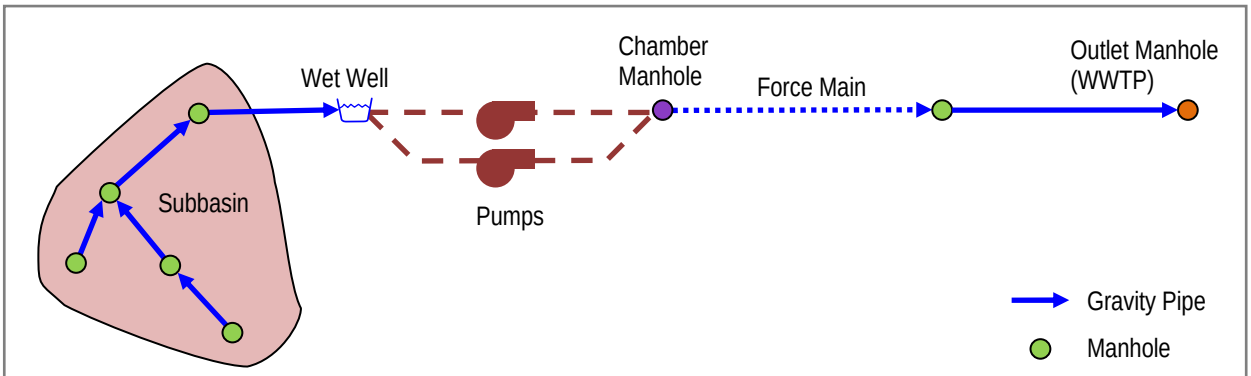

Figure 6-1. Wastewater Model Facilities

6.3.1 Manholes

Manholes were added to the model from multiple sources. The Town created a GIS manhole layer for existing manholes, which included some, but not all, rim elevations. Future planned piping was compiled from developer Master Plans as described in Section 5. Rim elevations were extracted from the master plan models if available. Rim elevations for manholes without rim elevation data were interpolated from a 2-foot line contour layer provided by the Town, which covered most of the Town south of I-10 and north of the Gila River. For the areas outside of the 2-foot contour layer, elevations were interpolated from the NED elevation data produced by the USGS. The NED data consists of a grid of points every 10 meters. Manholes are the location where flows enter the collection system model. The calculation and assignment of the inflows is described later in this section.

Besides regular manholes, two other types of manholes were also created in the model, chamber, and outlet manholes. Chamber manholes connect pumps and force mains. Outlet manholes are the location where flow leaves the model, usually at WWTPs.

6.3.2 Pipes

The model pipe network was also built using multiple sources. The Town created a GIS piping layer for existing piping, which included the location of the piping, pipe diameters for most of the pipes, and invert elevations and pipe material for some pipes. For pipes without diameters or inverts, the missing diameters and inverts were estimated and interpolated from surrounding pipes. Future planned piping was compiled from developer Master Plans as described in Section 5. After the piping was compiled, H2OMAP Sewer tools were used to clean up the piping, such as fixing overlapping pipes and identifying locations where the piping did not connect at manholes. See Appendix D for more details.

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6.3.3 Pumps and Wet Wells

Lift stations were added to the model with a gravity pipe draining into a wet well, then with a pump discharging into a force main as shown on Figure 6-1. No existing lift stations were added to the model because the Sundance collection system was not modeled and the lift station on Broadway and Miller Road serves smaller diameter piping that was not modeled. Future lift stations were sized according to the future flows.

6.3.4 Sub-basins

Sub-basins define a drainage area that drains to a manhole. Sub-basins were drawn for the existing and future service areas by subdividing the MAG 208 Plan collection area boundaries for each of the existing and proposed WWTPs. A flow was calculated for each sub-basin and the sub-basin was assigned to drain to a model manhole as explained below. Figure 6-2 shows the model sub-basins. The figure also shows three types of areas within the 208 boundaries that were excluded from the analysis which are:

- Flood Control – Land north of the levee along I-10 is owned by the Flood Control District of Maricopa County. The areas are for flood control and will not contribute wastewater flows.
- High Slope – A few areas north of I-10 have ground slopes of greater than 15 percent. Town staff indicated that these areas will not be developed.
- River Floodplain – Areas within the Gila and Hassayampa River floodplains were assumed to not contribute wastewater flow.

6.4 Flow Allocation

The existing and future inflows described in Section 4 of this report were allocated in the model as described below. The peaking factors calculated in Section 4 were then applied to the model flows.

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6.4.1 Existing System Allocation

Existing system flows were allocated to the collection system based on winter-time water billing data as explained in Section 4. The following steps describe how the existing system flows were assigned to the model. Figure 6-3 illustrates the process.

1. Obtain billing data including addresses for each customer and calculate the winter water use of each customer.
2. Geocode (locate geographically) the customers by matching the customer address to a parcel.
3. Subdivide the service area into sub-basins, or drainage areas.
4. Calculate the total flow within each sub-basin and assign the sub-basin flow to the most downstream modeled manhole within the sub-basin.

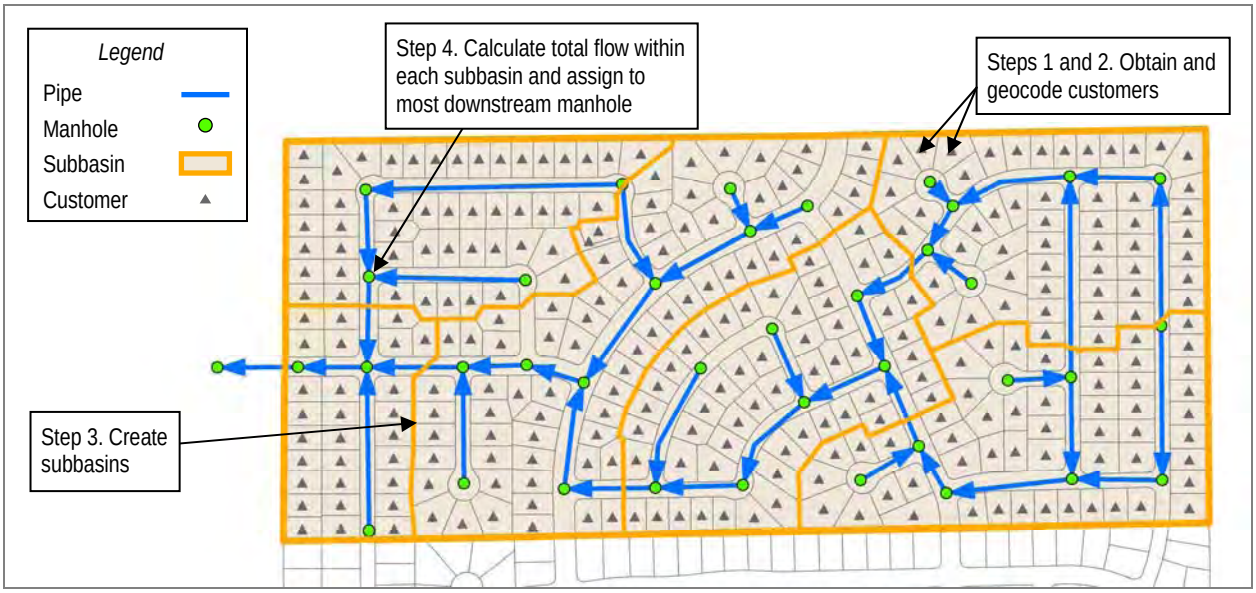

Figure 6-3. Existing Flow Allocation from Billing Data

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6.4.2 Future System Allocation

Future system flow allocation involves distributing the projected future system flows to the appropriate manholes in the computer model. The following steps describe how the future system flows were assigned to the model. Figure 6-4 illustrates the process.

1. Obtain the general land use plan and develop unit flow rates for each land use category.
2. Subdivide the service area into sub-basins, or drainage areas.
3. Calculate the total flow for a sub-basin by multiplying the area of each land use category that falls within the sub-basin by the corresponding unit flow rates. Assign the sub-basin flow to the most downstream manhole within the sub-basin.

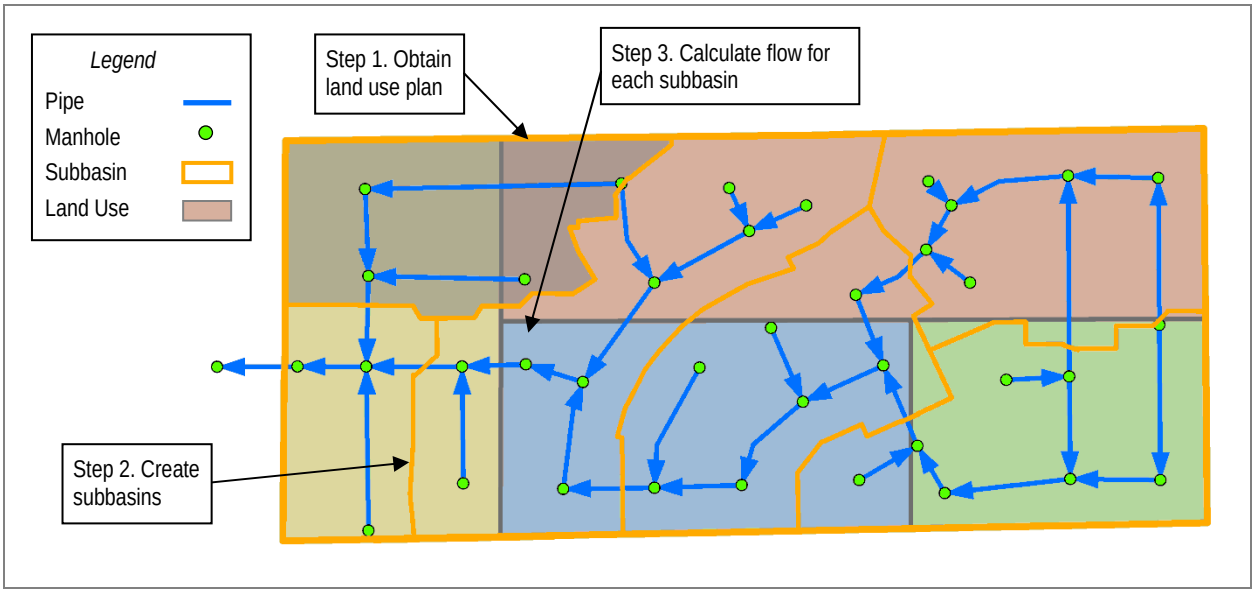

Figure 6-4. Future Flow Allocation from Land Use Data

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6.5 Model Calibration

The model was calibrated to ensure that model results are representative of actual system operations. The winter water use discussed in Section 4 was added to the model and the average daily flows were compared to the flows for the four flow meters placed in the collection system (see Figure 4-3 for the location of the meters). Table 6-1 compares the water use and flow meter flows.

Table 6-1. Calibration Results

Flow Meter	Average Daily Flow Meter Wastewater Flow (MGD)	Average Winter Water Use (MGD)	Ratio (Wastewater / Water)
Meter 1	1.10	1.40	0.78
Meter 2	0.30	0.20	1.53
Meter 3	0.28	0.44	0.63
Meter 4	0.32	0.21	1.50

MGD = million gallons per day

As shown in the table, the total collection system flow as measured at Meter 1 was about 78 percent of the water use, which is a reasonable ratio. However, the ratio between water and wastewater varied greatly at the other three meters. This could either be due to inaccurate water data or incorrect pipe connectivity in the model. The winter water use is an approximation and thus has some inherent uncertainty, but the problem is probably due to incorrect piping. The water data for Meter 3 is too high, which means that some of the locations that drain to Meter 3 in the model could actually drain to Meters 2 and 4. The Town recently created GIS layers of the piping and some corrections were made to the piping during this project. The model is a good tool for estimating flows throughout the existing collection system. However, to improve accuracy, it is suggested that the Town continue to verify and update the collection system GIS. The model should then be recalibrated to see if there are any additional issues.

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7. WATER SYSTEM EVALUATION

The purpose of this section is to summarize the evaluation of the Town's existing water system under existing and future demands. The model was used to identify deficiencies in the water system. The improvements developed to fix these deficiencies are discussed in Section 9.

7.1 Evaluation Criteria

The Design and Evaluation Criteria Technical Memorandum in Appendix B was created to identify the standards used for the evaluation of the water system. The technical memorandum includes evaluation criteria used to identify deficiencies in the system and the design criteria used to design improvements for existing deficiencies and for future growth.

7.2 System Evaluation

The existing water system facilities were evaluated for existing (2007-2008), 2010, and buildout demand conditions. For each year, two scenarios were used to simulate the demand conditions that represent the greatest strain on the system: a 24-hour MDD simulation and a steady-state MDD plus fire flow simulation.

Table 7-1 lists the demands calculated for each pressure zone for each year. The demands for Zone 1 were summed because the three zones in Zone 1 will be hydraulically connected in the future. Additionally, the Zone 2 Sundance and East Zone 2 will be combined, however the Valencia service area will separate the West Buckeye Zone 2 from the rest of Zone 2. Model results were compared to the evaluation criteria and areas in the existing system that did not meet the criteria are discussed below.

Table 7-1. Demands per Pressure Zone

Pressure Zone	Fire Storage (MG)[2]	Existing (MGD)			2010 (MGD)			Buildout (MGD)		
		ADD	MDD	PHD	ADD	MDD	PHD	ADD	MDD	PHD
Historic Zone 1	0.96	0.51	0.92	1.53	2.21	3.98	6.64	3.69	6.63	11.06
East Zone 1	0.96	-	-	-	Negligible	Negligible	Negligible	24.40	43.91	73.19
West Buckeye Zone 1	0.96	-	-	-	Negligible	Negligible	Negligible	33.51	60.32	100.53
Total Zone 1	*0.96*	*0.51*	*0.92*	*1.53*	*2.21*	*3.98*	*6.64*	*61.59*	*110.86*	*184.77*
Sundance Zone 2[1]	0.96	0.88	1.59	2.65	1.20	2.16	3.60	2.28	4.10	6.84
East Zone 2	0.96	-	-	-	Negligible	Negligible	Negligible	18.26	32.88	54.79
Total East/Sundance Zone 2	*0.96*	*0.88*	*1.59*	*2.65*	*1.20*	*2.16*	*3.60*	*20.54*	*36.98*	*61.63*

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Table 7-1. Demands per Pressure Zone										
Pressure Zone	Fire Storage (MG)[2]	Existing (MGD)			2010 (MGD)			Buildout (MGD)		
		ADD	MDD	PHD	ADD	MDD	PHD	ADD	MDD	PHD
West Buckeye Zone 2	*0.96*	-	-	-	*0.78*	*1.40*	*2.34*	*35.42*	*63.76*	*106.27*
Sundance Zone 3[1]	*0.96*	*1.00*	*1.79*	*2.99*	*2.50*	*4.49*	*7.49*	*3.15*	*5.67*	*9.44*
Total		2.39	4.30	7.17	6.69	12.03	20.06	120.70	217.26	362.11

1. *For the existing Sundance system, the PRVs between Sundance Zones 2 and 3 were active during the time that SCADA records were collected. Therefore, the demand within each zone could not be determined separately. The demand for each zone was estimated by taking the total Sundance demand from SCADA and dividing it by the ratio of the billed water use in each zone for June to August 2008.*
2. *The fire flow is the maximum fire flow in each zone. For all zones, the maximum fire flow is 4,000 gpm for 4 hours.*
3. *ADD = average day demand*
4. *MDD = maximum day demand*
5. *MGD = million gallons per day*
6. *PHD = peak hour demand*

7.2.1 Pressure

Overall, the Town's water system provides water to service connections at adequate pressures, with a few exceptions. Figures 7-1 (Sundance) and 7-2 (Historic Buckeye) show the areas in the distribution piping that do not meet the minimum allowable pressure of 40 psi under MDD conditions. The causes of the pressure deficiencies in these two zones are discussed briefly below; annotations and notes are also included on the figures.

There is one area of pressure deficiencies in the Sundance area. The pressure deficiencies in Sundance Zone 3 are due to the original setup of the Sundance Zone 3 pressure zone. The 150-foot range of elevations in Zone 3 is more than the Town's current standard of a 130-foot range for a pressure zone. It is projected that the area north of I-10 will have pressure problems in the future with pressures as low as 26 psi. The solution to this problem may be to serve the area north of the freeway from a future development north of the freeway. Because the area north of the freeway is not in the modeled area (apart from this small extension of Sundance Zone 3), this potential solution was not studied further and is not addressed in the CIP.

In Historic Buckeye, there are two primary areas of low pressures:

- Low pressures were identified for future development along the well piping from Wells 12 and 14. Future development along this line includes the Desert Creek and Cipriani MPCs, which are anticipated to be served by local supply wells that would likely not connect to the existing line. Because the location and timing of future developments or MPCs along this line are not known, these deficiencies are not addressed in the CIP. As the existing farmland in these areas begins to develop, an investigation should be done to determine if a connection to the Historic Buckeye system would be desirable, and then identify the best location for the connection.
- Low pressures throughout the Historic Buckeye area are due to increased demands at buildout on 1- and 2-inch pipes. This is not addressed in the CIP because these pipes would be replaced as these areas are redeveloped.

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7.2.2 Velocity and Headloss

The existing system meets the velocity requirements of less than 10 feet per second (ft/s), with the exception of a short 2-inch pipe which reaches 18 ft/s in the Historic Zone at the intersection of 4th Street and East Narramore Avenue. The pipe diameter listed in GIS in this area should be verified. For buildout conditions, the velocity requirement of 10 ft/s was also exceeded at the Historic Zone booster pump station piping, with velocities up to 35 ft/s. Because this high of a velocity is unlikely, the pipe diameters in the GIS at the pump station should also be verified. Other than these pipes with high velocities, no areas of excessive head loss were identified for existing or future conditions.

7.2.3 Fire Flow

Fire demands were applied to the existing fire hydrant junctions based on the surrounding land use type as described in Appendix B. The lower density residential land use types have a required fire flow of 1,500 gallons per minute (gpm) (including Community Master Planned, Low Density Residential, Medium Density Residential, and Very Low Density Residential). The other land use types require 4,000 gpm. The criteria also specify that the fire flow should be supplied while maintaining pipe velocities below 10 ft/s.

Based on the land use, all of the hydrants in the Historic Zone have a fire flow requirement of 4,000 gpm. Most of the hydrants in Sundance have a fire flow requirement of 1,500 gpm with a few areas of 4,000 gpm. The fire hydrant junctions that cannot meet these requirements are shown on Figures 7-1 and 7-2. At this time, however, 1,500 gpm fire flow may be adequate for most of the Historic Zone because it is primarily residential. Piping in the Historic Zone can be replaced with larger piping in the future when aging piping is replaced. The additional locations in the existing system that will not be able to handle fire flows under buildout demand conditions are also shown on the figures.

As noted on the figures, these fire flow deficiencies are not addressed in the CIP. Based on the Town's fire flow criteria in place prior to this Plan (Town of Buckeye, 2009), the required fire flow was not as high as 4,000 gpm. Therefore, the piping in both Central Buckeye and Sundance was probably not designed for a fire flow of 4,000 gpm. Many areas in Sundance can meet the 1,500 gpm criteria, but to meet this flow, the velocity exceeds 10 ft/s. The Town's recent changes to the fire flow criteria will be required for new development. These new criteria should be applied as areas in Sundance and Historic Buckeye are further developed, redeveloped, or when aging piping is replaced.

The figures highlight three specific cases of fire flow deficiencies:

- Sundance Zones 2 and 3: Many of the fire flows in Sundance Zones 2 and 3 can be met by the distribution system, but they were flagged as deficiencies because the velocity exceeded 10 ft/s during the fire flow. These fire flow deficiencies are not addressed in the CIP because it is not feasible to require upsizing of much of the relatively new piping in Sundance. However, during redevelopment or the replacement of piping, these deficiencies should be addressed.

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- Sundance Sunora Zone: Many of the fire flow deficiencies in the Sundance Sunora zone are due to the low pressures maintained in the zone. These fire flow deficiencies are not addressed in the CIP because one potential solution would be to remove the PRVs into the zone and raise the hydraulic grade in the entire zone. Because of the old piping, this is not possible. Therefore, these problems should be addressed during redevelopment of this area.
- Historic Buckeye: Many of the fire flow deficiencies are due to the old, small piping (much less than 8-inch diameter). According to the Town's fire chief, these deficiencies should be addressed during redevelopment and when aging piping is replaced in the future, because it is not feasible to replace much of the Historic Buckeye distribution piping. Therefore, these fire flow deficiencies are not addressed in the CIP.

7.2.4 Booster Pump Stations

Table 7-2 lists the available vs. required booster pump capacity for each pressure zone. To size the booster pump stations, the largest of the following criteria must be met:

- MDD plus fire flow; or
- PHD with the largest pump out of service.

The table simply lists the PHD, MDD, and fire flow. The sizing of the individual pumps will be completed during the detailed design of individual pump stations, at which time the size of the largest pump will be calculated. Depending on the timing of the construction of the pump station, each pump station should not have to meet the 4,000 gpm fire flow demand by itself. However, if a development is constructed that will be connected to the rest of the distribution system in the future, but it is not connected at the time the development is constructed, the pump station may need to handle the entire fire flow.

Table 7-2. Booster Pump Station Capacity Analysis

Pressure Zone	Available Capacity (gpm)	Required Capacity (gpm)						Required Fire Capacity (gpm)[1]
		Existing		2010		Buildout		
		MDD	PHD	MDD	PHD	MDD	PHD	
Historic Zone 1	3,750	640	1,060	2,764	4,611	4,603	7,680	4,000
East Zone 1	-	-	-	Negligible	Negligible	30,491	50,823	4,000
West Buckeye Zone 1	-	-	-	Negligible	Negligible	41,886	69,808	4,000
Total Zone 1	*3,750*	*640*	*1,060*	*2,764*	*4,611*	*76,980*	*128,311*	*4,000*
Sundance Zone 2	4,500	1,104	1,840	1,500	2,500	2,847	4,750	4,000
East Zone 2	-	-	-	Negligible	Negligible	22,831	38,046	4,000
Total East/Sundance Zone 2	*4,500*	*1,104*	*1,840*	*1,500*	*2,500*	*25,678*	*42,796*	*4,000*
West Buckeye Zone 2	-	-	-	*972*	*1,625*	*44,274*	*73,793*	*4,000*
Sundance Zone 3	*15,800*	*1,242*	*2,076*	*3,118*	*5,201*	*3,937*	*6,555*	*4,000*
Total	24,050	2,986	4,976	8,354	13,937	150,869	251,455	4,000

gpm = gallons per minute
MDD = maximum day demand
1. The Required Fire Capacity is the largest fire flow in each pressure zone.
PHD = peak hour demand

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Table 7-3 summarizes the available versus required booster pump station capacity for the existing system. For existing demands, the Historic Zone 1 does not have sufficient pumping capacity to handle the MDD plus fire flow. Sundance Zone 2 does not have enough pumping capacity by itself for existing demands, but Sundance Zone 3 can make up the difference by serving Zone 2 through the PRVs connecting the zones.

Table 7-3. Existing Booster Pump Station Capacity Analysis (gpm)

	Timeframe	Historic Zone 1	Sundance Zone 2	Sundance Zone 3[2]
MDD + Fire Flow				
Total Existing Capacity	Existing	3,750	4,500	15,800
Required (MDD + 4,000 gpm fire flow)	Existing	4,640	5,104	5,242
	2010	6,764	5,500	7,118
	Buildout	8,603	6,847	7,937
Deficient	Existing	890	604[1]	Not deficient
	2010	3,014	1,000	Not deficient
	Buildout	4,853	2,347	Not deficient
PHD				
Existing Capacity Without Largest Pump at Each Pump Station	Existing	2,500	3,500	12,500
Required (PHD)	Existing	1,060	1,840	2,076
	2010	4,611	2,500	5,201
	Buildout	7,680	4,750	6,555
Deficient	Existing	Not deficient	Not deficient	Not deficient
	2010	2,111	Not deficient	Not deficient
	Buildout	5,180	1,250	Not deficient

1. *Sundance Zone 3 can deliver the deficient flow through PRVs into Zone 2*
2. *Sundance Zone 3 includes North Airport Road Pump Station which adds excess capacity that may be used for areas outside of the model area, north of I-10.*
3. *MDD = maximum day demand*
4. *PHD = peak hour demand*

7.2.5 Storage

Table 7-4 shows the available vs. required storage for each pressure zone. The required storage is the greatest of several storage criteria as listed in Appendix B:

1. Peak Hour Storage – Four hours of PHD without using more than 80 percent of the total storage capacity without wells.
2. Fire Flow – 25 percent of the MDD plus the highest required fire storage in the pressure zone.
3. Operating Storage – 20 percent of the MDD.
4. Emergency Storage – ADD without using more than 80 percent of the total storage capacity without wells.

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The Emergency storage requirement is usually the largest requirement. In Table 7-4, the required storage was calculated to be the Emergency storage except for the cells with a "(FF)" in them, which signifies that the Fire Flow requirement is larger. For a smaller area, the Fire Flow requirement can be larger. But as the area develops, the ADD grows larger than the Fire Flow demand, so the Emergency storage requirement becomes the driving criterion. The other two criteria, Operating and Peak Hour Storage, are multiples of the Emergency storage and are always smaller than the Emergency storage (for example, the Operating storage is 0.2 x MDD = 0.2 x ADD x 1.8 = 0.36 x ADD, which is lower than the Emergency storage of 1.0 x ADD / 0.8 = 1.25 x ADD).

Table 7-4. Storage Analysis

Pressure Zone	Available Storage (MG)	Existing (MG)		2010 (MG)		Buildout (MG)	
		Required	Deficient	Required	Deficient	Required	Deficient
Historic Zone 1	1.45	1.2 (FF)	None	2.8	1.3	4.6	3.2
East Zone 1	-	-	-	-	-	30.5	30.5
West Buckeye Zone 1	-	-	-	-	-	41.9	41.9
Total Zone 1	*1.45*	*1.2*	*None*	*2.8*	*1.3*	*77.0*	*75.5*
Sundance Zone 2[1]	2.05	1.4 (FF)	None	1.5 (FF)	None	2.8	0.8
East Zone 2	-	-	-	-	-	22.8	22.8
Total East/Sundance Zone 2	*2.05*	*1.4*	*None*	*1.5*	*None*	*25.7*	*23.6*
West Buckeye Zone 2	*-*	*-*	*-*	*1.3 (FF)*	*1.3*	*44.3*	*44.3*
Sundance Zone 3[1]	*4.05*	*1.4 (FF)*	*None*	*3.1*	*None*	*3.9*	*None*
Total	7.55	4.0	None	7.4	2.6	150.9	143.4

1. The storage tanks serving Sundance can serve both zones 2 and 3. For this analysis, it was assumed that half of the storage would serve each zone.
2. FF = fire flow
2. MG = million gallons

It is recommended that the Town review their storage criteria. The American Water Works Association (AWWA) method for calculating storage includes calculating and summing the storage required for maximum day operations, for fire, and for emergencies (AWWA, 2005). This may give the Town a more meaningful calculation for storage. With the current requirements, the Emergency storage criterion is usually the largest of the four criteria, which does not take into account separate requirements for operation and fire storage. Using the AWWA method to calculate storage could give larger or smaller values for required storage.

It is also recommended that the Town monitor storage requirements for individual developments to ensure compatibility with the storage requirements for the entire pressure zone. For example, two separate developments may construct separate (duplicate) storage to satisfy emergency and fire storage requirements, but if the developments are in the same pressure zone and will be connected in the future, they may be able to share storage. The intent is to avoid constructing too much storage, which can lead to problems with maintaining sufficient chlorine residual and bacterial growth.

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8. WASTEWATER COLLECTION SYSTEM EVALUATION

The purpose of this section is to summarize the evaluation of the Town's existing wastewater system under existing and future demand conditions. The model was used to identify deficiencies in the wastewater system. The improvements developed to fix these deficiencies are discussed in Section 10.

8.1 Evaluation Criteria

The Design and Evaluation Criteria Technical Memorandum (Appendix B) contains the standards used for the evaluation of the existing and future wastewater systems. The technical memorandum includes evaluation criteria used to identify deficiencies in the system and the design criteria used to design improvements for existing deficiencies and for future growth.

8.2 System Evaluation

The existing wastewater system was evaluated for existing (2007-2008), 2010, and buildout flows. For each year, peak flows were added to the model and model results were compared to the evaluation criteria. Areas in the existing system that do not meet the criteria are discussed below. The evaluation only included the modeled piping, which included pipes larger than 10 inches (although some critical smaller diameter piping was modeled). There are potentially smaller diameter collection system pipes with capacity problems that were not modeled.

Although corrections were made to the Town's GIS layers for piping during the course of this project, some uncertainty remains with respect to how some pipes are connected into the collection system. Therefore, there could also be unidentified capacity problems if there are incorrect pipe connections in the model. The Town should continue to verify and update the pipe and manhole data in their GIS.

8.2.1 Piping

For each flow scenario, peak flows in the existing system piping were calculated by the model. The depth to diameter ratio (d/D) and peak velocity were calculated for each pipe and compared to the evaluation criteria. The evaluation criteria requires a d/D under 1.0 (flow remains within the pipe) and a peak velocity less than 10 ft/s. Note that the d/D ratio criterion is different for pipe evaluation versus pipe design. Pipes with a d/D greater than 1.0 were identified for possible replacement based on the evaluation, while when designing a new pipe, a d/D of 0.75 is used.

For existing flows, the highest d/D for modeled pipes was 0.625 and the highest velocity was 6.2 ft/s, both of which are which are within the evaluation criteria. For buildout flows, several areas are predicted to have capacity problems with d/D greater than 1.0 as shown on Figure 8-1. Pipe velocities were calculated to be less than or equal to 10 ft/s for buildout flows.

8.2.2 Lift Stations

No lift stations are located in the modeled portion of the collection system. Therefore existing lift stations were not evaluated.

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9. WATER SYSTEM CAPITAL IMPROVEMENTS PLAN

This section presents the CIP for the Town's water system. Planning horizons that were evaluated in the CIP include: existing system (2007-2008) and buildout, providing the Town with the two most crucial planning horizons. The mid-term timelines can be added in a future update, when updated population projections are available. Note that this CIP includes only the modeled area, and thus represents only a portion of the CIP projects that will be considered in the Town's planning process.

A CIP was developed to assist the Town in budgeting for needed improvements to provide the required level of service to the Town's water and wastewater customers. Improvement projects were developed for short- and long-term flow projections. The short-term projects are primarily for deficiencies identified during the existing model evaluation (see Sections 7 and 8) and the Town should consider addressing the short-term projects during the next 5 years. The long-term projects are primarily to serve future development. The water and wastewater facilities shown in the master plans were added to the model as discussed in Section 1.6. Facilities were also added for areas not covered by the master plans and to connect the master planned and existing systems.

The CIP projects depend on the accuracy of development, population, and demand projections. The CIP should be updated regularly (every 5 years is recommended) to refine the implementation dates as planning, population, and water use trends change.

Figure 9-1 shows a hydraulic schematic of the modeled area with buildout facilities. Figure 9-2 is an overall map of the proposed improvement projects; detailed views of each improvement project are presented on Figures 9-3 through 9-6.

9.1.1 Water CIP Project Descriptions

The following is a brief description of each improvement project. These projects include major piping, pumping, and storage. The projects do not include the smaller diameter distribution piping within developments. On the figures, this smaller diameter piping is labeled as "Future Development Pipe." Refer to individual master plans for details on the piping within the developments.

- West Buckeye Zone 2 – This project includes the piping needed to serve the West Buckeye Zone 2 service area as shown on Figure 9-3. The piping, tank, and booster pump layout is based on the West Buckeye Master Plan completed by CMX in September 2006. The facilities in the West Buckeye Master Plan were upsized as needed to meet the Town's current design criteria. The figure shows the updated piping. The only existing piping in this area is at the Buckeye Airport and the Well 12 and 14 transmission piping. The Well transmission piping will continue to be in service to provide water to the Historic Buckeye service area. This service area will have six booster pump and tank sites.
- West Buckeye Zone 1 – This project includes the piping needed to serve the West Buckeye Zone 2 service area as shown on Figure 9-4. This area is also based on the West Buckeye Master Plan and was also modified to meet the current criteria. The Well 12 and 14 transmission piping also runs through this area. There will be seven booster pump and tank sites to service this area.

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- East Buckeye Zone 2 – This project includes the piping needed to serve the East Buckeye Zone 2 service area as shown on Figure 9-5. This area includes the existing Sundance and Sunora developments. The existing piping in Sundance and Sunora has sufficient capacity for future growth. This service area will have six additional booster pump and tank sites.
- East Buckeye Zone 1 – This project includes the piping needed to serve the East Buckeye Zone 1 service area as shown on Figure 9-6. The existing Historic Buckeye service area is within this service area. There will be seven additional booster pump and tank sites to service this area.
- Historic – This project includes adding additional pumping and storage capacity to meet future demands. A separate figure was not created for the Historic service area because no additional piping needs to be added.
- Sundance Zone 2 – This project includes adding additional pumping and storage capacity to meet future demands. A separate figure was not created for the Sundance Zone 2 service area because no additional piping needs to be added.

9.2 Water CIP Project Costs

Unit costs (Table 9-1) were developed from bid tabs on projects recently constructed for the Town. Unit costs provided by the Town were reviewed and updated based on current industry costs by Brown and Caldwell's Construction Cost Estimating Group. All unit prices represent installed costs and include excavation, bedding, backfill, compaction, materials, appurtenances, and delivery to the site.

Detailed cost estimates were developed for each project (Table 9-1) based on a budgetary, planning-level, and engineer's opinion of probable project costs. The costs for each recommended improvement are presented in present-day value.

The cost estimates are based on Brown and Caldwell's perception of current conditions in the project location. The estimates reflect Brown and Caldwell's professional opinion of costs at this time and are subject to change. Brown and Caldwell has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's method of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Brown and Caldwell cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein. Table 9-2 summarizes the probable estimates of construction costs for each water system improvement project.

Allowances for Contingency and EAC (Engineering, Legal, Administration, and Construction Management Services) are included in the cost estimates. The planning-level estimates include 25 percent for construction contingency and 15 percent for EAC. The cost information should be updated regularly using the *Engineering News-Record* (ENR) Construction Cost Index (CCI) value to account for fluctuations in construction cost over time. The ENR CCI at the time the cost estimates were prepared was 8,805 (ENR, June 2010).

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Table 9-1. Water CIP Detailed Cost Estimates

Description	Unit	Unit Cost	Qty	Total	Qty	Total	Qty	Total	Qty	Total	Qty	Total	Qty	Total	Qty	Total	Qty	Total
Project			Historic Zone 1 (Existing)		Historic Zone 1 (Buildout)		Sundance Zone 2 (Buildout)		Sundance Zone 3 (Buildout)		West Buckeye Zone 1 (Buildout)		West Buckeye Zone 2 (Buildout)		East Buckeye Zone 1 (Buildout)		East Buckeye Zone 2 (Buildout)	
General Conditions		10%		$59,274		$741,714		$270,310				$19,666,360		$19,807,905		$14,327,436		$10,149,594
Ductile Iron Pipe																		
8	LF	$88									316,873	$27,884,848	279,916	$24,632,650	134,959	$11,876,429	43,930	$3,865,839
12	LF	$132									310,422	$40,975,741	276,903	$36,551,196	309,424	$40,843,979	211,521	$27,920,767
16	LF	$176									75,704	$13,323,987	80,180	$14,111,668	46,236	$8,137,593	43,653	$7,683,013
18	LF	$198																
20	LF	$220									14,837	$3,264,161	28,612	$6,294,714	8,831	$1,942,726	11,870	$2,611,330
24	LF	$264									7,491	$1,977,738	9,754	$2,575,160	275	$72,564	987	$260,522
30	LF	$330											424	$140,022	3,456	$1,140,451	1,177	$388,336
Railroad Tunneling Costs	LF	$1,000									1,350	$1,350,000			1,200	$1,200,000		
Canal Crossing	LF	$1,250									1,350	$1,687,500	1,200	$1,500,000	600	$750,000	750	$937,500
Storage Capacity	MG	$1,425,000			3.2	$4,560,000	0.8	$1,140,000			41.9	$59,707,500	44.3	$63,127,500	30.5	$43,462,500	22.8	$32,490,000
Pumping Capacity	gpm	$666	890	$592,740	4,290	$2,857,140	2,347	$1,563,102			69,808	$46,492,128	73,793	$49,146,138	50,823	$33,848,118	38,046	$25,338,636
TOTAL DIRECT COST				$652,014		$8,158,854		$2,973,412				$216,329,963		$217,886,953		$157,601,797		$111,645,537
Contingency		25%		$164,000		$2,040,000		$744,000				$54,083,000		$54,472,000		$39,401,000		$27,912,000
SUBTOTAL				$817,000		$10,199,000		$3,718,000				$270,413,000		$272,359,000		$197,003,000		$139,558,000
Engineering and Services During Construction		15%		$123,000		$1,530,000		$558,000				$40,562,000		$40,854,000		$29,551,000		$20,934,000
TOTAL ESTIMATED PROJECT COST				$940,000		$11,729,000		$4,276,000				$310,975,000		$313,213,000		$226,554,000		$160,492,000

Assumptions:

Open cut across highways

150 Linear Feet of 48" casing per RR and Canal Crossing

At grade Steel Storage tanks

Open cut construction for all pipe except RR and Canals

Notes:

All costs are in present-day dollars (June 2010, ENR CCI = 8,805)

All unit prices represent installed costs and include excavation, bedding, backfill, compaction, materials, appurtenances, and delivery to the site.

The cost estimates are based on Brown and Caldwell's perception of current conditions in the project location. The estimates reflect Brown and Caldwell's professional opinion of costs at this time and are subject to change.

gpm = gallons per minute

LF = linear feet

MG = million gallons

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Table 9-2. Water System Capital Improvements Plan			
Project Name	Facilities to Construct	Project Description	Estimated Cost
Short Term (Existing)			
Historic	1.3 MGD Pumping Capacity	Additional pumping capacity for increased fire demand requirement of 4,000 gpm	$940,000
Total Short Term			$940,000
Long Term (Buildout)			
Historic	3.2 MG Storage Capacity 6.2 MGD Pumping Capacity (additional beyond short term)	Additional storage and pumping for future growth	$11,729,000
Sundance Zone 2	0.8 MG Storage Capacity 3.4 MGD Pumping Capacity	Additional storage and pumping for future growth	$4,276,000
West Buckeye Zone 1	726,000 LF of 8 to 24-in DIP Pipe 41.9 MG Storage 100.5 MGD Pump Capacity	See West Buckeye Master Plan	$310,975,000
West Buckeye Zone 2	676,000 LF of 8 to 30-in DIP Pipe 44.3 MG Storage 106.3 MGD Pump Capacity	See West Buckeye Master Plan	$313,213,000
East Buckeye Zone 1	504,000 LF of 8 to 30-in DIP Pipe 30.5 MG Storage 73.2 MGD Pump Capacity	Water infrastructure to connect Historic Buckeye Zone 1 and developer master planned areas	$226,554,000
East Buckeye Zone 2	314,000 LF of 8 to 30-in DIP Pipe 22.8 MG Storage 54.8 MGD Pump Capacity	Water infrastructure to connect Sundance Zone 2 and developer master planned areas	$160,492,000
Total Long Term			$1,027,239,000

MG = million gallons
MGD = million gallons per day
All costs are in present-day dollars (June 2010, ENR CCI = 8,805)

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10. WASTEWATER COLLECTION SYSTEM CAPITAL IMPROVEMENTS PLAN

This section presents the CIP for the Town's wastewater collection system. Planning horizons that were evaluated in the CIP include: existing system (2007-2008) and buildout, providing the Town with the two most crucial planning horizons. The mid-term timelines can be added in a future update, when updated population projections are available.

Note that this CIP includes only the modeled area, and thus represents only a portion of the CIP projects that will be considered in the Town's planning process.

10.1 Wastewater CIP Projects

A CIP was developed to assist the Town in budgeting for needed improvements to provide the required level of service to the Town's water and wastewater customers. Improvement projects were developed for short- and long-term flow projections. The short-term projects are primarily for deficiencies identified during the existing model evaluation (see Sections 7 and 8). The long-term projects are primarily to serve future development. The water and wastewater facilities shown in the master plans were added to the model as discussed in Section 1.6. Facilities were also added for areas not covered by the master plans and to connect the master planned and existing systems.

The CIP projects depend on the accuracy of development, population, and demand projections. The CIP should be updated regularly (every 5 years is recommended) to refine the implementation dates as planning, population, and water use trends change.

10.1.1 New Piping Elevations

For new piping, the pipe inverts were calculated for each new manhole based on the elevations of the area draining to that manhole. Figure 10-1 shows an example of this process. The invert elevation was calculated at each drainage manhole so that the manhole could drain the entire sub-basin by gravity. A tool was developed that placed an imaginary 8-inch pipe at each point in the sub-basin. The elevation needed to drain each point while maintaining the minimum slope for an 8-inch pipe was calculated. Figure 10-1b shows a sample point draining to the manhole. The invert was then compared to the minimum cover requirement of 6 feet above the top of the pipe (see the design criteria in Appendix B).

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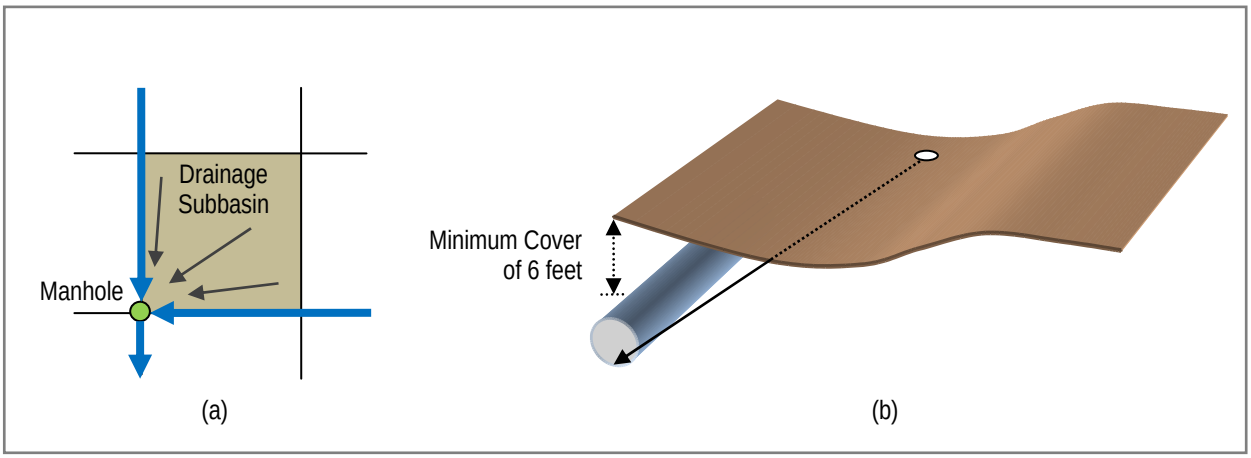

Figure 10-1. New Piping Invert Calculations

10.1.2 Wastewater Collection System CIP Project Descriptions

Figure 10-2 shows the location of the proposed improvement projects; detailed views of each improvement project are presented on Figures 10-3 through 10-6. The following is a brief description of each improvement project. These projects include major piping and lift stations; future treatment plants are not included.

The projects also exclude small-scale piping within developments and future piping and lift stations in the SR85, Miller Road, and Southeast Buckeye Interceptor Sewer (SEBIS) planning areas. On the figures, these pipes are labeled as "Future Development Pipe." The small-scale piping is in the model, but it is not activated as this level of detail is outside of the scope of this Plan. Piping for SR85, Miller Road, and SEBIS is in the model and is active; however, the planning for these three regions has recently changed significantly and is still in a state of flux. These regions were modeled, but because the information is known to be out of date, it is not presented in this report. The piping and assumptions for these three regions should be updated in the model as soon as they are available. Refer to the most recent individual master plans for details on those areas identified by "Future Development Pipe."

- Palo Verde Road – This project includes the piping needed to serve the Palo Verde Road service area as shown on Figure 10-3. The only existing piping in this area is at the Buckeye Airport. The airport piping will drain into this new piping, which will be conveyed to the future Palo Verde Road WWTP. A single lift station will need to be constructed to pump flows over the flood control berm north of I-10.
- Gila Hassayampa – This project includes the piping needed to serve the Gila Hassayampa service area as shown on Figure 10-4. There is no existing piping within this area. The piping will drain by gravity to the future Gila Hassayampa WRF.

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- Gila 85 – This project includes the piping needed to serve the Gila 85 service area as shown on Figure 10-4. There is no existing piping within this area. Most of the piping will drain by gravity to the future Gila 85 WRF. A lift station will be needed to serve the area south of the projected Gila 85 WRF location.
- Central Buckeye – This is a set of projects to account for future infill and growth in the Central Buckeye region. It is projected that some existing piping does not have sufficient capacity to serve future growth. These projects include upsizing piping along main interceptor sewers for increased capacity. Figures 10-5a and 10-5b show the location of each pipeline replacement. These replacement projects were grouped into a single project because the timing of each individual project cannot be projected as this time.

10.2 Wastewater Collection System CIP Project Costs

Unit costs (Table 10-1) were developed from bid tabs on projects recently constructed for the Town. Unit costs provided by the Town were reviewed and subsequently updated based on current industry costs by Brown and Caldwell's Construction Cost Estimating Group. All unit prices represent installed costs and include excavation, bedding, backfill, compaction, materials, appurtenances, and delivery to the site. Allowances for Contingency and EAC (Engineering, Legal, Administration, and Construction Management Services) are included in the cost estimates. The planning-level estimates include 25 percent for construction contingency and 15 percent for EAC.

Detailed cost estimates were developed for each project (Table 10-1) based on a budgetary, planning-level, and engineer's opinion of probable project costs. The costs for each recommended improvement are presented in present-day value. The cost information should be updated regularly using the ENR Construction Cost Index value to account for fluctuations in construction cost over time. The ENR Construction Cost Index at the time the cost estimates were prepared was 8,805 (ENR, June 2010).

The cost estimates are based on Brown and Caldwell's perception of current conditions in the project location. The estimates reflect Brown and Caldwell's professional opinion of costs at this time and are subject to change. Brown and Caldwell has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's method of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Brown and Caldwell cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein. Table 10-2 summarizes the probable estimates of construction costs for each wastewater system improvement project.

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Table 10-1. Wastewater CIP Detailed Cost Estimates

Description	Unit	Unit Cost	Qty	Total	Qty	Total	Qty	Total	Qty	Total
Project			Central Buckeye (Buildout)		Palo Verde (Buildout)		Gila 85 (Buildout)		Gila Hassayampa (Buildout)	
General Conditions		10%		$503,082		$2,748,183		$1,684,645		$1,899,430
RCP Gravity Pipe										
8	LF	$152			55,238	$8,396,118	10,309	$1,566,906	20,249	$3,077,889
10	LF	$161			25,717	$4,140,406	7,933	$1,277,190	7,523	$1,211,261
12	LF	$172	6,893	$1,185,573	9,756	$1,677,949	10,568	$1,817,727	6,217	$1,069,289
15	LF	$192	8,096	$1,554,431	9,064	$1,740,258	8,790	$1,687,661	17,081	$ 3,279,499
18	LF	$216	2,390	$516,339	17,340	$ 3,745,452	16,977	$3,667,040	10,904	$2,355,158
21	LF	$214	1,674	$358,132	9,693	$ 2,074,326	5,473	$1,171,237	18,780	$4,019,001
24	LF	$276			2,696	$743,967	2,654	$732,532	5,728	$1,580,966
30	LF	$353	923	$325,923	2,509	$885,536	2,638	$931,106		
36	LF	$445	302	$134,387	1,197	$532,883	2,099	$933,883	144	$64,034
42	LF									
48	LF									
54	LF	$600	1,245	$746,734						
60	LF									
66	LF									
Force Main										
8	LF	$88								
10	LF	$110					2,806	$308,693		
12	LF	$132			1,337	$176,481				
Railroad Tunneling Costs	LF	$1,250					300	$375,000	600	$750,000
Canal Crossing	LF	$1,250			200	$250,000	400	$500,000	600	$750,000
SR-85 Crossing	LF	$1,250								
I-10 Crossing	LF	$1,250			100	$125,000				
Manhole	EA	$4,025	52	$209,300	320	$1,288,000	162	$652,050	208	$837,200

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Table 10-1. Wastewater CIP Detailed Cost Estimates

Description	Unit	Unit Cost	Qty	Total	Qty	Total	Qty	Total	Qty	Total
Project			Central Buckeye (Buildout)		Palo Verde (Buildout)		Gila 85 (Buildout)		Gila Hassayampa (Buildout)	
1 MG Lift Station	MG	$666,666			2.6	$1,705,451	1.8	$1,225,421		
TOTAL DIRECT COST				$5,533,901		$30,230,008		$18,531,090		$20,893,726
Contingency		25%		$1,384,000		$7,558,000		$4,633,000		$5,224,000
SUBTOTAL				$6,918,000		$37,789,000		$23,165,000		$26,118,000
Engineering and Services During Construction		15%		$1,038,000		$5,669,000		$3,475,000		$3,918,000
TOTAL ESTIMATED PROJECT COST				$7,956,000		$43,458,000		$26,640,000		$30,036,000

Notes:

1) All costs are in present-day dollars (June 2010, ENR CCI = 8,805)

2) All unit prices represent installed costs and include excavation, bedding, backfill, compaction, materials, appurtenances, and delivery to the site.

3) The cost estimates are based on Brown and Caldwell's perception of current conditions in the project location. The estimates reflect Brown and Caldwell's professional opinion of costs at this time and are subject to change.

EA = each

LF = linear feet

MG = million gallons

RCP = reinforced concrete pipe

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Table 10-2. Wastewater System Capital Improvements Plan			
Project Name	Facilities to Construct	Project Description	Estimated Cost
Long Term (Buildout)			
Palo Verde Road (Buildout)	134,000 LF of 8 to 36-in gravity pipe 2,000 LF of 12-in force main pipe 2.6 MGD Pumping Capacity	New infrastructure for Palo Verde Road	$43,458,000
Gila Hassayampa (Buildout)	87,000 LF of 8 to 36-in gravity pipe	New infrastructure for Gila Hassayampa	$30,036,000
Gila 85 (Buildout)	68,000 LF of 8 to 36-in gravity pipe 3,000 LF of 12-in force main pipe 1.8 MGD Pumping Capacity	New infrastructure for Gila 85	$26,640,000
Central Buckeye (Buildout)	21,000 LF of 12 to 36-in gravity pipe	Pipe replacement in Central Buckeye due to increased future flows	$7,956,000
Total Long Term			$108,090,000

LF = linear feet
MGD = million gallons per day
All costs are in present-day dollars (June 2010, ENR CCI = 8,805)

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11. SUMMARY AND RECOMMENDATIONS

This section summarizes the results of the water and wastewater modeling and CIPs, and provides recommendations to the Town.

11.1 Summary

- A Design and Evaluation Criteria Technical Memorandum (Appendix B) was created to establish and identify standards used for the water and wastewater system modeling and assumptions in this Plan.
- Water System:
  - Areas of low system pressure were identified in the existing Historic Buckeye and Sundance water systems.
  - Areas with fire flow deficiencies were identified in the existing Historic Buckeye and Sundance systems and should be addressed during redevelopment or when aging piping is replaced in the future.
  - Booster pump station, storage capacity, and piping for existing, short-term, and long-term future growth was established and compared with the current available capacity within the water model area. From this capacity analysis, deficiencies were identified and CIP projects were identified.
- Wastewater:
  - There are no existing deficiencies in the wastewater system.
  - Long-term future capacities were established and evaluated for the existing wastewater system. Piping in the Central Buckeye service area that needs to be increased in size has been identified.
  - CIP projects including piping and lift stations were developed for the areas within the wastewater model area.
- Accomplished the main purpose of the project, which was to compile information into a common framework, and begin the planning process for the Town as a whole.
- The computer models created for the water and wastewater systems will be important tools as the Town continues to plan for growth. Keeping the models current will greatly assist the Town in ensuring that future development will correspond to the Town's Master Plan.

11.2 Recommendations

- Typically, 5-year intervals are recommended for water and wastewater master plans; however given the fluctuations in the current economic climate, an update within the next 3 years would be advised. Similarly, the CIP should be updated regularly (every 5 years is recommended) to refine the implementation dates as planning, population, and water use trends change. For consistency, the first update should be planned within the next 3 years.

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- As soon as new planning data is available for the SR85, Miller Road, the Western Industrial Corridor, and SEBIS regions it should be incorporated into the wastewater model; this step should not wait for the 3-year update.
- The modeling focus in this Plan generally encompasses that portion of the Town's MPA south of I-10 and north of the Gila River (Figure 1-3). South of I-10, the wastewater model area excludes the Sundance and Cipriani service areas. All regions that were excluded from this version of the Plan should be added when performing the 3-year update (except the region south of the Buckeye Hills).
- When this Master Plan is updated, it may be appropriate to review the location of the planned WWTPs and consider whether all of the WWTPs should be built, whether some could be consolidated, and whether some should be interconnected to serve adjacent areas.
- The process of building and verifying the GIS infrastructure database that began during this project should be continued. A number of issues identified during calibration and analysis of system deficiencies may be resolved with additional QC of the underlying GIS data.
- The water and wastewater models were built using H2OMAP Water and Sewer, which are stand-alone software packages developed by MWH Soft. MWH Soft also sells InfoWater and InfoSewer, which are the same as H2OMAP Water and Sewer except that they run inside of GIS (ArcView). The advantage of the fully integrated GIS software is that the water and wastewater GIS piping can be linked to the model so changes to the GIS can automatically be transferred to the model. However, this GIS/model linking is more complicated. The Town may want to eventually convert the models to the fully integrated GIS software, which is a very quick process. Using either the stand-alone or GIS-integrated software, the Town can quickly update the model as they receive GIS shapefiles or Geodatabases from developers.
- It is recommended that the Town develop guidelines and standards for water and wastewater model submittals, requiring electronic GIS files that will be compatible with the models developed for this Plan.
- As the Town's collection system grows and wet weather flow is recorded over a larger area, it is recommended that a more detailed analysis be done to refine the wet weather peaking factor used in calculating peak wet weather wastewater flows.
- The Town may want to look at the following design criteria:
  - Storage – The Town's storage criteria does not conform to the AWWA storage criteria (see Section 7.2.5). The Town may want to look at modifying the storage criteria to more closely follow the AWWA criteria of providing operational, fire, and emergency storage.
  - Pipe Velocity – The Town requires that distribution pipes be sized to handle fire flows with velocities under 10 ft/s. The Town may want to allow velocities over 10 ft/s for the relatively infrequent and short durations of a fire flow in existing residential areas, and address velocity issues when aging piping is replaced.

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12. REPORT LIMITATIONS

This report was prepared solely for Town of Buckeye in accordance with the standards of the environmental consulting industry at the time the services were performed and in accordance with the contract between Town of Buckeye and Brown and Caldwell dated July 1, 2008. This report is governed by the specific scope of work authorized by Town of Buckeye. We have relied on information or instruction provided by Town of Buckeye and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

13. REFERENCES

American Water Works Association, 2005. Computer Modeling of Water Distribution Systems (M32), 2005.

Arizona Administrative Code, Title 12 (2009). http://www.azsos.gov/public_services/Title_12/12_table.htm

Arizona Department of Commerce (ADC), 2010. July 1, 2009 Population Estimates for Arizona's Counties, Incorporated Places and Balance of County. http://www.azcommerce.com/doclib/econinfo/FILES/2009Estimates.pdf

ADC, 2010. Arizona Population Estimates 1980-2008. http://www.azcommerce.com/econinfo/demographics/Population+Estimates.html

Arizona Department of Water Resources, 1999. *Third Management Plan for Phoenix Active Management Area 2000-2010*, December, 1999.

CMX, 2007. *MAG 208 Water Quality Management Plan Comprehensive Amendment for the Town of Buckeye*, October 2007.

Engineering News-Record, June 2010.

Town of Buckeye, 2007. *Town of Buckeye 2007 General Plan Update*, adopted January 18, 2008.

Town of Buckeye, 2009. *Preliminary Town of Buckeye Water and Sewer Design Standards,* February 11, 2005, revised September 28, 2009.

Vest, Marshall J., 2010. "Recession is Over: Let Recovery Begin!" Arizona's Economy, Economic and Business Research Center, Eller College of Management, The University of Arizona, April 2010: Spring Issue.

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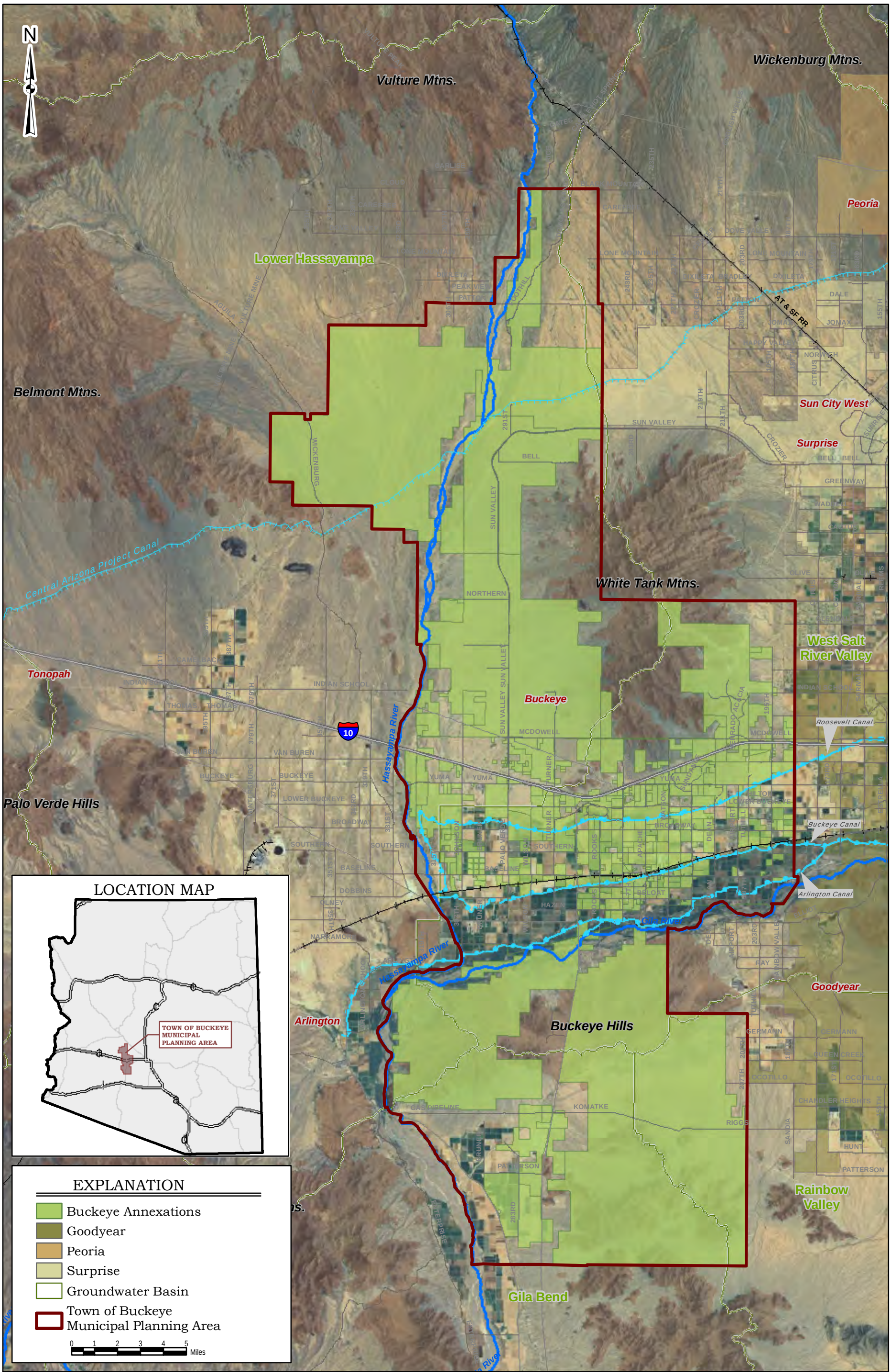

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INTEGRATED WATER RESOURCES PLAN
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MASTER PLAN
TOWN OF BUCKEYE, ARIZONA

Figure 1-1
Town of Buckeye
Municipal Planning Area

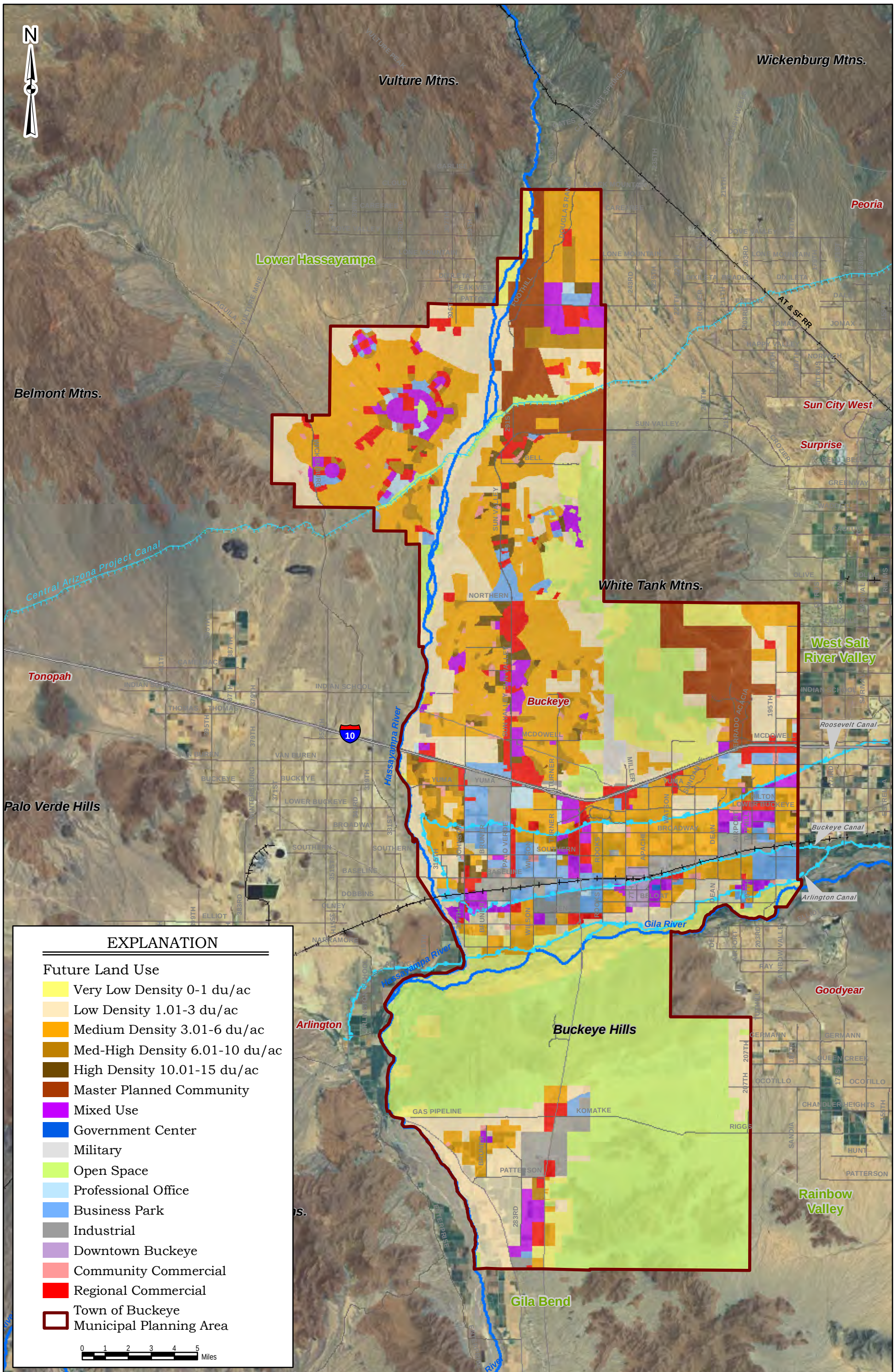

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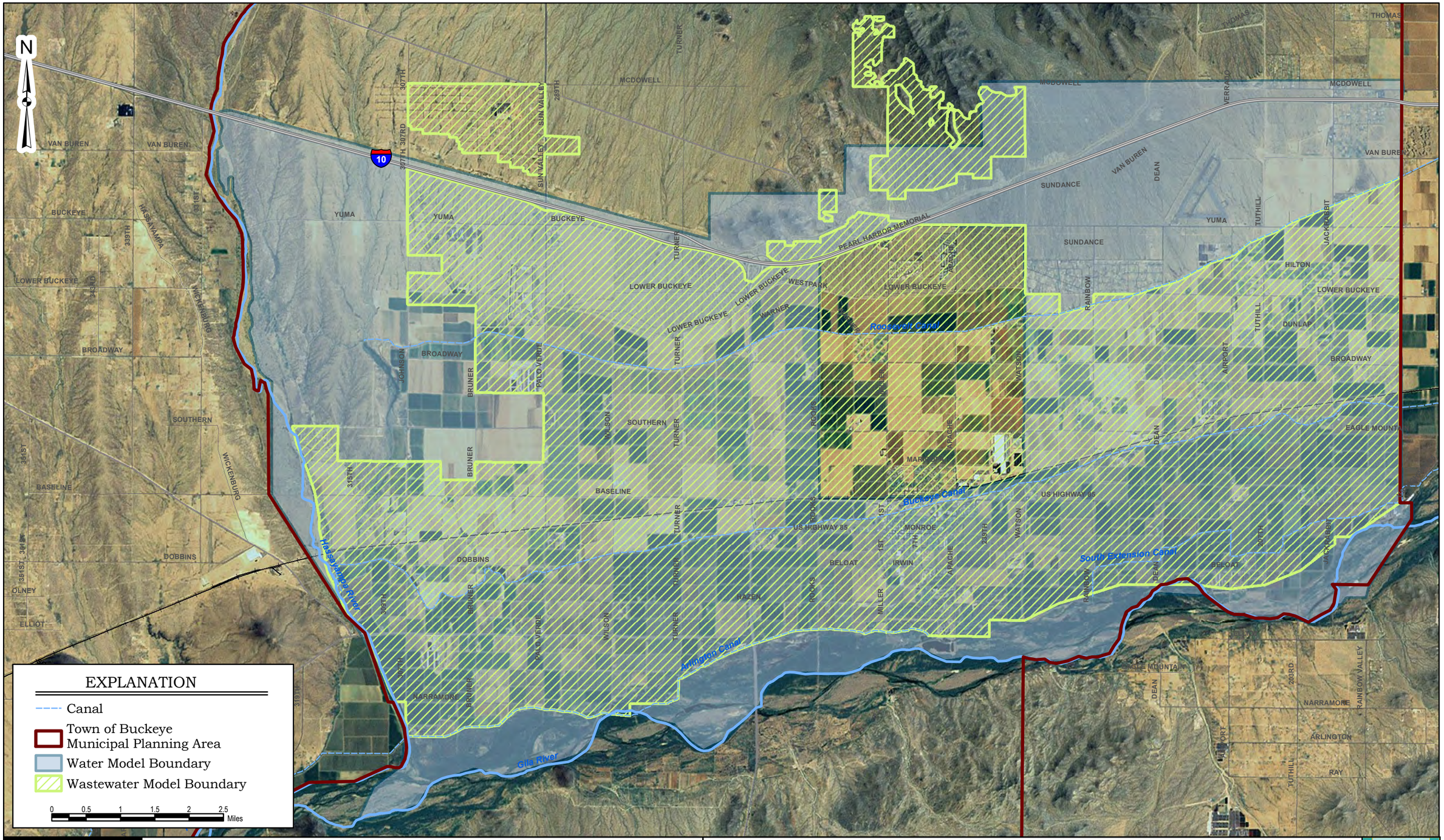
Figure 1-2
Town of Buckeye General Plan
Future Land Use



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TOWN OF BUCKEYE, ARIZONA

Figure 1-3
Modeled Areas

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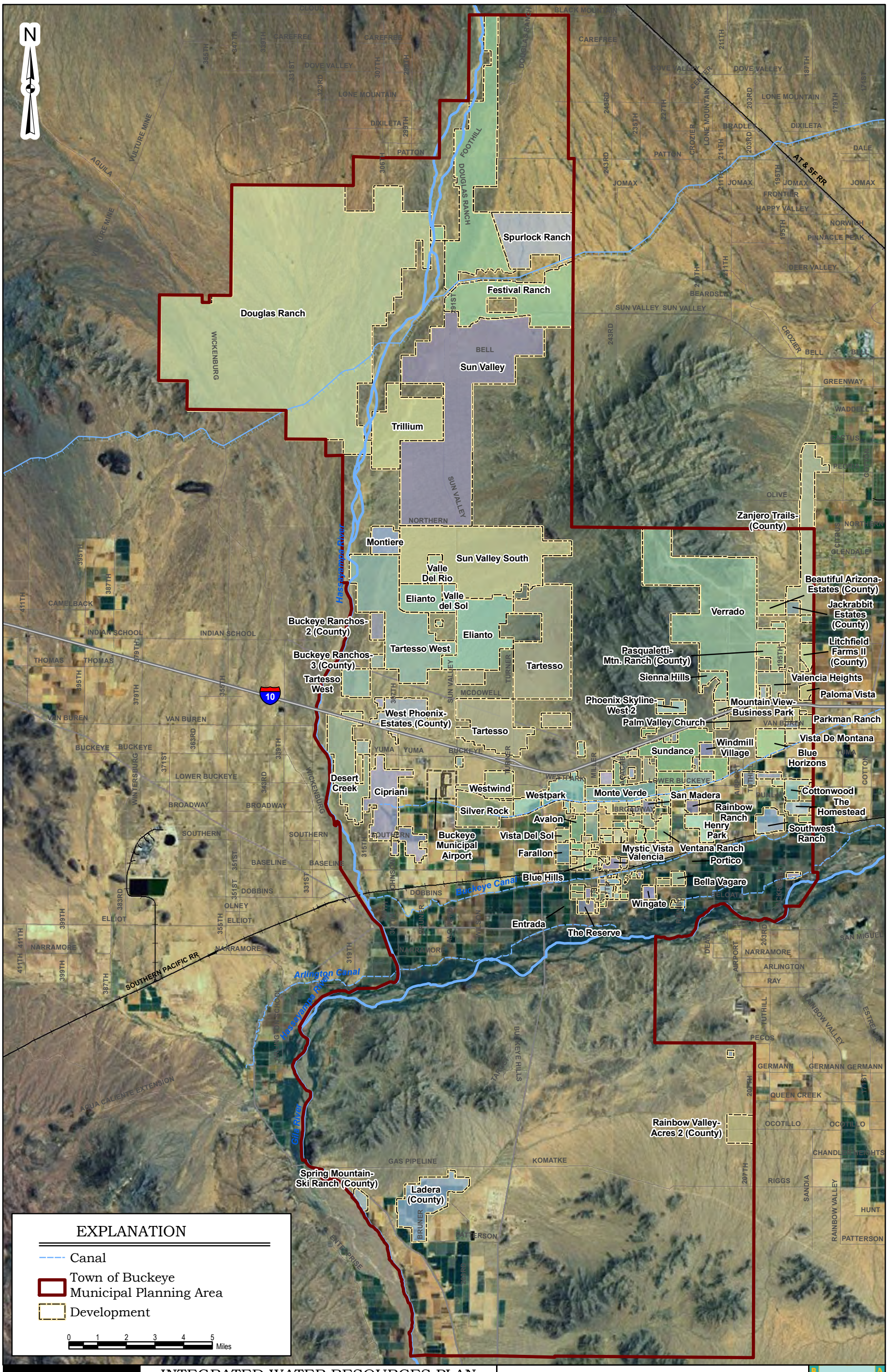

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TOWN OF BUCKEYE, ARIZONA

Figure 1-4
Development Areas

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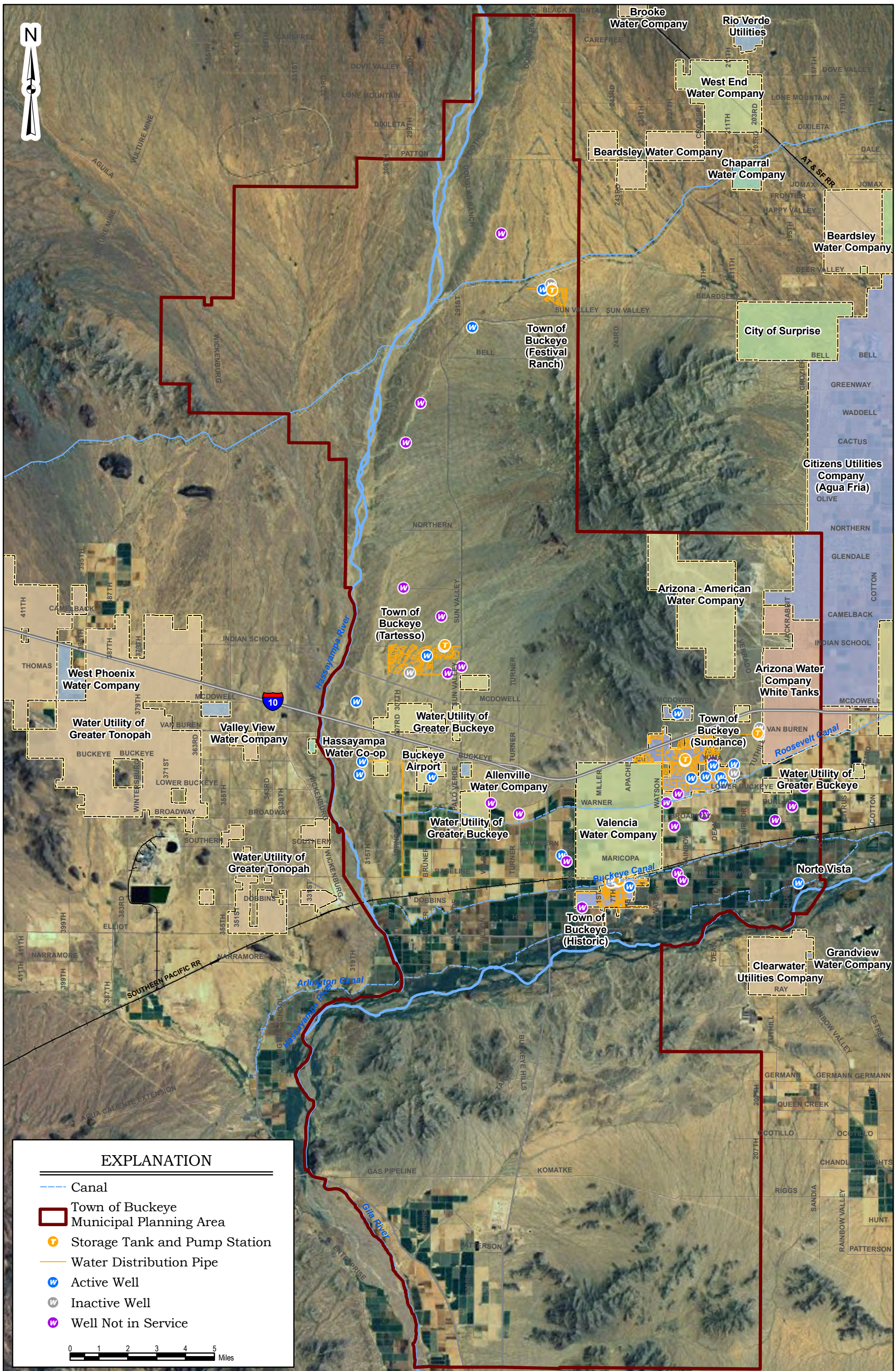

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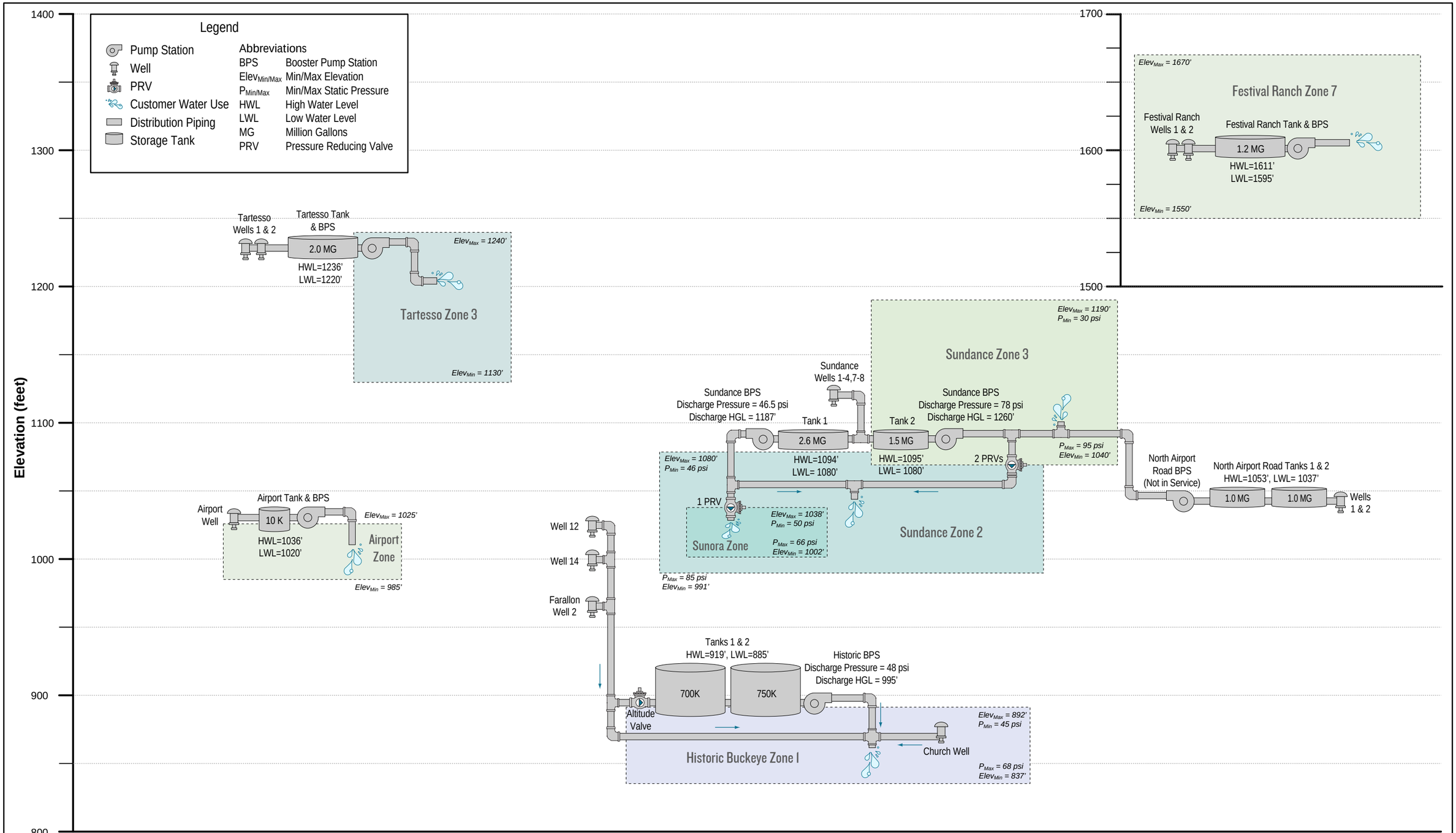
MASTER PLAN
TOWN OF BUCKEYE, ARIZONA

Figure 2-1
Existing Water Systems



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TOWN OF BUCKEYE, ARIZONA

Figure 2-2
Existing Water System Hydraulic Schematic

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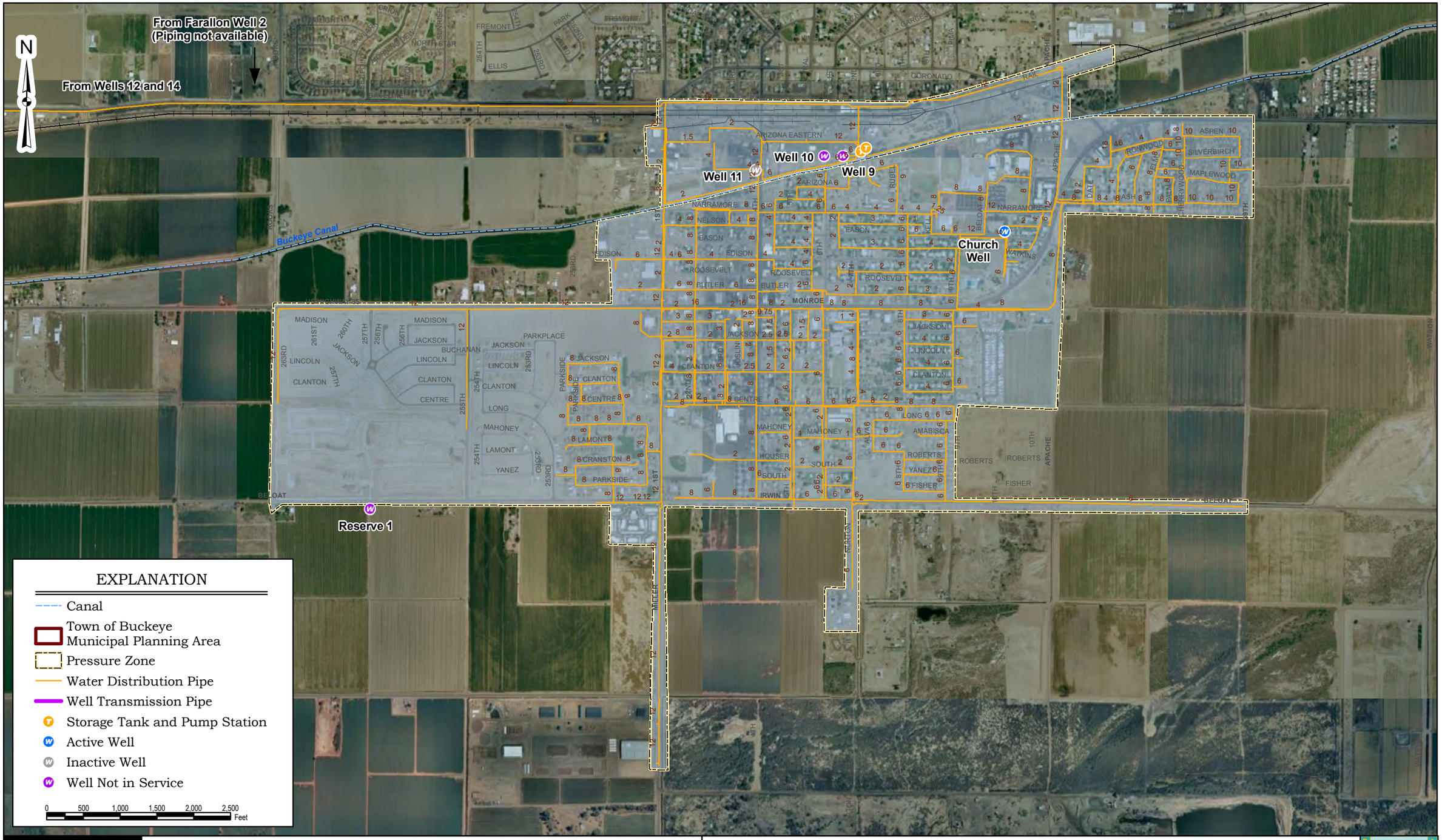

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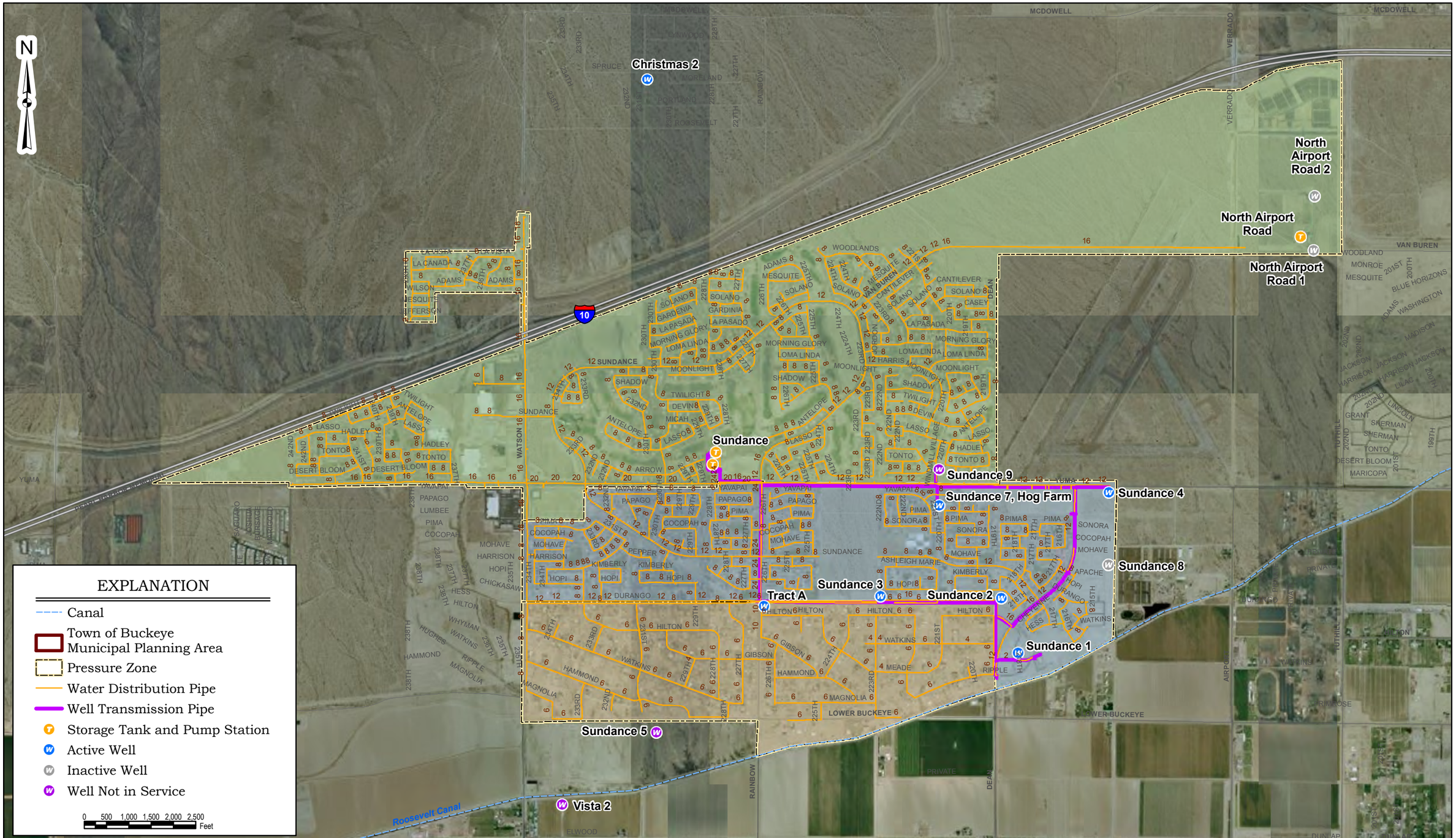
Figure 2-3
Existing Water Systems Detail,
Historic Buckeye



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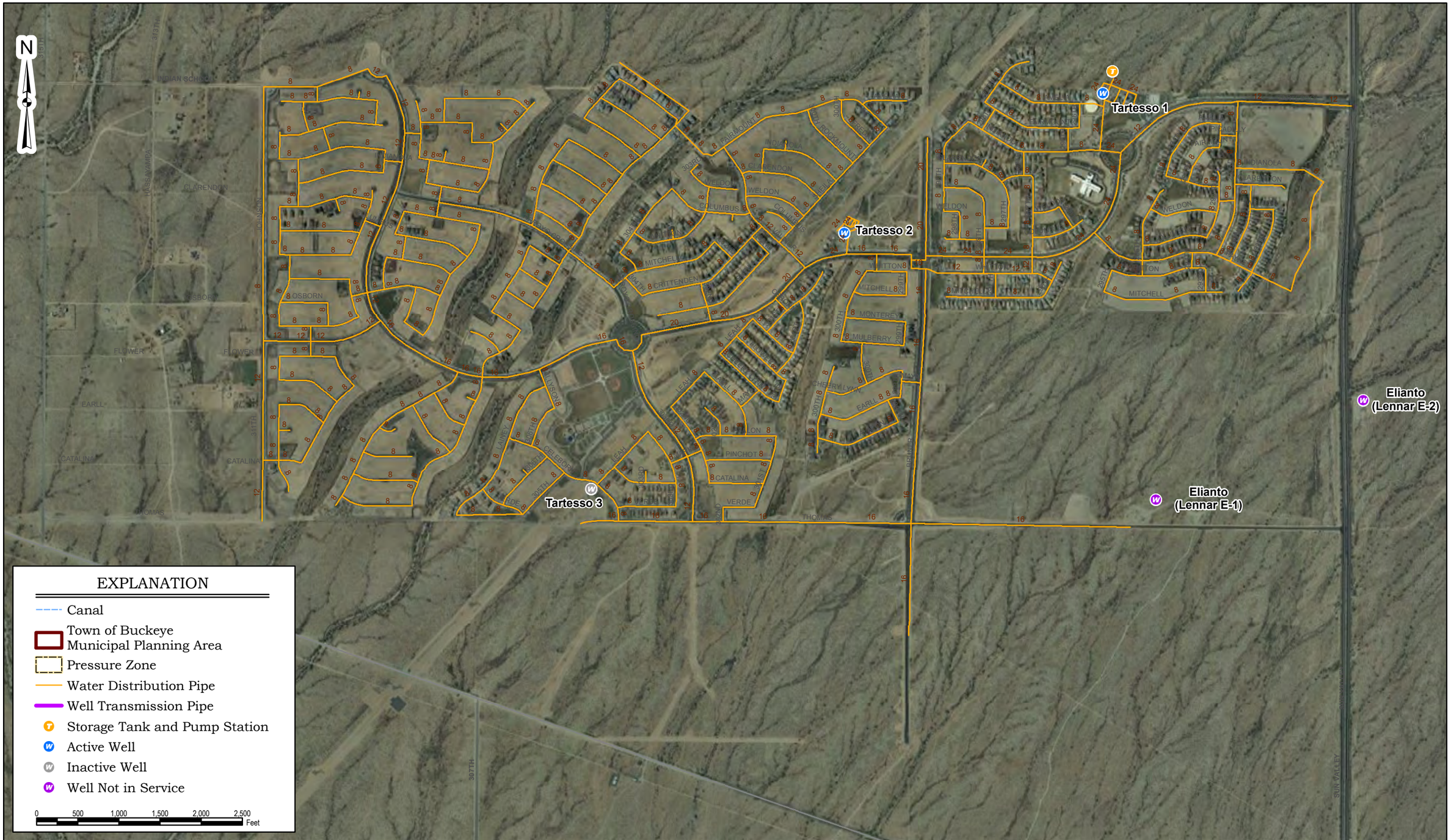
TOWN OF BUCKEYE, ARIZONA

Figure 2-4
Existing Water Systems Detail,
Sundance



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TOWN OF BUCKEYE, ARIZONA

Figure 2-5
Existing Water Systems Detail,
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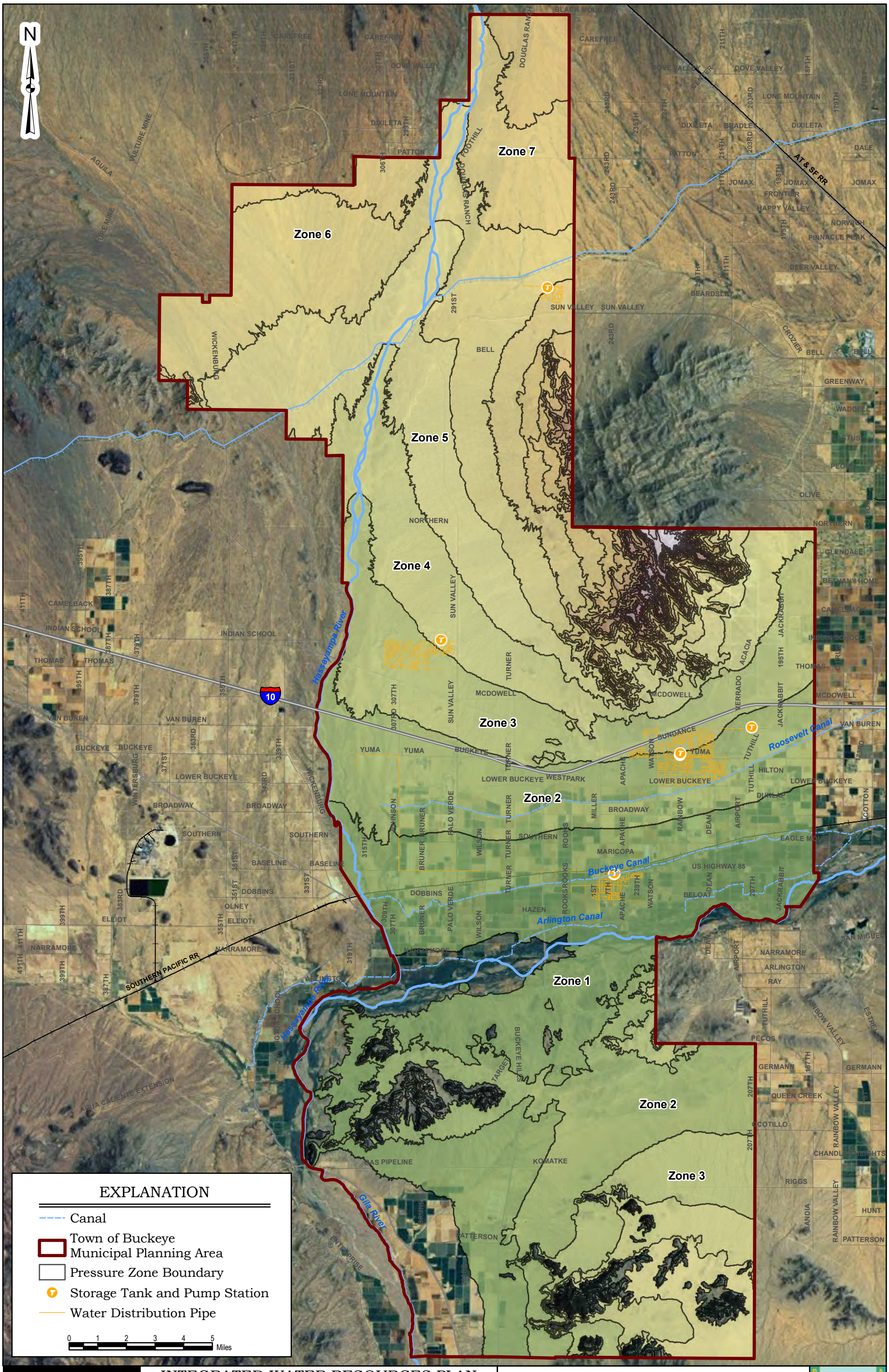
TOWN OF BUCKEYE, ARIZONA

Figure 2-6
Existing Water Systems Detail,
Festival Ranch



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MASTER PLAN
TOWN OF BUCKEYE, ARIZONA

Figure 2-7
Pressure Zone Boundaries

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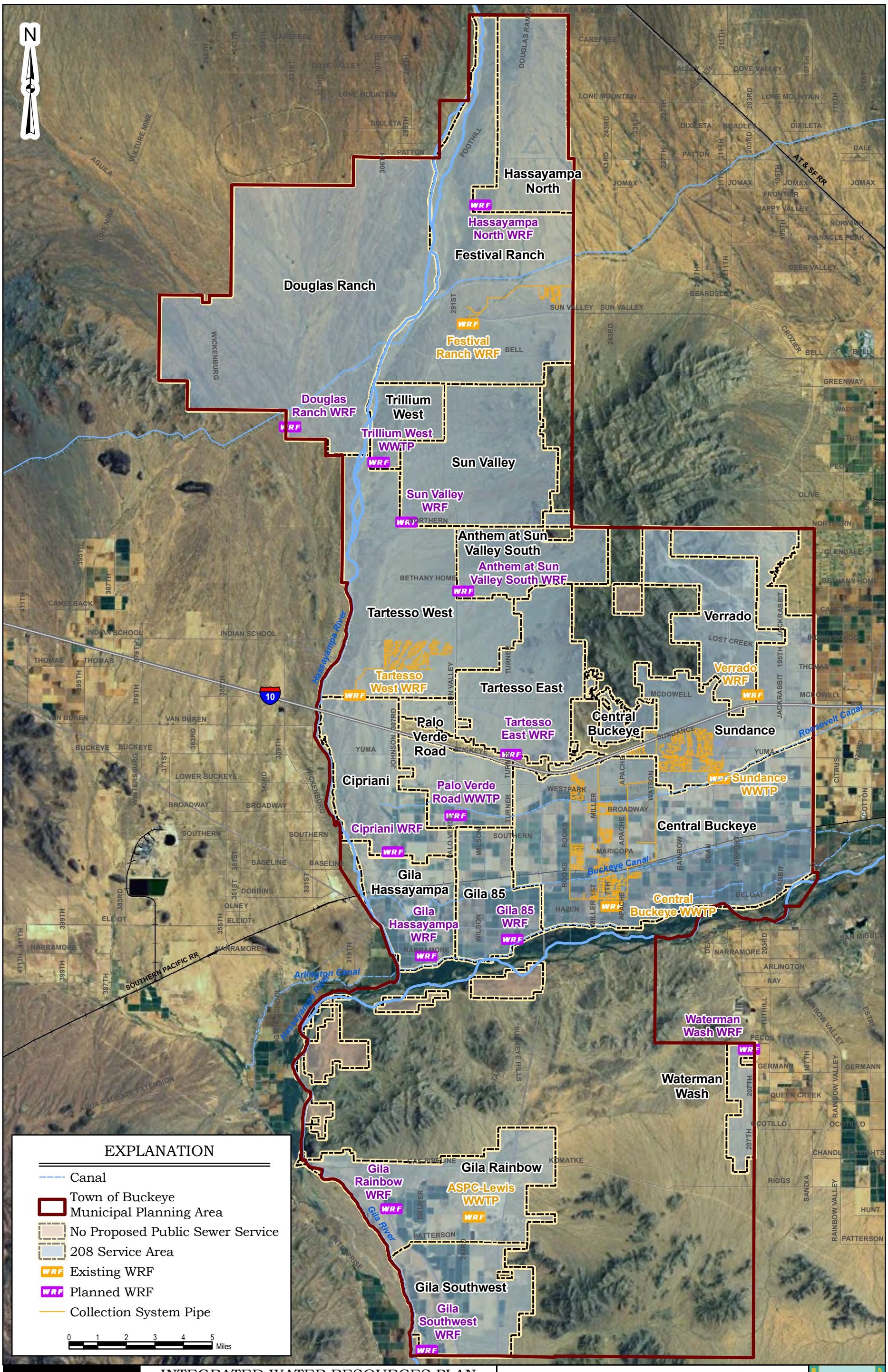

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TOWN OF BUCKEYE, ARIZONA

Figure 3-1
Existing and Planned Wastewater Systems

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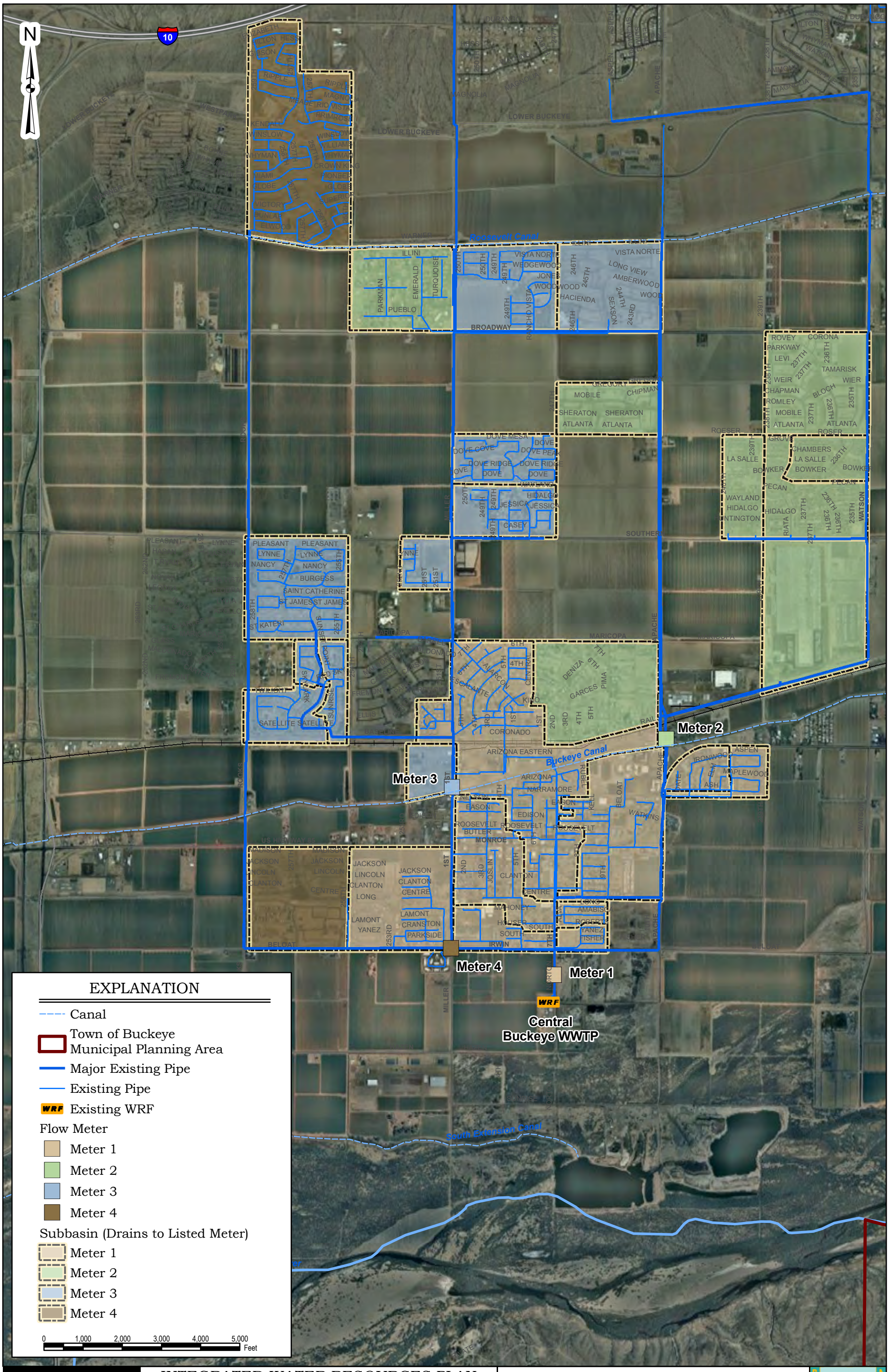

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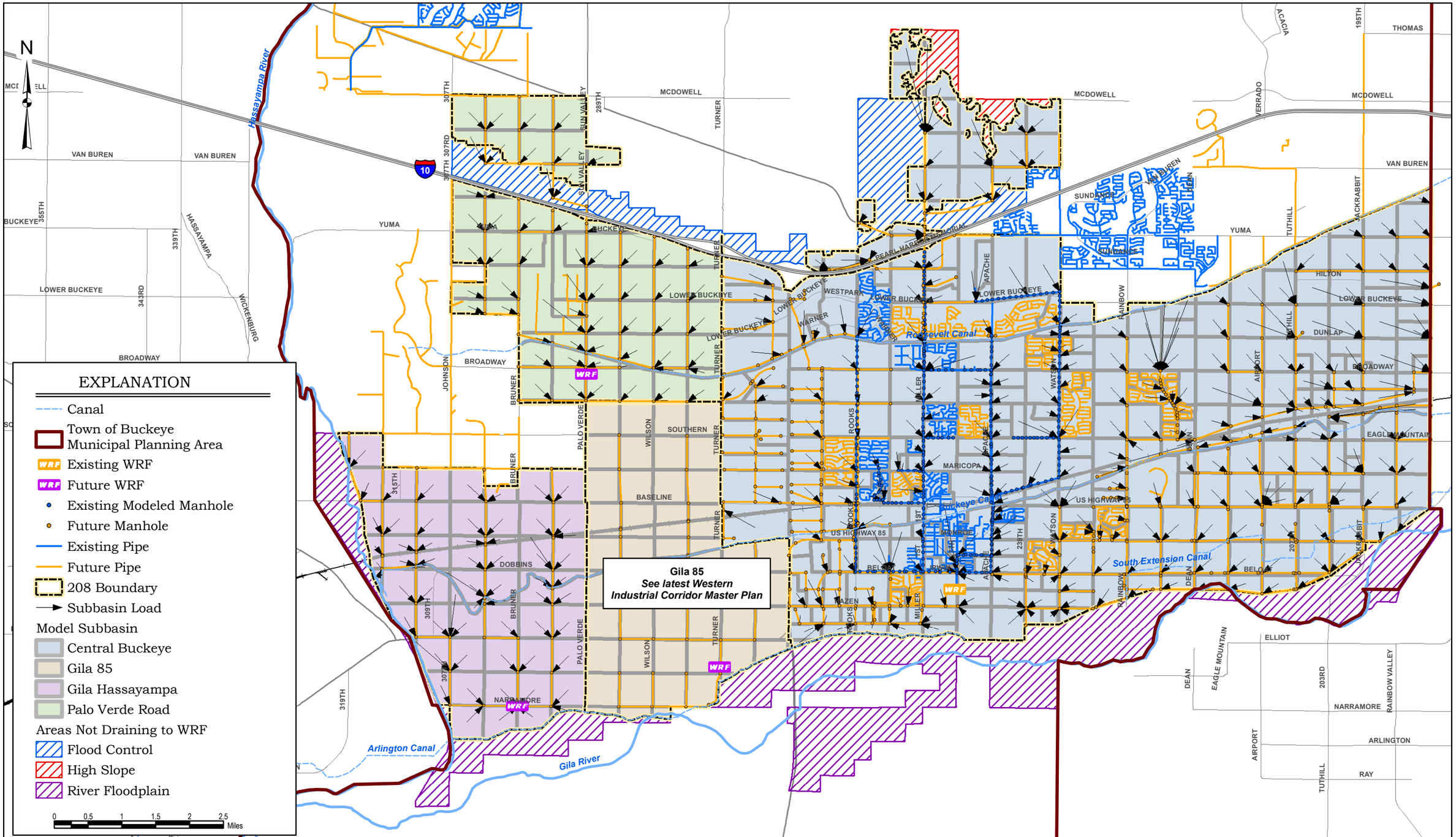
TOWN OF BUCKEYE, ARIZONA

Figure 4-3
Wastewater Flow Meter Locations



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VOLUME II -- WATER/WASTEWATER MASTER PLAN
TOWN OF BUCKEYE, ARIZONA

Figure 6-2
Wastewater Drainage Subbasins

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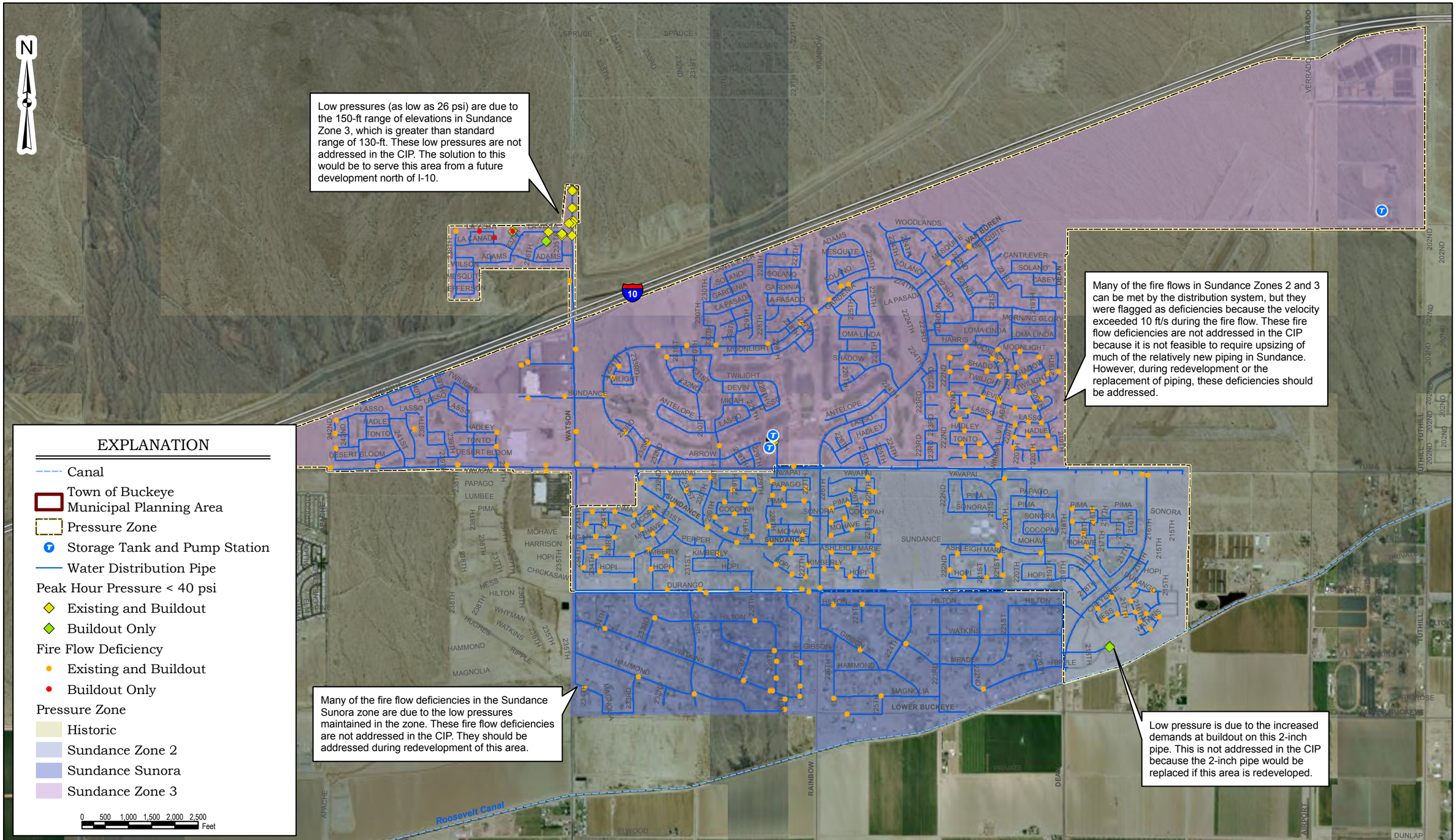

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TOWN OF BUCKEYE, ARIZONA

Figure 7-1
Existing Water System Deficiencies - Sundance

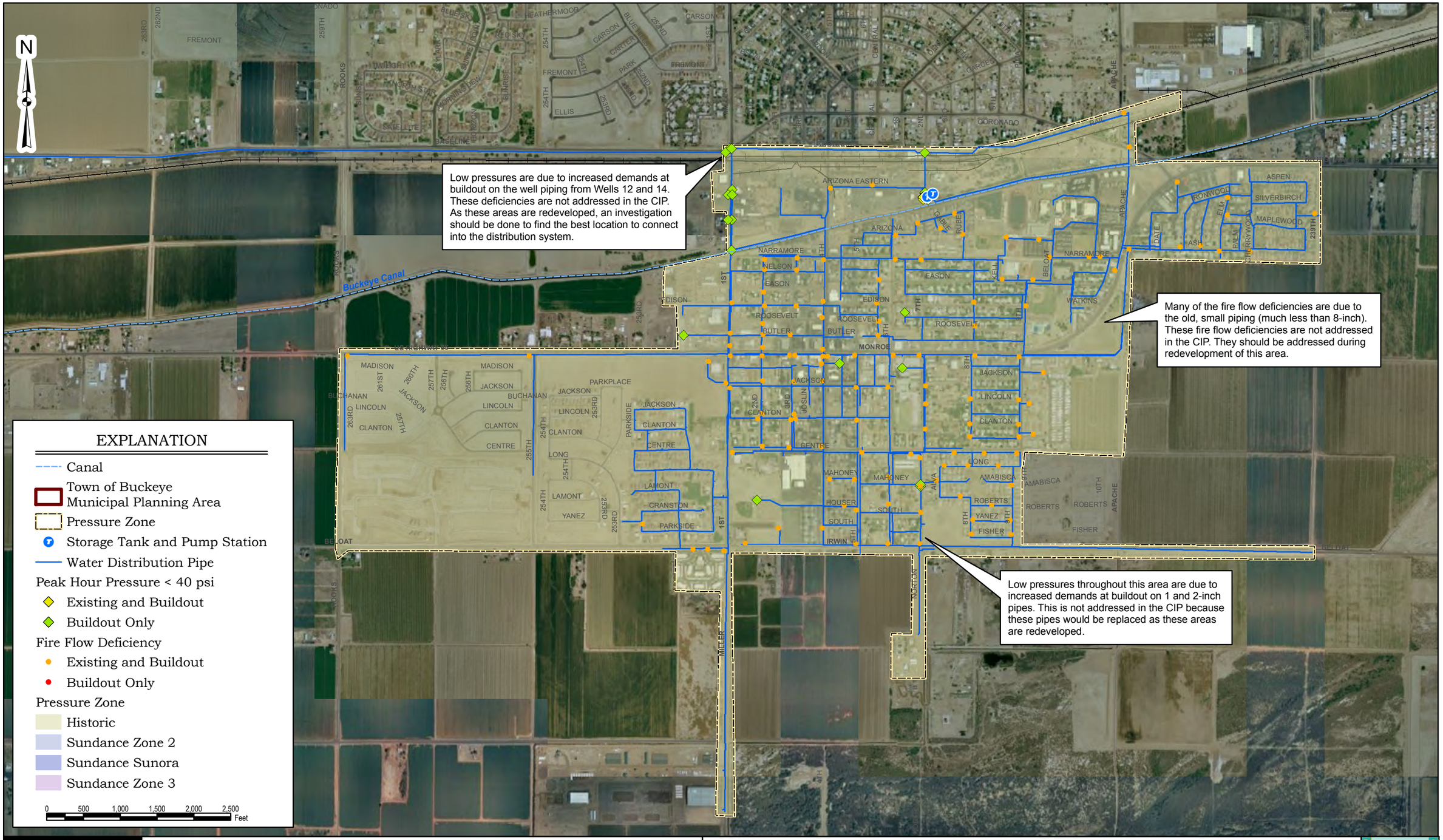

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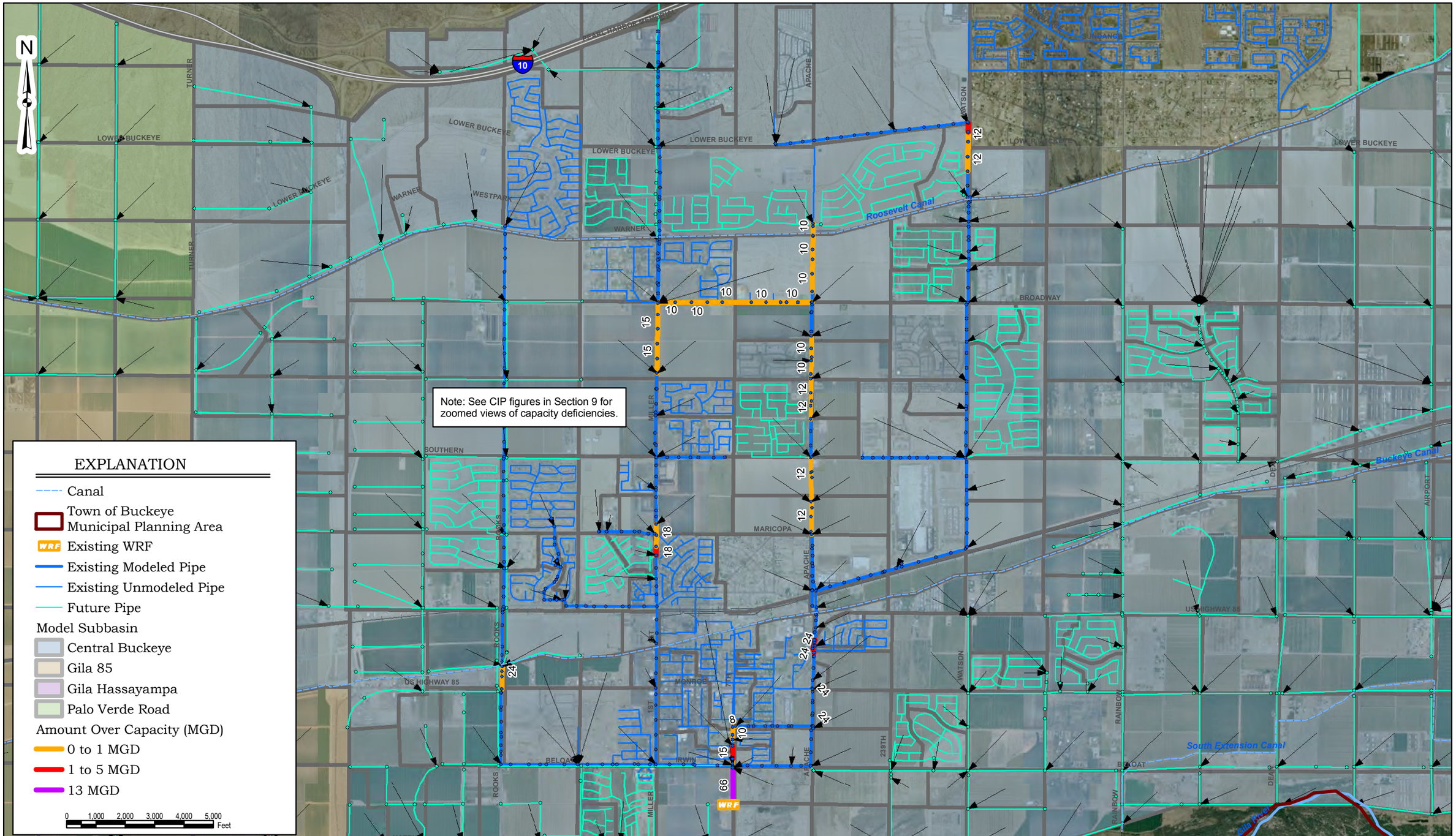
Figure 7-2
Existing Water System Deficiencies - Historic Buckeye



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TOWN OF BUCKEYE, ARIZONA

Figure 8-1
Existing Wastewater System Deficiencies at Buildout Flows

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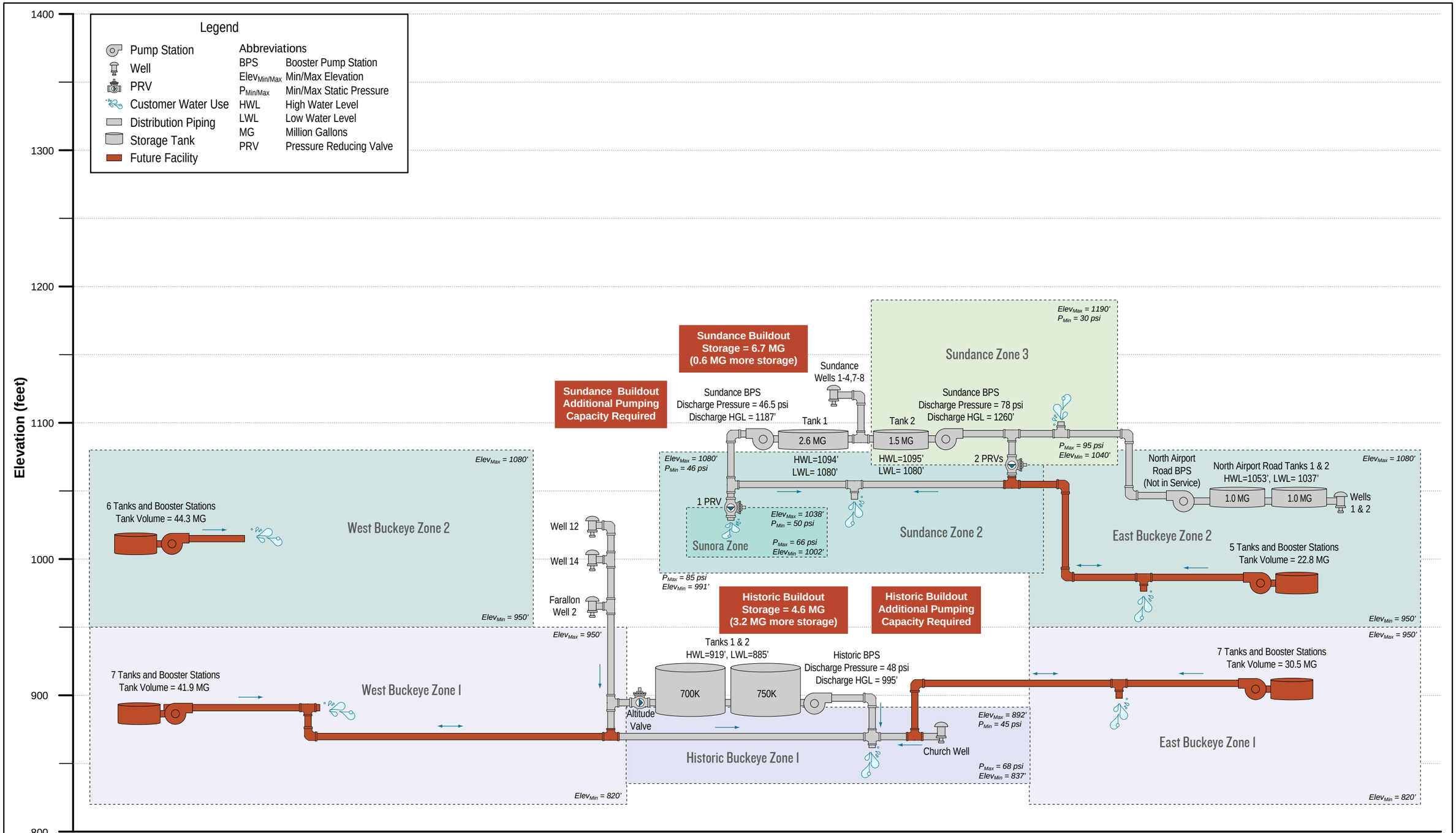

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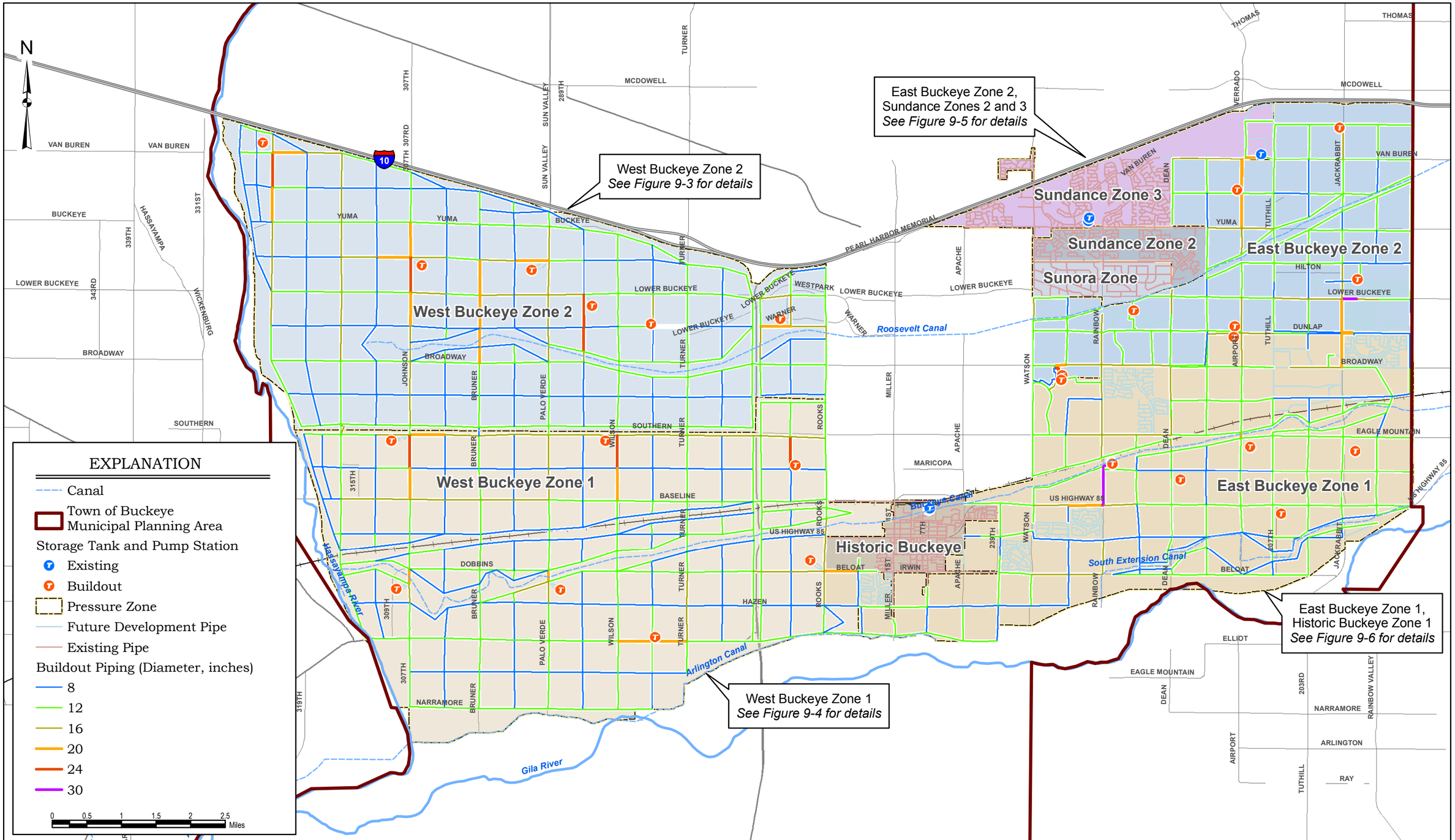
TOWN OF BUCKEYE, ARIZONA

Figure 9-1
Buildout Water System Hydraulic Schematic (Model Area Only)



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TOWN OF BUCKEYE, ARIZONA

Figure 9-2
Water System CIP - Overall

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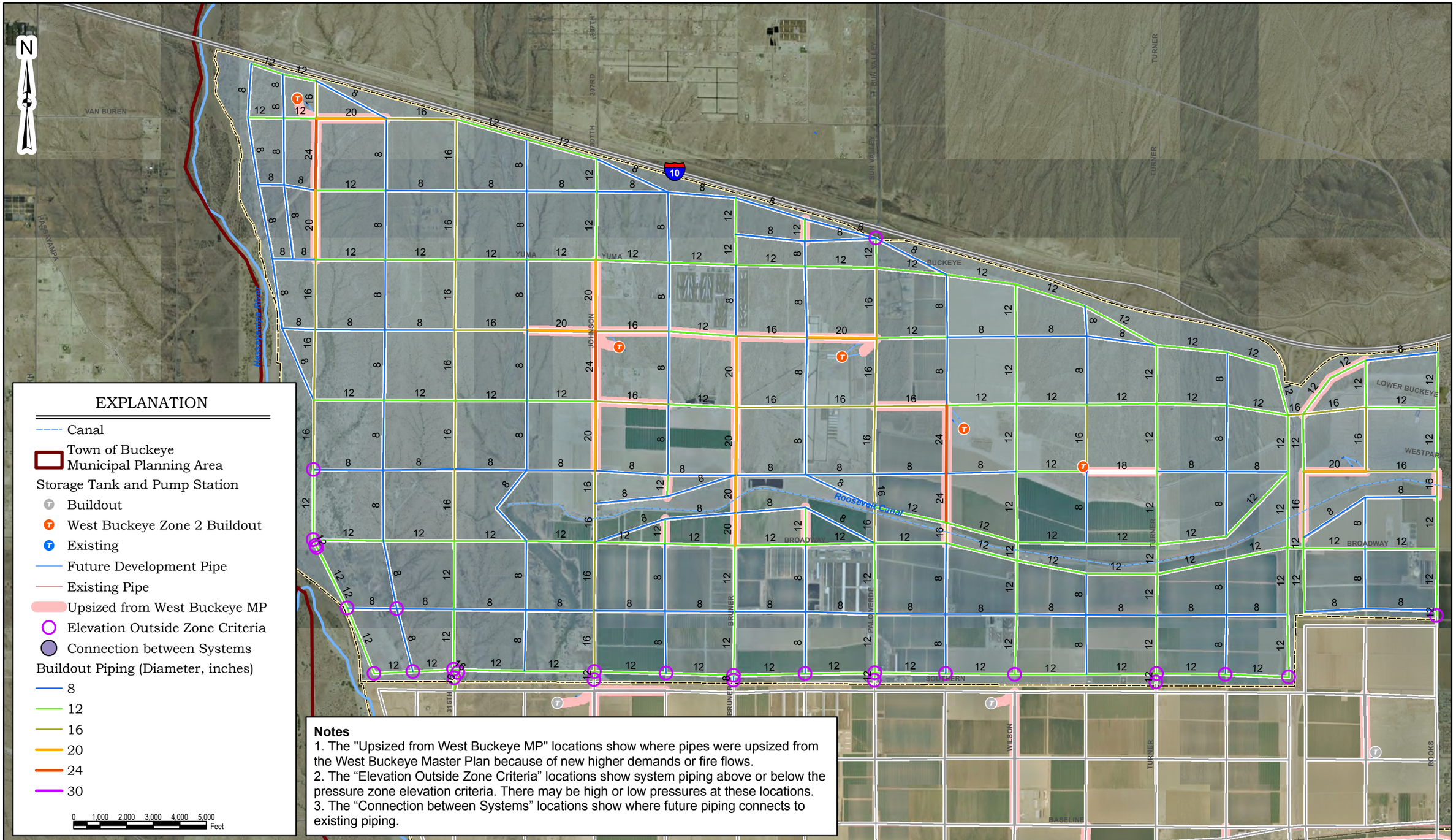

Notes
1. The "Upsized from West Buckeye MP" locations show where pipes were upsized from the West Buckeye Master Plan because of new higher demands or fire flows.
2. The "Elevation Outside Zone Criteria" locations show system piping above or below the pressure zone elevation criteria. There may be high or low pressures at these locations.
3. The "Connection between Systems" locations show where future piping connects to existing piping.

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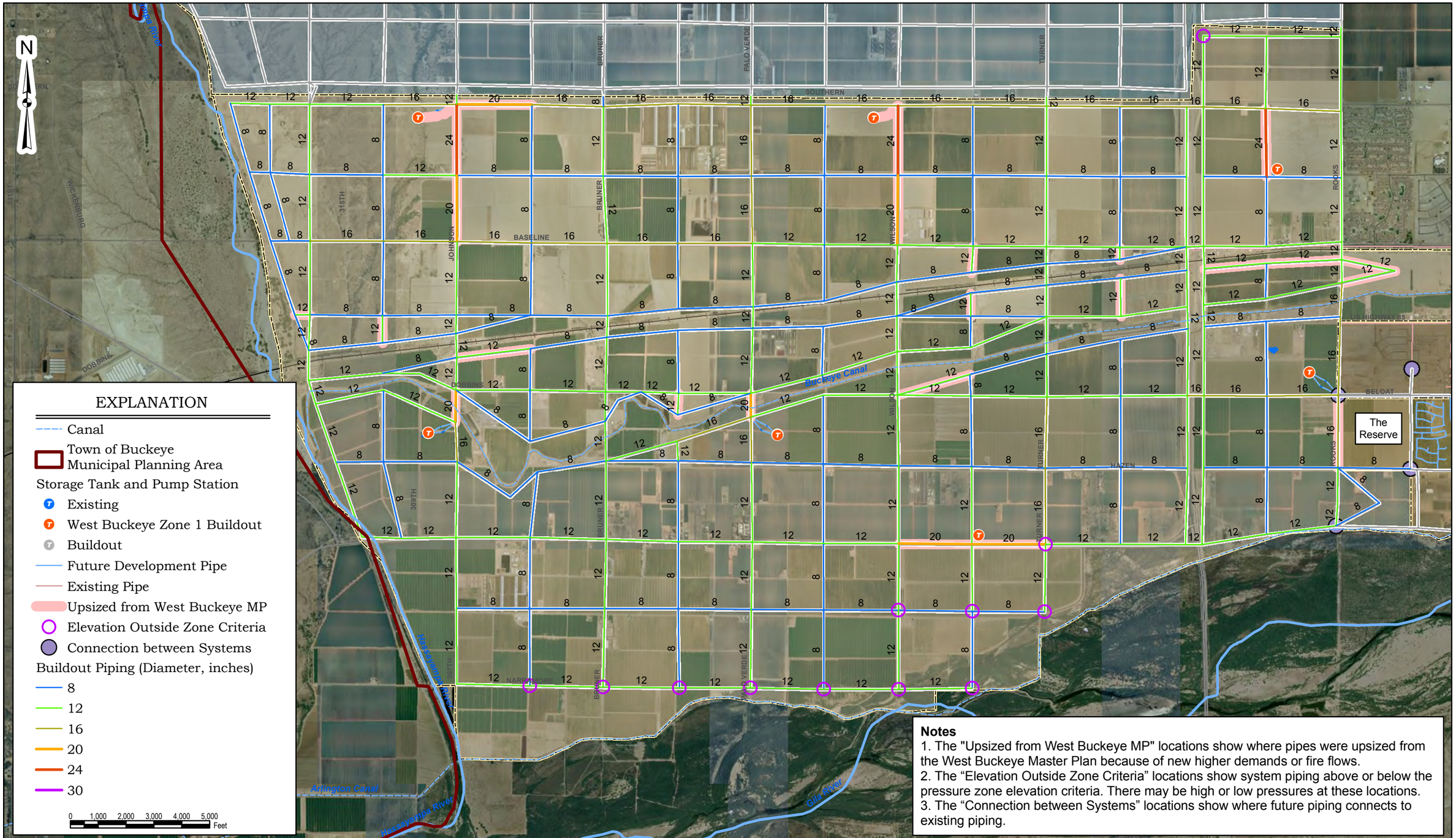
TOWN OF BUCKEYE, ARIZONA

Figure 9-3
Water System CIP - West Buckeye Zone 2



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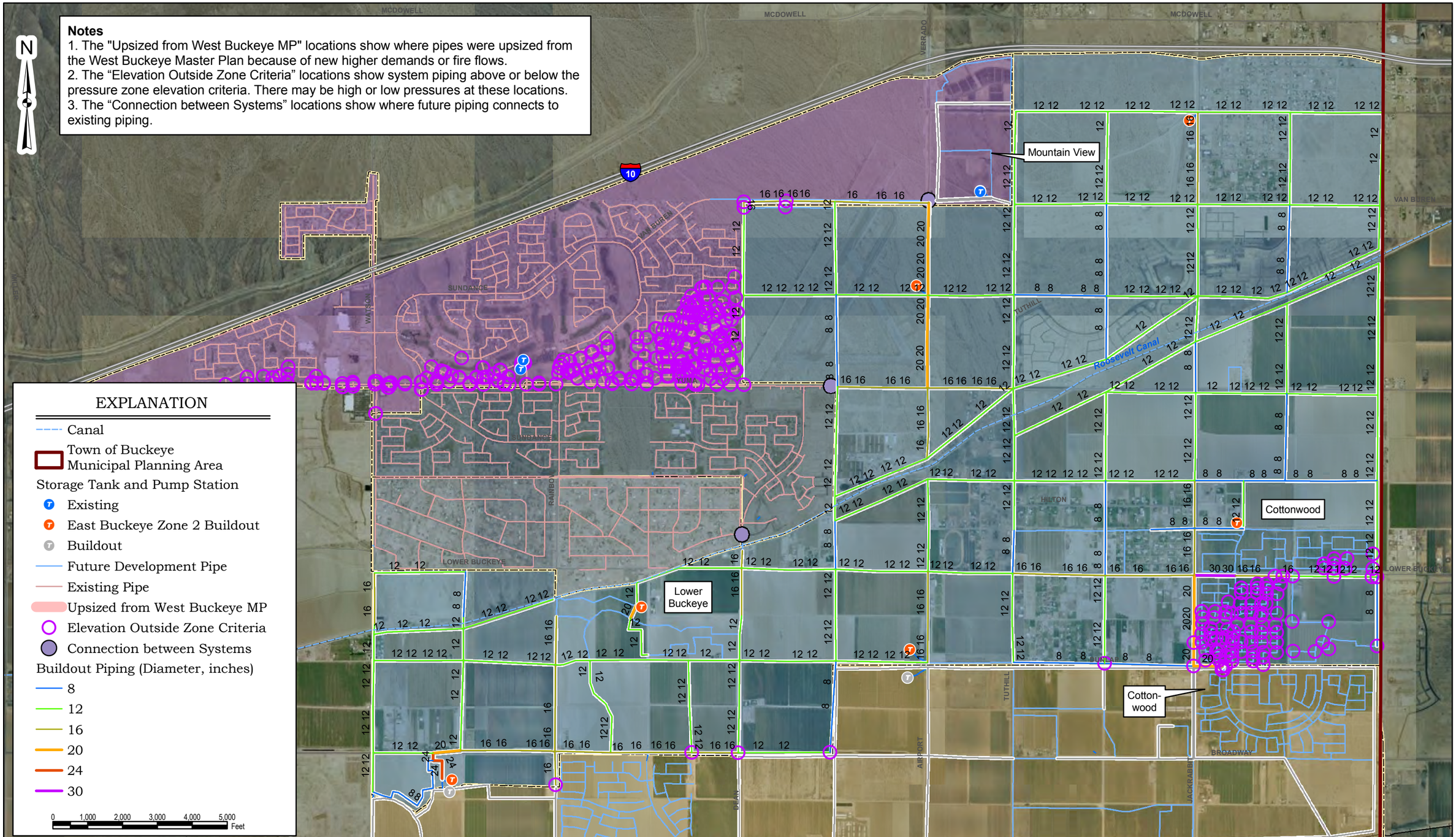
TOWN OF BUCKEYE, ARIZONA

Figure 9-4
Water System CIP - West Buckeye Zone 1



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TOWN OF BUCKEYE, ARIZONA

Figure 9-5
Water System CIP -
East Buckeye Zone 2, Sundance Zones 2 and 3

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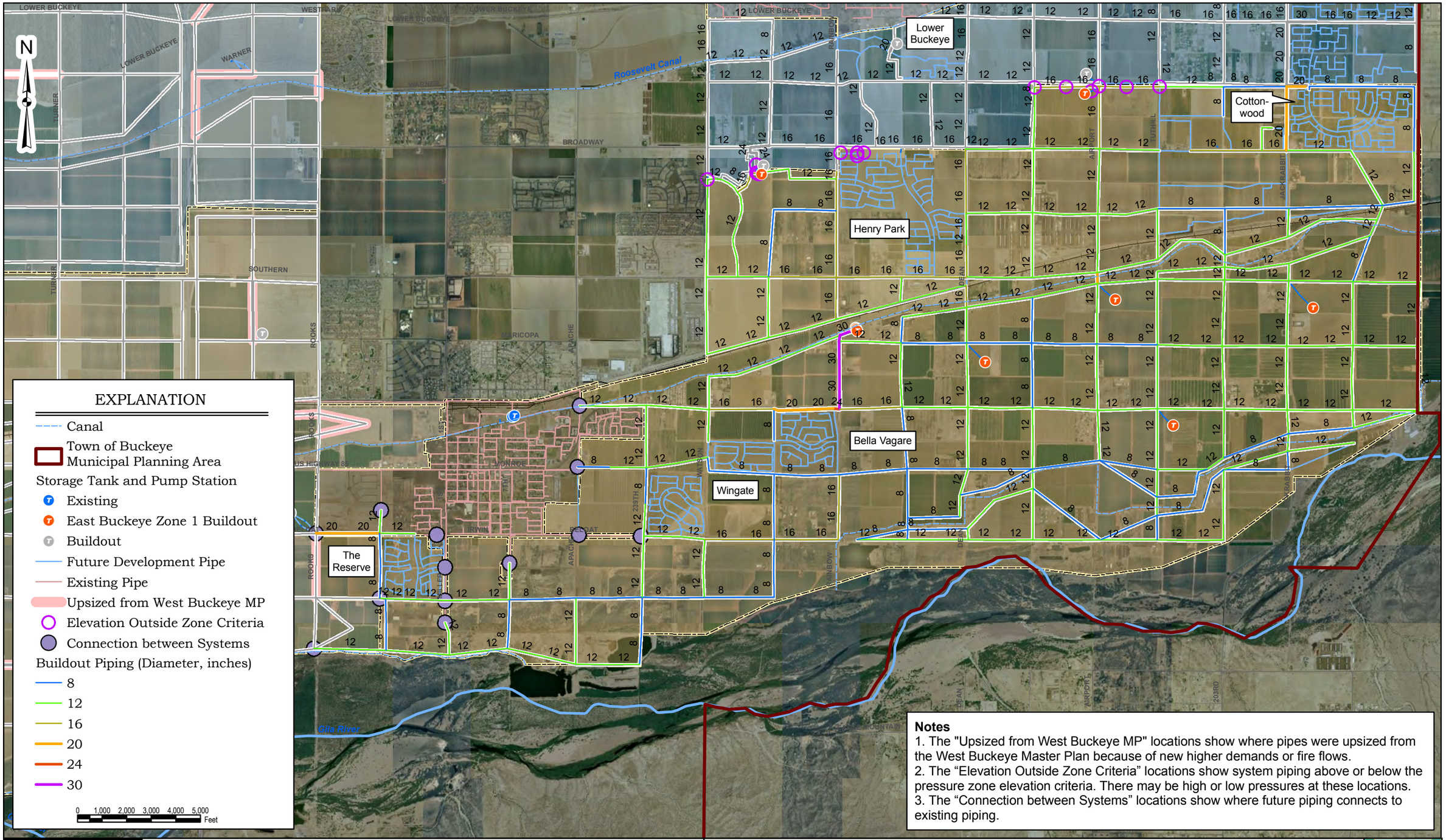

Notes

1. The "Upsized from West Buckeye MP" locations show where pipes were upsized from the West Buckeye Master Plan because of new higher demands or fire flows.
2. The "Elevation Outside Zone Criteria" locations show system piping above or below the pressure zone elevation criteria. There may be high or low pressures at these locations.
3. The "Connection between Systems" locations show where future piping connects to existing piping.

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Figure 9-6
Water System CIP -
East Buckeye Zone 1, Historic Buckeye Zone 1

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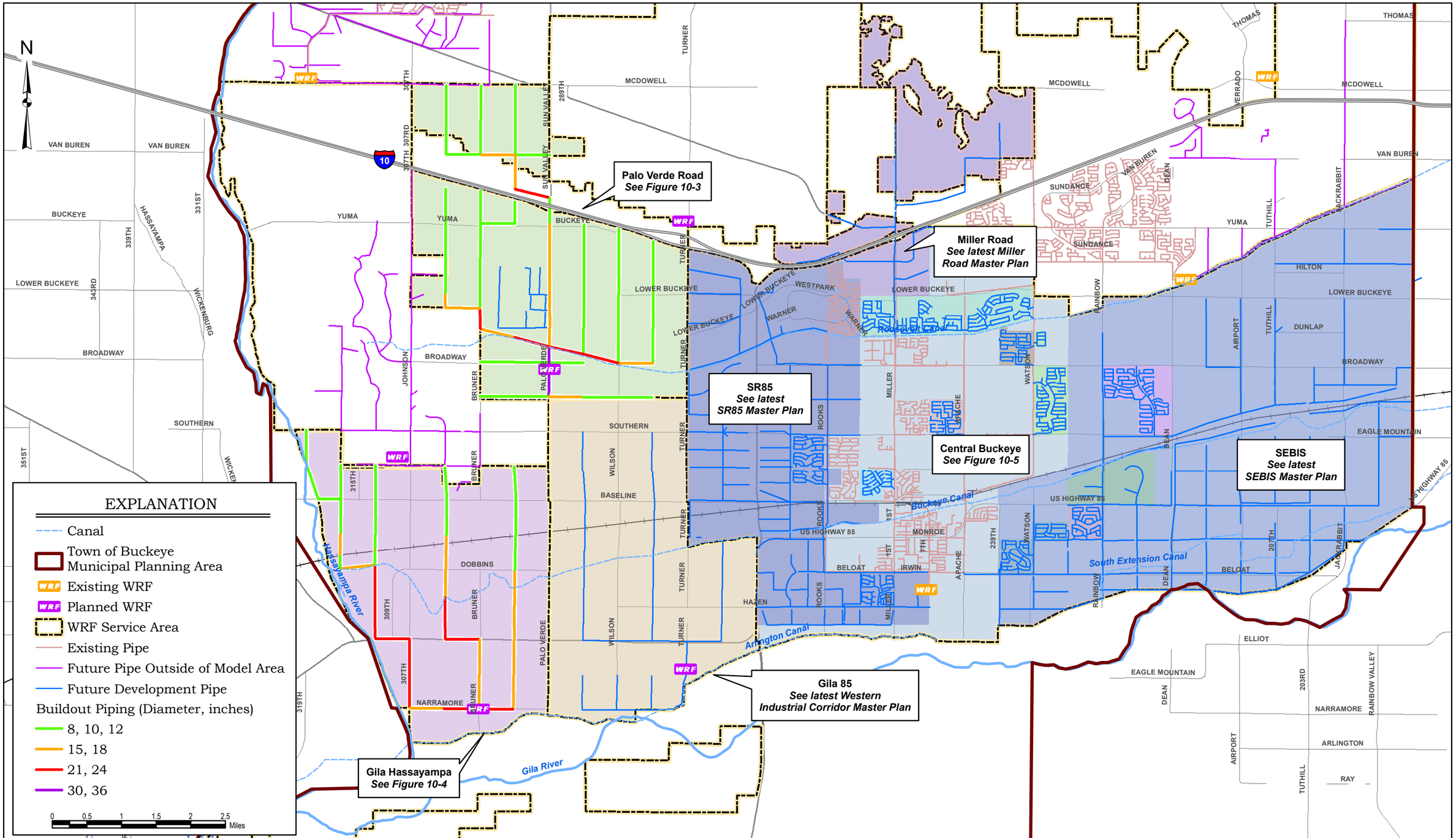

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TOWN OF BUCKEYE, ARIZONA

Figure 10-2
Wastewater System CIP - Overall

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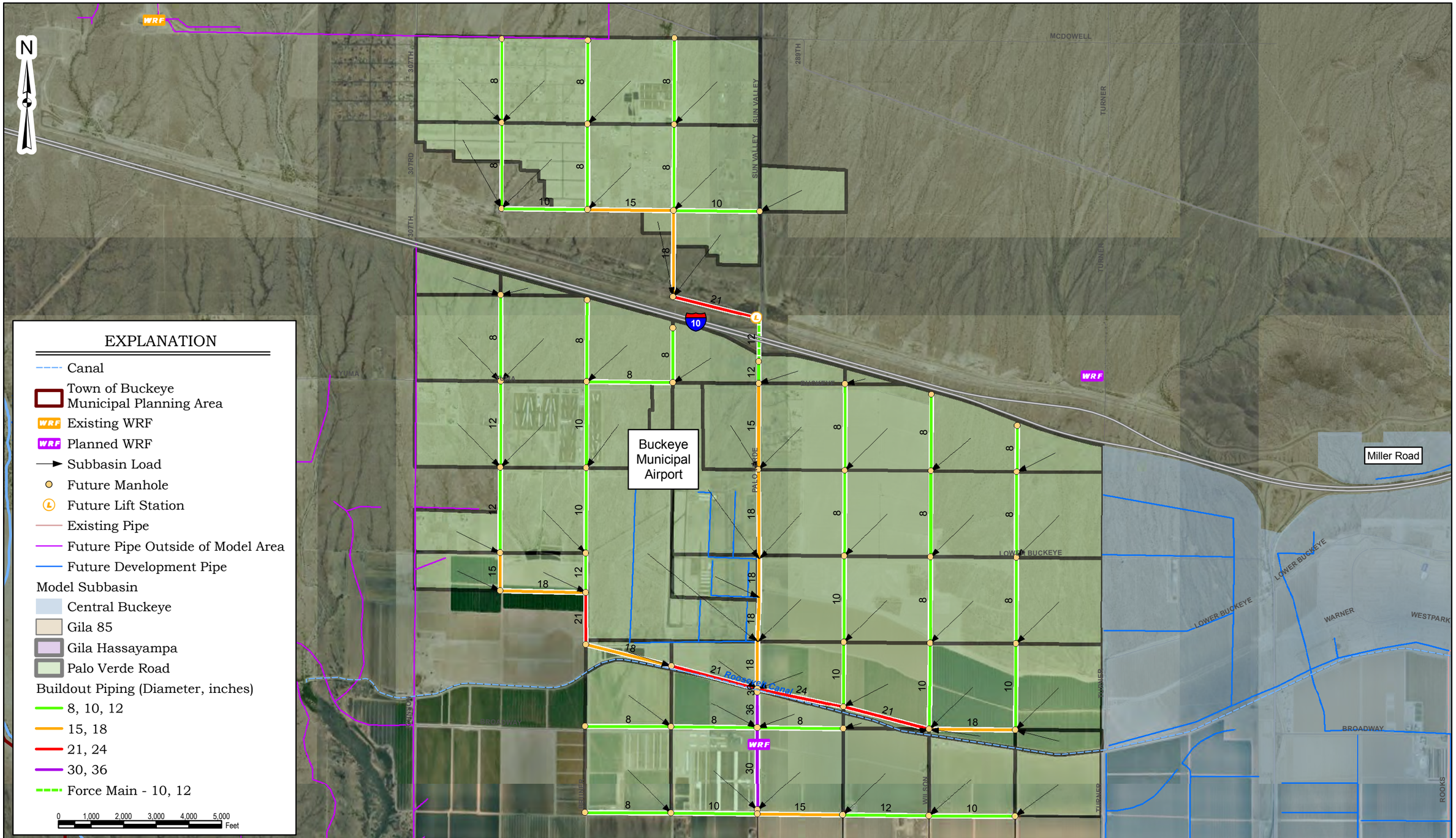

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TOWN OF BUCKEYE, ARIZONA

Figure 10-3
Wastewater System CIP - Palo Verde Road

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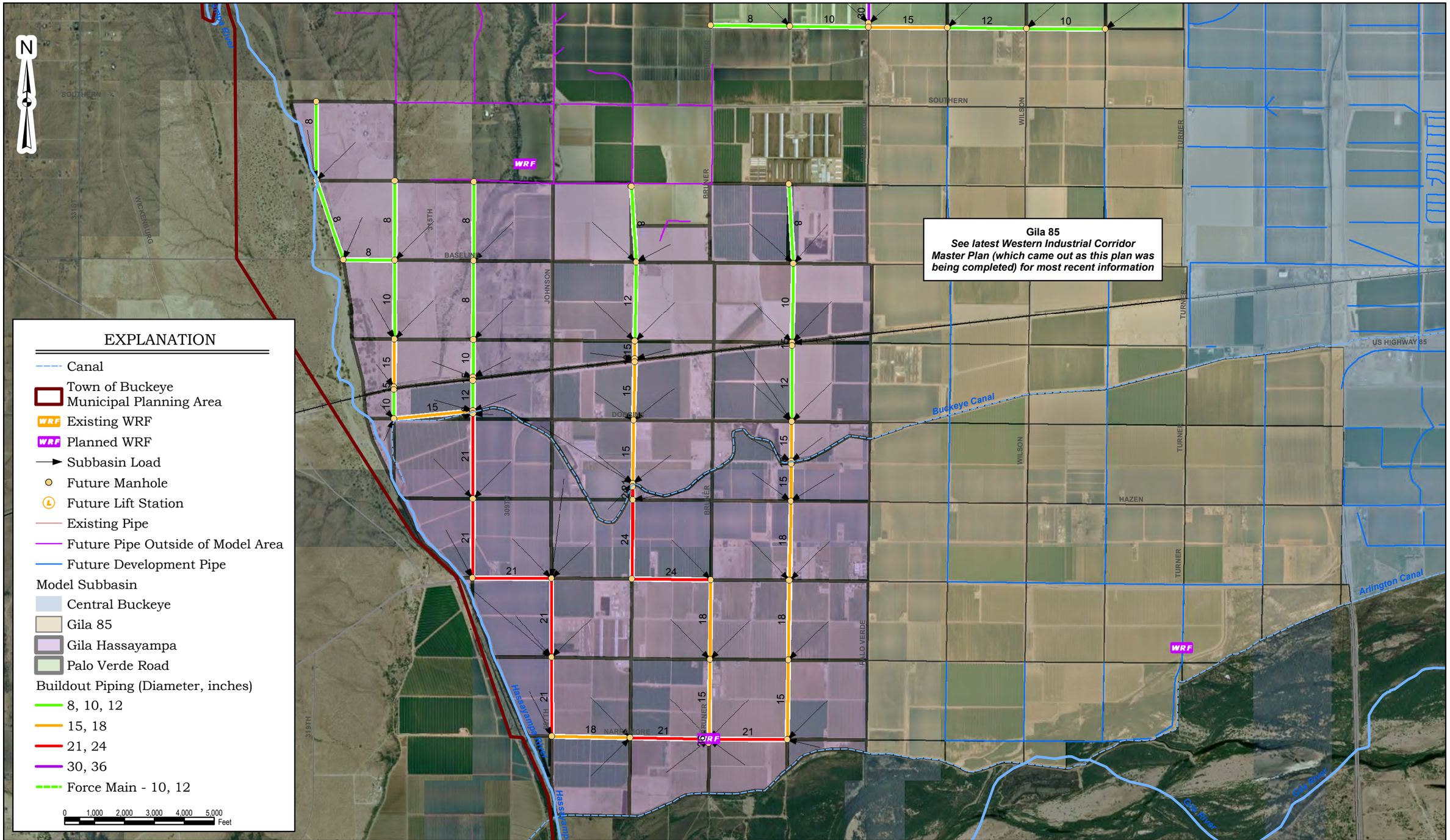

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TOWN OF BUCKEYE, ARIZONA

Figure 10-4
Wastewater System CIP - Gila 85 and Gila Hassayampa

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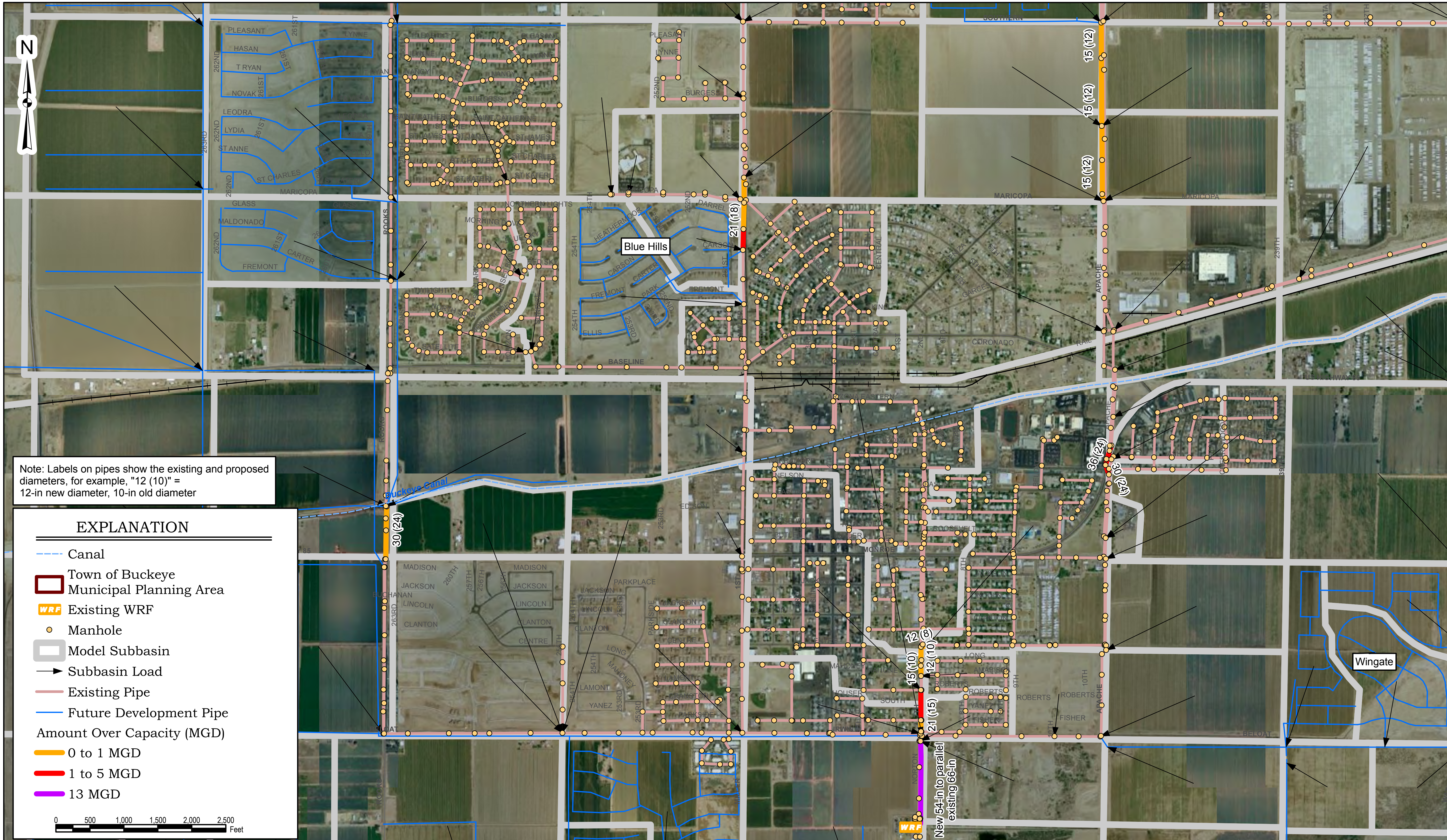
TOWN OF BUCKEYE, ARIZONA

Figure 10-5a
Wastewater System CIP - Central Buckeye North



INTEGRATED WATER RESOURCES PLAN
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TOWN OF BUCKEYE, ARIZONA

Figure 10-5b
Wastewater System CIP - Central Buckeye South

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APPENDIX A

Scope of Work

Use of data contained on this sheet is subject to the limitations specified in Section 12 of this document.

EXHIBIT A
TOWN OF BUCKEYE
INTEGRATED WATER RESOURCES PLAN

Volume 1: Water Resources Plan

- Project Management
- Data Gathering and Compilation
- Projections
  - Population and Employment Projections
  - Unit Demands
  - Water Projections
  - Wastewater Projections
- Reuse/Recharge Plan
  - Reuse/Recharge Modeling
  - Potential Recharge Locations
- Water Supply Assessments
  - Water Resources Assessment/Existing Supply Portfolio
  - Initial Sustainability Assessment
  - Water Balance: Supply versus Demand
  - Future Water Supply Alternatives
- Water Resources Plan Report
- City Council Workshops

Volume 2: Water System Master Plan

- Site Visits and Water System Schematic
- Existing System Review and Base Map
- Supply Side Analysis
- Distribution Side Analysis: Hydraulic Modeling
- Water Capital Improvement Program (CIP) Plan
- Water Master Plan Report

Volume 3: Wastewater System Master Plan

- Compile Base System Maps
- Review Existing System
- Hydraulic Modeling
- Wastewater Master Planning and CIP Plan
- Wastewater Master Plan Report

SCOPE OF WORK

Goals

The overall goals of the Town of Buckeye Integrated Water Resources Plan include:

- Development of a management tool to plan for future water and wastewater service, with a specific focus on planning and development in the Central Buckeye region;
- Development of Capital Improvement Program (CIP) plans for water and wastewater, to identify critical infrastructure needs;
- Provide basic planning documents that will support the Town's efforts to secure a Designation of Assured Water Supply.

Study Area

The study area for this Scope of Work is defined as the Town of Buckeye (TOB) Planning Area, excluding those regions in the Gila River floodplain and the Gila Bend and Rainbow Valley regions south of the Gila River. The floodplain adjacent to the Gila River is excluded as it is not a region that will be developed. The Gila Bend and Rainbow Valley regions are not anticipated to experience significant growth over the next 5 years, and due to geographic considerations, will have independent water systems, wastewater systems, and treatment. As such, they are excluded from this initial master planning effort, with the intention that they will be incorporated into a future update as appropriate.

The study area defined above will be used for the Water Resources Plan (Volumes I), the Water Master Plan (Volume II), and the Wastewater Master Plan (Volume III) of this Scope of Work.

Specific tasks in the Water Resources Plan will rely on the Hassayampa groundwater model simulations, thus the study area for these tasks will be a sub-region of the Planning Area that is located within the groundwater model boundary.

Separate study areas are defined for the hydraulic modeling (water and wastewater) tasks included in this scope of work, which will generally be confined to the region bounded by I-10 on the north, the Gila River on the south, by the Hassayampa River to the west, and by Perryville Road to the east. The hydraulic model boundaries will be defined in the assumptions for those specific tasks.

Planning Horizon

The planning horizon for the Integrated Water Resources Plan will begin with present-day, defined as 2007 conditions. Projections will be developed for (1) the short-term period from 2008 through 2010, (2) for 2020, and (3) for buildout, as shown below. Buildout will be defined in conjunction with Town staff during the population and employment projection task. Buildout population projections will be based on Maricopa Association of Governments (MAG) projection data, and may or may not equate to a specific time period.

- 2007
- 2010
- ~~2020~~
- Buildout

Data Needs

Data needs include, but are not limited to the information itemized below. The Town of Buckeye will provide the requested information to Brown and Caldwell, and will provide CAD/GIS support on the development of key items that may not yet be available in electronic format, including but not limited to, the existing system map. The project schedule and successful completion of the tasks are dependent on timely receipt of the requested information or data. Brown and Caldwell's scope has been developed with the assumptions that the information needs listed below will be received within the first 30 days of the project.

Information needs include, but are not limited to:

1. Collection system maps, treatment plants' design capacity, process and effluent quality descriptions.
2. System operations and maintenance data.
3. Repair and rehabilitation data.
4. Current reuse and recharge operations.
5. Available population / growth projections.
6. Available land use maps, General Plan guidance.
7. Information regarding current and upcoming developments.
8. Development Plans submitted by the developers within the study area.
9. Staff interview to capture the town's vision and plan for growth.
10. All previous master plans.
11. Existing water and wastewater system information.
12. Historical water use (consumption) and wastewater flow data.
13. Maricopa Association of Government's (MAG) land use projections (GIS).
14. The Town of Buckeye's population and growth projections.
15. History of infrastructure to date, including installation, upgrades, and expansions.
16. Town of Buckeye 208 Plan and GIS coverage.
17. Electronic copy of the existing hydraulic model for the wastewater system and the related report(s).
18. Electronic copy of the existing hydraulic model for the water system and related report(s).
19. Electronic maps of the existing water system.
20. Electronic road base map for central study area.
21. Description of any planned future water system improvements.
22. The Town of Buckeye's design standards for water systems – to include pipe velocities under given conditions, fire flow requirements, required sizing of storage, and booster pump station improvements.
23. Fire flow requirements for residential, commercial, and industrial uses.
24. Topographic map at 2-foot contour resolution for model area.
25. Pump curves for existing TOB wells.
26. Summary of system inventory – pumps, pipes, control valves, storage.
27. Storage tank dimension/elevations.
28. Road map in electronic format – centerline file plus edge-of-road. (Parcels would be a good base to show individual lots and right-of-way.).
29. Water system map showing pipes with sizes and valves.
30. Record drawings of water facilities including wells, booster stations, and storage tanks.
31. Master plans for proposed developments including proposed sewer and water lines, and anticipated sewer flows and water demands.

32. Billing records, by month, for all months of 2007 for Festival and Sundance developments showing number of accounts, category of account (commercial, residential, etc.), and total water use.
33. Records of total water use and total sewage flow received by month for all months of 2007.
34. Maximum day water demand or production for 2007; peak hour water production for 2007.
35. Maximum day and peak hour flow from the WWTP for 2007.
36. Current water treatment and historical water quality data.

If electronic maps and schematics are not available, a contingency task to digitize the data from paper maps will be performed, at the direction of the Town (see Contingency Tasks in Appendix).

As the project progresses, additional information may be requested to facilitate completion of the project as planned. If additional information from the Town of Buckeye is necessary, BC will request the information in writing, directed to the Town's Project Manager. It is assumed that the Town will provide the additional information requested by Brown and Caldwell in a timely manner.

Time to Completion

The timeline for completion of the project is within 1 year of the Notice to Proceed.

VOLUME I: WATER RESOURCES PLAN

Task 100 – Project Management

Manage the budget, schedule, tasks, and sub-tasks for successful, timely completion of the project. Hold project kickoff and status meetings with Town staff and stakeholders as identified by the Town.

1. A Project Kickoff meeting will be held with Town staff after Brown and Caldwell receives the Notice to Proceed. Maps of the respective study areas for the Water Resources Master Plan, Water Master Plan, and Wastewater Master Plan components will be developed for the meeting. Overall goals for the Plan will be discussed and the Town staff will be introduced to key Brown and Caldwell project team members.
2. A total of three one-on-one interviews with political representatives (i.e., City Council members or the Mayor) will be held, at the request of Town Staff, to capture their vision for growth.
3. A project schedule will be developed for the master plans based on a one-year completion date. The project plan will be developed around this schedule, and include review by the Town. The schedule will be updated on a monthly basis.
4. Monthly invoices and project status summaries will be provided to the Town's Project Manager.
5. Monthly project status meetings will be held with the Town's project manager, and stakeholders will be invited to participate by the Town. Bi-weekly conference calls will take place between the Brown and Caldwell and Town Project Managers.
6. Project coordination and communications with Town staff will be included in this task.

Task 200 – Data Gathering and Compilation

Gather and analyze information needed for the Water Resources Master Plan, Water Master Plan, and Wastewater Master Plan.

1. Collect related reports, maps, GIS coverages, databases, and model files to support development of this Scope of Work. This task will be on-going as additional data needs will likely be identified as the work progresses.
2. Review and analyze data to develop a status of the Town's information base. The level of effort devoted to this task over the course of the project will be limited to one month of work. If electronic maps and schematics are not available to perform this task, a contingency task to digitize the data from paper maps will be performed, at the direction of the Town (see Contingency Tasks in Appendix).
3. Design and develop an initial map series that will provide all background information necessary for the master plan scopes of work. To the extent possible, this task will rely on data collection and compilation activities from the Hassayampa model project and the on-going work on the Town's Designation of Assured Water Supply. It is assumed that the Town's GIS and Planning staff will provide support, information, and assistance, to the extent feasible, on this task.
4. Compile water quantity data available for the Town's planning area, including drilling/testing reports from developers.

Deliverables: Land Use Map; Boundary Map (TOB Annexed Area and Planning Area; Hydraulic Model Areas; Hassayampa Model Boundary; Other Providers' Service Areas and CCNs); Hydrology Map (Irrigation Districts, Basin Boundaries, Canals/Diversions, Wells).

Task 300 -- Projections

Task 310 – Population and Employment Projections

Brown and Caldwell will use the Maricopa Association of Governments (MAG) population and employment projections approved in 2007 as the basis for projecting water and wastewater demand and flows for the study years. The MAG data is available for the year 2005, 2010, 2020, and Buildout ("capacity"). The work under this task will include the following:

1. Collect projection data from MAG in the form of shapefiles for Traffic Analysis Zones (TAZ) with attached population and employment data.
2. Derive a 2007 growth scenario through interpolation of the 2005 and 2010 MAG scenarios.
3. Develop a formula for water demand and wastewater flows based on population and employment numbers for each target year.
4. Prepare a spreadsheet that shows where the growth is occurring by area (could be quarter sections, by development, etc.)
5. Review data for each planning year (2007, 2010, 2020, Buildout) with the Town staff.

Deliverables: Spreadsheet displaying growth by area.

Task 320 – Unit Demands

Develop unit demands by category for water and wastewater, based on existing available information received from Global Water, Arizona-American for the Anthem development, Valencia Water and from the Town of Buckeye for the Sundance region.

1. Procure and review actual water use data to provide a basis for development of unit demands.
2. Identify and separate data into categories, appropriate to the level of detail provided by billing information from the Town. The following categories are assumed: residential, commercial, and open space.
3. Review and compare values derived from above data with unit demands for similar land use categories by the City of Goodyear.

The flow monitoring described under Task 340 will be one source of data to develop unit demands for different categories of use.

Deliverables: Unit demands by category based on historical data for water and wastewater.

Task 330 – Water Projections

Assumptions:

- The Town will provide daily production and booster pumping records for 2007.
- The Town will provide hourly pumping records for booster stations for the maximum week in 2007.

1. Review data and records provided by the Town for 2007.
2. Develop water demand projections by TAZ for planning years, based on the formula derived under Task 310. Develop maximum day and peak hour factors based on the Town's data.

Deliverables: Water demands by area for planning years for average day, maximum day and peak hour scenarios.

Task 340 – Wastewater Projections

Develop wastewater flow projections by TAZ for planning years, based on formula derived for study years. Develop dry weather peaking factor based on data provided by the Town of Buckeye.

Assumptions:

- The Town will provide wastewater treatment plant influent flow data for treatment plants within the study area; flow records to include daily flow for 3 years to provide an adequate basis for calculating statistical trends. If data for a 3-year period is not available, Brown and Caldwell will use the data provided by the Town under the assumption that the current trends are anticipated to continue.
- Brown and Caldwell will review the average data, then select periods for which hourly flow data will be needed. The Town will provide hourly flow data to determine peaking characteristics.
- The Town does not consider infiltration/inflow to be a factor requiring analysis in its sewer system design. An analysis on the Central plant data will be performed to verify this assumption.

1. Historical wastewater flows will be reviewed to understand daily fluctuations. Brown and Caldwell will develop one dry weather diurnal peaking factor for the study area.
2. Based on the drainage characteristics of the study area and physical collection system boundaries, Brown and Caldwell will delineate major collection areas.
3. Brown and Caldwell will develop current and future flow projections based on MAG population projections.
4. Flow monitoring will be conducted at a maximum of four locations for 14 days. Key test locations identified by the Town include: Sundance, the commercial core on Watson, and perhaps a single test at Central Buckeye. Brown and Caldwell will compare the monitored peak flow with peak flow calculated by using various population and flow-based theoretical peaking factors (example: Harmon's equation, Arizona Administrative Code, Fedrov's equation, MOP-9, etc.). A reasonable and conservative factor will be selected based on a broader understanding of how the system will grow in the future. Brown and Caldwell will work with the Town to make a consensus decision in selecting the peaking criteria.

Deliverables: Wastewater flow projections for planning years, by area for average and peak flow scenarios.

Task 400 – Effluent Reuse/Recharge

Task 410 – Reuse/Recharge Modeling

Assumptions:

- Reuse potential for specific planning areas will be based on projected wastewater flows and effluent availability derived from MAG-based projections.

Develop a reuse/recharge plan for treated effluent that is consistent with the Town's planning guidelines and policies. A sub-region of the Town's Planning Area Boundary, consisting of that portion of the Planning Area that is simulated with the Hassayampa model, will be the study area for this task.

1. Brown and Caldwell will meet with Town staff to incorporate their ideas/goals in the reuse/recharge plan.
2. Brown and Caldwell will compare actual and projected effluent quantities to assumptions in the Hassayampa model study:
   - Previous planning estimate: effluent = 30 percent of total water demand
   - Alternatives: 19, 40, and 50 percent of total water demand
3. Individual developers' master plans will be reviewed to identify capacity.
4. An overview of recharge methods and the pros/cons of each method will be provided.
5. An analysis of seasonal impacts on the water budget will be performed, including estimates of summer/winter effluent generation and demand.
6. Brown and Caldwell will separate the planning areas into zones based on the need (hydrogeologically speaking) for recharge to offset pumping impacts.

7. Sensitive regions within the planning area boundary that require special consideration (i.e., waterlogged area) will be identified.
8. The proposed locations of water reclamation facilities (WRF) as shown in the MAG 208 Plan will be used.
9. ~~Update Hassayampa simulations with revised effluent assumptions, run model, and analyze impacts (one simulation will be performed).~~ No modeling will be performed on this task.
10. Guidelines for reuse/recharge within each of the zones will be developed and then refined in conjunction with Town staff.
11. A conceptual backbone reuse pipe network with pipe sizes, to serve golf courses, parks, open space, and large commercial sites will be identified, where feasible. For areas south of I-10, where more detailed information may be available, reuse piping plans will be incorporated in the network schematic.

Deliverables: Map Series for Effluent, including Estimated Effluent Available by Area (Summer/Winter), Reuse Potential by Area (Summer/Winter) and Effluent Available for Recharge (Summer/Winter); Map of Aquifer Zones that will be amenable to Recharge; ~~Model Simulation(s);~~ Guidelines for Reuse/Recharge by Zone; Backbone Reuse Pipe Network Schematic.

Task 420 – Potential Recharge Locations

Assumptions:

- No additional groundwater modeling simulations will be performed for this task. Evaluation of potential recharge locations and an assessment of the waterlogged area will be based on either existing Hassayampa modeling simulations, simulations performed in Task 410, or on previously published work performed by Brown and Caldwell and others.

Brown and Caldwell will build on the recharge assessments performed for the Hassayampa model project to identify potential recharge sites for that portion of the TOB Planning Area that is located within the model boundary. Reuse lines will be incorporated into the conceptual backbone reuse pipe network from Task 410.

1. Based on the Hassayampa modeling results from the June 2007 update, MAG population projections, and the results of Task 410, potential recharge locations will be identified in the Town's Planning Area within the region defined by the Hassayampa model boundary.
2. The Central Arizona Project's (CAP's) approach to recharge site feasibility studies will be modified for a "first cut" assessment; areas will be excluded from further consideration based on the evaluation criteria.
3. Timeline for recharge to become viable in the waterlogged area will be discussed, assuming that the majority of the agricultural lands will convert to other land uses. This task will be restricted to assessments of existing simulations.
4. Conceptual reuse lines to recharge locations will be identified, if feasible, tying into the conceptual backbone network that will be developed in Task 410.
5. The recharge/reuse plan will be developed based on the planning horizon through buildout, as defined at the beginning of the project; assessments based on the Hassayampa model results will be on the 100-year predictive timeline of the model simulations.

Deliverables: Map of potential recharge locations; estimated timeline for recharge to become viable in the waterlogged area; conceptual reuse lines for the final selected recharge alternative.

Task 500 – WATER SUPPLY ASSESSMENT

Task 510 – Water Resources Assessment/Existing Supply Portfolio

1. Sources of water supply will be inventoried, and quantities tabulated, including: groundwater, CAP water, reclaimed water, and irrigation district supplies. Incidental recharge (4 percent of deliveries) will be included, as allowed by Assured Water Supply regulations.
2. Groundwater supplies will be assessed based on simulations performed for the June 2007 model update and the Town's Designation of Assured Water Supply application; no new simulations are planned in support of this analysis.
3. The waterlogged area as a supply source will be discussed. Dewatering in this region totals approximately 30,000 acre-feet per year (AFY), and the potential for a long-term source of supply has been the subject of previous studies. Results from the previous studies, combined with Hassayampa modeling results, will be used for a planning-level assessment of this potential source of supply.
4. The physical, legal, and continuous availability of each supply source will be assessed using a simple matrix analysis. Legal availability will be limited to a generalized overview. Detailed legal questions will be deferred to TOB attorneys, should further evaluation be desirable for inclusion in this master plan.

Deliverables: Water Supply Portfolio Summary; Assessment of the Waterlogged area supplies; Table summarizing matrix analysis of Physical, Legal and Continuous Availability

Task 520 – Sustainability Assessment (100 year timeline)

1. A sustainability assessment will be performed for the groundwater supply; this assessment will be based on a 100-year timeline, consistent with Assured Water Supply regulations, and will be restricted to that portion of the TOB Planning Area that is located within the Hassayampa model boundary.
2. In conjunction with Town staff, sustainability criteria will be developed for the first iteration of the sustainability assessment. Criteria will be specific to the Town's needs, and may include: water quantity, water quality, depth to water, infrastructure costs, recharge/reuse, and aquifer limitations.
3. ~~The sustainability criteria will be applied to Hassayampa model runs performed in support of the Town's Designation of Assured Water Supply, the most recent version of the groundwater model.~~ A series of sustainability scenarios will be simulated, based on assumptions developed in conjunction with Town staff. The sustainability criteria will be applied to this series of model runs. Output from the groundwater model will be assessed in the context of these criteria, and an estimate of the sustainable supply of groundwater will be calculated.

Deliverables: Sustainability Criteria; Model Output; Sustainability Assessment section in final report.

Task 530 – Water Balance: Supply versus Demand

The Town's sustainable water supply will be compared to the Town's projected water demand through buildout to assess the water balance.

1. A water budget will be developed to compare water supply sources to water demands. The results of the sustainability assessment will be used as the groundwater supply for this analysis, as it takes into account constraints on either the physical aquifer system or the infrastructure and related costs.
2. Graphs of the supply versus demand will be developed to identify budget deficits and timing to reach the deficit. Short-term needs versus long-term deficits will be quantified.

Deliverables: Water Budget Analysis (graphs and tables).

~~*Task 540 – Future Water Supply Alternatives*~~

1. ~~Identify future water supply alternatives available to the Town, including interconnectivity with adjoining water providers (Global, Goodyear, Arizona American).~~
2. ~~Evaluate the water supply alternatives in the context of the regulatory requirements, i.e., based on physical, legal, and continuous availability.~~
3. ~~Make recommendations on selected alternatives to study further. This discussion will include a summary of immediate needs and concerns as well as long-term planning projects. Data gaps will be identified with suggestions for future work~~.

~~*Deliverables: Listing and discussion of water supply alternatives; ranking matrix; recommendations on selected alternatives that warrant future study.*~~

Task 600 – Water Resources Plan Report

A Water Resources Plan report summarizing all the results and including deliverables from previous tasks will be submitted to the Town of Buckeye for review.

1. A draft of the final report will be prepared; 10 copies will be circulated for review/comment.
2. One review meeting will be conducted to discuss comments and address any questions from the reviewers. The Town will provide review comments at least one week prior to the review meeting.
3. The draft report will be finalized, and comments will be incorporated as appropriate. One review copy of the final report will be submitted to the Town's project manager.
4. Town's project manager will review the final report to ensure incorporation of review comments.
5. Once approved by the Town's project manager, Brown and Caldwell will issue 10 copies of the Final Report.

Deliverables: Ten copies of the draft report will be produced in black and white for comment and review, with electronic files of figures in color. One copy of the final draft will be produced for the Town's Project Manager. Ten hard copies of the Final Report will be produced and submitted after approval by the Town's Project Manager. Each Final Report will include an Appendix with a CD. The CD will include a PDF version of the Final Water Resources Plan Report as well as CADD, GIS, and modeling files.

~~Task 650 – City Council Workshops~~

~~Two workshops with City Council will be held to discuss key results and findings. Workshop topics and results to be presented will be identified in conjunction with Town staff.~~

~~Large-scale maps and figures will be developed to support workshop discussions and illustrate findings. It is assumed that a PowerPoint™ presentation will not be developed.~~

~~Key project team members will attend and present at the workshop, as directed by Town staff.~~

~~*Deliverables: Workshop outline, maps/figures, and attendance.*~~

VOLUME 2: WATER SYSTEM MASTER PLAN

The Town of Buckeye Water System Master Plan will establish a framework for the future water system for the Central Buckeye area, defined generally as the region between I-10 and the Gila River, with the objective of supporting development. The Water System Master Plan will also compile developer information for the planning area north of I-10 to provide an overall view of the future system with schematic supply side network.

Task 700 -- Water System Master Plan

Task 710 – Site Visits and System Schematic

1. Collect paper records of water system inventory items
2. Conduct site visits of existing facilities
3. Prepare schematic of the existing water system showing the system layout, pressure zones, pumping and storage by zone.

Deliverables: Schematic of the existing water system showing the system layout, pressure zones, pumping and storage by zone.

Task 720 – Existing System Review and Base Map

1. Base System map: The Base System Map will include a compilation of developer master plans. It is assumed that the Town will provide electronic files of the system maps collected from various developers. If electronic maps are not available, a contingency task to digitize the data from paper maps will be performed, at the direction of the Town (see Contingency Tasks in Appendix). Brown and Caldwell will compile the maps to develop one base system map in GIS, displaying the following: existing and proposed booster pump and water storage tank locations; pipes color-coded by pipe size; developer wells and piping connecting those wells to storage.
2. Water Model Map: The water model map will cover the area south of I-10 and north of the Gila River. The Town will provide the West Buckeye Master Plan model in electronic format. The water model map will include: the existing Town system; pipes 8-inches in size and larger and critical pipes 6-inches in size; pumps; and storage tanks. Piping from wells to storage tanks will not be included. Pipes will be defined between "nodes" with assigned elevations. Control valves will be included (e.g., pressure reducing valves at the boundary of pressure zones, flow control valves from a reservoir, etc.). Node elevations will be assigned based on topographic mapping. Facility attributes will be assigned in the map to include: pipe size and material, pump curves, facility elevations, storage tank dimensions and set point levels, control valve sizes and set points.

Deliverables: Compiled system map for Buckeye Municipal Planning Area north of the Gila River on 24" X 36" sheet; electronic water model map for Town of Buckeye between I-10 and Gila River.

Task 730 – ~~Supply Side Analysis~~

~~The supply side water master plan analysis will be performed for the Buckeye Planning area north of the Gila River and will identify a preliminary piping network, and approximate locations and capacity of required pumping to convey water to where it is needed. This analysis will be based on the locations of future wells and future water booster station and storage facilities, as shown in developer master plans.~~

~~*Deliverables: Map with assumed locations and quantities of source water; proposed piping schematic.*~~

Task 740 – Distribution Side Analysis: Hydraulic Modeling

1. Model Existing System- 2007 Demand Scenario: Water system modeling will be accomplished using Water CAD software, and will cover the area south of I-10 and north of the Gila River. The basis of the

water model will be the map generated under Task 720. The model will be input with demand information generated in the Water Resources Plan, Volume 1 of this Scope of Work. Documentation of the model loading (which areas are loaded to which nodes) will be provided as an appendix to the water master plan report. All pipes 8-inches and larger in the existing system will be modeled. The critical 6-inch pipes that are needed to maintain system continuity and representativeness will also be included. The model will be run under steady state conditions for the following demand scenarios.

- Average Day Demand
- Maximum Day Demand
- Peak Hour Demand
- Maximum Day plus fire flow

2. Model Calibration: The existing system model will be calibrated to actual operating system information provided by the Town of Buckeye. The model will be calibrated such that node pressures under static conditions are within 5 psi of measured values. The success of the model calibration is dependent on the ability of the Town to verify pipe connectivity and pipe sizes for areas not calibrating correctly.
3. Fire hydrant flow tests: Fire hydrant flow tests will be taken at locations throughout the system under peak demand times. System conditions that must be known or monitored at the time of the flow tests include: water levels in storage facilities, pumping rates, flow through pressure reducing valves, etc. Brown and Caldwell will provide two staff members and equipment to perform fire hydrant flow tests. Fifteen flow tests are assumed. The Town of Buckeye will provide adequate staff to provide access to sites and to assist in recording water system parameters during the testing.
4. Analysis and Results: The model analysis will be used to identify system deficiencies such as undersized pipes and pumps. Steady state analysis cannot be used to identify storage deficiencies. Extended period simulation is required for a complete storage analysis, and is not included in this Scope of Work.
5. Model Future System – 2010, 2020, and Buildout: The existing system model will be expanded to cover the service area south of I-10 and north of the Gila River. The locations of demands for future years will be identified in order to develop a plan for infrastructure for these interim planning years. Growth patterns (location and rate of growth) will be taken from the MAG projections.

Deliverables: Overall water system map showing pipelines, pumping and storage facilities for each of the target study years: 2010, 2020, and Buildout, as well as model analysis for each of the study years; identification of required infrastructure for each of the target years.

Task 750 – Water Capital Improvement Program (CIP)

This task will bring together information and results from hydraulic modeling to develop a water system Capital Improvement Program (CIP) plan.

1. Using the output from the hydraulic model in the core study area, recommendations on deficiencies and future water infrastructure will be developed.
2. Planning level cost estimates for recommended water infrastructure will be calculated, and the recommended projects will be prioritized.
3. A CIP spreadsheet will be developed for the core study area with project timeline and costs for infrastructure. The CIP spreadsheet will be developed for the planning years: 2010, 2020, and Buildout. The CIP will be the basis for the Town's Financial Plan, which is not included in this Scope of Work. Detailed descriptions of the projects are not included in this Scope of Work.

Deliverables: The master plan and the CIP spreadsheet will be documented in a chapter of the final report.

Task 760 – Prepare Draft and Final Water Master Plan Report

A Draft Water Master Plan report summarizing all the results and including deliverables from previous tasks will be submitted to the Town.

1. A draft of the final report will be prepared; 10 copies will be circulated for review/comment.
2. One review meeting will be conduced to discuss comments and address any questions from the reviewers. The Town will provide review comments at least one week prior to the review meeting.
3. The draft report will be finalized, and comments will be incorporated as appropriate. One review copy of the final report will be submitted to the Town's project manager.
4. Town's project manager will review the final report to ensure incorporation of review comments.
5. Once approved by the Town's project manager, Brown and Caldwell will issue 10 copies of the Final Report.

Deliverables: Ten copies of the draft report will be produced in black and white for comment and review, with electronic files of figures in color. One copy of the final draft will be produced for the Town's Project Manager. Ten hard copies of the Final Report will be produced and submitted after approval by the Town's Project Manager. Each Final Report will include an Appendix with a CD. The CD will include a PDF version of the Final Water Resources Plan Report as well as CADD, GIS, and modeling files.

Task 770 – Compile and Digitize Water/Wastewater Lines

Brown and Caldwell will compile and digitize water and wastewater piping and pertinent specifications for future developments to support hydraulic modeling for the future short-term and buildout scenarios.

VOLUME 3: WASTEWATER SYSTEM MASTER PLAN

The core study area for the Wastewater System Master Plan is bounded by the Gila River on the south, by the Hassayampa River to the west, and by Perryville Road to the east. The northern boundary of the Study Area is defined by the Palo Verde, Sundance, Central Buckeye, and Cipriani planning area boundaries.

Task 800 – Wastewater Master Plan

Task 810 – Compile Base System Maps

In this task, Brown and Caldwell will compile collection system maps previously developed by others, to create a single reference document.

Assumptions:

- The Town will provide Brown and Caldwell with electronic copies of the collection system maps with size, material, and elevation information as available from various developers. If electronic maps are not available, a contingency task to digitize the data from paper maps will be performed, at the direction of the Town (see Contingency Tasks in Appendix).

1. Brown and Caldwell will compile electronic copies of the collection system maps provided by the Town.
2. A Base System Map will be developed using GIS; the map will display pipe sizes, lift stations, and treatment plant locations.

Deliverables: A Base System Map showing the existing and planned infrastructure.

Task 820 – Review Existing System

A review of the Town's existing wastewater system will be performed to provide a clear picture of the present-day status and identify data gaps.

Assumptions:

- The core study area defined for this project is bounded by the Gila River on the south, by the Hassayampa River to the west, and by Perryville Road to the east. The northern boundary of the Study Area will be defined by the Palo Verde, Sundance, Central Buckeye, and Cipriani planning area boundaries.
- The Town will provide collection system maps with size, material, and elevation information, as available. The Town will work with Brown and Caldwell to compile data that is not yet available in this format (see Contingency Tasks in Appendix).
- The Town will provide record drawings for the existing wastewater treatment plant and critical lift stations.
- The Town will provide development plans for the collection system as designed by each developer within the Study Area.

1. The existing system will be reviewed for capacity analysis. The Town of Buckeye's wastewater system within the Study Area will be documented.
2. If deemed useful, conduct site visits to critical facilities for which information is missing.
3. Town's operations and maintenance staff will be interviewed (one interview session) to capture and document the operations and maintenance issues.

Deliverables: Existing infrastructure capacity and O&M issues will be discussed in one chapter of the Master Plan Report. A Base Map showing the existing critical infrastructure will be included in this chapter.

Task 830 – Hydraulic Modeling

Brown and Caldwell will update and expand the existing H2OMap Sewer model (developed for the East Buckeye Wastewater Master Plan) to cover the core study area, excluding the Cipriani and Sundance Service Areas. The updated model of the collection system will be used for existing system evaluation and layout of future expansions.

Assumptions:

- The Town will provide an electronic copy of the current hydraulic model and model report, covering the eastern Buckeye planning area.
- The Town will provide a CAD or GIS map of the current collection system with pipe diameter, material, and invert and rim elevation information, as available. If electronic maps are not available, a contingency task to digitize the data from paper maps will be performed, at the direction of the Town (see Contingency Tasks in Appendix).
- The Town will provide lift station pumping and wet well geometry data, as well as treatment plant data.

1. Existing H2OMap Sewer model assumptions and results will be reviewed.
2. The model will be update and expanded with data from the current system map. (The updated model will be a skeletonized steady state model which will include all pipes with 12-inch and larger diameter.) Brown and Caldwell will coordinate with the Town to include critical pipelines with diameters below the 12-inch cutoff. The operational and control information collected during the staff interview will be used to develop a representative hydraulic model for the collection system.
3. Model verification will be conducted, and projected flows for various planning years will be loaded. Existing model flows will be based on 2007 data.
4. The model will be calibrated by using flow monitoring data collected in Task 340. The modeled flows will be compared against the field measured data. Physical system parameters including pipe connectivity, invert elevation, manhole elevation, and pumping data will be examined for any deviations between the modeled and measured data. Roughness coefficients of pipes will be adjusted to bring the modeled flow, velocity, and depth to diameter ratio within 10 percent of measured values.
5. After calibration, the model will be used to evaluate the existing system. A system performance criteria list will be developed using Arizona Administrative Code and Town of Buckeye's Sewer Conveyance System Design Manual. Model results for the existing system will be compared against the system performance criteria to identify deficiencies. Brown and Caldwell will evaluate alternatives to identify the optimal solutions to remedy each deficiency.
6. Modeling scenarios for the years 2010, 2020, and Buildout will be developed after reviewing the existing system. Based on the projected flows and infrastructure needs by known, approved future developments, Brown and Caldwell will lay out and size the future collection system. These future model scenarios will also provide information on the existing system's upgrade needs.
7. Area north of I-10 will be conceptually reviewed for infrastructure planning. See Task 840 for more details.

Deliverables: Computerized collection system model, output in the form of maps and reports. The modeling task will be summarized in a chapter of the master plan report.

Task 840 – Wastewater Master Planning and Capital Improvement Program (CIP)

This task will bring together information and results from hydraulic modeling to update the existing wastewater master plan, developing a comprehensive roadmap to guide expansions and decisions associated with Buckeye's wastewater system for the planning horizon.

1. A list of major projects to upgrade the current system using the output of the hydraulic models will be developed for the core study area.
2. The master plan will document the needed conveyance facilities, required treatment plan capacities, and related improvements.
3. A CIP spreadsheet will be developed for the core study area with project timeline and costs for infrastructure. The CIP spreadsheet will be developed for the planning years: 2010, 2020, and Buildout. The CIP will be the basis for the Town's Financial Plan, which is not included in this Scope of Work. Detailed descriptions of the projects are not included in this Scope of Work.
4. A conceptual level capacity analysis will be conducted to review wastewater collection systems north of I-10. Based on flow projections developed in this scope of work, and future development information provided by the Town, Brown and Caldwell will delineate future wastewater system layouts and develop a map showing conceptual size and location of critical, future infrastructure.

Deliverables: The master plan and the CIP spreadsheet will be documented in a chapter of the final report.

Task 850 – Prepare Draft and Final Wastewater System Master Plan Report

A Draft Wastewater System Master Plan report summarizing all the results and including deliverables from Tasks 1 through 5 will be submitted to the Town.

1. A draft of the final report will be prepared; 10 copies will be circulated for review/comment.
2. One review meeting will be conduced to discuss comments and address any questions from the reviewers. The Town will provide review comments at least one week prior to the review meeting.
3. The draft report will be finalized, and comments will be incorporated as appropriate. One review copy of the final report will be submitted to the Town's project manager.
4. Town's project manager will review the final report to ensure incorporation of review comments.
5. Once approved by the Town's project manager, Brown and Caldwell will issue 10 copies of the Final Report.

Deliverables: Ten copies of the draft reports will be produced in black and white for comment and review, with electronic files of figures in color. Ten hard copies of the Final Report will be produced and submitted after incorporating Town's review comments. Each Final Report will include an Appendix with a CD. The CD will include a PDF version of the Final Master Plan Report as well as CADD, GIS, and modeling files

APPENDIX I

CONTINGENCY TASKS

MAPPING AND COMPILATION OF DATA

Digitize Paper Maps/Schematics into Electronic Format

In the event that maps and schematics from developers and other sources are not available in digital format, a contingency task to address manual digitization of these data for conversion to CAD or GIS format will be performed at the direction of the Town of Buckeye Project Manager.

1. Brown and Caldwell will digitize paper maps/schematics and convert data into CADD or GIS format, as appropriate.
2. Because the level of effort that may be associated with this task is uncertain, the scope is limited to two weeks of effort by a GIS or CAD analyst, with oversight from the Project Manager or Project Engineer.

Deliverables: CADD or GIS files with supporting data for each paper map or schematic that is converted.

WATER QUALITY TASKS

Source Water Quality Review/Assessment

Source water quality of the Town's groundwater supply will be assessed with existing, publicly and privately available information. Work to be performed in this task will rely on a water quality database developed by Town staff with oversight by Brown and Caldwell.

1. Compile water quality data from multiple sources in support of database development for the Town. Design database with flexibility to accommodate the differing data types in a GIS platform. It is assumed that Town staff will populate the database, and specific constituents of concern will be limited to total dissolved solids (TDS), arsenic, fluoride, and nitrates.
2. Spatially review and analyze the database in GIS. Identify aquifer zones of concern and evaluate any trends. Data gaps and areas with limited data will be identified.
3. Generate a series of water quality maps for the Town's planning area. Areas of no data or limited data will be flagged separately.
4. If adequate data are available to map the three separate aquifer units (upper, middle, and lower alluvial units), water quality maps of the aquifer units will be developed.
5. A separate, more detailed map will be developed for TDS in the waterlogged area, which has been identified as a key area of concern for the Town.

Water Treatment Analysis

The objective of this task is to provide planning level information and comparison on treatment options to address anticipated water quality issues within the Town's planning area.

1. Treatment alternatives for high arsenic, fluoride, nitrate, and TDS will be identified and compared for the Town's use in planning for future facilities. The comparison will include typical capital and operating costs, land requirements, waste stream, and reliability.
2. The anticipated water quality by area within the study area will be reviewed, and the value of on-site versus centralized locations of treatment facilities will be generally evaluated. The locations of potential centralized treatment facilities will be identified on a map within the report, and considerations for decision making in this area will be outlined.

MISCELLANEOUS WASTEWATER SYSTEM TASKS

Collection System Rehabilitation, Replacement, and Maintenance Plan

A plan for infrastructure rehabilitation, repair, and maintenance will be developed; the focus of this task will be on the vitrified clay pipe (VCP) in the Central Buckeye region.

Assumption:

- The Town will provide CCTV and other inspection records for pipe condition assessment.
- No new CCTV work will be done under this project.
    1. Deterioration of Central Buckeye's 4-inch and 6-inch VCP lines is the Town's major concern and will be the main focus of this task. Brown and Caldwell will review Town's CCTV work and other inspection records to evaluate current condition.
    2. Brown and Caldwell will identify other areas of concern based on age, known deterioration, and operator's concerns.
    3. Brown and Caldwell will provide generic recommendations and a plan for pipe condition assessment, rehabilitation, and replacement work.

Brine Disposal

BC will review the feasibility of discharging brine (RO reject water) in the Town's wastewater collection system.

Assumptions:

- The Town will provide projected RO reject water quantity and quality data for future systems. Alternatively, Brown and Caldwell will work in conjunction with the Town to develop conceptual estimates for these data.
- The Town will provide Town's guidelines and goals regarding brine.
    1. Brown and Caldwell will evaluate the constraints and guidelines for brine disposal into the collection system, and treatment via wastewater treatment plant process.
    2. The feasibility of the brine disposal process through the wastewater system will be reviewed based on the collection system's sewer capacity limitations, treatment system's quantity limitations, biological process limitations, and effluent re-use and recharge limitations. The impacts of brine disposal on the salinity of the treated effluent will also be analyzed.

Wastewater Treatment Plan/Biosolids Handling

Brown and Caldwell will review the existing biosolids plans at the plants, and assess the current capacity with respect to future production.

1. Visit the plants; review and compare current biosolids handling systems at the plants, centrifuge versus belt press.
2. Evaluate need for additional capacity, based on projected quantities and operational issues (i.e., land application).
3. Make recommendations to address future needs.

APPENDIX B

System Design and Evaluation Criteria

Use of data contained on this sheet is subject to the limitations specified in Section 12 of this document.
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Draft Technical Memorandum

201 East Washington Street, Suite 500
Phoenix, Arizona 85004
Tel: 602-567-4000
Fax: 602-567-4001

Prepared for: Town of Buckeye

Project Title: Integrated Water Resources Plan

Project No: 135867

Draft Technical Memorandum 1 (version 5) – System Design and Evaluation Criteria

Subject: Tech Memo Subject

Date: June 11, 2010

To: Damon Dequenne, Town of Buckeye; Woody Scoutten, W. C. Scoutten, Inc.

From: Tiffany Ashforth, Andrew Fugal; Brown and Caldwell

Limitations:

This is a draft memorandum and is not intended to be a final representation of the work done or recommendations made by Brown and Caldwell. It should not be relied upon; consult the final report.

This document was prepared solely for the Town of Buckeye in accordance with professional standards at the time the services were performed and in accordance with the contract between the Town of Buckeye and Brown and Caldwell. This document is governed by the specific scope of work authorized by the Town of Buckeye; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the Town of Buckeye and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

1. INTRODUCTION

This technical memorandum (TM) describes the criteria to be used in evaluating the existing water and wastewater systems and for the master planning level design of future improvements for the Town of Buckeye (TOB). The documents listed below were reviewed for the development of these criteria. The acronym shown with each document is used to reference the document in the tables in this TM.

- AWWA: *Computer Modeling of Water Distribution Systems, Manual of Water Supply Practices, M32* (American Water Works Association, 2005) – This document was referenced where criteria were not provided by state or Town guidelines.
- AAC: *Arizona Administrative Code, Title 12* (2009) – This document contains the state regulations for water transmission, supply, pumping, and storage facilities.
- B10: *Arizona Department of Environmental Quality Engineering Bulletin 10* (May 1978) – This document provides guidelines for the construction of water systems.
- BC: Brown and Caldwell experience with evaluation and design of systems.
- LIND: *Civil Engineering Reference Manual for the PE Exam*, Eighth Edition, Michael R. Lindeburg, 2001, Professional Publications, Inc.
- TOB: *Preliminary Town of Buckeye Water and Sewer Design Standards* (February 11, 2005, revised September 28, 2009) – This four documents lists design standards for calculating water and wastewater flows.
- TOB General Plan: *Town of Buckeye 2007 General Plan Update* (Adopted January 18, 2008) – This document contains descriptions of land use types.

2. FLOW AND DEMAND CRITERIA

Table 2-1 lists the residential flow per person calculations. The Town standard is 150 gallons per day (gpd) per person for water and 100 gpd/person for wastewater. However, these values were increased to account for flows from schools and open space. Because the general land use plan does not have details on the location and number of schools and open space for parks, the flow for these uses needs to be accounted for as an increased flow per person. Table 2-1 lists the calculations done to account for these additional uses.

Table 2-1. Residential Flow per Person

Item	Water Value	Wastewater Value	units	Source / Note
Open Space (Neighborhood Parks)				
Developed Open Space Water Use per Acre	1,800	0	gpd/acre	TOB Design Standards (9/28/09)
Turf Water Use per Acre	8,825	0	gpd/acre	TOB Design Standards (9/28/09)
Percent Developed Open Space	80%	0%	percent	Estimate
Percent Turf	20%	0%	percent	Estimate
Total Open Space Use	3,205	0	gpd/acre	Calculated from values above
Open Space % of Gross Acreage	10%	0	percent	Parks, Trails and Open Space Master Plan, November 2005 (pg 2-22)
Total Open Space Water Use per Gross Acre	*320.5*	*0*	*gpd/acre*	*Additional flow added to residential areas per acre to account for open space*

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Use of contents on this sheet is subject to the limitations specified at the beginning of this document.

Table 2-1. Residential Flow per Person				
Schools				
High School Students per EDU	0.2	0.2	students/EDU	W.C. Scoutten
Elem School Students per EDU	0.58	0.58	students/EDU	W.C. Scoutten
Total Students per EDU	0.78	0.78	students/EDU	Sum of values above
Residential Population per EDU	2.7	2.7	population/EDU	TOB 2007 General Plan Update, January 2008 (pg 8-1)
Total Students per person	0.29	0.29	students/person	Calculated from values above (0.78 / 2.7)
Student Water Use	75	28	gpd/student	TOB Design Standards (9/28/09)
Total Student Use per person	*21.7*	*8.1*	*gpd/person*	*Additional flow added to residential water use to account for schools*
Total Use				
Residential Domestic Use	150	100	gpd/person	TOB Design Standards (9/28/09)
Total Residential Use	*172*	*108*	*gpd/person*	*Total residential flow per person*

Water demands and wastewater flows for each land use type are listed in Table 2-2. The land use codes listed in the table correspond to the land use classifications listed in the Town's General Plan. The text following the table describes each column of data in more detail.

Table 2-2. Land Use Demands							
Land Use Code	**Land Use Description**	**DU per acre**	**Residential Demand/Flow per Person (gpcd)**		**Non-Residential Demand/Flow per Acre (gpd/acre)**		**Comments**
			Water	**Waste water**	**Water**	**Waste water**	
BP	Business Park	-	-	-	2,232	1,500	
GC	Government Center	-	-	-	2,009	1,500	
I	Industrial	-	-	-	2,009	1,500	
Military	Military	-	-	-	2,009	1,500	
NC	Community Commercial	-	-	-	2,009	1,500	
OFF	Professional Office Employment	-	-	-	2,009	1,500	
RC	Regional Commercial	-	-	-	2,009	1,500	
OS	Open Space	-	-	-	-	-	No water use because General Plan states that Open Space areas will be left in a natural state. Note that Open Spaces in the General Plan are very large open areas and are different from smaller open spaces/parks shown in Community Master Plans.

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Use of contents on this sheet is subject to the limitations specified at the beginning of this document.

Table 2-2. Land Use Demands							
Land Use Code	Land Use Description	DU per acre	Residential Demand/Flow per Person (gpcd)		Non-Residential Demand/Flow per Acre (gpd/acre)		Comments
			Water	Waste water	Water	Waste water	
VCMU	Mixed Use	10	172	108	2,232	1,500	From General Plan, Mixed Use consists of: - 60% High Density Residential (10 du/acre) - 20% commercial - 20% employment
CMP	Master Planned Community	1.6	172	108	-	-	
		2.4	172	108	-	-	
DO	City Center	10	172	108	-	-	This area will include mixed uses. See comments for Mixed Use above.
HDR	High Density Residential	12.5	172	108	-	-	
LDR	Low Density Residential	2	172	108	-	-	
MDR	Medium Density Residential	4.5	172	108	-	-	
MHD	Medium High Density Residential	8	172	108	-	-	
VLDR	Very Low Density Residential	0.5	172	108	-	-	

The source of the information in Table 2-2 includes:

- *General Plan Land Use Code/Description* – The land use codes and descriptions as listed in the General Plan.
- *General Plan DU per acre* – The number of dwelling units (DU) per acre as listed in the General Plan.
- *Residential Demand per Person, Water /Wastewater* – The residential demand per person as calculated in Table 2-1.
- *Non-Residential Demand per Acre, Water* – Non-residential demands are often calculated from the total billed water use within a land use area. However, this method was not used for this study because of the relatively small dataset of billed water use locations and because the Town's current water use profile is anticipated to undergo substantial changes in the years to come. Values for the non-residential demands were initially taken from the Town's General Plan Update. Those values were then compared with values used in the City of Goodyear Integrated Master Plan (June 2008). The General Plan values are within 10% of the Goodyear values. Therefore, the General Plan values will be used. These values are higher than the 1,500 gpd/acre in the Town's design standards. The General Plan assumes that 80% of non-residential land will be built out.
- *Non-Residential Flow per Person, Wastewater* – The non-residential flow per acre as specified in the Town's Design Standards (TOB).

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3. WATER SYSTEM CRITERIA

3.1 Supply Criteria

The Town relies on groundwater to supply the drinking water system. Sustainable future well supply and well locations are summarized in the Water Resources Plan. The Town's Well Facility Design Manual (DM 301) also addresses other criteria such as backup power. Table 3-1 only lists criteria related to supplying the distribution system.

Table 3-1. Supply and Demand Criteria

Criteria	Value\Description	Reference
Supply		
Well Capacity	Meet Maximum Daily Demand (MDD) of the system with each well running a maximum duration of 18 hours per day	TOB
Redundant Well Capacity	Include 15% backup capabilities, with a minimum of 1 backup well	TOB
Demand		
Max Day Peaking Factor	1.8 x Average Day Demand	TOB
Peak Hour Peaking Factor	3.0 x Average Day Demand	TOB

3.2 Pipe Criteria

Table 3-2 summarizes the water system piping criteria.

Table 3-2. Pipe Criteria

Criteria	Value\Description	Reference
Diameter		
Minimum	8 inch	TOB
System Pressures		
Minimum – Maximum Day Minimum – Maximum Day plus Fire Flow Maximum	40 psi 20 psi Max pressure depends on pressure zone boundaries	TOB TOB TOB
Fire Flow at Maximum Day Demand and 20 psi		
4,000 gpm for 4 hours	BP (Business Park) GC (Government Center) I (Industrial) Military (Military) NC (Community Commercial) OFF (Professional Office Employment) RC (Regional Commercial) VCMU (Mixed Use) DO (City Center)	TOB

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Table 3-2. Pipe Criteria		
Criteria	**Value\Description**	**Reference**
	HDR (High Density Residential) MHD (Medium High Density Residential)	
1,500 gpm for 2 hours	CMP (Master Planned Community) LDR (Low Density Residential) MDR (Medium Density Residential) VLDR (Very Low Density Residential)	TOB
Velocity		
Maximum Evaluation Velocity Maximum Design Velocity Maximum Design Velocity with Fire Flow	10 ft/s (For identifying high velocity for potential replacement) 5 ft/s 10 ft/s	TOB
Headloss		
Maximum Design Headloss	10 ft / 1,000 ft	TOB
Reliability		
Distribution	Looping required except in a cul-de-sac	TOB
Hydraulic Analysis		
Hazen-Williams Friction Factor for Design ACP Cast Iron (lined) Ductile Iron PVC/HDPE Steel (lined) Unknown	 140 130 130 140 130 130	LIND

3.3 Pump Station Criteria

Table 3-3 summarizes the pump station criteria.

Table 3-3. Pump Station Criteria		
Criteria	**Value\Description**	**Reference**
Pump Sizing	Booster pump stations shall be sized to meet the MDD plus Fire Flow and the peak hour demand with the largest pump out of service	TOB

3.4 Storage Criteria

The volume of required storage for a service area consists of three components: equalization/operational, fire, and emergency storage. Equalization/operational storage capacity is used to meet demands when they exceed supply to the system (e.g. during peak demand periods). Fire storage capacity is reserved to supply fire demand for the duration of a fire event. Emergency storage capacity is reserved to provide water during events such as power outages, standard maintenance procedures, natural disasters, facility failures, etc. The

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hydraulic evaluation of the system using the computer model and a cost comparison of alternatives will assist in determining the number and location of new storage tanks. Table 3-4 summarizes the storage tank criteria.

Table 3-4. Storage Criteria

Criteria	Value\Description	Reference
Capacity		
The largest of the following 1. Peak Hour Storage – 4 hours of Peak Hour Demand without using more than 80% of the total storage capacity without wells. 2. Fire Flow – 25% of the MDD plus the highest required fire storage in the pressure zone. 3. Operating Storage – 20% of the MDD. 4. Emergency Storage – Average Day Demand (ADD) without using more than 80% of the total storage capacity without wells.		TOB
Operations		
Maximum Water Level (for general tank sizing)	30 feet	B10
Elevated vs. Ground Level Storage	The analysis will look at using some storage at an elevated ground level (as compared to only using ground level pumped storage) for the following reasons: 1. Elevated storage is considered more reliable during a power failure (especially during a fire event) 2. Elevated storage provides stable system pressures 3. The system is easier to operate with elevated storage because it maintains the HGL without pumps or controls	AWWA

3.5 Pressure Zone Criteria

Table 3-5 lists the elevations of the pressure zones used by the Town.

Table 3-5. Pressure Zone Elevations

Zone	Low Elevation (feet)	High Elevation (feet)
1	820	950
2	950	1,080
3	1,080	1,210
4	1,210	1,340
5	1,340	1,470
6	1,470	1,600
7	1,600	1,730
8	1,730	1,860
9	1,860	1,990
10	1,990	2,120
11	2,120	2,250
12	2,250	2,380
13	2,380	2,510
14	2,510	2,640

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Table 3-5. Pressure Zone Elevations		
Zone	**Low Elevation (feet)**	**High Elevation (feet)**
15	2,640	2,770
16	2,770	2,900
17	2,900	3,030
18	3,030	3,160

4. WASTEWATER SYSTEM CRITERIA

Table 4-1 lists general criteria for the evaluation and design of the collection system.

Table 4-1. Wastewater System Criteria		
Criteria	**Value\Description**	**Reference**
Capacity (depth / diameter)		
Maximum Evaluation Capacity Maximum Design Capacity	100% (Surcharged, for identifying existing pipes for potential replacement) 75%	BC TOB
Velocity (flowing full)		
Minimum Maximum	2 ft/s 10 ft/s	TOB
Other		
Design Roughness	0.013	TOB
Minimum Pipe Cover (surface to top of pipe)	6.0 feet	TOB

Table 4-2 lists the minimum and maximum pipe slopes for designing new wastewater pipes. The minimum pipe slopes from the TOB standards and the maximum pipes slopes are based on a pipe flowing full at a velocity of 10.0 ft/s.

Table 4-2. Pipe Slopes		
Pipe Size (inches)	**Minimum Slope (ft/ft)**	**Maximum Slope (ft/ft)**
8	0.00400	0.08299
10	0.00240	0.06164
12	0.00190	0.04833
15	0.00140	0.03590
18	0.00110	0.02815
21	0.00146	0.02292
24	0.00127	0.01918
30	0.00102	0.01425
36	0.00085	0.01117

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Table 4-2. Pipe Slopes		
Pipe Size (inches)	**Minimum Slope (ft/ft)**	**Maximum Slope (ft/ft)**
42	0.0007 (minimum for constructability)	0.00910
48	0.0007	0.00761
54	0.0007	0.00651
60	0.0007	0.00565
66	0.0007	0.00498
72	0.0007	0.00443
78	0.0007	0.00398
84	0.0007	0.00361
90	0.0007	0.00329
96	0.0007	0.00302

Table 4-3 lists the peaking factors for peaking average dry weather flow to peak wet weather flow.

Table 4-3. Peaking Factors			
Pipe Size	**Upstream Population**	**Peaking Factor[1]**	**Reference**
Less than 12-inch	All	4.0	TOB
Greater than and equal to 12-inch	100	3.62	AAC, R18-9-E301
	200	3.14	
	300	2.90	
	400	2.74	
	500	2.64	
	600	2.56	
	700	2.50	
	800	2.46	
	900	2.42	
	1000	2.38	
	1001 to 10,000	$(6.330 \times p^{-0.231}) + 1.094$ (ranges from 2.38 to 1.85)	
	10,001 to 100,000	$(6.177 \times p^{-0.233}) + 1.128$ (ranges from 1.85 to 1.55)	
	More than 100,000	$(4.500 \times p^{-0.174}) + 0.945$ (ranges from 1.55 to 1.35)	

1. p = Upstream population

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APPENDIX C

Flow Metering Report

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Town of Buckeye

Sanitary Sewer Flow Monitoring Report

Integrated Water Resources Plan

Prepared for:

Brown and Caldwell
201 East Washington Street Suite 500
Phoenix, AZ 85004
Prepared by:

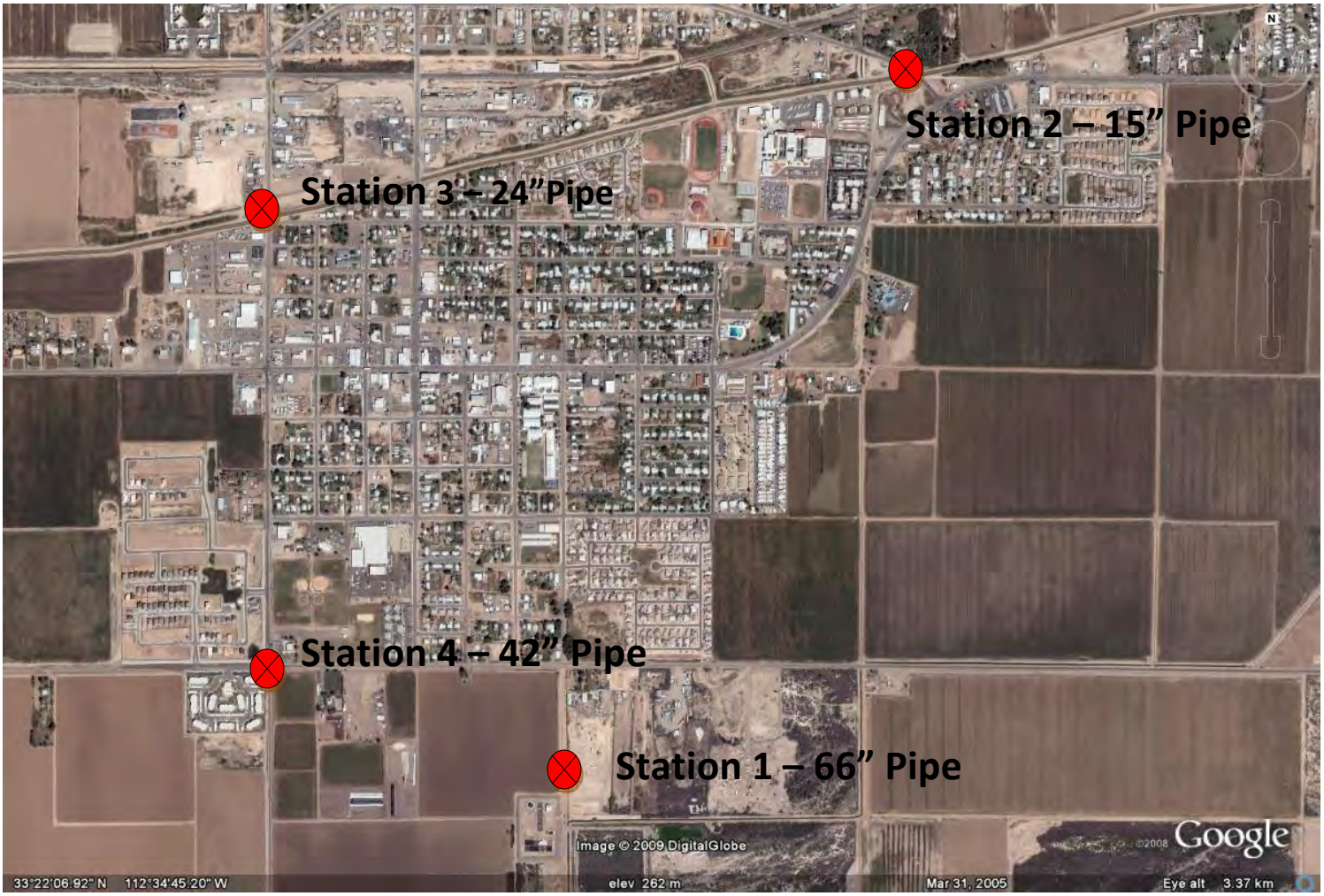
B&F Contracting, Inc.
11011 N. 23rd Avenue
Phoenix, AZ 85029

Executive Summary

B&F Contracting, Inc. has completed a sanitary sewer flow monitoring analysis for Brown and Caldwell at stations 1, 2, 3 & 4 in the Town of Buckeye for the Integrated Water Resource Plan Project. Flow monitoring was conducted over a two (2) week period from December 28, 2008 to January 11, 2009 at four (4) different flow monitoring locations pre-selected by Brown and Caldwell. Each individual location was monitored over a fourteen (14) day period with its own ISCO 2150 Area Velocity Flow Module and Sensor. The flow monitoring locations can be seen on page three (3) of the project overview. The scope of work for the project includes the following items:

- Install the flow monitoring equipment at the four (4) monitoring sites. Flow data was recorded in 5-minute intervals over a two (2) week period.
- Data from flow monitoring is shown on three (3) separate graphs including, weekly flow rate, level and velocity readings with each of the peaks and minimums annotated on the graph.
- Data points for flow rate, level and velocity to be provided in excel spreadsheet form in 5-minute intervals.
- Site specific flow monitoring descriptions and results sheets.

Project Overview



Manhole Locations:

Station 1 - 7th Street South of Beloat Rd.

Station 2 - South of Baseline Road & North of Buckeye Canal

Station 3 - 1st Avenue North of Buckeye Canal

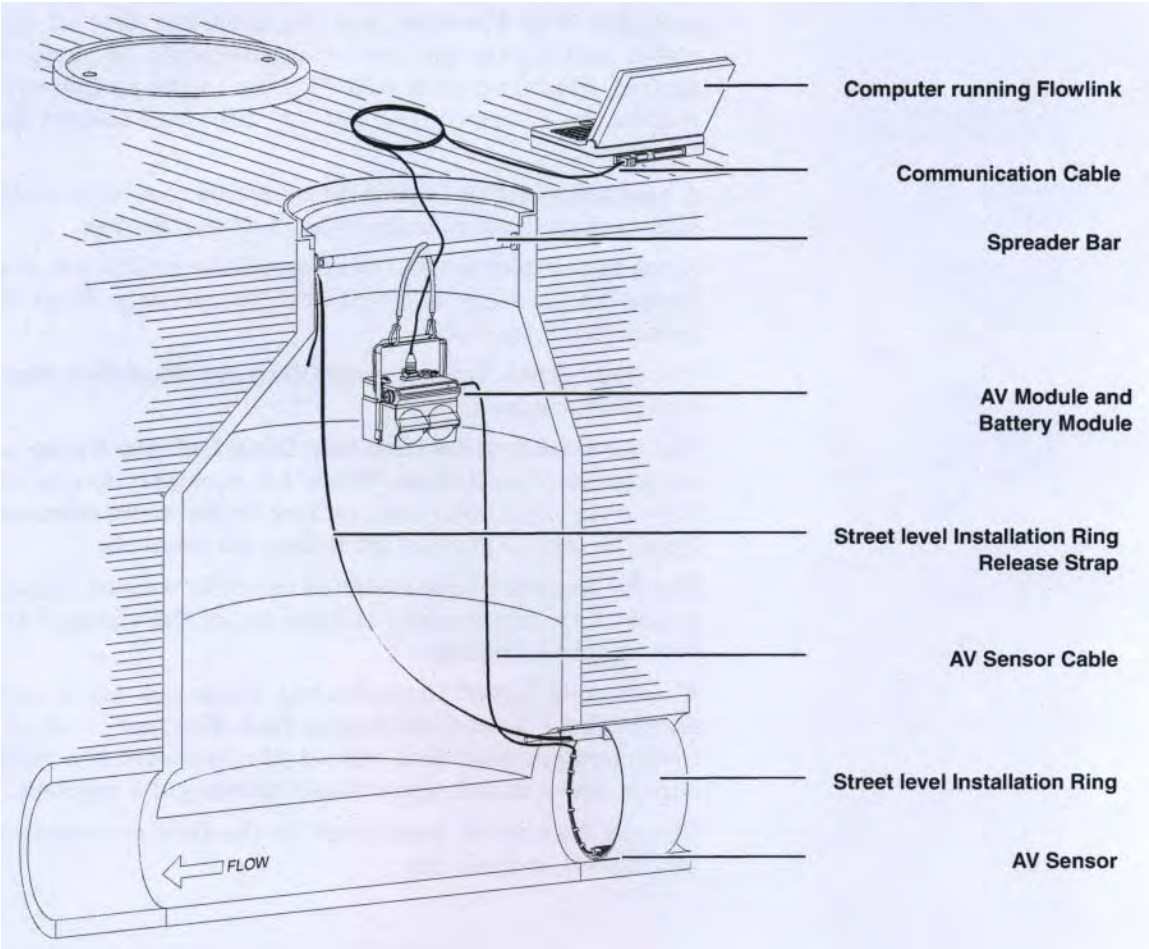
Station 4 - Intersection of Irwin & 1st Street

Methods & Materials

Meter Installation

Four (4) Teledyne ISCO Area Velocity Flow Modules and Sensors were installed by B&F crews as directed by Brown and Caldwell at stations 1, 2, 3 & 4. See figure 1 for graphical sketch of installation.

Figure 1



Continuous flow rate, level and velocity readings were taken and recorded in 5-minute intervals and downloaded onto the Flowlink 5 software required by the ISCO Area Velocity Flow Module. The 2150 Flow Module uses continuous wave Doppler technology to measure mean velocity. The sensor transmits a continuous ultrasonic wave and then measures the frequency shift of returned echoes reflected by air bubbles or particles in the flow.

Flow Monitoring Descriptions & Results

Location: Station 1

Crossroads: 7th Street South of Beloat Road

Sewer Size: 66” Diameter

Pipe Material: Hobas Pipe

Monitoring Period: Sunday 12/28/2008 (12:00 AM) to Sunday 1/11/2009 (11:55 PM)

Summary of Events:

After review of the data retrieved from the flow module there were no irregularities shown within the results. Please review attachments A thru D for data on the following:

Attachment A – Summary of Peak, Minimum & Average Flows (Table 1)

Attachment B – Manhole Street View Photo

Attachment C – Flow Rate Graph

Attachment D – Flow Level Graph

Attachment E – Flow Velocity Graph

Attachment F – Data Points for Flow Rate, Flow Level & Velocity

<u>Attachment 'A'</u> – Station 1 (66-inch line)

Summary of Peak, Minimum & Average Flows

Table 1.

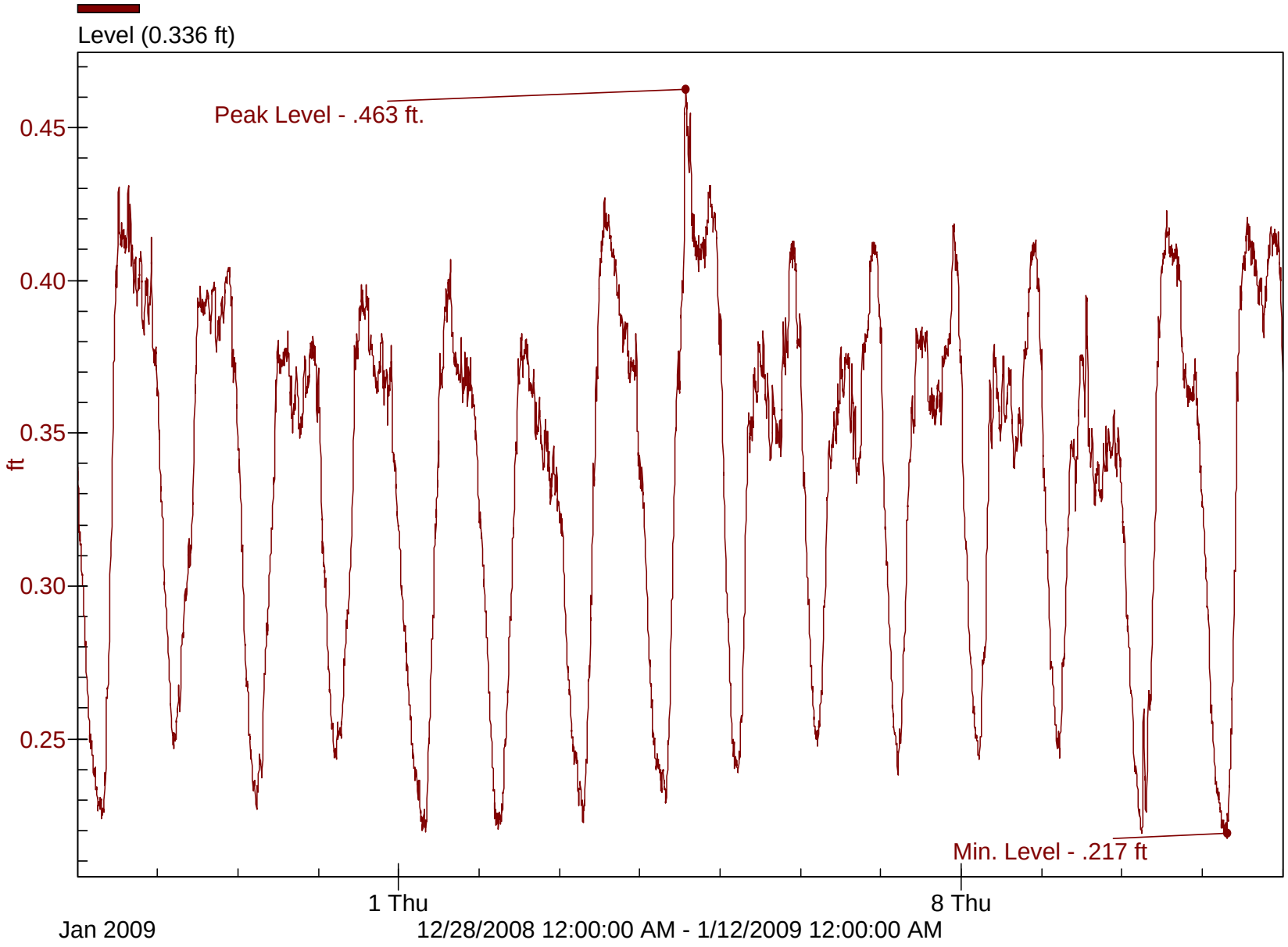
	Level	**Velocity**	**Flow Rate**
Peak	.463 ft	3.78 ft/s	1430 gpm
Minimum	.217 f.	1.61 ft/s	250 gpm
Average	.336 ft	2.71 ft/s	750 gpm

Attachment 'B'

Manhole Street View: Station 1 (66" Diameter) Facing North

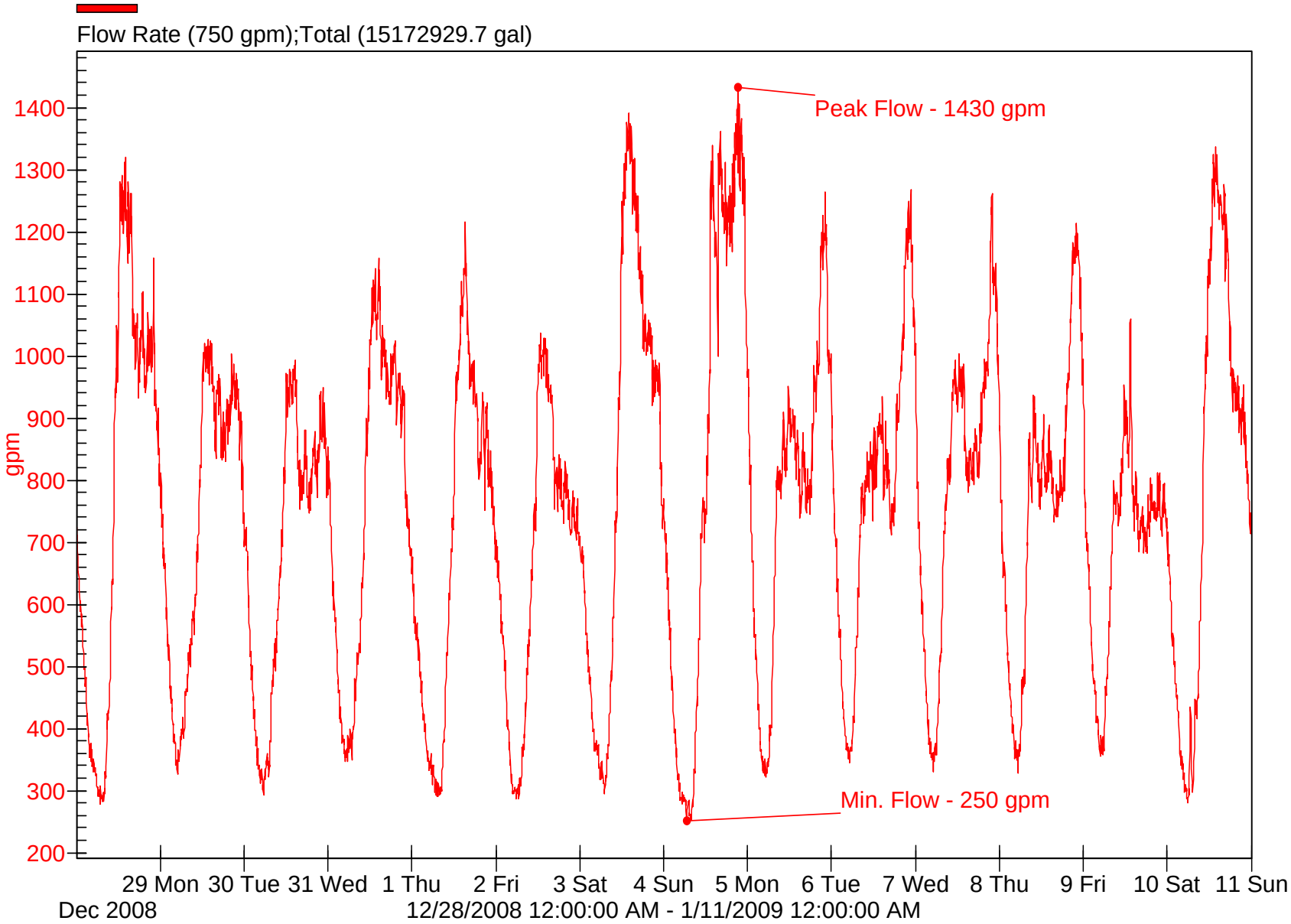
Station 1- Beloat and Irwin- 66 inch

Flow Level Graph - From 12/28/2008 to 1/11/2009 - Attachment 'D'



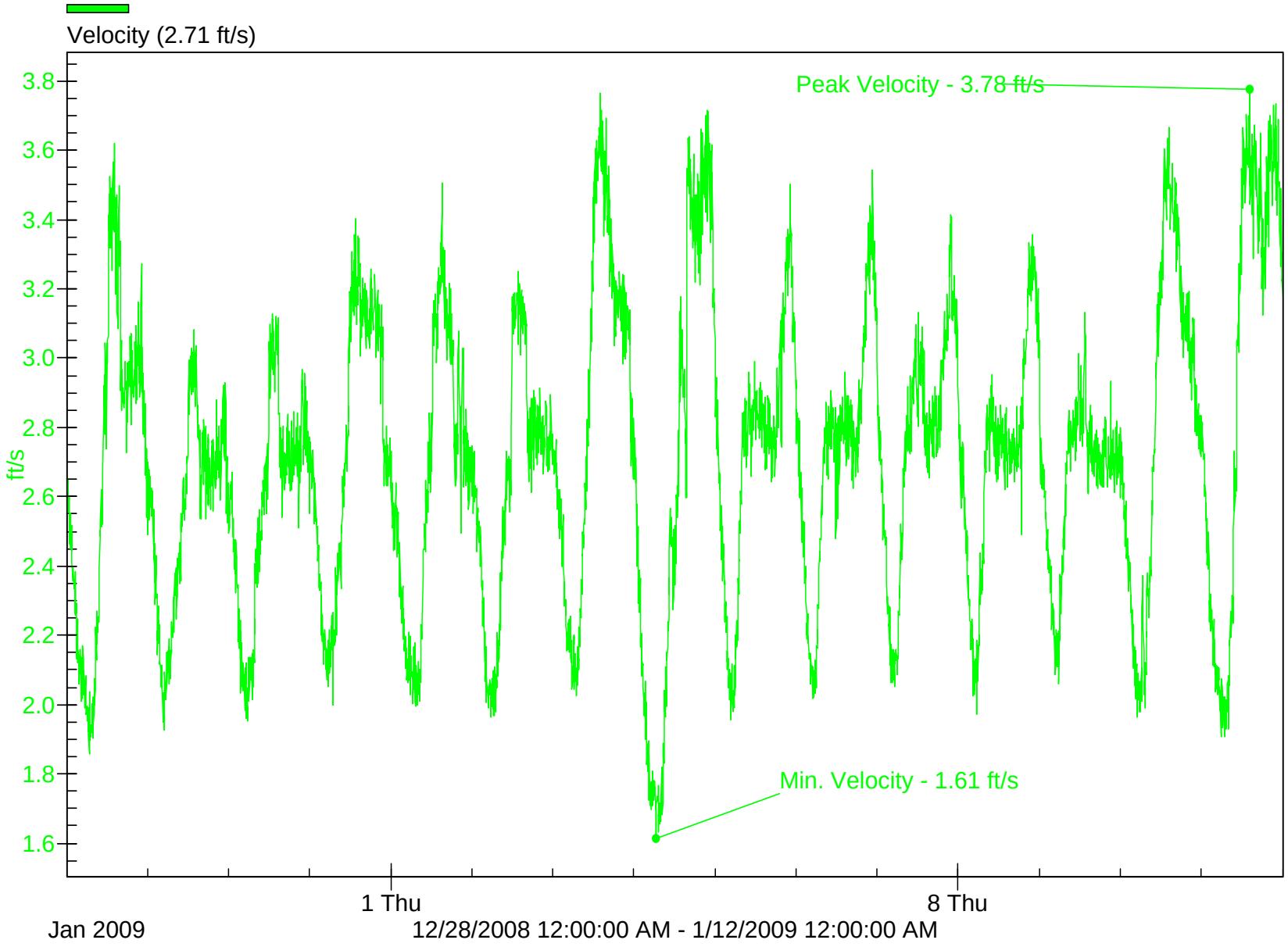
Station 1- Beloat and Irwin- 66 inch

Flow Rate Graph - From 12/28/2008 to 1/11/2009 - Attachment 'C'



Station 1- Beloat and Irwin- 66 inch

Flow Velocity Graph - From 12/28/2008 to 1/11/2009 - Attachment 'E'



Flow Monitoring Descriptions & Results

Location: Station 2

Crossroads: South of Baseline Road on Apache

Sewer Size: 24” Diameter

Pipe Material: Concrete Pipe

Monitoring Period: Sunday12/28/2008 (12:00 AM) to Sunday 1/11/2009 (11:55 PM)

Summary of Events:

After review of the data retrieved from the flow module there were no irregularities shown within the results. Please review attachments A thru D for data on the following:

Attachment A – Summary of Peak, Minimum & Average Flows (Table 1)

Attachment B – Manhole Street View Photo

Attachment C – Flow Rate Graph

Attachment D – Flow Level Graph

Attachment E – Flow Velocity Graph

Attachment F – Data Points for Flow Rate, Flow Level & Velocity

<u>Attachment 'A'</u> - Station 2 (24-inch line)

Summary of Peak, Minimum & Average Flows

Table 1

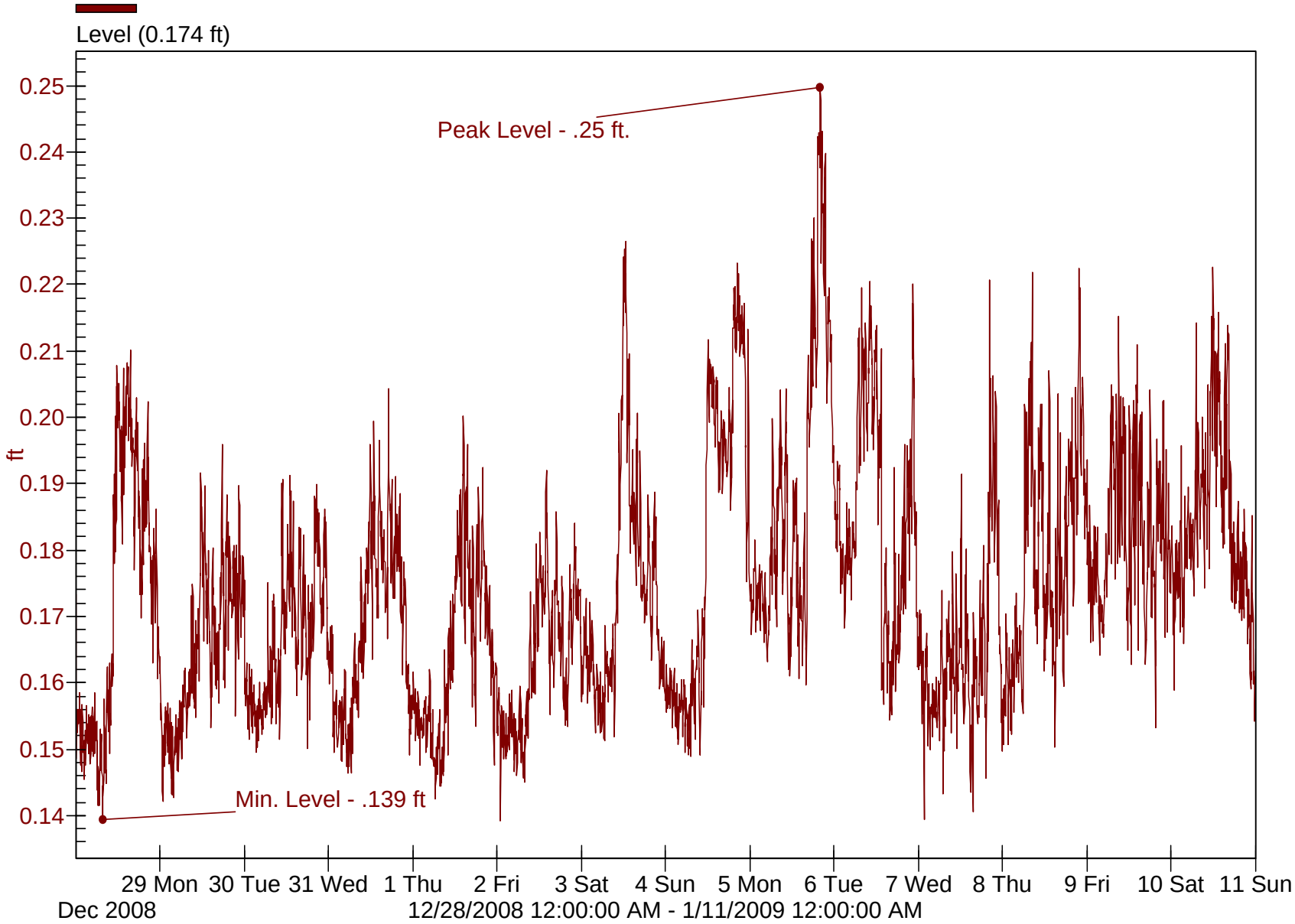
	Level	**Velocity**	**Flow Rate**
Peak	.250 ft	5.09 ft/s	450 gpm
Minimum	.139 ft	1.26 ft/s	60 gpm
Average	.174 ft	3.39 ft/s	210 gpm

Attachment 'B'

Manhole Street View: **Station 2 – (24" Diameter) Facing North**

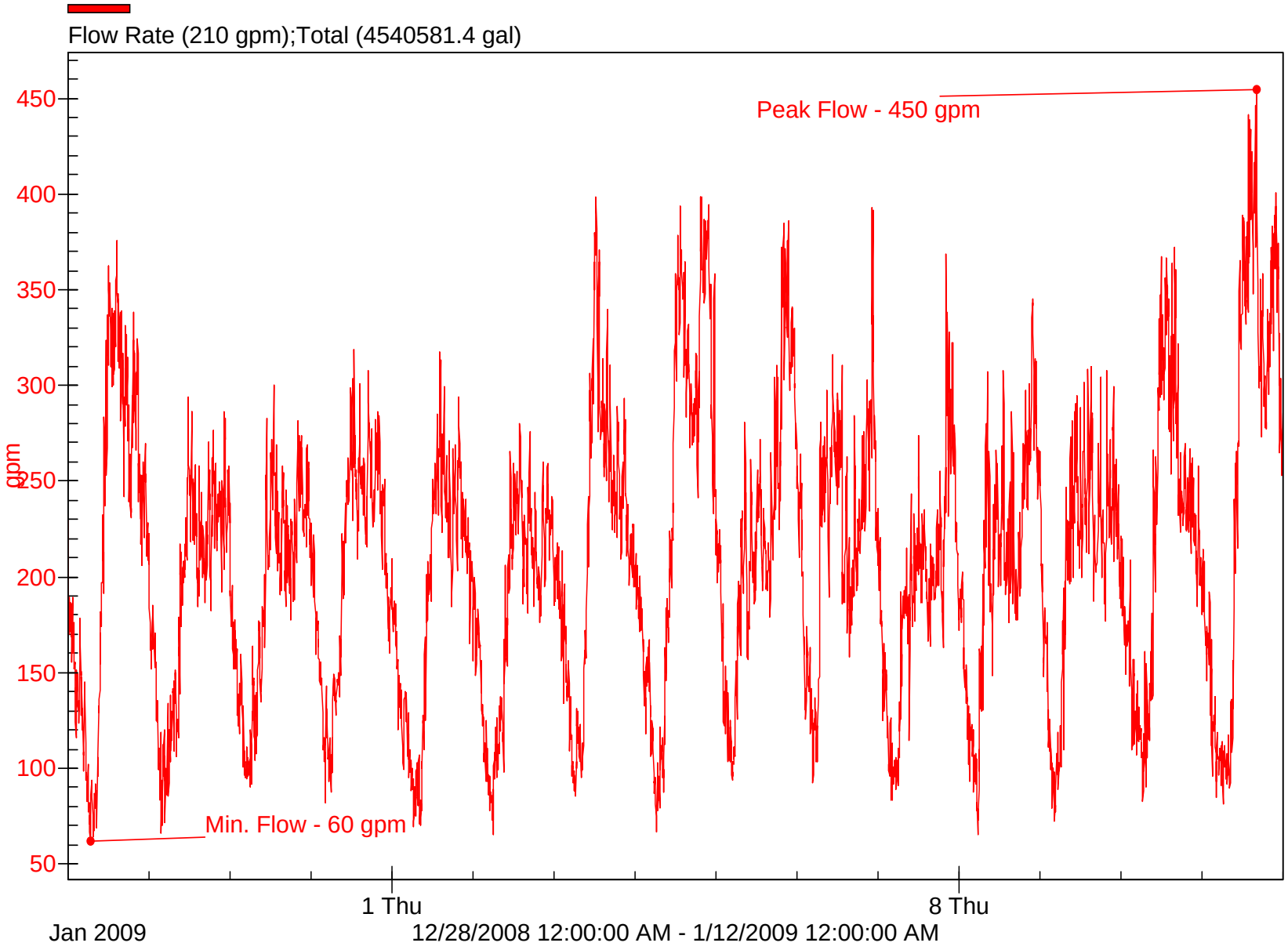
Station 2 - Baseline Apache- 24 inch

Flow Level Graph - From 12/28/2008 to 1/11/2009 - Attachment 'D'



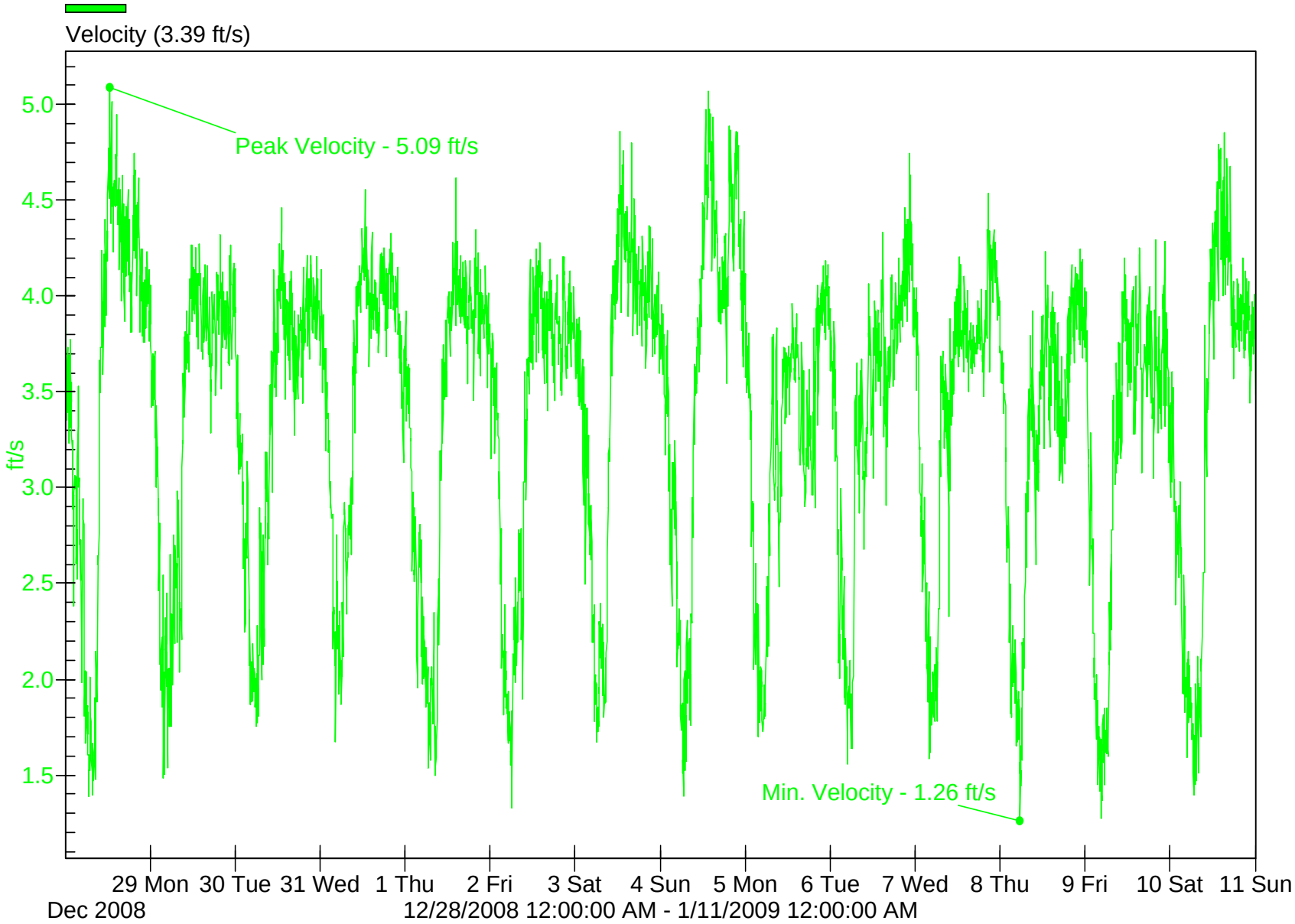
Station 2 - Baseline Apache- 24 inch

Flow Rate Graph - From 12/28/2008 to 1/11/2009 - Attachment 'C'



Station 2 - Baseline Apache- 24 inch

Flow Velocity Graph - From 12/28/2008 to 1/11/2009 - Attachment 'E'



Flow Monitoring Descriptions & Results

Location: Station 3

Crossroads: 1st Avenue North of Buckeye Canal

Sewer Size: 24” Diameter

Pipe Material: Corrugated HDPE

Monitoring Period: Sunday 12/28/2008 (12:00 AM) to Sunday 1/11/2009 (11:55 PM)

Summary of Events:

After review of the data retrieved from the flow module there were no irregularities shown within the results. Please review attachments A thru D for data on the following:

Attachment A – Summary of Peak, Minimum & Average Flows (Table 10

Attachment B – Manhole Street View Photo

Attachment C – Flow Rate Graph

Attachment D – Flow Level Graph

Attachment E – Flow Velocity Graph

Attachment F – Data Points for Flow Rate, Flow Level & Velocity

<u>Attachment 'A'</u> - Station 3 (24-inch line)

Summary of Peak, Minimum & Average Flows

Table 1

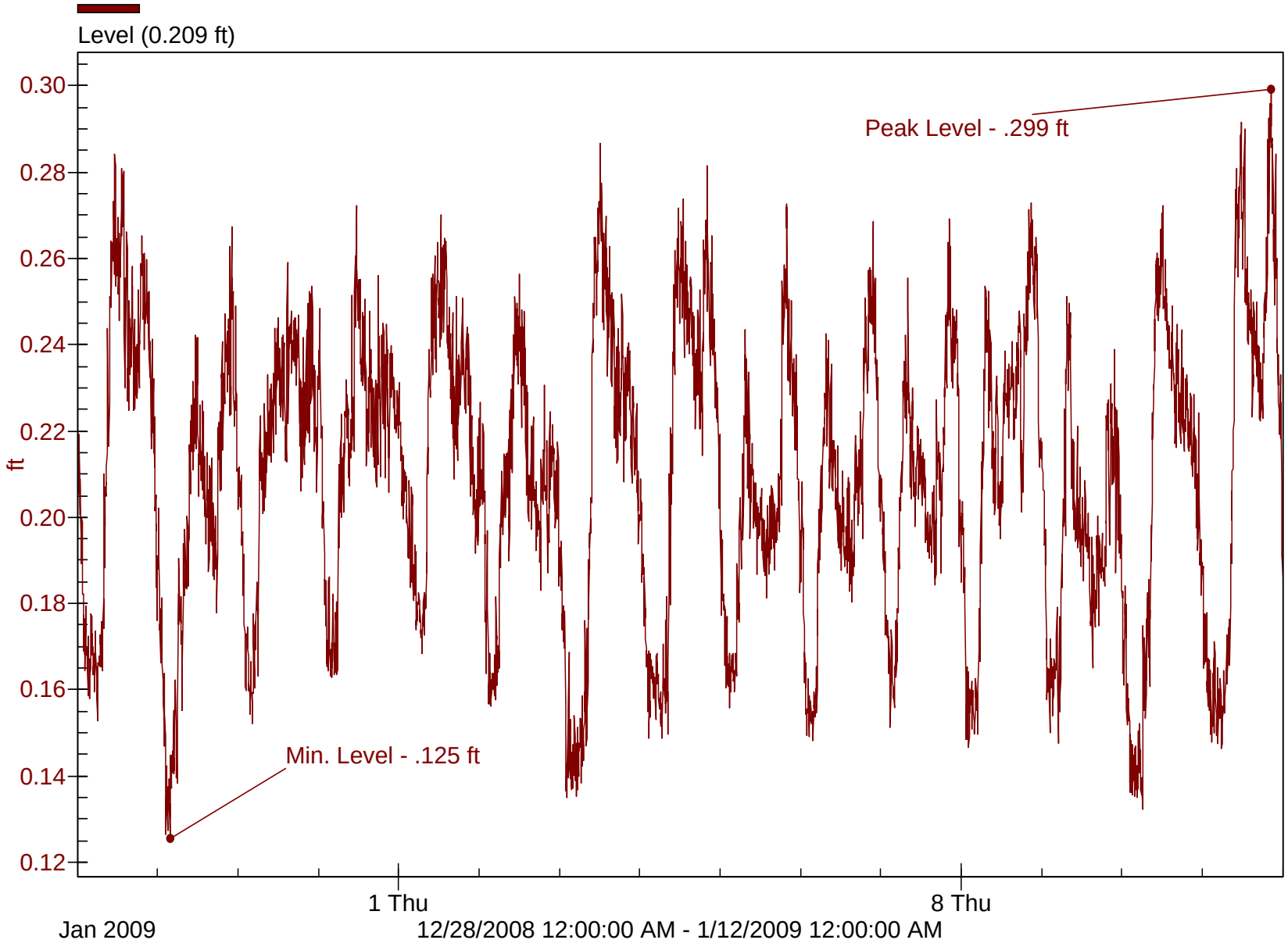
	Level	**Velocity**	**Flow Rate**
Peak	.299 ft	3.71 ft/s	480 gpm
Minimum	.125 ft	1.07 ft/s	50 gpm
Average	.209 ft	2.36 ft/s	190 gpm

Attachment 'B'

Manhole Street View: Station 3 – (24" Diameter) Facing North

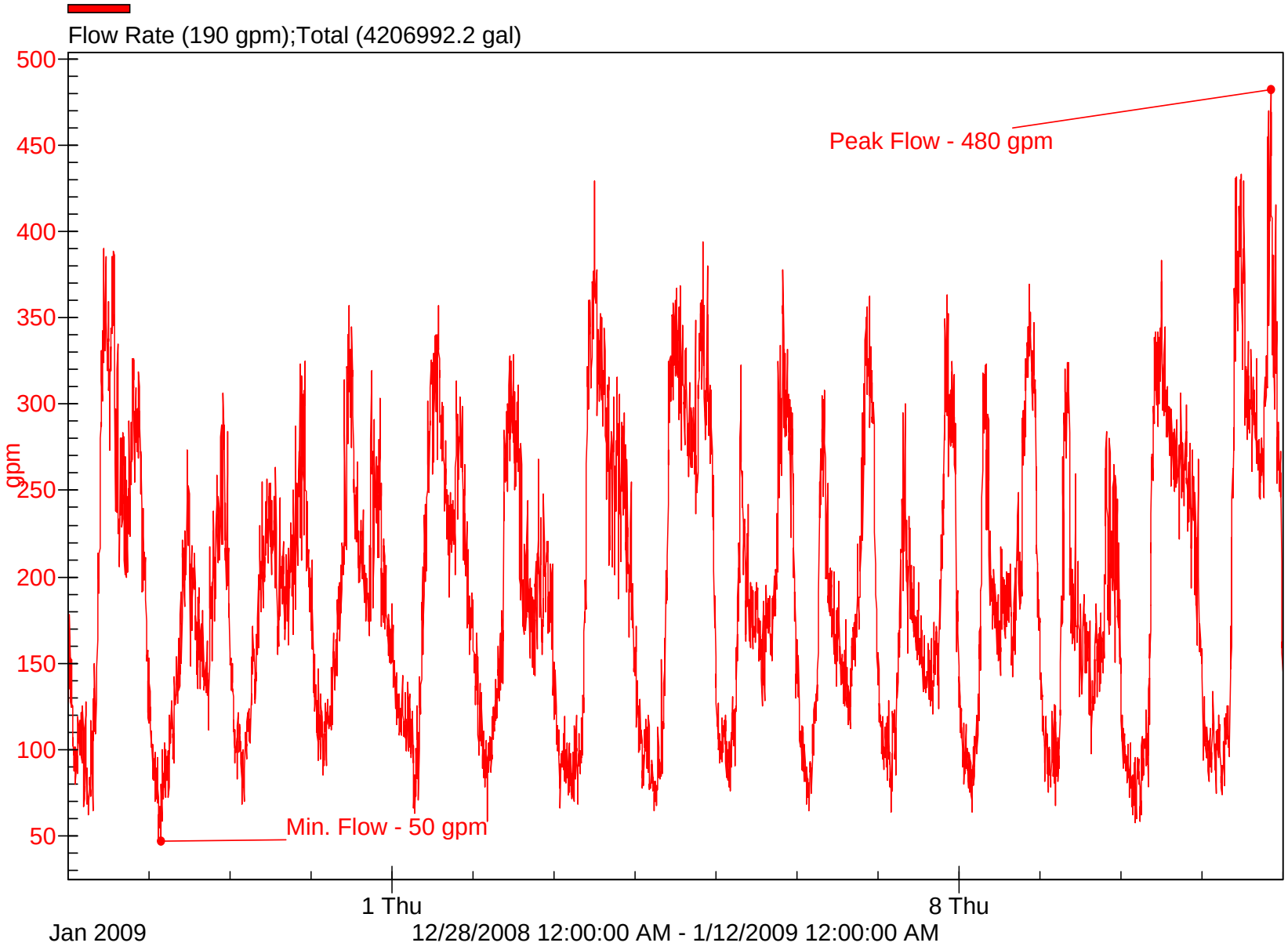
Station 3 - 1st Avenue - 24 inch

Flow Level Graph - From 12/28/2008 to 1/11/2009 - Attachment 'D'



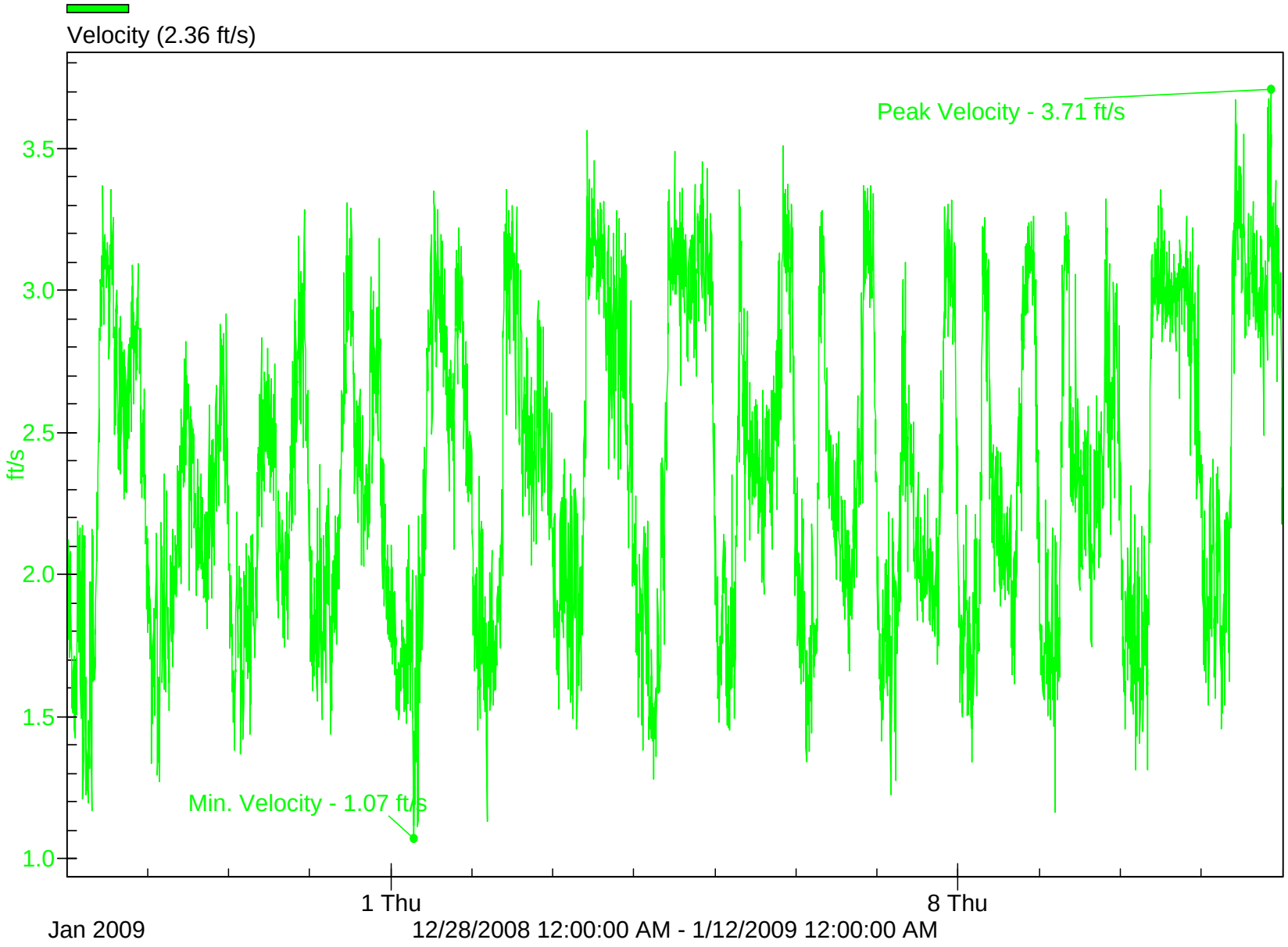
Station 3 - 1st Avenue - 24 inch

Flow Rate Graph - From 12/28/2008 to 1/11/2009 - Attachment 'C'



Station 3 - 1st Avenue - 24 inch

Flow Velocity Graph - From 12/28/2008 to 1/11/2009 - Attachment 'E'



Flow Monitoring Descriptions & Results

Location: Station 4

Crossroads: Irwin/Beloat & 1st Street

Sewer Size: 42”

Pipe Material: Corrugated HDPE

Monitoring Period: Sunday 12/28/2008 (12:00 AM) to Sunday 1/11/2009 (11:55 PM)

Summary of Events:

After review of the data retrieved from the flow module there were no irregularities shown within the results. Please review attachments A thru D for data on the following:

Attachment A – Summary of Peak, Minimum & Average Flows (Table 1)

Attachment B – Manhole Street View Photo

Attachment C – Flow Rate Graph

Attachment D – Flow Level Graph

Attachment E – Flow Velocity Graph

Attachment F – Data Points for Flow Rate, Flow Level & Velocity

<u>Attachment 'A'</u> - Station 4 (42-inch line)

Summary of Peak, Minimum & Average Flows

Table 1

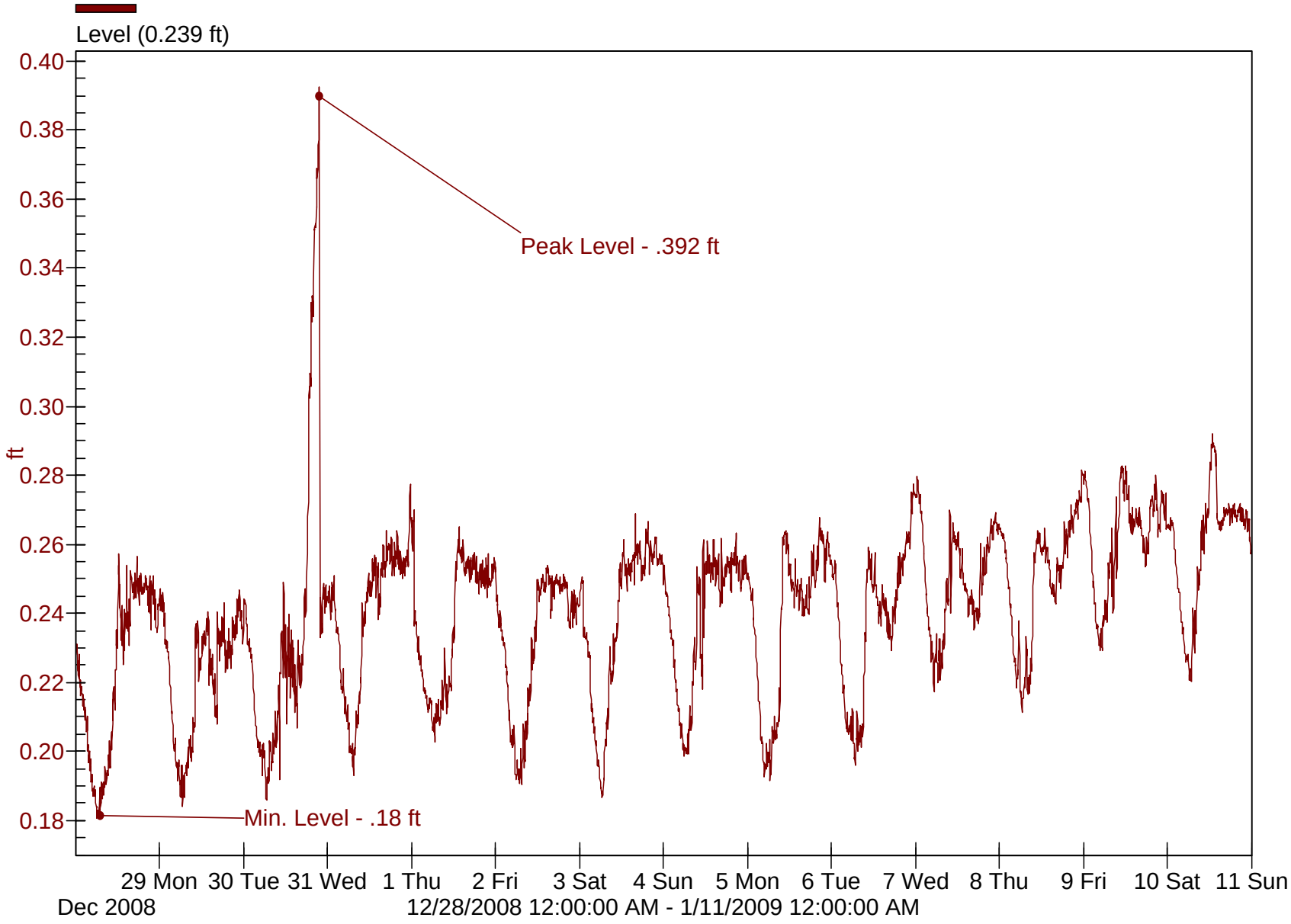
	Level	**Velocity**	**Flow Rate**
Peak	.392 ft	2.45 ft/s	490 gpm
Minimum	.180 ft	.7 ft/s	80 gpm
Average	.239 ft	1.67 ft/s	220 gpm

Attachment 'B'

Manhole Street View: Station 4 – (42" Diameter) Facing West

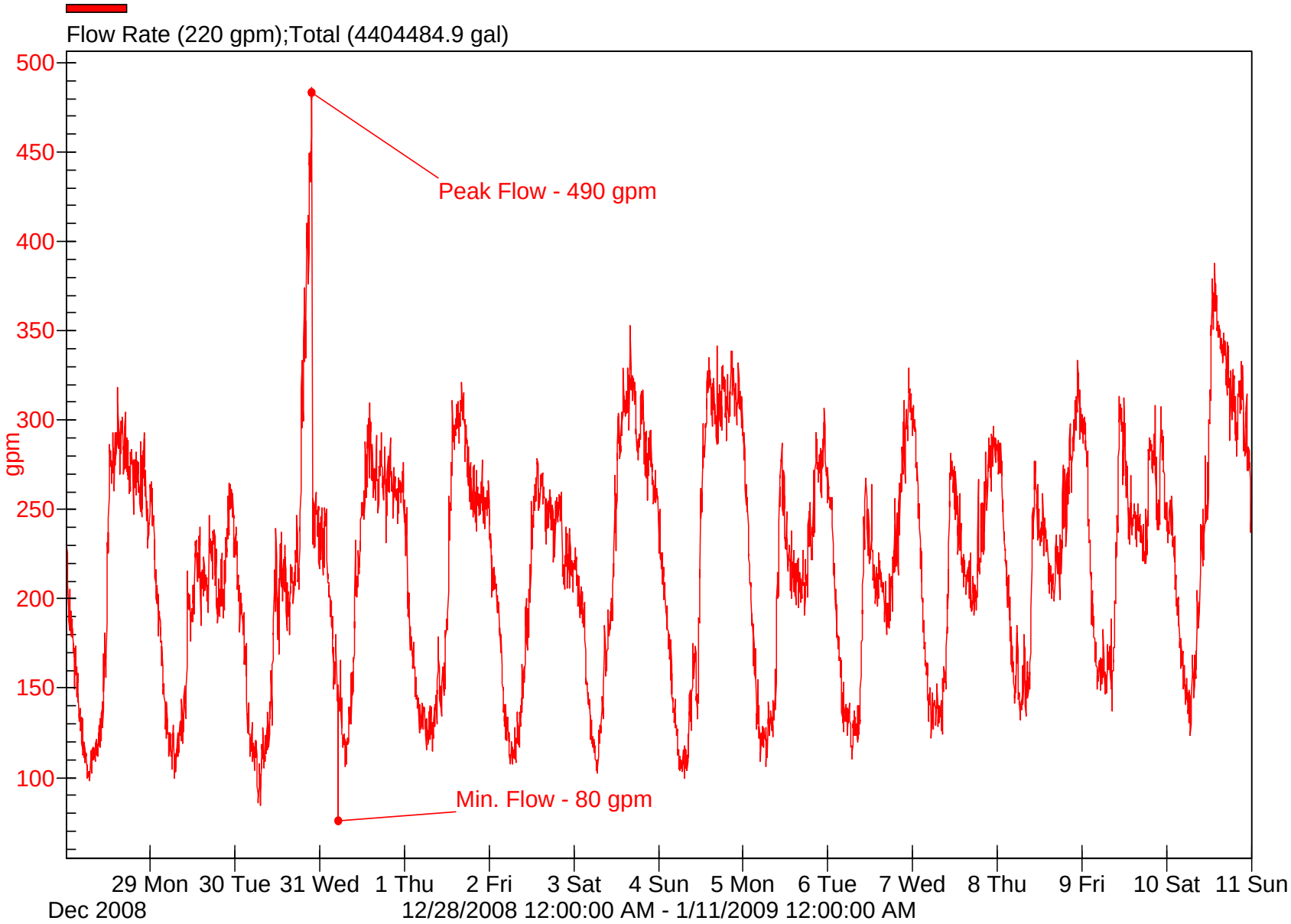
Station 4 - 1st Ave and Irwin- 42 in.

Flow Level Graph - From 12/28/2008 to 1/11/2009 - Attachment 'D'



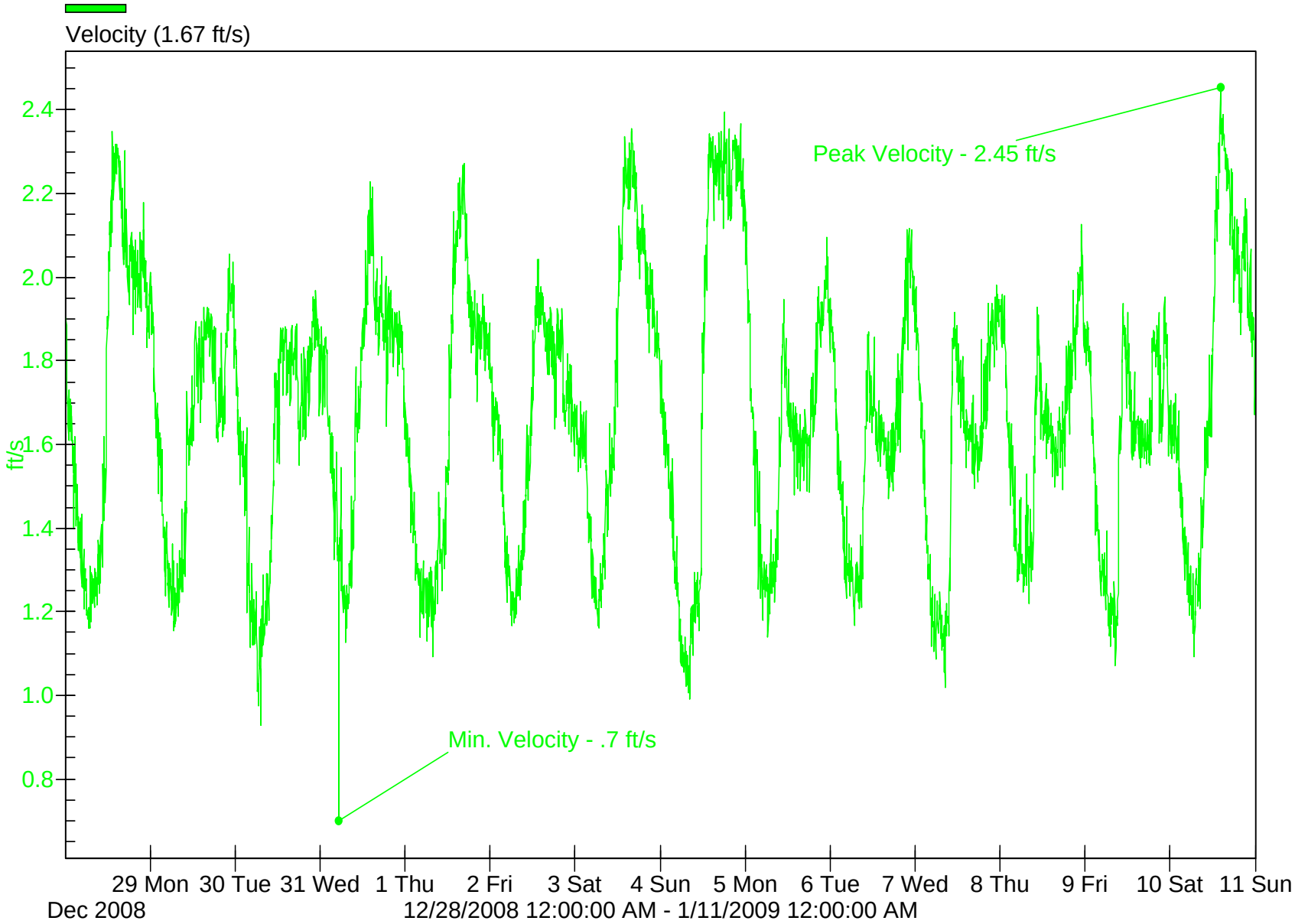
Station 4 - 1st Ave and Irwin- 42 in.

Flow Rate Graph - from 12/28/2008 to 1/11/2009 - Attachment 'C'



Station 4 - 1st Ave and Irwin- 42 in.

Flow Velocity Graph - From 12/28/2008 to 1/11/2009 - Attachment 'E'



APPENDIX D

Computer Model Facility Attributes

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APPENDIX D
COMPUTER MODEL FACILITY ATTRIBUTES

This section describes the attributes and fields used in the water and wastewater models. This is given as a reference for updating and maintaining the model. Table D-1 describes the model attributes that apply to the water and wastewater model facilities. Attributes unique to each type of facility are described in the following sub-sections. Model fields that were not used for this project are not described.

Table D-1. Model Facility Attributes

Attribute	Value
ID	ID numbering is alphanumeric, with a prefix and a unique identifier as shown in the individual attribute tables below.
Description	For some facilities, this text field has a description of the facility, such as a tank name.
Zone	For the water model only, pressure zone of the facility based on the pressure zone boundaries.
Development	Text field used to identify in which development the facility is located. This field includes existing (e.g. Sundance) and future developments. For future growth areas that are not within a planned development, a generic identifier of "Future" was used.
Installation Year	This attribute is used to include future facilities in model scenarios based on the year for which they are planned. Installation year information was not available for the existing model facilities, so a generic value of 2008 was used for those facilities. Future system facilities were assigned the year by which they should be implemented. For facilities not within the model area or not being modeled, an installation year of 0 was assigned to exclude them from the model calculations.
Retirement Year	This attribute is used to exclude facilities from a model scenario based on the year that they are proposed to be abandoned. The retirement year was set to a default of 9999. Facilities that are abandoned in future scenarios were given the appropriate retirement year.
Existing	Field to flag facilities as Existing if they came from the Town's GIS data.

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Water Model Facilities

This section describes attributes related to the water model facilities.

Water Model Junctions

Table D-2 lists the model attributes used for junctions.

Table D-2. Junction Attributes

Attribute	Value		
ID	*Facility* J (Junction) JH (Hydrant Junction) J-FUT (Future junction)	*Unique Identifier* 1, 2, …	*Sample ID* J-1, J-2, … JH-1, JH-2, … J-FUT-1, J-FUT-2, …
Elevation	Elevations were interpolated from a 2-foot line contour layer provided by the Town, which covered much of the central part of the Town. For the areas outside of the 2-foot contour layer, elevations were interpolated from the National Elevation Dataset (NED), elevation data produced by the USGS. The NED data consists of a grid of points every 10 meters.		
DMND_JCT	Yes/No – Specifies which junctions are used for demand allocation. Most junction were set to Yes, but junctions at pumps or tanks or on transmission mains were set to No.		
FHID_NO	The Fire Hydrant ID from the Town's GIS if the junction represents a fire hydrant.		
Demand1	*Scenario*	*Description*	
	Calibration Scenarios	Demand at time of calibration test	
	2008_MAXDAY	Existing maximum day demands	
	2010_MAXDAY	2010 future maximum day demands	
	Buildout_MAXDAY	Buildout maximum day demands	
Pattern1	The MAXDAY_2008 pattern was used for the 2007-2008, 2010, and Buildout Max Day extended period simulations. The calibration scenarios were steady state scenarios and did not require a pattern.		

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Water Model Pipes

Table D-3 lists the model attributes used for pipes.

Table D-3. Pipe Attributes

Attribute	Value		
ID	*Facility* P (Pipe) P-FUT (Future Pipe)	*Unique Identifier* 1, 2, …	*Sample ID* P-1, P-2, … P-FUT-1, P-FUT-2, …
Length	Pipe length calculated by model based on GIS length of pipe.		
Diameter	Pipe diameter for the GIS data provided for the existing system and in the developer master plans for the futures planning areas.		
Roughness (Hazen-Williams C Factor)	The model uses the Hazen-Williams equation to determine friction-related headloss. Lower factors equate to higher headloss. The roughness factor (C-Factor) used in the equation was assumed for each pipe based on pipe material as shown below. If the material was unknown, a generic C-Factor value was assumed. Future piping is assumed to be Ductile Iron based on discussions with the Town.		
	Pipe Material Asbestos Cement Cast Iron, Lined Ductile Iron Polyvinyl Chloride/HDPE Steel Unknown	*C Factor* 140 130 130 140 130 130	*Reference* [2, Linsley]
Material	Pipe material was available for some existing pipes from the GIS data.		
Check Valve	This field was set to Yes for pipes that are used as check valves to limit flow direction.		
Abandoned	This field was set to Yes for existing pipes that were labeled as Abandoned in the GIS.		
Fixed_Diam	The pipe size if available from GIS for existing pipes and from development plans for future pipes.		
Pipe_Size	Field from the GIS.		

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Water Model Tanks

Table D-4 lists the model attributes used for tanks.

Table D-4. Tank Attributes			
Attribute	Value		
ID	*Facility* T (Tank) T-FUT (Future Tank)	*Sample Tank Name* SUN-1 ZONE1-1	*Sample ID* T-SUN-1 T-FUT-ZONE1-1
Type	Tanks can be set as Cylindrical or Fixed Head Reservoirs. Tanks were modeled as Fixed Head Reservoirs because supply is not modeled and there is assumed to be sufficient supply to keep the tanks full. This works because the tanks are pumped storage. If a tank is modeled as floating on the system (on elevated ground), it will be necessary to model the tank as Cylindrical to allow the tank level to change with the changing system HGL.		
Elevation	For Fixed Head Reservoirs, the water elevation (tank floor elevation plus average depth of water). For Cylindrical tanks, the tank floor elevation.		
Initial Level	For Cylindrical tanks, the depth of water for the start of the model run.		
Maximum Level	For Cylindrical tanks, the highest water depth possible in the tank, usually the overflow depth.		
Diameter	For Cylindrical tanks, the tank diameter.		

Water Model Wells

Table D-5 lists the model attributes used for wells.

Table D-5. Tank Attributes			
Attribute	Value		
ID	*Facility* W (Well) W-FUT (Future Well)	*Sample Well Name* OLD-14 WESTBUCK-01	*Sample ID* W-OLD-14 W-FUT-WESTBUCK-01
Type	Wells were modeled as a Fixed Head Reservoir with a pump downstream.		
Elevation	The water elevation (not depth) of the groundwater. For existing wells, this value was calculated from data supplied by the Town.		

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Water Model Pumps

Table D-6 lists the model attributes used for pumps.

Table D-6. Pump Attributes			
Attribute	Value		
ID	*Facility* PMP (Pump) PMP-FUT (Future Pump)	*Sample Pump Name* OLD-1 WESTBUCK-01	*Sample ID* PMP-OLD-1 PMP-FUT-WESTBUCK-01
Type	For existing pumps where a pump curve was available, the type was set to Multiple Point Curve, which allows pump curves to be entered into the model. For other existing and future pumps, the type was set to Design Point Curve, which only requires a design flow and design head.		
Curve	The pump curve for pumps set to use the Multiple Point Curve option.		
Design Head	Pump design head.		
Design Flow	Pump design flow.		

Water Model Valves

Table D-7 lists the model attributes used for valves.

Table D-7. Valve Attributes			
Attribute	Value		
ID	*Facility* PRV, PRV-FUT (Pressure reducing valve) VFD, VFD-FUT (Variable frequency drive) FCV, FCV-FUT (Flow control valve)	*Sample Valve Name* SUN-WATSON-1 WESTBUCK-01 WESTBUCK-01	*Sample ID* PRV-SUN-WATSON-1 VFD-FUT-WESTBUCK-01 FCV-FUT-WESTBUCK-01
Type	The type was set to Pressure Reducing Valve for PRVs and also for PRVs which were added to the discharge side of pumps to model VFDs. The type was set to Flow Control Valve for FCVs.		
Diameter	Valve diameter if available from the Town or developer master plans, otherwise the default value of 12-inches was used. This value is not important to the model.		
Setting	PRV and VFD pressure setting or FCV flow setting based on information from the Town.		

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Wastewater Model Facilities

This section describes attributes related to the wastewater model facilities.

Wastewater Model Manholes

Table D-8 lists the model attributes used for manholes.

Table D-8. Manhole Attributes

Attribute	Value		
ID	*Facility* MH OFFALL	*Unique Identifier* 1, 2, …	*Sample ID* MH-1, MH-2, … OFALL-1, OFALL-2, …
Type	Manholes were set to be the Loading type, which means they can have a load/flow added. Outfalls at WWTPs were set to be the Outlet type. Nodes connecting a wet well and pump were set to the Chamber type.		
Elevation/Rim Elevation	The Elevation and Rim Elevation fields were set to be equal to the ground elevation. Elevations were interpolated from a 2-foot line contour layer provided by the Town, which covered much of the central part of the Town. For the areas outside of the 2-foot contour layer, elevations were interpolated from the National Elevation Dataset (NED), elevation data produced by the USGS. The NED data consists of a grid of points every 10 meters.		
Fixed_Elev	The ground elevation when available from GIS for existing manholes and from development plans for future manholes. If available, this value was used instead of the interpolated elevation values.		
Topo_Elev	The elevation interpolated from the Town's 2-foot contour layer.		
NED_Elev	The elevation interpolated from the NED contour layer.		
Diameter	The diameter of the manhole. This value is used to calculate storage at manholes. A default value of 4-feet was used.		
Load1	*Scenario*	*Description*	
	2008_MAXDAY	Existing average daily dry weather flow/load	
	2010_MAXDAY	2010 future average daily dry weather flow/load	
	Buildout_MAXDAY	Buildout average daily dry weather flow/load	
Type1	Set to Peakable Base. With this option, the model peaks the Load1 average daily dry weather flow using a peaking curve.		
Pattern1	The model is steady state so this field is not used.		
Coverage1	The model is steady state so this field is not used.		

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Wastewater Model Pipes

Table D-9 lists the model attributes used for manholes.

Table D-9. Pipe Attributes			
Attribute	Value		
ID	*Facility* P	*Unique Identifier* 1, 2, …	*Sample ID* P-1, P-2, …
Type	This field defaults to Gravity Main for most pipes and was set to Force Main for force mains.		
Length	Pipe length calculated by model based on GIS length of pipe.		
Diameter	Pipe diameter for the GIS data provided for the existing system and in the developer master plans for the futures planning areas.		
Material	Pipe material was available for some existing pipes from the GIS data.		
From Invert	The upstream invert elevation of the pipe.		
To Invert	The downstream invert elevation of the pipe.		
USINTERP	Upstream invert elevation interpolated from neighboring pipes for some existing pipes.		
DSINTERP	Downstream invert elevation interpolated from neighboring pipes for some existing pipes.		
FIXEDUSINV	The upstream invert elevation if available from GIS for existing pipes and from development plans for future pipes.		
FIXEDDSINV	The downstream invert elevation if available from GIS for existing pipes and from development plans for future pipes.		
FIXEDDIAM	The pipe size if available from GIS for existing pipes and from development plans for future pipes.		

Wastewater Model Lift Stations

Table D-10 lists the model attributes used for pumps at lift stations.

Table D-10. Lift Station Attributes			
Attribute	Value		
ID	*Facility* PU	*Unique Identifier* 1, 2, …	*Sample ID* PU-1, PU-2, …
Type	Because the only pumps modeled in the wastewater model are for future conditions, the pump type was set to Constant Capacity rather than using another option with a design point or pump curve. Because a head is not entered for a Constant Capacity pump, the model calculates the required head at this capacity.		
Capacity	The capacity of the pump.		

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Wastewater Model Wet Wells

Table D-11 lists the model attributes used for wet wells.

Table D-11. Wet Well Attributes			
Attribute	Value		
ID	*Facility* WW	*Unique Identifier* 1, 2, …	*Sample ID* WW-1, WW-2, …
Type	The shape of the wet well. The Cylindrical option was used in the model.		
Bottom Elevation	The bottom elevation of the wet well.		
Minimum Level	The level at which a pump will turn off. Because the model is steady state, this value is not used and was set to a default value of 1.		
Maximum Level	The level at which a pump will turn on. Because the model is steady state, this value is not used and was set to a default value of 10.		
Initial Level	The water level in a wet well at the beginning of a model run. Because the model is steady state, this value is not used and was set to a default value of 5.		
Diameter	Wet well diameter.		

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APPENDIX E

Calibration Testing Plan

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Technical Memorandum

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Prepared for: Town of Buckeye

Project Title: Integrated Water Resources Plan

Project No: 135867

Technical Memorandum – Calibration Testing Plan

Subject: Calibration Testing Plan

Date: September 25, 2008

To: Ryan Nielsen, Town of Buckeye

From: Tiffany Ashforth, Andrew Fugal; Brown and Caldwell

Limitations:

This document was prepared solely for the Town of Buckeye in accordance with professional standards at the time the services were performed and in accordance with the contract between the Town of Buckeye and Brown and Caldwell. This document is governed by the specific scope of work authorized by the Town of Buckeye; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the Town of Buckeye and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

1. INTRODUCTION

This technical memorandum (TM) describes the calibration field testing for the Historic Buckeye and Sundance areas. This TM discusses the required personnel and equipment for testing, the collection of SCADA information, and testing procedures and locations for the fire flow tests. The fire flow tests are not the same as hydrant tests performed to determine available flow from a hydrant. These flow tests are done to "stress" the distribution system so that the calibration data will reflect the system's reactions to a range of operating conditions.

2. PERSONNEL AND EQUIPMENT

Two representatives from Brown and Caldwell (BC) will be present to coordinate the calibration testing and to help collect and record test data. At least one staff member from Buckeye will escort BC staff, will assist with data collection, and will operate hydrants. The Town will be responsible for providing a vehicle to transport staff and equipment to each test location. The testing is expected to take up to 2 days.

Table 2-2 lists the equipment needed for the calibration testing. Equipment will be checked prior to the day of testing to verify that it is functional and/or accurate.

Table 2-2. Calibration Testing Equipment

Item	Number	Provided By
Hydrant Wrench	1	Buckeye
Valve Wrench (if any valves need to be opened)	1	Buckeye
Hydrant Flow Diffuser	2	BC
Crescent Wrenches	2	BC
Digital Camera	1	BC
Watch (Synchronized to District's SCADA and to Personnel Collecting Data by Hand)	1	BC
Calibrated 100 psi Pressure Gauge	2	BC
Calibrated 200 psi Pressure Gauge	2	BC

3. COLLECTION OF SCADA DATA

SCADA data will be collected for the days of field testing for the Sundance area. The data should be provided in an electronic format for the shortest time step available (e.g. every 5 minutes). The following data will be collected from the SCADA:

- Pump discharge flow rate, and suction and discharge pressure (if available)
- Well status and flows
- Tank water levels

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4. FLOW TEST PROCEDURES

The fire flow tests consist of attaching a flow diffuser to a hydrant (flow hydrant) and flowing the hydrant. A pressure gage is attached to a neighboring hydrant (residual hydrant) and the system pressure is recorded before, during, and after flowing the flow hydrant. For the tests, all data and comments should be recorded on the forms provided by BC. During the testing period, any valves in the system that are known or suspected to be closed as well as any pipe breaks or other water system emergency should be reported to a BC representative. The detailed procedures include:

Step 1 - Locate the pressure and flow hydrants. Hydrant flows may cause flooding or erosion damage. Check the area around the hydrants prior to running the test to ensure that each location is suitable.

Step 2 - Set up one pressure gage at the residual hydrant (remove cap from 2-1/2 inch nozzle and open hydrant valve to flush barrel before attaching pressure gauge).

Step 3 - Record the static pressure at residual hydrant and the time of the test.

Step 4 - Set up the hydrant diffuser at the flow hydrant (flush the hydrant prior to installing the diffuser to clear debris that could damage the diffuser or interfere with the test).

Step 5 - By radio or hand signal, the test coordinator instructs the person operating the flow hydrant to start flowing the hydrant. The hydrant is opened until a minimum 5 psi pressure drop is observed at the residual test site hydrant. If a sufficient pressure drop cannot be obtained, add an additional diffuser to the flow hydrant and repeat this step.

Step 6 - When the pressure at the residual hydrant stabilizes (usually three to five minutes), the coordinator calls for and records the flow from the flow hydrant and records the pressure at the residual hydrant. The time of the reading is recorded. It is also important to record the location of each hydrant.

Step 7 - The coordinator instructs the flow hydrants to be closed. It is **VERY IMPORTANT** that the hydrants be closed **SLOWLY** (over about a one minute period) to prevent potential damage to pipes caused by water hammer.

Step 8 - The coordinator again records the static pressure at the residual hydrant.

Step 9 - The test is concluded. Remove the equipment. Move to the next site and perform the next test (Steps 2-8).

5. TEST LOCATIONS

The attached figures show the fire flow test locations.

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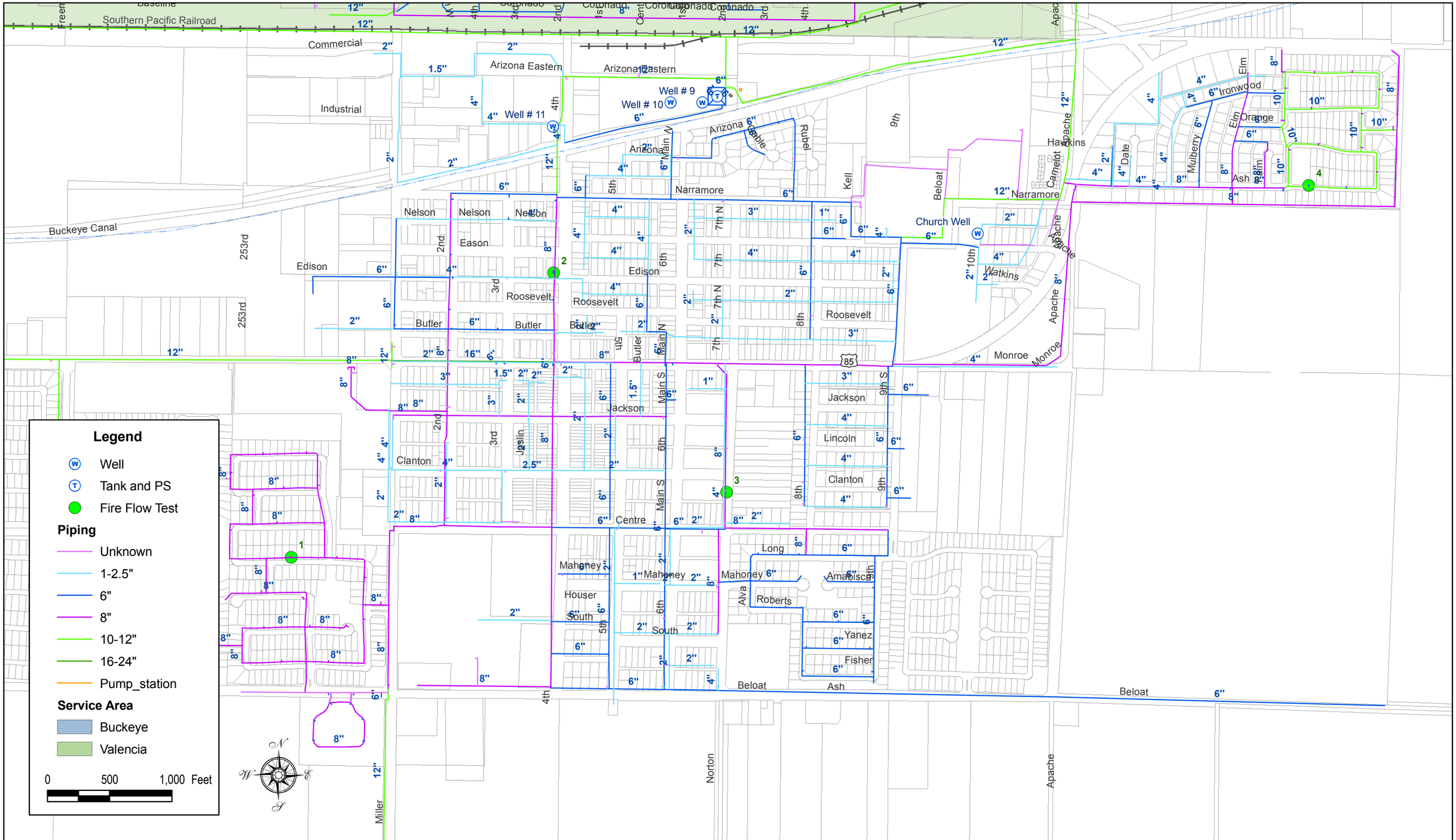
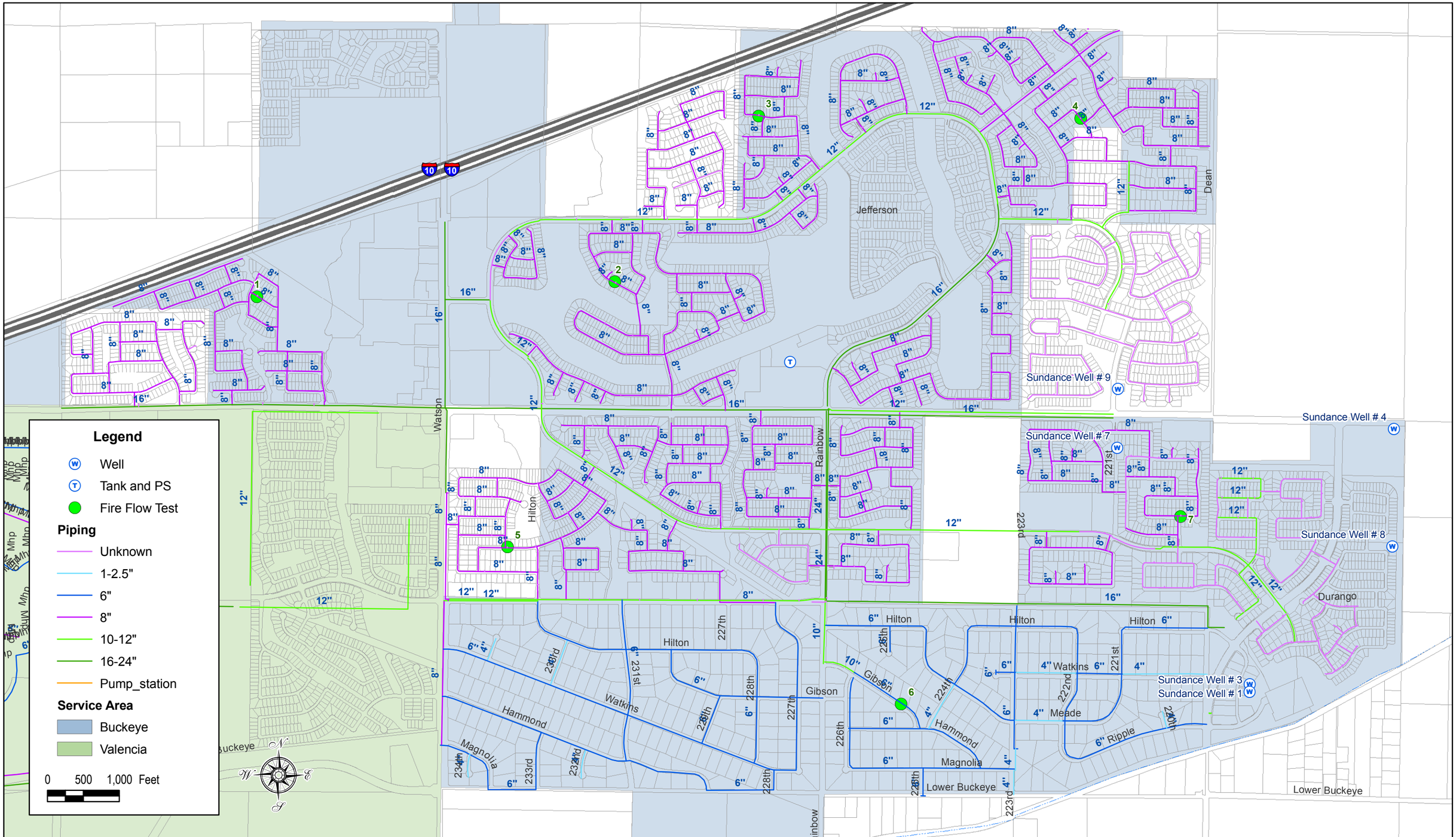


BROWN AND CALDWELL

BUCKEYE WATER SYSTEM MASTER PLAN

Calibration Plan - Historic Buckeye



BROWN AND CALDWELL

BUCKEYE WATER SYSTEM MASTER PLAN

Calibration Plan - Sundance

APPENDIX F

Electronic Database for Volumes I and II of the Integrated Water Resources Plan (Provided on CD)