

City of Prescott

2017 Water and Wastewater Models

# TECHNICAL MEMORANDUM 2 - FIVE TO FIFTEEN YEAR CAPITAL IMPROVEMENT PROGRAM AND INFRASTRUCTURE IMPROVEMENT PLAN

FINAL | November 2018





City of Prescott  
2017 Water and Wastewater Models  
TECHNICAL MEMORANDUM 2

## Abbreviations

%	percent
2013 Study	2013 Water and Wastewater Models Study
A.A.C.	Arizona Administrative Code
A.A.C.E.	Association for the Advancement of Cost Engineers
AADF	average annual daily wastewater flows
ADOA	Arizona Department of Administration
CIP	Capital Improvement Program
CVID	Chino Valley Irrigation District
d/D	depth over diameter
fps	feet per second
ft	feet
ft/ft	feet per foot
gpm	gallons per minute
IBC	International Building Code
IFC	International Fire Code
IIP	Infrastructure Improvement Plan
in	inch
MDWWF	maximum daily wet weather flows
MG	million gallons
mgd	million gallons per day
PCC	Prescott City Code
PRV	pressure reducing valve
psi	pounds per square inch
PVC	polyvinyl chloride
TM <sub>1</sub>	Technical Memorandum 1
WRF	water reclamation facility
WRP	water reclamation plant
WWTP	wastewater treatment plant
YPIT	Yavapai-Prescott Indian Tribe
YRMC	Yavapai Regional Medical Center

## Technical Memorandum 2

# FIVE TO FIFTEEN YEAR IIP

This technical memorandum presents the proposed water and wastewater projects and recommendations associated with the City's Infrastructure Improvement Plan (IIP). The IIP includes projects that are required to serve growth areas.

Infrastructure recommendations are based on the hydraulic modeling results of the water and wastewater systems and related analyses.

This document includes the following:

**Section 1 – Planning Framework** – identifies the population growth assumptions, water demands, and wastewater flows that form the basis of the capacity analyses.

**Section 2 – Water System Evaluation** – describes the existing water system, summarizes the performance criteria or standards of measurement used in the infrastructure evaluations, and presents the results of the supply, storage, booster pumping, and distribution system analyses.

**Section 3 – Wastewater System Evaluation** – describes the existing wastewater system, summarizes the performance criteria or standards of measurement used in the infrastructure evaluations, and presents the results of the pipe and lift station capacity analyses.

**Section 4 – Costs and Project Timing** – presents the costing methodology, water and wastewater project summaries, and timing of projects.

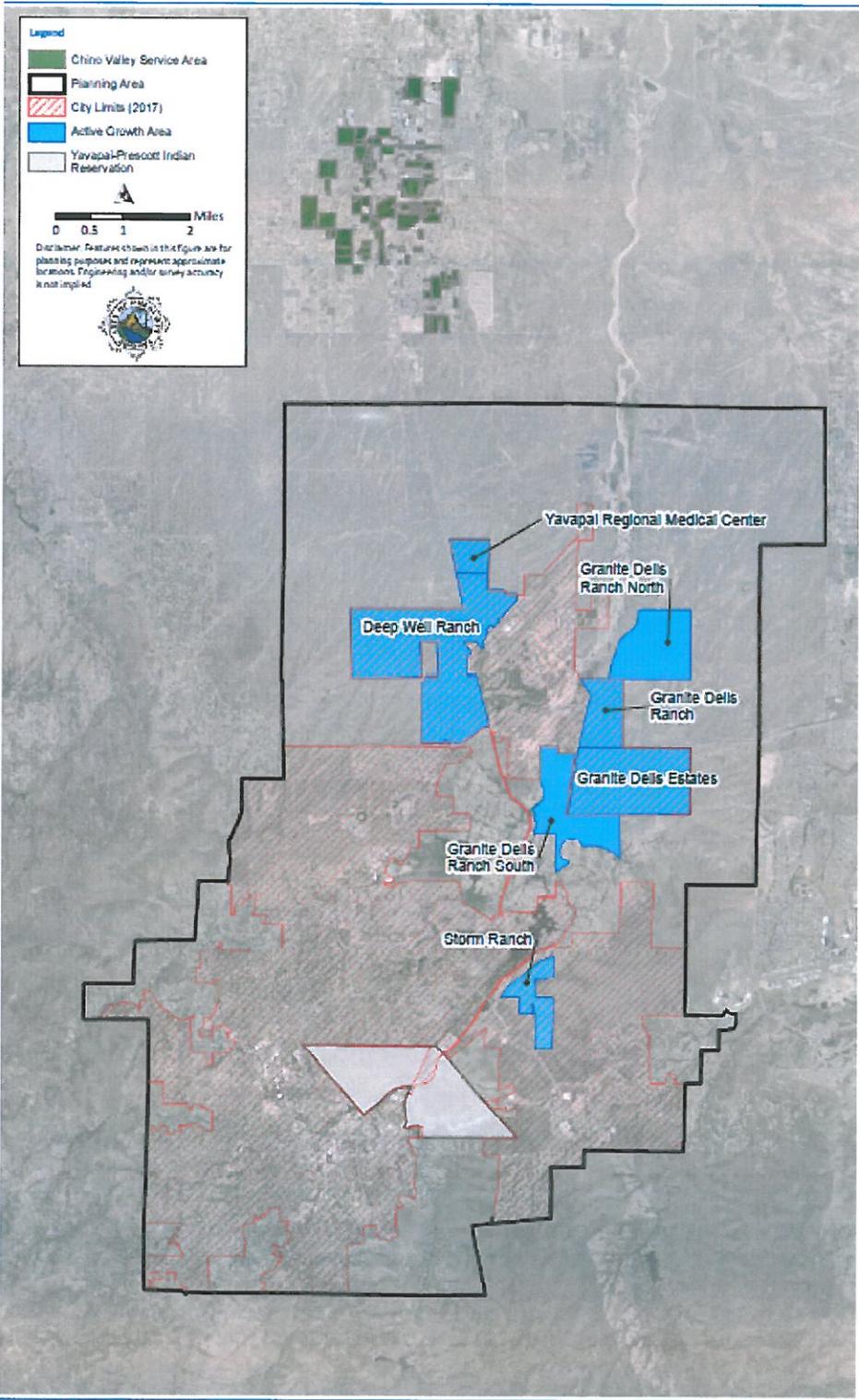
## Section 1 – Planning Framework

### 1.1 Study Area

The study area includes the City's Planning Area as illustrated in Figure 3.1, which includes the Chino Valley Irrigation District (CVID) and Yavapai-Prescott Indian Tribe (YPIT) reservation. There is growth projected in City's planning areas over the next fifteen years within the incorporated City limits and the unincorporated areas adjacent to the City. The City identified seven growth areas that are likely to develop in the next 5 to 15 years, including:

- Deep Well Ranch
- The Yavapai Regional Medical Center (YRMC), part of Deep Well Ranch
- Storm Ranch
- Granite Dells Estates
- Granite Dells Ranch – Commercial
- Granite Dells Ranch – North (outside 2017 incorporated limit)
- Granite Dells Ranch – South (outside 2017 incorporated limit)

Figure 3.1 Study Area



The timing of development in each of these growth areas was estimated using input from the City. All areas except the Granite Dells Ranch – North and South growth areas are expected to develop within the next 5 to 15 years. Table 3.1 summarizes the amount of growth expected in each planning year expressed as a percentage of the total development for the growth area.

Table 3.1 Anticipated Development Percentage in Growth Areas

Growth Area	Planning Year			
	2017	2022	2027	2032
Deep Well Ranch	0%	15%	30%	50%
YRMC	0%	0%	0%	30%
Storm Ranch	0%	30%	60%	100%
Granite Dells Estates	30%	60%	75%	90%
Granite Dells Ranch – Commercial	0%	30%	50%	80%
Granite Dells Ranch – North	0%	0%	0%	10%
Granite Dells Ranch – South	0%	10%	30%	50%

## 1.2 Population, Water Demand, and Wastewater Flow Projections

The City provided the following planning data to support the development of growth projections over the next 15 years:

- Historical population and housing trends
- Water production and billing records
- Wastewater flow records
- Land use and zoning classifications

This information was used to establish baseline (year 2017) water use and wastewater generation rates and to project water demands and wastewater flows for years 2022, 2027 and 2032. The methodology used to develop these projections is consistent with the approach taken in the City's 2013 Water and Wastewater Models Study (2013 Study) .

### 1.2.1 Population Growth Summary

The growth projections from the 2013 Study for years 2017 through 2030 were compared to the Arizona Department of Administration (ADOA) Office of Employment and Population Statistics for years 2016 through 2050. The ADOA growth projections trended significantly lower than the 2013 Study with a projected year 2030 population of 42,300 compared to the 2013 Study projection of 52,500. To address this difference, Prescott's actual residential (single and multi-family) permit activity for years 2015 through 2017 was used to estimate that 300 new residential permits would be added each year through year 2037. Population estimates were then calculated assuming 1.6 people per home, which is the same figure used in the 2013 Study. Appendix A contains a graph that shows the population trends from the 2013 study, the ADOA 2016-2050 projections, and the projections for the 5- to 15-year IIP.

Table 3.2 summarizes the population and housing permit projections for the 5- to 15-year IIP.

Table 3.2 Prescott Population and Housing Permit Forecast

Year	Population <sup>(1)</sup>	Change in Population <sup>(2)</sup>	Percent Population Change (%)	New Housing Units (No)
2016	42,500	509	1.21	318
2017	42,999	499	1.17	312
2018	43,479	480	1.12	300
2019	43,959	480	1.10	300
2020	44,439	480	1.09	300
2021	44,919	480	1.08	300
2022	45,399	480	1.07	300
2023	45,879	480	1.06	300
2024	46,359	480	1.05	300
2025	46,839	480	1.04	300
2026	47,319	480	1.02	300
2027	47,799	480	1.01	300
2028	48,279	480	1.00	300
2029	48,759	480	0.99	300
2030	49,239	480	0.98	300
2031	49,719	480	0.97	300
2032	50,199	480	0.97	300

Notes:

(1) Year 2016 population provided by City.

(2) Year 2017 population growth calculated as: number of new housing units x 1.6 people per home (312 x 1.6 = 499). Years 2018 through 2032 population growth assumes 300 units added per year times 1.6 people per home.

### 1.2.2 Water Demand Summary

Average daily water demands were developed for each 5-year planning period over the next 15 years. Maximum day demands were estimated using a peaking factor of 1.8 (maximum day to average daily demand), which was developed using year 2012 through 2016 water production records. Peak hour demands were estimated using a peaking factor of 3.24 (peak hour to average daily demand), which is consistent with the value the City used in the 2013 Study.

A summary of the water demands for the 5- to 15-year IIP is presented in Table 3.3.

Table 3.3 Water Demand Projection Summary

Planning Year	Water Demand (mgd) <sup>(1)</sup>		
	Average Daily	Maximum Daily <sup>(2)</sup>	Peak Hour <sup>(3)</sup>
2017	5.9	10.7	19.2
2022	6.7	12.0	21.6
2027	7.5	13.4	24.2
2032	8.4	15.0	27.1

Notes:

(1) Values include non-revenue water (8.5% of water production)

(2) Maximum daily to average daily demand peaking factor: 1.8

(3) Peak hour to average daily demand peaking factor: 3.24

Abbreviation:

mgd = million gallons per day

### 1.2.3 Wastewater Flow Summary

Average annual daily wastewater flows (AADF) were developed for each 5-year planning period over the next 15 years. Maximum daily wet weather flows (MDWWF) were estimated using the methodology established in the 2007 Wastewater Collection Model Study and carried forward to the 2013 Study. The City has two wastewater service areas. The Sundog service area sends flow to the Sundog Wastewater Treatment Plant (WWTP) and the Airport service area sends flow to the Airport Water Reclamation Facility (WRF). The City is consolidating these two service areas into one and will eventually send all wastewater flows to the Airport WRF.

A summary of the wastewater flows for the 5- to 15-year IIP by wastewater service area is presented in Table 3.4.

Table 3.4 Wastewater Flow Projection Summary

Planning Year	Wastewater Flow (mgd)					
	Airport AADF	Airport Peak <sup>(1)</sup>	Sundog AADF	Sundog Peak <sup>(1)</sup>	Prescott AADF	Prescott Peak <sup>(1)</sup>
2017	1.7	3.0	2.5	9.3	4.2	12.3
2022	1.9	3.2	2.8	9.6	4.7	12.8
2027	2.1	3.4	3.1	9.9	5.3	13.3
2032	2.4	3.7	3.4	10.2	5.8	13.9

Notes:

- (1) Maximum day wet weather values included in Airport, Sundog and Prescott totals. For the Airport service area a wet weather flow of 1.3 mgd was added to the average annual daily flow, and for the Sundog service area a wet weather flow of 6.8 mgd was added to the average annual daily flow. These values were determined through inflow and infiltration analyses conducted as part of the 2007 Wastewater Collection Model Study.

## Section 2 – Water System Evaluation

### 2.1 Water System Description

The City of Prescott's water distribution system contains over 500 miles of distribution mains, approximately 37 miles of transmission mains that deliver water from five production wells in Chino Valley, two production wells in the Prescott Airport Area, 25 storage tanks, 38 booster pump stations, 72 pressure reducing valve (PRV) stations and is currently divided into 82 pressure zones.

The City's water distribution system hydraulic model was used in this analysis. This model was updated and validated as part of the 2017 Water and Wastewater Models Study (2017 Model Study).

## 2.2 Performance Criteria

### 2.2.1 Background

Performance criteria are the standards of measurement used to evaluate the adequacy of water system infrastructure including supply, storage, booster pumping, and distribution system capacity. Performance criteria are based on legal requirements and engineering best practices. The criteria in this document have been reviewed with City staff and represent the level of service the City strives to provide to its customers. The water system performance criteria have not changed since the 2013 Study.

According to the Arizona Administrative Code (A.A.C.), public water systems shall be designed using good engineering practice (A.A.C. R-18-5-502). The City's water system performance criteria includes standards from the A.A.C., Engineering Bulletin No. 10 (issued by the Arizona Department of Health Services, May 1978), water industry best practices, and criteria established in the 2004 Water Distribution Model Study and 2013 Study using data collected by the City. The City's water system performance criteria are considered good engineering practice and provide acceptable levels of water system performance and reliability.

### 2.2.2 Water System Components

The City's water system consists of the following components:

- Groundwater wells in the Chino Valley well field and Airport Area wells
- Power sources
- PRV stations
- Booster pump stations
- Storage tanks
- Transmission and distribution mains

The function of these water system components and their associated performance criteria is discussed in the following sections.

### 2.2.3 Basis of Criteria

The acceptable level of service expected from the water system is defined by the adequacy and reliability of the water supply delivered to the customer. A reasonable level of service usually includes the provision for adequate system pressure, fire protection, and supply reliability.

Therefore, water system performance criteria address the following areas:

- **Water Supply Redundancy:** a level of service such that water supplies can be delivered into the distribution system from more than one source.
- **Water System Reliability:** a level of service such that the distribution system infrastructure can deliver water to as many areas as possible even when a key facility is not in service.
- **System Operational Requirements:** a level of service such that water can be delivered reliably under fire flow, maximum day demand, and peak hour demand conditions.

### 2.2.3.1 Water Supply Redundancy

Water supply redundancy refers to the degree to which water can be supplied to the City's customers in the event that one or more of the water supply sources is unavailable. Decisions about the extent of redundancy are often policy decisions influenced by the price a utility is willing to pay for redundancy compared to the risk of having to implement water use restrictions or provide a lower level of service to the customer if a water supply source is unavailable. Under some conditions, it may be more economical for the City to implement water demand management or conservation measures rather than build infrastructure that will be used infrequently in response to water source availability.

Although no firm guidelines exist, many communities seek to provide redundant or backup water supplies for average day demand conditions because the average day demand provides sufficient water for public health and safety.

### 2.2.3.2 Water System Reliability

The City's water system reliability is dependent on the reliability of all the components within the system and the reliability of the energy sources that supply the pump stations and wells. The level of reliability provided is usually based on historic operational experience and judgment, which results in confidence that the system can deliver water under a variety of normal and emergency conditions. Consequently, professional judgment must be used when specifying system components and the number and location of components needed to meet reliability criteria.

Reliability of the City's water system is provided by a combination of the following factors:

- Sufficient water sources to meet maximum day demand,
- Reserve system storage to meet emergency conditions, in addition to fire and normal operational needs,
- Transmission capacity to deliver water to the distribution system,
- Looped transmission and distribution system networks,
- Sufficient booster pumping capabilities with a pump station or the largest pump in a pump station out of service, and
- Backup power supply for critical facilities

### 2.2.3.3 Water System Operational Requirements

System operational requirements provide for a defined level of service from the City to the customer. Levels of service include maximum and minimum pressures, maximum flow velocities, storage, redundancy, and provisions for emergency conditions. Adequate pressure is usually defined in terms of a minimum pressure under certain demand conditions, such as peak hour or fire flow. Adequate fire protection refers to providing adequate flow to meet firefighting demands. The water system is considered to be adequate when system demand conditions are satisfied while meeting system performance criteria, such as system pressure, velocity, and head loss.

### 2.2.4 Water Production Facilities

Production facilities for the water system should have sufficient capacity to meet the demands of the maximum day of the year.

State regulations regarding emergency operation plans require that municipalities be equipped to address emergency conditions, such as loss of a source of water supply. The City has provisions for emergency conditions codified in Prescott City Code (PCC) 3-10-11.

**2.2.5 Fire Flow**

Fire flow requirements are usually determined by the local fire department. The City has adopted the 2012 International Building Code (2012 IBC) and International Fire Code (2012 IFC), which specifies fire flow requirements for different types of building construction. The City may also consider establishing unique fire flow requirements of the wooded residential areas in parts of the City that are adjacent to the national forest (urban/wild land interface).

For one- and two-family dwellings, the 2012 IFC is specific for the minimum required fire flows as follows:

- < 3,600 square foot fire area: 1,000 gallons per minute (gpm) for 1 hour.
- ≥ 3,600 square foot fire area: refer to 2012 IFC Appendix B, Table B105.1.

Depending on the type of use, construction and fire area, the required fire flow and duration for fire areas greater than or equal to 3,600 square feet ranges from 1,500 gpm for 2 hours to 8,000 gpm for 4 hours.

Standard engineering practice is to assume that a major fire will not occur during the peak hour of the day, since the chance of this happening is minimal. It is more likely that a fire could occur under maximum day demand conditions. Consequently, this condition was used to evaluate water system infrastructure.

To assess the adequacy of the Prescott water system with respect to maximum day demand plus fire demand conditions, a land-use based approach was taken to assign fire flow requirements and durations as summarized in Table 3.5.

Table 3.5 Land Use Fire Flow Criteria

Type of Development (Land Use)	Fire Flow (gpm)	Duration (hours)
Single Family Residential 1 <sup>(1)</sup>	1,000	2
Single Family Residential 2 <sup>(2)</sup>	1,500	2
Multi-Family Residential	2,500	2
Commercial – Low Risk	2,500	3
Commercial – High Risk	4,000	4
Industrial – Low Risk	6,000	4
Industrial – High Risk	10,000	4

Notes:

(1) Residential area originally designed with fire flow standard less than 1,500 gpm.

(2) Residential area originally designed with fire flow standard of 1,500 gpm.

Some areas of the City were originally designed with a lower fire flow standard. In these parts of the City, the fire flow delivery capability is not raised to current standards arbitrarily, but may be raised on a case-by-case basis, driven by the economic viability of raising the standard.

### 2.2.6 Pump Stations

Pump stations are often the most critical components in a distribution system with respect to meeting reliability/redundancy criteria, because these facilities are subject to disruption by power outages, mechanical failures or line breaks.

Table 3.6 summarizes these conditions and the associated reliability criteria.

Table 3.6 **Booster Pump Station Reliability Criteria**

Condition	Result	Criteria
Power Outage	Creates loss of pumping capacity at one or more pumping facilities.	Provide emergency backup power supply or dual power feed to critical facilities.
Mechanical Failure	Creates loss of pumping capacity due to pumps, electrical controls or other components being out of service.	Produce sufficient pumping capacity to each booster pump station to meet maximum day demands with the largest pump out of service ("firm" capacity).
Line Break	Occurrences at or near the booster station, creates a loss of all or a portion of the pumping capacity of the facility.	Mitigate short-term (less than 24 hours) disruption in supply caused by a line break by providing multiple pumping facilities, storage, looped transmission/distribution lines, PRV stations throughout the system.

For line breaks affecting critical pumping facilities, reliability/redundancy criteria are established so that average day rather than maximum day demand conditions can be met in each pressure zone in the distribution system.

When pumping to a closed system with no other sources or elevated storage, a pump station should be sized for the larger of peak hour demand or maximum day demand plus fire flow demand conditions. Diurnal demands and fire demands will be supplied through the pumps. Pump stations should be designed based on the firm capacity that can be consistently provided with the largest pump out of service. In addition, pump stations that deliver water into higher pressure zones must be sized to meet the demands of both zones.

The booster pump station criteria are:

- When pumping to a closed system, the capacity equals the larger of peak hour demand or maximum day demand plus fire flow.
- The allowance for reliability and uncertainties in demand projections equals 10 percent.
- Booster pump stations should be sized to meet demands with the largest pump out of service (firm capacity) except when a single high capacity pump is required only for fire flow.
- When multiple booster pump stations supply a pressure zone, if the largest station is out of service, the remaining stations should be able to supply average day demands.

The firm capacity of booster pump stations that pump from tanks is often set so that half of the tank can be emptied in a six-hour period. These booster pump stations should also have a pumping capacity that exceeds the well capacity feeding the storage tank.

### 2.2.7 Transmission and Distribution Mains

Water system piping serve three basic purposes:

- To transfer water from the source of production to storage
- To provide a conduit for domestic water supply
- To provide a conduit for firefighting water

Water distribution mains should be looped and interconnected wherever possible so that in the event of a fire, a failure of a portion of the distribution system, or another emergency, there is more than one path for water to flow to supply customer demands and fire flows.

Transmission and distribution mains are sized for the greater of the following two demand conditions:

- Maximum day demand plus fire flow, or
- Peak hour demand.

The following pressure criteria are required for the distribution system:

- **Maximum Day Demand plus Fire Flow:** a minimum of 20 pounds per square inch (psi) at the point of maximum fire draft.
- **Peak Hour Demand:** a minimum service pressure of 40 psi.

The City's plumbing code (2012 International Plumbing Code) requires service line PRVs when distribution system pressures exceed 80 psi. Due to Prescott's topography and pressure zone elevation ranges, there are many areas which require service line PRVs.

The recommended pipeline maximum water velocity and head loss criteria are listed in Table 3.7 for maximum day, peak hour, and fire flow conditions.

Table 3.7 Water Main Velocity and Head Loss Criteria

Condition	Pipe Diameter (in)	Maximum Velocity (fps)	Maximum Head Loss (ft head loss per 1,000 ft of pipe)
Maximum Day	< 36	≤ 5	2 – 7
	≥ 36	≤ 6	1 – 2.5
Peak Hour	All	≤ 8	< 10
Fire Flow	All	≤ 10	NA

Abbreviations:  
in = inch; fps = feet per second

### 2.2.8 Storage Facilities

Because production facilities are designed to operate at a steady rate over an extended period of time, storage tanks are used to accommodate fluctuating demands. Storage tanks should be designed and operated to meet daily demand fluctuations, fire demand, and emergency reserve storage, while achieving storage turnover to minimize water quality degradation.

#### 2.2.8.1 Storage for Diurnal Demands

The storage capacity required to meet diurnal demand fluctuation is the volume of water required to meet the peak hour demands exceeding the maximum day demand production rate (the difference between maximum day and peak hour). For storage volume planning, a

conservative value of 20 percent of maximum day demand was used to evaluate storage capacity.

**2.2.8.2 Storage for Fire Demand**

The fire flow duration for determining storage requirements is determined by the local fire department, but generally ranges from 2 to 4 hours for single fire flow occurrences within a pressure zone. For planning purposes, a land use and zoning approach was taken to develop fire flow and storage requirements. The required fire flow storage by development type is summarized in Table 3.8.

Table 3.8 Storage Required for Fire Flow

Type of Development	Maximum Fire Flow		Duration (hours)	Fire Storage (MG)
	(gpm)	(mgd)		
<b>Fire Flow and Storage <sup>(1)</sup></b>				
Single Family Residential 1 <sup>(2)</sup>	1,000	1.4	2	0.12
Single Family Residential 2 <sup>(3)</sup>	1,500	2.2	2	0.18
Multi-Family Residential	2,500	3.6	2	0.30
Commercial – Low Risk	2,500	3.6	3	0.45
Commercial – High Risk	4,000	5.8	4	0.96
Industrial – Low Risk	6,000	8.6	4	1.44
Industrial – High Risk	10,000	14.4	4	2.40

Notes:

- (1) The City's Fire Marshall determines fire flow requirements for new construction. Reductions in maximum fire flow may be allowed under the 2012 IFC and upon approval from the Fire Marshall.
- (2) Residential area originally designed with fire flow standard less than 1,500 gpm.
- (3) Residential area originally designed with fire flow standard of 1,500 gpm.

There are some older developments in the City where the water infrastructure was designed using standards with lower required fire flows and storage requirements than are contained in the City's current performance criteria. In some of these areas, it may not be economically feasible to increase storage volumes to meet fire storage requirements because land may not be available for new or expanded tanks. In these cases, fire storage deficiencies may be met by utilizing available pumping capacity from lower pressure zones.

**2.2.8.3 Storage for Emergency Reserve**

Emergency or reserve storage capacity is an additional volume of water that is held in the tank to meet various emergency conditions, such as facility outage. Emergency reserve storage is also available to provide reliability/redundancy to adjacent pressure zone through booster pump stations. The volume of emergency storage that a utility should plan for is largely based on professional judgment, and is influenced by a number of factors such as power outage history, line break frequency, and overall supply redundancy. For storage volume planning, a value of 10 percent of maximum day demand was used for emergency reserve storage.

**2.2.9 Performance Criteria Summary**

Table 3.9 summarizes the City's water system performance criteria. These criteria were used in the distribution system capacity evaluation to determine the adequacy of the water system, and for planning infrastructure improvements.

Table 3.9 Water System Performance Criteria Summary

Description		Criteria			
<b>Water Production</b>		Maximum day demand for existing system evaluation; Maximum day demand + 10% reserve for future planning			
<b>Water Storage</b>					
	Equalizing (Diurnal)	20% of maximum day demand			
	Fire	Volume based on development type			
	Emergency	10% of maximum day demand			
<b>Booster Pumping</b>					
	Without Elevated Storage	Firm capacity equal to larger of peak hour <u>or</u> maximum day + fire flow + 10%			
	Firm Capacity	Capacity with the largest pump out of service			
<b>Transmission/Distribution Pipes <sup>(1)</sup></b>					
	Maximum day				
	Pipes < 36-in	≤ 5 fps			
	Pipes ≥ 36-in	≤ 6 fps			
	Peak hour	≤ 8 fps			
	Fire flow	≤ 10 fps			
<b>System Pressure Criteria <sup>(2)</sup></b>					
	Minimum	≥ 40 psi			
	Maximum	≤ 120 psi			
	Fire flow	≥ 20 psi			
Type of Development	Maximum Fire Flow		Duration (hours)	Fire Storage (MG)	
	(gpm)	(mgd)			
<b>Fire Flow and Storage <sup>(3)</sup></b>					
	Single Family Residential 1 <sup>(4)</sup>	1,000	1.4	2	0.12
	Single Family Residential 2 <sup>(5)</sup>	1,500	2.2	2	0.18
	Multi-Family Residential	2,500	3.6	2	0.30
	Commercial – Low Risk	2,500	3.6	3	0.45
	Commercial – High Risk	4,000	5.8	4	0.96
	Industrial – Low Risk	6,000	8.6	4	1.44
	Industrial – High Risk	10,000	14.4	4	2.40

Notes:

- (1) Pipe head loss should be less than 10 ft per 1,000 linear feet of pipe.
- (2) City's plumbing code requires service line PRVs in areas where static pressures are greater than 80 psi.
- (3) The Adopted International Fire Code determines fire flow requirements for new construction. Reductions in maximum fire flow may be allowable under the 2012 IFC upon approval from the Fire Marshall.
- (4) Residential area originally designed with fire flow standard less than 1,500 gpm.
- (5) Residential area originally designed with fire flow standard of 1,500 gpm.

Abbreviations:

in = inch; fps = feet per second; MG = million gallons; ft = feet

### 2.3 Water Production

The City's maximum day water demand projections were used to evaluate the adequacy of the City's water supply. For year 2017, maximum day demands were compared to the firm production capacity (largest well out of service). For years 2022 through 2032, maximum day demands plus 10 percent were compared to the firm production capacity. New well sources were added as required in each planning year to increase supplies to meet demands.

## 2.4 Distribution System

This capacity of the distribution system piping was evaluated using the City's hydraulic model, the demands prepared for the model update as described in Section 1.2.2, and the City's water system performance criteria. There are several areas that require distribution system improvements so that the required fire flows can be delivered or the required peak hour pressures can be met. These recommended pipe improvements include areas identified in the City's 2013 Study as well as one additional area, including:

- Highway 69 from the New Zone 56/76 Booster Station to the new Zone 56 Tank
- Stony Creek Drive and Northridge Drive
- River Oaks Road & Shinnery Road and Valley Road & Tabosa Road
- From the Virginia Pump Station to Haisley Road & Valley Ranch Road
- Thumb Butte Road to the Thumb Butte Tank and to Upper Thumb Butte Tank
- Gail Gardner Drive from Fair Road to Linwood Road
- Pine Lakes Road
- Iron Springs Road
- Zone 61, 41, 40, 0 in various locations
- Zone 31
- Zone 51
- Buttermilk Drive
- Arrowhead Road from Iron Springs Road to Sidewinder Road
- White Cloud Road, Meadow Ridge Road and Estrella Road
- Highland Avenue from Evergreen Road to Copper Basin Road (2017 Model Study)

## 2.5 Infrastructure for Growth Areas

The Intermediate Storage Tanks and Booster Pump Station (planned for Year 2019) are needed to serve growth in the Deep Well Ranch Area. Future connections in Deep Well Ranch and adjacent areas were assumed to be supported by the Intermediate Storage Tank and a separate pump station (CIP Project 156 W) to serve future Pressure Zone 110.

The Intermediate Storage Tanks and Booster Pump Station project will include a fill valve to allow Airport (Pressure Zone 12) supplies to enter the Intermediate Storage Tanks where they would then be available to serve existing customers as well as future growth in Pressure Zone 110.

Table 3.10 summarizes the pipes required for each growth area.

Table 3.10 Growth Area Water Pipes

Growth Area and Pipe Size (inch)	Length (ft)	Total Length (ft)
<b>Deep Well Ranch</b>		<b>78,581</b>
12	65,877	
16	12,705	
<b>Granite Dells Estates</b>		<b>66,421</b>
8	53,735	
12	6,257	
16	6,428	
<b>Granite Dells Ranch</b>		<b>7,219</b>
8	1,888	
12	3,250	
16	2,081	
<b>Granite Dells Ranch North</b>		<b>17,991</b>
8	6,529	
12	4,869	
16	6,593	
<b>Granite Dells Ranch South</b>		<b>30,649</b>
8	19,364	
12	11,285	
<b>Storm Ranch</b>		<b>16,375</b>
12	16,375	
<b>Yavapai Medical</b>		<b>12,439</b>
12	10,887	
16	1,553	

## 2.6 Water Capital Improvement Project Summary

Figure C.1 in Appendix B shows the locations of the recommended water system capital improvement projects and the projects required for growth areas. The project numbers correspond to the numbering convention adopted in the 2013 Study. A tabulation of all water projects is included in Section 4 – Costs and Project Timing.

The IIP Service Areas developed in the 2013 Study were modified to include the growth areas identified in the 2017 Model Study. Additionally, the IIP Service Areas have been reduced to 2 Service Areas. Area A includes the entire water service area, Area B begins just north of the Airport and continues south to the City limits. All projects identified in the 2017 Model Study were assigned a Service Area.

## Section 3 – Wastewater System Evaluation

### 3.1 Wastewater System Description

The City's wastewater system contains over 355 miles of gravity mains, 18 miles of force mains, 61 sewage lift stations and three wastewater treatment facilities. Some parts of the City are not sewerred, so residents in those locations have individual septic systems.

The City is in the process of building the infrastructure that will allow all wastewater to be treated at the Airport WRF. Once this infrastructure is in place, the City will decommission the Sundog WWTP and utilize the site as a flow equalization basin with a lift station that will pump wastewater to the Airport WRF. The Hassayampa Water Reclamation Plant (WRP) will continue to operate as a flow scalping facility to provide reclaimed water for golf course turf irrigation.

The City's wastewater collection system hydraulic model was used in this analysis. This model was updated and validated as part of the 2017 Model Study.

### 3.2 Performance Criteria

#### 3.2.1 Background

Performance criteria are the standards of measurement used to evaluate the adequacy of wastewater collection system infrastructure including pipe (gravity and force main) and lift station capacity. Performance criteria are based on legal requirements and engineering best practices. The criteria in this document have been reviewed with City staff and represent the level of service the City strives to provide to its customers. The wastewater system performance criteria have not changed since the 2013 Study.

#### 3.2.2 Pipe Capacities

Sewer capacities are dependent on many factors. These include roughness of pipe, maximum allowable depth of flow, limiting velocity, and pipe slope. The Continuity Equation and Manning's Equation are used to calculate sewer capacity under steady-flow hydraulic conditions. The Manning's coefficient 'n' is a friction coefficient that varies with respect to pipe material, size of pipe, depth of flow, smoothness of joints, root intrusion, and other factors.

For gravity sewers, the Manning's coefficient ranges between 0.011 and 0.017. For planning purposes, an 'n' value of 0.013 is used for this project, except where modified during calibration of the wastewater system model to actual performance data, or where the pipe material is known. It should be noted that the A.A.C. requires the use of 0.013 for the design of new sewers (A.A.C. R18-9-E301(D)(2)(e))

#### 3.2.3 Flow Depth (d/D)

When designing sewers, it is common practice to adopt variable flow depth capacity criteria for various pipe sizes. This criterion is expressed as a ratio of maximum depth of flow (d) to pipe diameter (D). Design d/D ratios typically range from 0.5 to 0.75, with the lower values typically used for smaller pipes that may experience flow peaks greater than planned or may experience blockages from debris.

The Arizona Administrative Code requires that the d/D ratio for new sewers shall not exceed 0.75 for peak dry weather flow conditions (A.A.C. R-18-9-E301(D)(2)(e)). The flow depth criterion used in this study for new sewers is 0.5 for diameters less than 12 inches, and 0.75 for diameters 12

inches and greater. However, existing sewers were evaluated based on a flow depth criteria of 0.9 at peak flows because there are fewer unknowns, especially in established, built out areas, and because there is no need to replace or provide relief for an existing sewer until flows are at the design capacity of the pipe (A.A.C. R-18-E301(D)(b)(i)). The hydraulic criteria used for sizing proposed future gravity sewers will have a greater factor of safety than the criteria used to evaluate the capacity of the existing system due to the uncertainties in making projections of future flows.

### 3.2.4 Velocity

In order to minimize the settlement of solids in the flow and promote scouring, it is standard design practice to specify that a minimum velocity of 2 fps be maintained when the pipe is flowing half full. At this velocity, the sewer flow will typically provide adequate scouring to clean the pipe. Due to the hydraulics of a circular pipe, the velocity for half-full pipe flow approaches the velocity of nearly full pipe flow. The Arizona Administrative Code requires new sewers to be designed with minimum slopes calculated from Manning's Equation using a roughness coefficient of 0.013 and a velocity of 2 fps when flowing full (A.A.C. R-18-9-E301(D)(2)(e)).

Table 3.11 lists the minimum slopes for maintaining self-cleaning velocities at full flow with  $d/D = 1.0$ , which provides the most conservative minimum slope. The minimum slope listed in the table is 0.0008 feet per foot (ft/ft), which is the minimum practical slope for gravity sewer construction.

Table 3.11 Recommended Minimum Slopes for Circular Gravity Sewers

Pipe Diameter (in)	Minimum Slope (ft/ft) <sup>(1)(2)</sup>	Pipe Capacity <sup>(3)</sup>	
		(gpm)	(mgd)
8	0.0034 <sup>(4)</sup>	310	0.45
10	0.0025	485	0.70
12	0.0020	700	1.02
14	0.0016	960	1.38
15	0.0015	1,100	1.59
16	0.0014	1,250	1.80
18	0.0012	1,580	2.28
20	0.001	1,960	2.82
21	0.001	2,160	3.11
24	0.0008	2,820	4.06
>24	0.0008	--	--

Notes:

- (1) Slopes are calculated using Manning's Equation for pipes flowing full with a minimum velocity of 2 fps.
- (2) Sewers larger than 24-inches should have a slope  $\geq 0.0008$ .
- (3) Based on pipe flowing full ( $d/D = 1.0$ )
- (4) Prescott prefers a slope of 0.005 (0.5 percent), for 8-inch diameter pipes where possible.

Greater slopes are desirable if they are compatible with existing topography and infrastructure, provided that the wastewater velocity does not exceed the maximum velocity criteria of 10 fps established in A.A.C. R-18-9-E301(D)(2)(f) unless scour resistant material is used. Velocities greater than 10 fps may also result in turbulent flow conditions that contribute to odor problems.

The slopes listed in Table 3.11 are target criteria for existing and proposed sewer pipes. However, it should be noted that some of the existing sewer pipes in the City's collection system have flat slopes, and the minimum slope criteria may not be met in all locations with the wastewater system.

### 3.2.5 Manhole Spacing

Manholes are typically installed at grade changes, changes in sewer pipe sizes, alignment changes, and intersections with other sewer pipes. In addition, manholes should be located to facilitate sewer cleaning. The recommended maximum manhole spacing for different diameters of sewer pipe are listed in Table 3.2. The recommended maximum spacing is in accordance with A.A.C. R18-9-E301(D)(3)(a).

Table 3.12 Recommended Maximum Manhole Spacing

Sewer Pipe Diameter (in)	Maximum Manhole Spacing (ft) <sup>(1)</sup>
Less than 8-in	400
8-in to less than 18-in	500
18-in to less than 36-in	600
36-in to less than 60-in	800

Notes:

(1) A.A.C. R18-9-E301(D)(3)(a)

### 3.2.6 Changes in Pipe Size

When a smaller sewer joins a larger sewer, the invert of the larger sewer will be lowered sufficiently to maintain the same energy gradient across the manhole. The GIS data for the City's wastewater system was used for the sewer inverts. For master planning purposes, proposed sewer crowns were matched at manholes when a smaller sewer joins a larger one.

### 3.2.7 Lift Stations

Lift stations should be sized for a "firm" capacity greater than the peak daily flow. The lift station should be able to provide a firm pumping capacity with the largest pump out of service. This same concept applies to package lift stations with equally sized, duplex pumps where one pump acts as the duty pump and the other as the standby pump. In these cases, the required pumping capacity should be provided by the duty pump.

#### 3.2.7.1 Normal Operation

Lift station wet well sizing takes into consideration the fill time at average flow conditions and the minimum pump cycle time. The minimum wet well volume shall be per the City of Prescott General Engineering Standards. When selecting the minimum cycle time, the pump manufacturer's duty cycle recommendations will be utilized. Starting and stopping more than seven times an hour for any one pump is not recommended.

#### 3.2.7.2 Emergency Operation

The objective of emergency operation is to protect public health by preventing sewer back-ups and subsequent discharge into streets and other public or private property. The most common emergency would be a power outage. The City has permanent back-up generators with automatic transfer switches at their regional lift stations and portable generators that can be

used at all other stations. The City requires emergency generators to be installed at all new lift stations.

### 3.2.8 Force Mains

The Arizona Administrative Code requires that new force mains be designed to maintain a minimum flow velocity of 3 fps and a maximum flow velocity of 7 fps (A.A.C. R-18-9-E301(D)(4)(a)). These velocity criteria promote scouring so that the solids deposited in the force main while the pumps are off will be transported downstream when the pumps are operating. Wastewater retention time in the pipeline should also be considered in sizing force mains to avoid excessive hydrogen sulfide generation.

### 3.2.9 Gravity Sewer Planning Guidelines

Gravity sewers should be designed and constructed to have:

- A minimum of 4 feet of cover or sufficient depth to serve the ultimate drainage area
- A target depth of 7 feet of cover for new sewer main installation

Gravity sewers and force mains must have a minimum separation of 6 feet from potable water mains and reclaimed water mains unless they are provided with increased protection in accordance with A.A.C. R-18-5, Article 4 and A.A.C. R-18-9, Article 6.

Manholes with sewers intersecting at greater than or equal to 90-degree angles should provide 0.1 foot of invert drop across the manhole. Other manholes should provide a minimum 0.1 foot of invert drop.

### 3.2.10 Peaking Factors

Peaking factors for the City's wastewater system were calculated based on field data from the flow monitoring conducted in the spring of 2017. The peak hour to average daily flow ratio during the flow monitoring period was determined for each of the flow monitoring locations.

Table 3.13 summarizes the peak flow multipliers for each flow monitoring basin. The values range from 1.6 to 2.5, and are dependent on the size of the drainage area and type of development contributing to the flow monitoring point.

Table 3.13 Peak Hour Wastewater Flow Factors

Flow Monitoring Basin	Peak Flow Multiplier
North Force Main	1.66
Pinion Oaks	2.41
City Lights	2.14
Robinson	2.29
Prescott Lakes Parkway	1.69
Forest Trails	2.27
Hassayampa	2.52
Prescott Heights	1.63
Banning Creek	1.64
Copper Basin	1.62
Gurley	1.96

### 3.2.11 Storm Inflows

Storm inflows are based on a review of the historical flow data to the Sundog and Airport Plants and the wet weather flow analysis performed in the winter of 2004. The storm flow for the Sundog Basin was 6.8 mgd and the storm flow for the Airport Basin was 1.3 mgd.

Future inflow is modeled as an additional 30 percent of future dry weather flow in the Sundog Basin and 15 percent of future dry weather flow in the Airport Basin.

### 3.2.12 Performance Criteria Summary

Table 3.14 summarizes the City's wastewater collection system performance criteria.

Table 3.14 Wastewater System Performance Criteria Summary

Pipe Diameter (in)	Minimum Slope (ft/ft) <sup>(1)(2)</sup>	Pipe Capacity <sup>(3)</sup>	
		(gpm)	(mgd)
<b>Gravity Sewer Minimum Slope and Capacity</b>			
8	0.0034 <sup>(4)</sup>	310	0.45
10	0.0025	485	0.70
12	0.0020	700	1.02
14	0.0016	960	1.38
15	0.0015	1,100	1.59
16	0.0014	1,250	1.80
18	0.0012	1,580	2.28
20	0.001	1,960	2.82
21	0.001	2,160	3.11
24	0.0008	2,820	4.06
>24	0.0008	--	--
<b>Description</b>		<b>Criteria</b>	
<b>Maximum Velocity</b>		≤ 10 fps (polyvinyl chloride [PVC] pipe) > 10 fps (scour resistant pipe)	
<b>Flow Depth, d/D (dry weather peak)</b>			
d/D for evaluating existing mains		0.9	
d/D for planning new pipes < 12-in diameter		0.5	
d/D for planning new pipes ≥ 12-in diameter		0.75	
<b>Head Loss in Existing Pipes</b>			
Gravity main		Manning's "n" = 0.013	
Pressure pipes		Hazen Williams "C" = 120	
<b>Changes in Pipe Size</b>			
When a smaller sewer joins a larger sewer		Sewer crowns will be matched at a minimum or an internal drop at the transition manhole will be provided	
<b>Head Loss at Manholes</b>			
Manholes with pipes intersecting at angles greater than 90 degrees		Provide 0.1-ft invert drop	
Manholes with pipes intersecting at angles 90 degrees or less		Provide 0.1-ft invert drop	
<b>Collection System Peaking Factors</b>			
Peak flow to average daily flow <sup>(5)</sup>		1.6 – 2.5	
<b>Inflow and Infiltration</b>			
Sundog service area		6.8 mgd existing + 30% of future dry weather flow	
Airport service area		1.3 mgd existing + 15% of future dry weather flow	

Notes:

- (1) Slopes are calculated using Manning's Equation for pipes flowing full with a minimum velocity of 2 fps.
- (2) Sewers larger than 24-inches should have a slope ≥ 0.0008.
- (3) Based on pipe flowing full (d/D = 1.0) at the minimum pipe slope.
- (4) Prescott prefers a slope of 0.005 (0.5 percent), for 8-inch diameter pipes where possible.
- (5) Values measured during flow monitoring study conducted for 2017 Water and Wastewater Models Study.

Abbreviation:

d/D = depth over diameter

### 3.3 Collection System

Most of the pipes in the City's collection system have sufficient capacity to convey the existing and projected future flows. There are several areas where the estimated depth over diameter (d/D) exceeded 0.9 for 2017 flow conditions. These areas were previously identified in the 2013 Study and include:

- Sewers north of Virginia Street near Mount Vernon Street
- Sewers on Willow Creek Road, Rosser Street, and Demerse Avenue
- Sewers on Fifth Street, Sixth Street, and Hillside Avenue from the Sundog Trunk Main to Fifth Street
- Sewers on Granite Street from north of Aubrey Street to Sheldon Street
- Sewer on Sun Drive east of Scott Drive
- Sundog Trunk Main Phase I – Sundog WWTP to Highway 89
- Sundog Trunk Main Phase II – Sundog WWTP to Miller Valley Road
- Sewer on Josephine/Osburn Road from Plaza Drive to Miller Valley Road
- Sewer on Thumb Butte Road from Meadowbrook Road to Country Club Drive
- Sewer on Meadowbrook Road from Butte Canyon Drive to 200 feet east

The sewer on Prescott Lakes Parkway north of SR69 was identified in the model with a d/D of greater than 0.9 for 2017 conditions. However, the model predicted surcharging is limited and the City's field review of this area do not indicate a need for a capital improvement project at this time. It is recommended that the City continue to monitor this line, particularly if additional connections immediately upstream of this location are made or if the Ranch 1 lift station is ever modified with higher capacity pumps.

### 3.4 Infrastructure for Growth Areas

There are three lift stations shown on Figure C.2 in Appendix B, considered for future growth areas:

- Granite Dells Ranch (commercial) and Granite Dells Estates – New lift station on the east side of Granite Creek
- Deep Well Ranch – New lift station north west of the Prescott Airport
- Yavapai Regional Medical Center – one lift station on site, which will also convey flow to the new lift station north west of the Prescott Airport

Table 3.12 summarizes the pipes required for each growth area.

Table 3.12 Growth Area Wastewater Pipes

Growth Area and Pipe Size (inch)	Length (ft)	Total Length (ft)
<b>Deep Well Ranch</b>		<b>70,596</b>
8	27,567	
10	9,309	
12	17,470	
15	5,787	
18	10,463	
<b>Granite Dells Estates</b>		<b>42,207</b>
8	39,204	
10	1,197	
12	1,807	
<b>Granite Dells Ranch</b>		<b>12,788</b>
8	6,839	
10	2,661	
12	3,288	
<b>Granite Dells Ranch North</b>		<b>5,933</b>
10	5,651	
24	282	
<b>Granite Dells Ranch South</b>		<b>3,026</b>
8	975	
10	148	
12	1,903	
<b>Storm Ranch</b>		<b>17,226</b>
8	13,059	
10	3,139	
12	752	
18	276	
<b>Yavapai Medical</b>		<b>6,571</b>
8	6,571	

### 3.5 Wastewater Infrastructure Improvement Plan Summary

Figure C.2 in Appendix B shows the locations of the recommended wastewater system projects required for growth areas. The project numbers correspond to the numbering convention adopted in the 2013 Study. A tabulation of all wastewater projects is included in Section 4 – Costs and Project Timing.

The IIP Service Areas developed in the 2013 Study were modified to include the growth areas identified in the 2017 Model Study. Additionally, the IIP Service Areas have been reduced to a single Service Area with centralization of wastewater treatment. All projects identified in the 2017 Model Study were assigned the single Service Area.

## Section 4– Costs and Project Timing

### 4.1 Cost Development Methodology

Cost estimates have been developed for the water and wastewater capital improvement projects identified in the previous sections. These estimates were prepared in accordance with the guidelines of the Association for the Advancement of Cost Engineers (A.A.C.E) International for a Class 4 estimate unless otherwise noted. Table 3.16 summarized the A.A.C.E International cost estimating classifications, the level of project definition (percent of design), uses, appropriate cost estimating methodologies, and the expected accuracy of each class. Design work would need to be undertaken to obtain more precise cost estimates.

Table 3.16 A.A.C.E International Cost Estimating Classification Summary

Estimate Class	Maturity Level of Project Definition Deliverables - (Level of Engineering Design)	End Use	Typical Cost Estimating Methodology Used	Expected Accuracy Range (Low/High)
Class 5	0% to 2%	Conceptual screening	Capacity factored, parametric models, judgment or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -10% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

### 4.2 Unit Costs

Unit costs were developed for the recommended water and wastewater projects using R.S. Means and other unit cost sources, unless otherwise noted. Multipliers for general conditions (15%), construction overhead and profit (16%), sales tax (65% of applicable costs at 9.1%), contingencies (30%), and general conditions (15%) were then added to prepare unit construction costs. When

multiplied by the capacity, quantity, or size of infrastructure, the unit construction cost represents what the City should expect to pay a contractor to construct the project. The City will have other expenses to complete the project including design, inspection, project management, and contingencies. A multiplier of 1.4 was used to represent these additional costs and applied to the unit construction cost to obtain a project cost for each project.

Table 3.17 summarizes the water infrastructure unit costs for the 5- to 15-year IIP. The water infrastructure unit cost detail is included in Appendix C.

Table 3.17 Water Infrastructure Unit Costs

Infrastructure	Unit Construction Cost <sup>(1)</sup>
<b>Water Pipelines</b>	<b>(\$/LF)</b>
8-in	\$177
8-in (with hydrant)	\$206
12-in	\$195
12-in (with hydrant)	\$230
16-in	\$227
18-in	\$263
20-in	\$298
24-in	\$336
30-in	\$544
36-in	\$635
<b>Wells</b>	<b>(\$M)</b>
750 gpm (1.1 mgd)	\$2.2
1,400 gpm (2.0 mgd)	\$3.1
<b>Booster Pump Stations</b>	<b>(\$M)</b>
1.5 mgd	\$1.6
2.0 mgd	\$1.9
3.0 mgd	\$2.2
4.0 mgd	\$2.4
6.0 mgd	\$2.8
8.0 mgd	\$3.7
10.0 mgd	\$4.3
12.0 mgd	\$5.0
18.0 mgd	\$5.7
<b>Storage Tanks <sup>(2)</sup></b>	<b>(\$M)</b>
0.225 MG <sup>(3)</sup>	\$0.6
0.5 MG	\$1.8
1.0 MG	\$2.3
1.5 MG	\$2.6
2.0 MG	\$3.0
2.5 MG	\$3.6
3.0 MG	\$4.1
5.0 MG	\$6.1

Notes:

(1) ENR CCI = 10870 (20 Cities Index, November 2017)

- (2) Site-specific conditions impact the bid-based unit costs for tanks. The projects these costs are applied to in the 2017 CIP/IIP are expected to have similar site-specific conditions.
- (3) Storage tank unit construction costs are based on current bid pricing provided by the City.

Table 3.18 summarizes the wastewater infrastructure unit costs for the 5- to 15-year IIP. The wastewater infrastructure unit cost detail is included in Appendix C.

Table 3.18 Wastewater Infrastructure Unit Costs

Infrastructure	Unit Construction Cost <sup>(1)</sup>
<b>Force Mains</b>	<b>(\$/LF)</b>
6-in	\$163
8-in	\$169
12-in	\$192
18-in	\$374
20-in	\$391
<b>Gravity Sewers</b>	<b>(\$/LF)</b>
8-in	\$193
10-in	\$205
12-in	\$209
15-in	\$213
18-in	\$220
24-in	\$258
30-in	\$333
36-in	\$441
39-in	\$480
42-in	\$505
48-in	\$628
<b>Lift Stations</b>	<b>(\$M)</b>
0.2 mgd	\$0.6
0.5 mgd	\$0.7
0.8 mgd	\$0.8
3.0 mgd	\$2.2
6.0 mgd	\$3.3
9.0 mgd	\$4.3
12.0 mgd	\$5.0
15.0 mgd	\$5.6

Notes:

(1) ENR CCI = 10870 (20 Cities Index, November 2017)

### 4.3 Water System Project Summary

Table 3.19 summarizes the water system projects needed to serve future growth. The City has two IIP service areas for the water system:

- Area A – includes the entire system from the Chino Valley wells, tanks and booster station.
- Area B – includes all portions of the system except the Chino Valley wells, tanks and booster station.

The number of EDUs that are expected to be added to the system between year 2017 and year 2032 was determined to allocate the portion of new infrastructure cost for new development (fees) with existing customers (rates). For the growth areas shown in Figure 3.1, the ultimate number of EDUs was used as a basis for the new growth cost allocation because the initial phases of development will be laying the back bone infrastructure for these areas and the infrastructure should be sized for ultimate needs of the area that it serves.

The water IIP service areas are shown in Figure C.1 in Appendix B. Table 3. identifies which projects are part of the water IIP, the service area the project is in, and an estimate of the percent cost allocation associated with impact fees and rates based on projected growth within each service area.

Table 3.19 summarizes the water system project costs and construction costs.

### 4.4 Wastewater System Project Summary

Table 3.20 summarizes the wastewater system projects needed to serve future growth. There is one IIP service area for the wastewater system because the City has adopted a centralized wastewater collection and treatment approach. Therefore cost allocations between new development and existing customers will be shared for projects required to serve the entire system.

The wastewater IIP service areas are shown in Figure C.2 of Appendix B. Table 3.20 identifies which projects are associated with the wastewater IIP, the service area the project is in, and estimate of the percent cost allocation associated with impact fees and rates based on projected growth within each service area.

Table 3.20 summarizes the wastewater system project costs and construction costs.

Table 3.19 2018-2032 Water System Infrastructure Improvement Plan

Project No.	Description	Diameter (in)	Length (ft)	Capacity (gpm or MG)	Unit Cost (\$)	Construction Cost (\$)	Project Cost (\$)	IIP (Y/N)	Service Area	% Fees	% Rates	Planning Year
44 W.1	Replace Lower Yavapai Hills Pump Station	--	--	1,600 gpm	--	2,239,000	3,135,000	Y	B	35	65	2020
44 W.2	New Zone 56 Storage Tank	--	--	1.5 MG	--	2,646,000	3,704,000	Y	B	35	65	2020
44 W.3	Upsize water main along Hwy 69 from Zone 56 Storage Tank west towards future Zone 56/76 booster pump station (U-Haul)	16	4,560	--	227	1,034,800	1,449,000	Y	B	35	65	2020
52 W	New Water Main from Centerpointe/Side Rd. to Heckthorn Rd.	12	2,105	--	230	484,000	678,000	Y	B	100	0	2025
60 W	Future Airport Well No. 5 - Location not yet determined	--	--	950 gpm	--	2,166,000	3,032,000	Y	B	35	65	2019
64 W	Upsize water main along Hwy 69 from new Zone 56/76 booster pump station to U-Haul	16	7,225	--	227	1,639,500	2,285,000	Y	B	35	65	2024
68 W.1	Upsize water main from Zone 27 Tank to Zone 24 Tank	12	5,910	--	230	1,359,000	1,903,000	Y	B	35	65	2019
68 W.2	Upsize water main from Zone 24 Pump Station to Zone 24 Tank	12	1,630	--	230	375,000	525,000	Y	B	35	65	2019
70 W	Upper Rancho Vista Booster Pump upsize	--	--	1,000 gpm	Prev. Proj. Specific	--	755,000	Y	B	35	65	2019
76 W	Sundog Ranch Rd. Connector Water line between Yavpe Connector and Prescott Lakes Parkway	12	8,826	--	230	2,030,000	2,842,000	Y	B	35	65	2022
90 W	Chino Valley Booster Facility upgrades	--	--	12,200 gpm	--	5,560,000	7,784,000	Y	A,B	35	65	2019
92 W.1	Intermediate Storage Tank Phase 1 and fill valve	--	--	10 MG	--	9,000,000	12,600,000	Y	A,B	35	65	2019
92 W.2	Intermediate Booster Pump Station	--	--	12,200 gpm	--	5,560,000	7,784,000	Y	A,B	35	65	2019
92 W.3	Water main from Zone 12 to Intermediate Storage Tank	16	5,050	--	227	1,146,000	1,604,000	Y	A,B	35	65	2019
<b>Total</b>						<b>35,239,300</b>	<b>50,080,000</b>					

Table 3.20 2018-2032 Wastewater System Infrastructure Improvement Plan

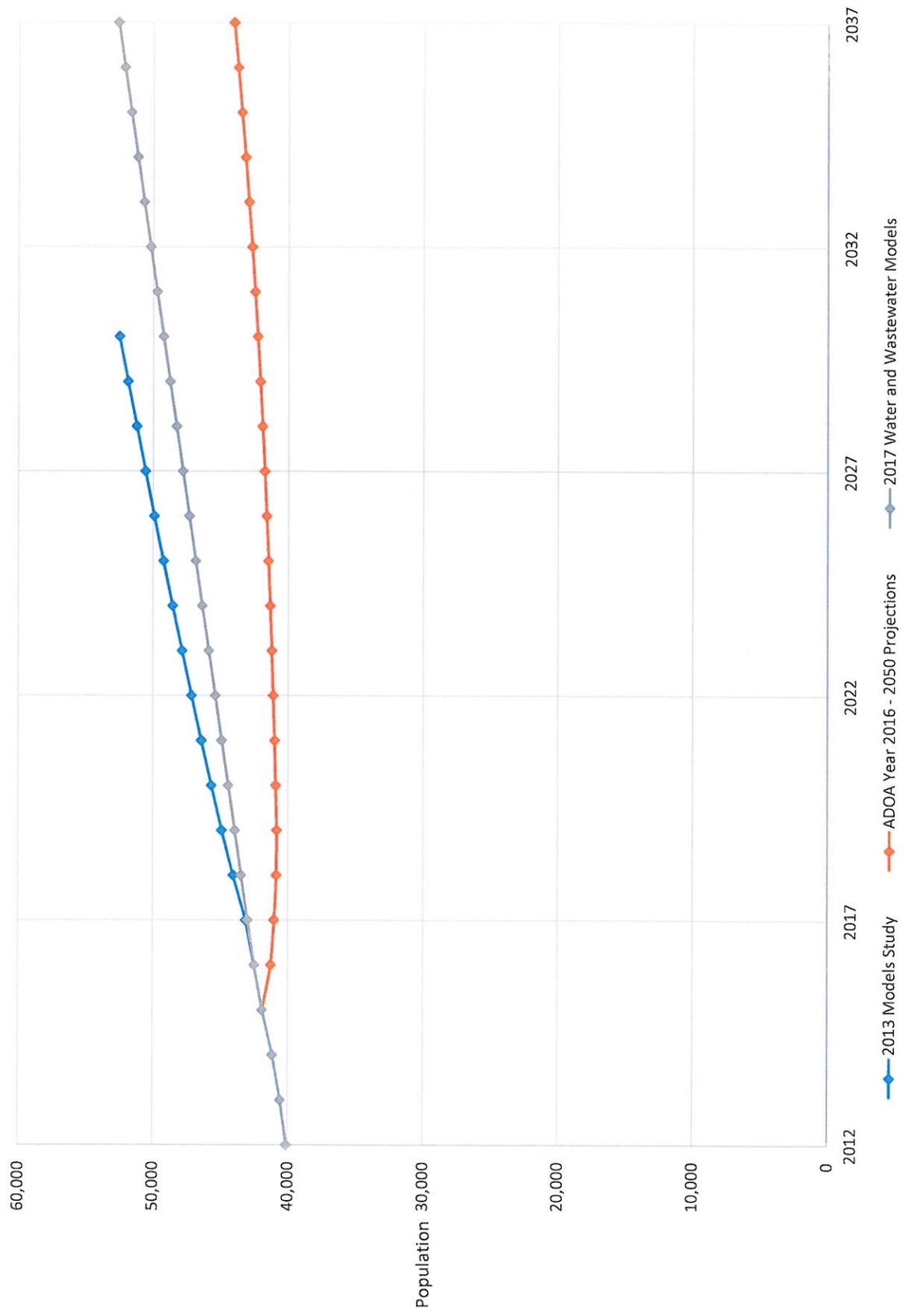
Project No.	Description	Diameter (in)	Length (ft)	Capacity (gpm or MG)	Unit Cost (\$)	Construction Cost (\$)	Project Cost (\$)	IIP (Y/N)	Service Area	% Fees	% Rates	Planning Year
26 WW.1	Sundog Trunk Main Phase C from Miller Valley Rd. to Veterans Administration (VA)	21	495	--	224	111,000	155,000	Y	A	35	65	2020
26 WW.2	Sundog Trunk Main Phase C from Miller Valley Rd. to Veterans Administration (VA)	24	4,565	--	258	1,179,000	1,651,000	Y	A	35	65	2020
26 WW.3	Sundog Trunk Main Phase C from Miller Valley Rd. to Veterans Administration (VA)	30	1,180	--	233	394,000	552,000	Y	A	35	65	2020
26 WW.4	Sundog Trunk Main Phase C from Miller Valley Rd. to Veterans Administration (VA)	36	4,750	--	441	2,096,000	2,934,000	Y	A	35	65	2020
32 WW.1	Granite Dells Development (DA) Wastewater Requirements – Airport East Regional Lift Station	--	--	1,000		1,800,000	2,340,000	Y	A	100	0	2025
32 WW.2	Granite Dells Development (DA) Wastewater Requirements – Airport East Pipelines	10	2,430	--	192	466,000	652,000	Y	A	100	0	2025
32 WW.3	Granite Dells Development (DA) Wastewater Requirements – Airport East Pipelines	12	1,348	--	209	282,000	395,000	Y	A	100	0	2025
34 WW.1	Centralization – Airport Trunk Main	48	10,640	--	628	6,678,000	9,349,000	Y	A	35	65	2020
34 WW.2	Centralization – Airport Trunk Main	36	6,410	--	441	2,828,000	3,959,000	Y	A	35	65	2020
36 WW	Montezuma Trunk Main Upsizing – Sewers on Granite St. from north of Aubrey to Sheldon St.	18	3,043	--	220	670,000	938,000	Y	A	35	65	2022
38 WW.1	Hassayampa Sewer Trunk Main Upsizing - Josephine/Osburn from Plaza to Miller Valley Rd.	8	1,131	--	193	218,000	305,000	Y	A	35	65	2022
38 WW.2	Hassayampa Sewer Trunk Main Upsizing - Josephine/Osburn from Plaza to Miller Valley Rd.	10	860	--	205	176,000	246,000	Y	A	35	65	2022
38 WW.3	Hassayampa Sewer Trunk Main Upsizing - Josephine/Osburn from Plaza to Miller Valley Rd.	12	2,862	--	209	598,000	837,000	Y	A	35	65	2022
38 WW.4	Hassayampa Sewer Trunk Main Upsizing - Josephine/Osburn from Plaza Dr. to Miller Valley Rd.	15	5,600	--	213	1,192,000	1,669,000	Y	A	35	65	2022

54 WW.1	Sundog Equalization Basin	NA	NA	--		Proj.	1,180,000	1,650,000	Y	A	35	65	2023
54 WW.2	Plant Decommissioning	NA	NA	--		Specific	--	175,000	Y	A	35	65	2023
56 WW.1	Upsize Willow Creek Trunk Main from Willow Lake Regional Lift Station west to Cottonwood Ln.	12	4,967	--		209	1,038,000	1,453,000	Y	A	35	65	2020
56 WW.2	Upsize Willow Creek Trunk Main from Willow Lake Regional Lift Station west to Cottonwood Ln.	15	3,926	--		213	836,000	1,170,000	Y	A	35	65	2020
56 WW.3	Upsize Willow Creek Trunk Main from Willow Lake Regional Lift Station west to Cottonwood Ln.	18	1,795	--		220	395,000	553,000	Y	A	35	65	2020
58 WW	Airport WRF Phase II Expansion	--	--	7.5		Proj. Specific	13,393,000	18,750,000	Y	A	35	65	2023
62 WW.1	Willow Creek Gravity Sewer from Willow Lake Regional Lift Station to Prescott Lakes Regional Lift Station	8	527	--		193	102,000	143,000	Y	A	35	65	2020
62 WW.2	Willow Creek Gravity Sewer from Willow Lake Regional Lift Station to Prescott Lakes Regional Lift Station	21	6,488	--		224	1,453,000	2,034,000	Y	A	35	65	2020
<b>Total</b>							<b>37,085,000</b>	<b>51,910,000</b>					

Appendix A

# CITY OF PRESCOTT POPULATION PROJECTIONS

Appendix A - Prescott Population Projections



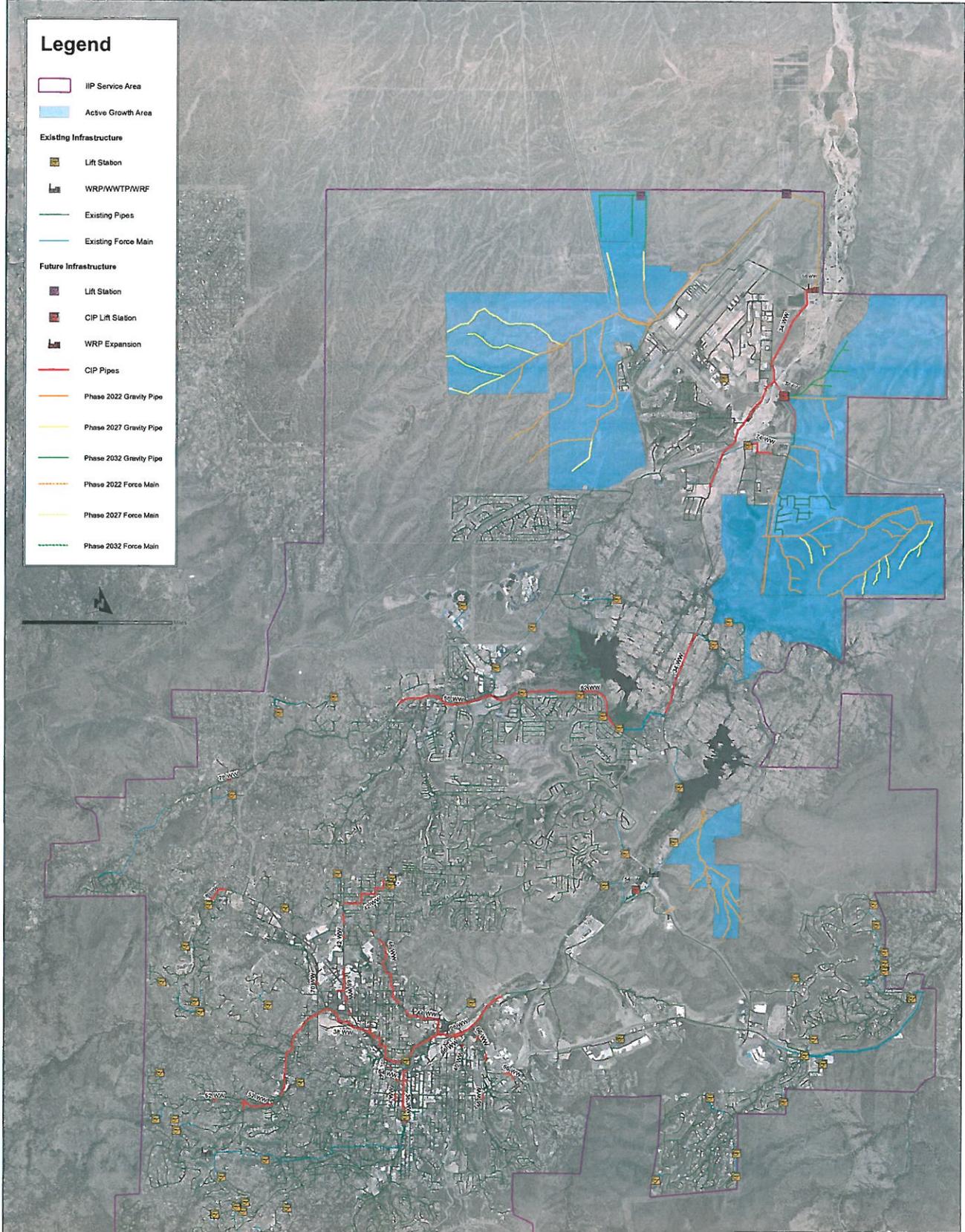
Appendix B

**WATER AND WASTEWATER PROJECT MAPS**



# Legend

-  IIP Service Area
-  Active Growth Area
- Existing Infrastructure**
-  Lift Station
-  WRP/WWTP/WRP
-  Existing Pipes
-  Existing Force Main
- Future Infrastructure**
-  LRA Station
-  CIP LRA Station
-  WRP Expansion
-  CIP Pipes
-  Phase 2022 Gravity Pipe
-  Phase 2027 Gravity Pipe
-  Phase 2032 Gravity Pipe
-  Phase 2022 Force Main
-  Phase 2027 Force Main
-  Phase 2032 Force Main



**WASTEWATER SYSTEM  
CIP PROJECTS  
FIGURE C.2  
CITY OF PRESCOTT  
2017 WATER AND  
WASTEWATER MODELS**

## Appendix C

# INFRASTRUCTURE UNIT COSTS













PROJECT : 2017 Water and Wastewater Models  
 JOB # : 10636A.00  
 CLIENT : City of Prescott  
 ELEMENT : Booster Pump Station Construction, 2 MGD

LOCATION FACTOR: 0.875  
 DATE : November-17  
 ENR : 10870  
 BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization (10%)	1	LS	\$ 103,602.62	\$ 103,603
2	Material Testing	1	LS	\$ 3,529.22	\$ 3,529
3	Piping - 12" MJ DIP	300	LF	\$ 47.75	\$ 14,325
4	12" DIP MJ Fittings	4	EA	\$ 6,495.18	\$ 25,981
5	125 hp Vertical Turbine Pump w/ Pump Can	2	EA	\$ 59,290.91	\$ 118,582
6	12" Discharge Piping FL DIP (10 FT per pump)	2	EA	\$ 1,027.07	\$ 2,054
7	12" FL Check Valve	2	EA	\$ 5,801.99	\$ 11,604
8	12" FL BFV	2	EA	\$ 1,954.96	\$ 3,910
9	12" DIP FL Fittings	4	EA	\$ 2,412.48	\$ 9,650
10	12" DIP FL Pipe - Manifold	30	LF	\$ 102.71	\$ 3,081
11	10" Flowmeter	1	EA	\$ 6,704.10	\$ 6,704
12	12" Reducers	2	EA	\$ 578.14	\$ 1,156
13	12" FL BFVs	2	EA	\$ 3,120.98	\$ 6,242
14	Pressure Transmitters and Instrumentation	2	LS	\$ 8,470.13	\$ 16,940
15	Piping Support Pad - (10'x20'x12")	7.5	CY	\$ 635.26	\$ 4,764
16	Misc Pipe Supports	1	LS	\$ 1,500.00	\$ 1,500
17	Chlorine Fiberglass Enclosure	1	LS	\$ 8,960.00	\$ 8,960
18	Chlorine Building Slab (6'x6'x8")	1	CY	\$ 327.34	\$ 327
19	Chlorine Equipment & Piping	1	LS	\$ 4,480.00	\$ 4,480
20	5,000 gallon hydromatic tank w/ air comp & controls	1	LS	\$ 173,275.20	\$ 173,275
21	Tank and A/C Pad (10'x20'x12")	7.5	CY	\$ 635.26	\$ 4,764
22	Electrical Service, Swichgear, Panels, Wiring, and Conduit	1	LS	\$ 238,376.46	\$ 238,376
23	125 hp Motor VFDs	2	EA	\$ 46,585.71	\$ 93,171
24	Electrical Pre-Cast Vault/Buidling	1	LS	\$ 70,584.42	\$ 70,584
25	Emergency Generator w/ Fuel Tank	1	LS	\$ 47,432.73	\$ 47,433
26	Generator Pad (15'x20'x18")	17	CY	\$ 635.26	\$ 10,799
27	RTU in NEMA Enclosure with Antenna	1	LS	\$ 28,233.77	\$ 28,234
28	Pole & Base	1	LS	\$ 705.84	\$ 706
29	Security Allowance	1	LS	\$ 10,587.66	\$ 10,588
30	Site Lighting	4	EA	\$ 3,952.73	\$ 15,811
31	Access Gate	1	EA	\$ 2,117.53	\$ 2,118
32	CMU Wall	590	LF	\$ 140.73	\$ 83,033
33	Site 4" ABC Finish	21780	SF	\$ 0.44	\$ 9,531
34	Concrete Drive	1	EA	\$ 1,411.69	\$ 1,412
35	Asphalt Driveway	1	LS	\$ 2,399.87	\$ 2,400
	OVERHEAD (10%)				\$ 113,963
	CONSTRUCTION PROFIT (6%)				\$ 68,378
	SALES TAX (65% of above costs at 9.1%)				\$ 67,409
	CONTINGENCY (30%)				\$ 341,889
	GENERAL CONDITIONS (15%)				\$ 170,944
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 1,902,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 2,662,800</b>



PROJECT : 2017 Water and Wastewater Models  
 JOB # : 10636A.00  
 CLIENT : City of Prescott  
 ELEMENT : Booster Pump Station Construction, 4 MGD

LOCATION FACTOR: 0.875  
 DATE : November-17  
 ENR : 10870  
 BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization (10%)	1	LS	\$ 130,974.78	\$ 130,975
2	Material Testing	1	LS	\$ 3,529.22	\$ 3,529
3	Piping - 16" MJ DIP	300	LF	\$ 55.06	\$ 16,518
4	16" DIP MJ Fittings	4	EA	\$ 3,079.59	\$ 12,318
5	125 hp Vertical Turbine Pump w/ Pump Can	3	EA	\$ 53,760.00	\$ 161,280
6	12" Discharge Piping FL DIP (10 FT per pump)	3	EA	\$ 1,072.97	\$ 3,219
7	12" FL Check Valve	3	EA	\$ 5,801.99	\$ 17,406
8	12" FL BFBV	3	EA	\$ 3,120.98	\$ 9,363
9	16" DIP FL Fittings	4	EA	\$ 3,079.59	\$ 12,318
10	16" DIP FL Pipe - Manifold	30	LF	\$ 181.04	\$ 5,431
11	12" Flowmeter	1	EA	\$ 8,288.88	\$ 8,289
12	16" Reducers	2	EA	\$ 1,066.57	\$ 2,133
13	16" FL BFBVs	2	EA	\$ 2,576.86	\$ 5,154
14	Pressure Transmitters and Instrumentation	2	LS	\$ 8,470.13	\$ 16,940
15	Piping Support Pad - (10'x20'x12")	7.5	CY	\$ 635.26	\$ 4,764
16	Misc Pipe Supports	1	LS	\$ 1,920.00	\$ 1,920
17	Chlorine Fiberglass Enclosure	1	LS	\$ 8,960.00	\$ 8,960
18	Chlorine Building Slab (6'x6'x8")	1	CY	\$ 317.37	\$ 317
19	Chlorine Equipment & Piping	1	LS	\$ 4,480.00	\$ 4,480
20	5,000 gallon hydromatic tank w/ air comp & controls	1	LS	\$ 237,163.64	\$ 237,164
21	Tank and A/C Pad (10'x20'x12")	7.5	CY	\$ 635.26	\$ 4,764
22	Electrical Service, Swichgear, Panels, Wiring, and Conduit	1	LS	\$ 317,474.99	\$ 317,475
23	125 hp Motor VFDs	3	EA	\$ 46,585.71	\$ 139,757
24	Electrical Pre-Cast Vault/Buidling	1	LS	\$ 70,584.42	\$ 70,584
25	Emergency Generator w/ Fuel Tank	1	LS	\$ 81,030.91	\$ 81,031
26	Generator Pad (15'x20'x18")	17	CY	\$ 635.26	\$ 10,799
27	RTU in NEMA Enclosure with Antenna	1	LS	\$ 28,233.77	\$ 28,234
28	Pole & Base	1	LS	\$ 705.84	\$ 706
29	Security Allowance	1	LS	\$ 10,587.66	\$ 10,588
30	Site Lighting	4	EA	\$ 3,952.73	\$ 15,811
31	Access Gate	1	EA	\$ 2,117.53	\$ 2,118
32	CMU Wall	590	LF	\$ 140.73	\$ 83,033
33	Site 4" ABC Finish	21780	SF	\$ 0.44	\$ 9,531
34	Concrete Drive	1	EA	\$ 1,411.69	\$ 1,412
35	Asphalt Driveway	1	LS	\$ 2,399.87	\$ 2,400
	OVERHEAD (10%)				\$ 144,072
	CONSTRUCTION PROFIT (6%)				\$ 86,443
	SALES TAX (65% of above costs at 9.1%)				\$ 85,219
	CONTINGENCY (30%)				\$ 432,217
	GENERAL CONDITIONS (15%)				\$ 216,108
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 2,405,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 3,367,000</b>



PROJECT : 2017 Water and Wastewater Models

LOCATION FACTOR: 0.875

JOB # : 10636A.00

DATE : November-17

CLIENT : City of Prescott

ENR : 10870

ELEMENT : Booster Pump Station Construction, 8 MGD

BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization (10%)	1	LS	\$ 171,054.92	\$ 171,055
2	Material Testing	1	LS	\$ 3,529.22	\$ 3,529
3	Piping - 24" MJ DIP	300	LF	\$ 108.47	\$ 32,541
4	24" DIP MJ Fittings	4	EA	\$ 6,495.45	\$ 25,982
5	125 hp Vertical Turbine Pump w/ Pump Can	5	EA	\$ 59,290.91	\$ 296,455
6	12" Discharge Piping FL DIP (10 FT per pump)	5	EA	\$ 2,919.89	\$ 14,599
7	12" FL Check Valve	5	EA	\$ 5,801.99	\$ 29,010
8	12" FL BFV	5	EA	\$ 1,954.96	\$ 9,775
9	24" DIP FL Fittings	4	EA	\$ 4,745.67	\$ 18,983
10	24" DIP FL Pipe - Manifold	30	LF	\$ 291.99	\$ 8,760
11	20" Flowmeter	1	EA	\$ 18,098.25	\$ 18,098
12	24" Reducers	2	EA	\$ 1,909.55	\$ 3,819
13	24" FL BFVs	2	EA	\$ 5,642.90	\$ 11,286
14	Pressure Transmitters and Instrumentation	2	LS	\$ 8,470.13	\$ 16,940
15	Piping Support Pad - (10'x20'x12")	7.5	CY	\$ 635.26	\$ 4,764
16	Misc Pipe Supports	1	LS	\$ 2,117.53	\$ 2,118
17	5,000 gallon hydromatic tank w/ air comp & controls	1	LS	\$ 237,163.64	\$ 237,164
18	Tank and A/C Pad (10'x20'x12")	7.5	CY	\$ 635.26	\$ 4,764
19	Electrical Service, Swichgear, Panels, Wiring, and Conduit	1	LS	\$ 440,741.78	\$ 440,742
20	125 hp Motor VFDs	5	EA	\$ 46,585.71	\$ 232,929
21	Electrical Pre-Cast Vault/Buidling	1	LS	\$ 70,584.42	\$ 70,584
22	Emergency Generator w/ Fuel Tank	1	LS	\$ 148,227.27	\$ 148,227
23	Generator Pad (15'x20'x18")	17	CY	\$ 635.26	\$ 10,799
24	RTU in NEMA Enclosure with Antenna	1	LS	\$ 28,233.77	\$ 28,234
25	Pole & Base	1	LS	\$ 705.84	\$ 706
26	Security Allowance	1	LS	\$ 10,587.66	\$ 10,588
27	Site Lighting	4	EA	\$ 3,952.73	\$ 15,811
28	Site 4" ABC Finish	21780	SF	\$ 0.44	\$ 9,531
29	Concrete Drive	1	EA	\$ 1,411.69	\$ 1,412
30	Asphalt Driveway	1	LS	\$ 2,399.87	\$ 2,400
31	20% Site Specific Requirements	20	%	\$ 376,320.83	\$ 376,321
	OVERHEAD (10%)				\$ 188,160
	CONSTRUCTION PROFIT (6%)				\$ 135,475
	SALES TAX (65% of above costs at 9.1%)				\$ 111,297
	CONTINGENCY (30%)				\$ 677,377
	GENERAL CONDITIONS (15%)				\$ 338,689
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 3,709,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 5,192,600</b>



PROJECT : 2017 Water and Wastewater Models

LOCATION FACTOR: 0.875

JOB # : 10636A.00

DATE : November-17

CLIENT : City of Prescott

ENR : 10870

ELEMENT : Booster Pump Station Construction, 12 MGD

BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization (10%)	1	LS	\$ 225,873.57	\$ 225,874
2	Material Testing	1	LS	\$ 3,529.22	\$ 3,529
3	Piping - 24" MJ DIP	300	LF	\$ 108.47	\$ 32,541
4	24" DIP MJ Fittings	4	EA	\$ 6,495.45	\$ 25,982
5	250 hp Vertical Turbine Pump w/ Pump Can	4	EA	\$ 74,113.64	\$ 296,455
6	16" Discharge Piping FL DIP (10 FT per pump)	4	EA	\$ 1,544.52	\$ 6,178
7	16" FL Check Valve	4	EA	\$ 18,981.24	\$ 75,925
8	16" FL BfV	4	EA	\$ 5,058.66	\$ 20,235
9	24" DIP FL Fittings	4	EA	\$ 6,495.45	\$ 25,982
10	24" DIP FL Pipe - Manifold	30	LF	\$ 291.99	\$ 8,760
11	20" Flowmeter	1	EA	\$ 18,098.25	\$ 18,098
12	24" Reducers	2	EA	\$ 2,118.45	\$ 4,237
13	24" FL BfVs	2	EA	\$ 5,642.90	\$ 11,286
14	Pressure Transmitters and Instrumentation	2	LS	\$ 8,470.13	\$ 16,940
15	Piping Support Pad - (10'x20'x12")	7.5	CY	\$ 635.26	\$ 4,764
16	Misc Pipe Supports	1	LS	\$ 2,117.53	\$ 2,118
17	10,000 gallon hydromatic tank w/ air comp & controls	1	LS	\$ 216,594.00	\$ 216,594
18	Tank and A/C Pad (10'x20'x12")	7.5	CY	\$ 635.26	\$ 4,764
19	Electrical Service, Swichgear, Panels, Wiring, and Conduit	1	LS	\$ 589,267.36	\$ 589,267
20	250 hp Motor VFDs	4	EA	\$ 141,168.83	\$ 564,675
21	Electrical Pre-Cast Vault/Buidling	1	LS	\$ 70,584.42	\$ 70,584
22	Emergency Generator w/ Fuel Tank	1	LS	\$ 187,754.55	\$ 187,755
23	Generator Pad (15'x20'x18")	17	CY	\$ 635.26	\$ 10,799
24	RTU in NEMA Enclosure with Antenna	1	LS	\$ 28,233.77	\$ 28,234
25	Pole & Base	1	LS	\$ 705.84	\$ 706
26	Security Allowance	1	LS	\$ 10,587.66	\$ 10,588
27	Site Lighting	4	EA	\$ 3,952.73	\$ 15,811
28	Access Gate	1	EA	\$ 2,117.53	\$ 2,118
29	Concrete Drive	1	EA	\$ 1,411.69	\$ 1,412
30	Asphalt Driveway	1	LS	\$ 2,399.87	\$ 2,400
31	20% Site Specific Requirements	20	%	\$ 496,921.85	\$ 496,922
	OVERHEAD (10%)				\$ 298,153
	CONSTRUCTION PROFIT (6%)				\$ 178,892
	SALES TAX (65% of above costs at 9.1%)				\$ 176,358
	CONTINGENCY (30%)				\$ 894,459
	GENERAL CONDITIONS (15%)				\$ 447,230
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 4,977,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 6,967,800</b>



**PROJECT :** 2017 Water and Wastewater Models  
**JOB # :** 10636A.00  
**CLIENT :** City of Prescott  
**ELEMENT :** Drill Well, 700 Ft Deep

**LOCATION FACTOR:** 0.875  
**DATE :** November-17  
**ENR :** 10870  
**BY :** NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization	1	LS	\$ 63,551.49	\$ 63,551
2	Well Drilling	700	LF	\$ 155.29	\$ 108,700
3	Casing & Gravel Pack Installation	500	LF	\$ 494.09	\$ 247,045
4	Stainless Steel Screen & Gravel Pack Installation	200	LF	\$ 777.70	\$ 155,541
5	Well Logging and Sampling	1	LS	\$ 70,584.42	\$ 70,584
6	Well Development and Testing	1	LS	\$ 53,644.16	\$ 53,644
	OVERHEAD (10%)				\$ 69,910
	CONSTRUCTION PROFIT (6%)				\$ 41,940
	SALES TAX (6.5%)				\$ 41,350
	CONTINGENCY (30%)				\$ 209,720
	GENERAL CONDITIONS (15%)				\$ 104,860
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 1,167,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 1,634,000</b>



PROJECT : 2017 Water and Wastewater Models

LOCATION FACTOR: 0.875

JOB # : 10636A.00

DATE : November-17

CLIENT : City of Prescott

ENR : 10870

ELEMENT : Drill Well, 1,100 Ft Deep

BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization	1	LS	\$ 93,800	\$ 93,800
2	Well Drilling	1100	LF	\$ 160	\$ 170,800
3	Casing & Gravel Pack Installation	900	LF	\$ 490	\$ 444,700
4	Stainless Steel Screen & Gravel Pack Installation	200	LF	\$ 780	\$ 155,500
5	Well Logging and Sampling	1	LS	\$ 91,800	\$ 91,800
6	Well Development and Testing	1	LS	\$ 74,800	\$ 74,800
	OVERHEAD (10%)				\$ 103,140
	CONSTRUCTION PROFIT (6%)				\$ 61,880
	SALES TAX (6.5%)				\$ 61,010
	CONTINGENCY (30%)				\$ 309,420
	GENERAL CONDITIONS (15%)				\$ 154,710
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 1,722,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 2,411,000</b>



PROJECT : 2017 Water and Wastewater Models  
 JOB # : 10636A.00  
 CLIENT : City of Prescott  
 ELEMENT : Tank Construction, 0.5 MG

LOCATION FACTOR: 0.875  
 DATE : November-17  
 ENR : 10870  
 BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Material Test	1	LS	\$ 3,530	\$ 3,530
2	Site Grading	10000	CY	\$ 49	\$ 487,700
3	Piping - 24" MJ DIP	300	LF	\$ 110	\$ 32,500
4	24" DIP MJ Fittings	8	EA	\$ 6,500	\$ 52,000
5	24" DIP Valve	3	EA	\$ 6,800	\$ 20,500
6	Backfill	2800	CY	\$ 10	\$ 28,000
7	Vapor Barrier	7000	SF	\$ 1	\$ 3,460
8	0.5 MG Steel Tank	1	LS	\$ 458,500	\$ 458,500
9	Level Transmitter and Instrumentation	1	LS	\$ 10,600	\$ 10,600
10	Tank Painting	3500	SF	\$ 2.70	\$ 9,400
	OVERHEAD (10%)				\$ 110,620
	CONSTRUCTION PROFIT (6%)				\$ 66,370
	SALES TAX (6.5%)				\$ 65,430
	CONTINGENCY (30%)				\$ 331,860
	GENERAL CONDITIONS (15%)				\$ 165,930
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 1,846,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 2,584,000</b>



PROJECT : 2017 Water and Wastewater Models

LOCATION FACTOR: 0.875

JOB # : 10636A.00

DATE : November-17

CLIENT : City of Prescott

ENR : 10870

ELEMENT : Tank Construction, 1.5 MG

BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Material Test	1	LS	\$ 3,530	\$ 3,530
2	Site Grading	10000	CY	\$ 49	\$ 487,700
3	Piping - 24" MJ DIP	300	LF	\$ 110	\$ 32,500
4	24" DIP MJ Fittings	8	EA	\$ 6,500	\$ 52,000
5	24" DIP Valve	3	EA	\$ 6,800	\$ 20,500
6	Backfill	2800	CY	\$ 10	\$ 28,000
7	Vapor Barrier	8000	SF	\$ 1	\$ 3,950
8	1.5 MG Steel Tank	1	LS	\$ 936,800	\$ 936,800
9	Level Transmitter and Instrumentation	1	LS	\$ 10,600	\$ 10,600
10	Tank Painting	3650	SF	\$ 2.70	\$ 9,800
	OVERHEAD (10%)				\$ 158,540
	CONSTRUCTION PROFIT (6%)				\$ 95,120
	SALES TAX (6.5%)				\$ 93,780
	CONTINGENCY (30%)				\$ 475,610
	GENERAL CONDITIONS (15%)				\$ 237,810
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 2,646,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 3,704,000</b>



PROJECT : 2017 Water and Wastewater Models

LOCATION FACTOR: 0.875

JOB # : 10636A.00

DATE : November-17

CLIENT : City of Prescott

ENR : 10870

ELEMENT : Tank Construction, 2.5 MG

BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Material Test	1	LS	\$ 3,529.22	\$ 3,529
2	Site Grading	10,000	CY	\$ 48.77	\$ 487,738
3	Piping - 24" MJ DIP	300	LF	\$ 83.80	\$ 25,140
4	24" DIP MJ Fittings	8	EA	\$ 7,311.18	\$ 58,489
5	24" DIP Valve	3	EA	\$ 12,881.42	\$ 38,644
6	Backfill	4,800	CY	\$ 10.00	\$ 48,000
7	Vapor Barrier	12,900	SF	\$ 0.49	\$ 6,374
8	2.5 MG Steel Tank	1	LS	\$ 1,444,250.00	\$ 1,444,250
9	Level Transmitter and Instrumentation	1	LS	\$ 10,587.66	\$ 10,588
10	Tank Painting	4,020	SF	\$ 2.68	\$ 10,782
	OVERHEAD (10%)				\$ 213,350
	CONSTRUCTION PROFIT (6%)				\$ 128,010
	SALES TAX (6.5%)				\$ 126,200
	CONTINGENCY (30%)				\$ 640,060
	GENERAL CONDITIONS (15%)				\$ 320,030
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 3,561,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 4,985,000</b>



PROJECT : 2017 Water and Wastewater Models

LOCATION FACTOR: 0.875

JOB # : 10636A.00

DATE : November-17

CLIENT : City of Prescott

ENR : 10870

ELEMENT : Tank Construction, 5 MG

BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Material Test	1	LS	\$ 3,529.22	\$ 3,529
2	Site Grading	10,000	CY	\$ 48.77	\$ 487,738
3	Piping - 24" MJ DIP	300	LF	\$ 108.47	\$ 32,541
4	24" DIP MJ Fittings	8	EA	\$ 6,495.18	\$ 51,961
5	24" DIP Valve	3	EA	\$ 27,078.30	\$ 81,235
6	Backfill	7,540	CY	\$ 10.00	\$ 75,400
7	Vapor Barrier	21,400	SF	\$ 0.49	\$ 10,574
8	5.0 MG Steel Tank	1	LS	\$ 2,869,000.00	\$ 2,869,000
9	Level Transmitter and Instrumentation	1	LS	\$ 10,587.66	\$ 10,588
10	Tank Painting	5,190	SF	\$ 2.68	\$ 13,921
	OVERHEAD (10%)				\$ 363,650
	CONSTRUCTION PROFIT (6%)				\$ 218,190
	SALES TAX (6.5%)				\$ 215,100
	CONTINGENCY (30%)				\$ 1,090,950
	GENERAL CONDITIONS (15%)				\$ 545,470
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 6,070,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 8,498,000</b>

















PROJECT : 2017 Water and Wastewater Models

LOCATION FACTOR: 0.875

JOB # : 10636A.00

DATE : November-17

CLIENT : City of Prescott

ENR CCI : 10870

ELEMENT : Lift Station Construction, 0.2 MGD

BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization (10%)	1	LS	\$ 34,499.55	\$ 34,500
2	Material Testing	1	LS	\$ 3,529.22	\$ 3,529
3	200,000 GPD Packaged Sewage Lift Station	1	LS	\$ 227,895.20	\$ 227,895
4	Electrical Service, etc.	1	LS	\$ 16,085.85	\$ 16,086
5	Electrical Shade Canopy	1	LS	\$ 5,236.54	\$ 5,237
6	Emergency Generator w/ Fuel Tank	1	LS	\$ 23,528.14	\$ 23,528
7	Generator Pad (10'x20'x18")	5.5	CY	\$ 635.26	\$ 3,494
8	Security Allowance	1	LS	\$ 10,587.66	\$ 10,588
9	Site Lighting	4	EA	\$ 2,094.61	\$ 8,378
10	Access Gate	1	EA	\$ 2,117.53	\$ 2,118
11	CMU Wall	400	LF	\$ 77.00	\$ 30,800
12	Site 4" ABC Finish	21780	SF	\$ 0.44	\$ 9,531
13	Concrete Drive	1	EA	\$ 1,411.69	\$ 1,412
14	Asphalt Driveway	1	LS	\$ 2,399.87	\$ 2,400
	OVERHEAD (10%)				\$ 37,950
	CONSTRUCTION PROFIT (6%)				\$ 38,295
	SALES TAX (65% of above costs at 9.1%)				\$ 22,447
	CONTINGENCY (30%)				\$ 113,849
	GENERAL CONDITIONS (15%)				\$ 56,924
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 649,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 909,000</b>



PROJECT : 2017 Water and Wastewater Models  
 JOB # : 10636A.00  
 CLIENT : City of Prescott  
 ELEMENT : Lift Station Construction, 0.8 MGD

LOCATION FACTOR: 0.875  
 DATE : November-17  
 ENR CCI : 10870  
 BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization (10%)	1	LS	\$ 44,190.13	\$ 44,190
2	Material Testing	1	LS	\$ 3,529.22	\$ 3,529
3	800,000 GPD Packaged Sewage Lift Station	1	LS	\$ 317,532.80	\$ 317,533
4	Electrical Service, etc.	1	LS	\$ 22,412.87	\$ 22,413
5	Electrical Shade Canopy	1	LS	\$ 5,236.54	\$ 5,237
6	Emergency Generator w/ Fuel Tank	1	LS	\$ 24,469.26	\$ 24,469
7	Generator Pad (10'x20'x18")	5.5	CY	\$ 635.26	\$ 3,494
8	Security Allowance	1	LS	\$ 10,587.66	\$ 10,588
9	Site Lighting	4	EA	\$ 2,094.61	\$ 8,378
10	Access Gate	1	EA	\$ 2,117.53	\$ 2,118
11	CMU Wall	400	LF	\$ 77.00	\$ 30,800
12	Site 4" ABC Finish	21780	SF	\$ 0.44	\$ 9,531
13	Concrete Drive	1	EA	\$ 1,411.69	\$ 1,412
14	Asphalt Driveway	1	LS	\$ 2,399.87	\$ 2,400
	OVERHEAD (10%)				\$ 48,609
	CONSTRUCTION PROFIT (6%)				\$ 29,165
	SALES TAX (65% of above costs at 9.1%)				\$ 28,752
	CONTINGENCY (30%)				\$ 145,827
	GENERAL CONDITIONS (15%)				\$ 72,914
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 811,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 1,136,000</b>



PROJECT : 2017 Water and Wastewater Models

LOCATION FACTOR: 0.875

JOB # : 10636A.00

DATE : November-17

CLIENT : City of Prescott

ENR CCI : 10870

ELEMENT : Lift Station Construction, 6 MGD

BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization (10%)	1	LS	\$ 178,564.34	\$ 178,564
2	Material Testing	1	LS	\$ 3,529.22	\$ 3,529
3	Piping - 6"	300	LF	\$ 63.00	\$ 18,900
4	6" Fittings	4	EA	\$ 3,247.59	\$ 12,990
5	75 hp Pump	4	EA	\$ 46,588.54	\$ 186,354
6	8" Discharge Piping (10 FT per pump)	4	EA	\$ 616.24	\$ 2,465
7	8" FL Check Valve	4	EA	\$ 3,481.19	\$ 13,925
8	8" FL Plug Valve	5	EA	\$ 2,150.45	\$ 10,752
9	8" Flowmeter	1	EA	\$ 4,550.00	\$ 4,550
10	Mechanical Bar Screen System, 10'	2	EA	\$ 12,891.55	\$ 25,783
11	Wetwell Excavation (Dual)	296	CY	\$ 48.77	\$ 14,437.05
12	Wetwell Construction (Dual)	104	CY	\$ 1,270.52	\$ 131,757.58
13	Pressure Transmitters and Instrumentation	3	LS	\$ 8,470.13	\$ 25,410
14	Piping Support Pad - (10'x20'x12")	10	CY	\$ 635.26	\$ 6,353
15	Pipe Shade Canopy	1	LS	\$ 20,963.57	\$ 20,964
16	Misc Pipe Supports	1	LS	\$ 1,500.00	\$ 1,500
17	Electrical Service, Swichgear, Panels, Wiring, and Cond	1	LS	\$ 260,073.52	\$ 260,074
18	75 hp Motor VFDs	3	EA	\$ 46,585.71	\$ 139,757
19	Electrical Pre-Cast Vault/Buidling	1	LS	\$ 70,584.42	\$ 70,584
20	Emergency Generator w/ Fuel Tank	2	EA	\$ 81,030.91	\$ 162,062
21	Generator Pad (15'x20'x18")	17	CY	\$ 635.26	\$ 10,799
22	RTU in NEMA Enclosure with Antenna	1	LS	\$ 28,233.77	\$ 28,234
23	Pole & Base	1	LS	\$ 705.84	\$ 706
24	Security Allowance	1	LS	\$ 10,587.66	\$ 10,588
25	Site Lighting	4	EA	\$ 3,952.73	\$ 15,811
26	Odor Control System	1	LS	\$ 500,000.00	\$ 500,000
27	Pump Removal Crane	1	EA	\$ 8,865.00	\$ 8,865
28	Access Gate	1	EA	\$ 2,117.53	\$ 2,118
29	CMU Wall	590	LF	\$ 140.73	\$ 83,033
30	Site 4" ABC Finish	21780	SF	\$ 0.44	\$ 9,531
31	Concrete Drive	1	EA	\$ 1,411.69	\$ 1,412
32	Asphalt Driveway	1	LS	\$ 2,399.87	\$ 2,400
	OVERHEAD (10%)				\$ 196,421
	CONSTRUCTION PROFIT (6%)				\$ 117,852
	SALES TAX (65% of above costs at 9.1%)				\$ 116,183
	CONTINGENCY (30%)				\$ 589,262
	GENERAL CONDITIONS (15%)				\$ 294,631
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 3,279,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 4,591,000</b>



PROJECT : 2017 Water and Wastewater Models

LOCATION FACTOR: 0.875

JOB # : 10636A.00

DATE : November-17

CLIENT : City of Prescott

ENR CCI : 10870

ELEMENT : Lift Station Construction, 12 MGD

BY : NWD

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization and Demobilization (10%)	1	LS	\$ 271,331.93	\$ 271,332
2	Material Testing	1	LS	\$ 3,529.22	\$ 3,529
3	Piping - 6"	300	LF	\$ 63.00	\$ 18,900
4	8" Fittings	4	EA	\$ 3,897.11	\$ 15,588
5	75 hp Pump	6	EA	\$ 46,588.54	\$ 279,531
6	8" Discharge Piping (10 FT per pump)	6	EA	\$ 616.24	\$ 3,697
7	8" FL Check Valve	6	EA	\$ 3,481.19	\$ 20,887
8	8" FL Plug Valve	7	EA	\$ 2,150.45	\$ 15,053
9	8" Flowmeter	1	EA	\$ 4,550.00	\$ 4,550
10	Mechanical Bar Screen System, 10'	3	EA	\$ 12,891.55	\$ 38,675
11	Wetwell Excavation (Dual)	444	CY	\$ 48.77	\$ 21,655.58
12	Wetwell Construction (Dual)	148	CY	\$ 1,270.52	\$ 188,225.11
13	Pressure Transmitters and Instrumentation	5	LS	\$ 8,470.13	\$ 42,351
14	Piping Support Pad - (10'x20'x12")	10	CY	\$ 635.26	\$ 6,353
15	Pipe Shade Canopy	1	LS	\$ 20,963.57	\$ 20,964
16	Misc Pipe Supports	1	LS	\$ 1,500.00	\$ 1,500
17	Electrical Service, Swichgear, Panels, Wiring, and Cond	1	LS	\$ 426,400.33	\$ 426,400
18	75 hp Motor VFDs	6	EA	\$ 46,585.71	\$ 279,514
19	Electrical Pre-Cast Vault/Buidling	1	LS	\$ 70,584.42	\$ 70,584
20	Emergency Generator w/ Fuel Tank	2	EA	\$ 160,932.47	\$ 321,865
21	Generator Pad (15'x20'x18")	17	CY	\$ 635.26	\$ 10,799
22	RTU in NEMA Enclosure with Antenna	1	LS	\$ 28,233.77	\$ 28,234
23	Odor Control System	1	LS	\$ 760,000.00	\$ 760,000
24	Pole & Base	1	LS	\$ 705.84	\$ 706
25	Security Allowance	1	LS	\$ 10,587.66	\$ 10,588
26	Site Lighting	4	EA	\$ 3,952.73	\$ 15,811
27	Pump Removal Crane	1	EA	\$ 8,865.00	\$ 8,865
28	Access Gate	1	EA	\$ 2,117.53	\$ 2,118
29	CMU Wall	590	LF	\$ 140.73	\$ 83,033
30	Site 4" ABC Finish	21780	SF	\$ 0.44	\$ 9,531
31	Concrete Drive	1	EA	\$ 1,411.69	\$ 1,412
32	Asphalt Driveway	1	LS	\$ 2,399.87	\$ 2,400
	OVERHEAD (10%)				\$ 298,465
	CONSTRUCTION PROFIT (6%)				\$ 179,079
	SALES TAX (65% of above costs at 9.1%)				\$ 176,542
	CONTINGENCY (30%)				\$ 895,395
	GENERAL CONDITIONS (15%)				\$ 447,698
	<b>TOTAL CONSTRUCTION COST</b>				<b>\$ 4,982,000</b>
	<b>TOTAL PROJECT COST (1.4 times Const Cost)</b>				<b>\$ 6,975,000</b>