



Chapter 2

Water System Overview

2020 City of Billings Water Master Plan
(Draft)

City of Billings, MT



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Introduction

The purpose of this chapter is to describe the existing City of Billings (City) water system, including existing infrastructure and the customers served.

Existing Water System

The City of Billings Gerald D. Underwood Water Treatment Facility (WTP) is a conventional surface water treatment plant that can deliver up to 60 million gallons per day (MGD). The source water for this treatment plant is the Yellowstone River. The City serves about 80,000 people via 35,800 service connections. Other major water system components include the following, most of which are shown in Figure 2-1:

- ◆ 12 pressure zones
- ◆ 18 storage facilities
- ◆ 12 booster stations
- ◆ 500 miles of transmission and distributions piping, ranging in size from 4" to 42"
- ◆ 5,930 active fire hydrants
- ◆ A Supervisory Control and Data Acquisition (SCADA) system with a Control Room at the WTP to monitor and control the entire distribution system.

Pressure Zones

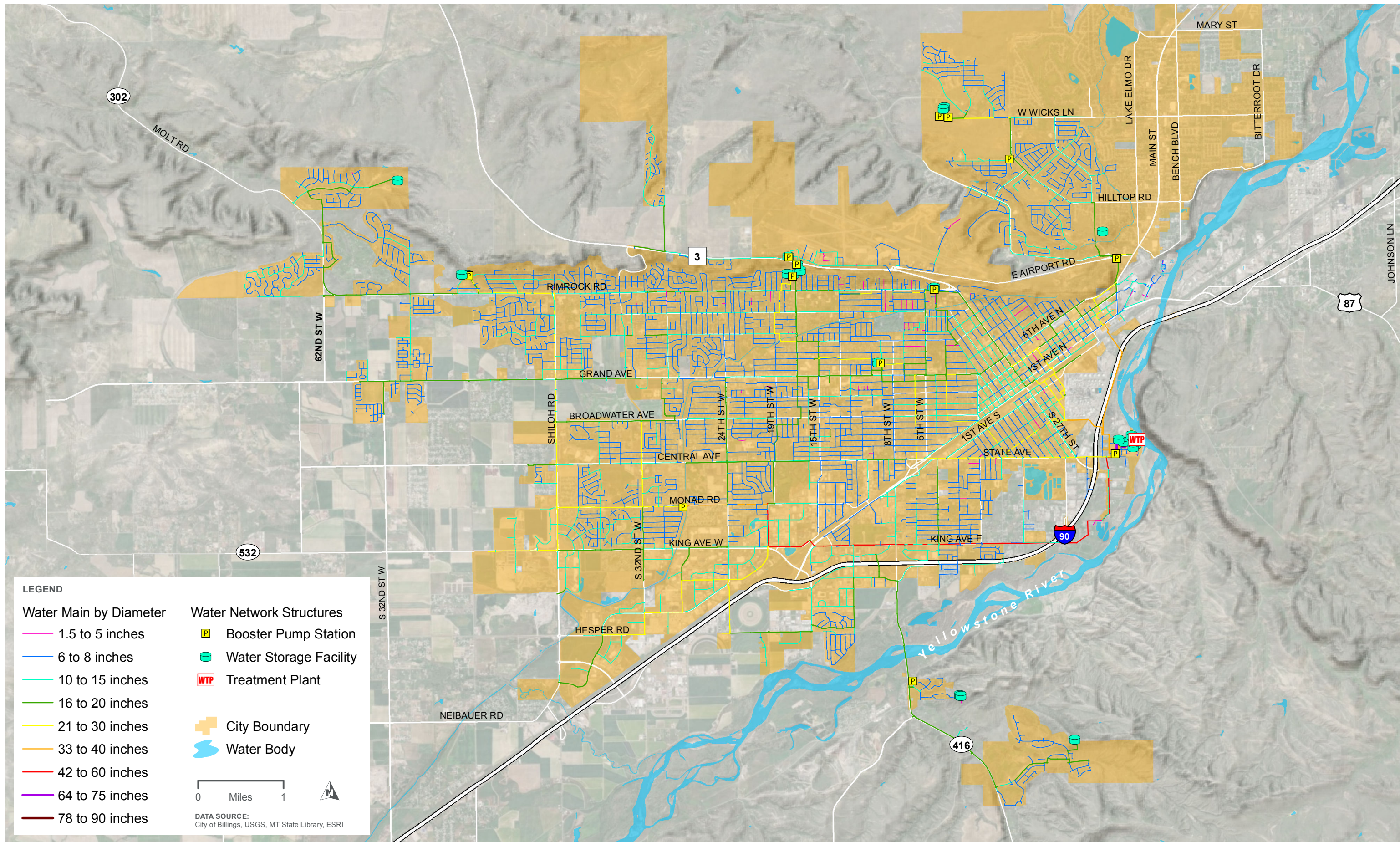
The City's water service area is divided into pressure zones based on location and ground elevations, which range from 3,104 to 3,750 feet. Pressure zone boundaries are shown Figure 2-2 and pressure zone characteristics are summarized in Table 2-1. A brief discussion of each of the City's pressure zones is provided herein.

ZONE 1

This portion of the system includes the majority of central Billings, including downtown and large industrial users (including the largest single user in the system, the Phillips 66 refinery) in the vicinity of the Interstate and Monad. The zone is roughly bound by the Arnold Drain, the City Drain, Alkali Creek and the Yellowstone River. Zone 1 currently serves the highest demands in the system with water supplied from the High Service Pump Station (HSPS) and the Leavens (3 MG) and Willett (3.25 MG) storage facilities.

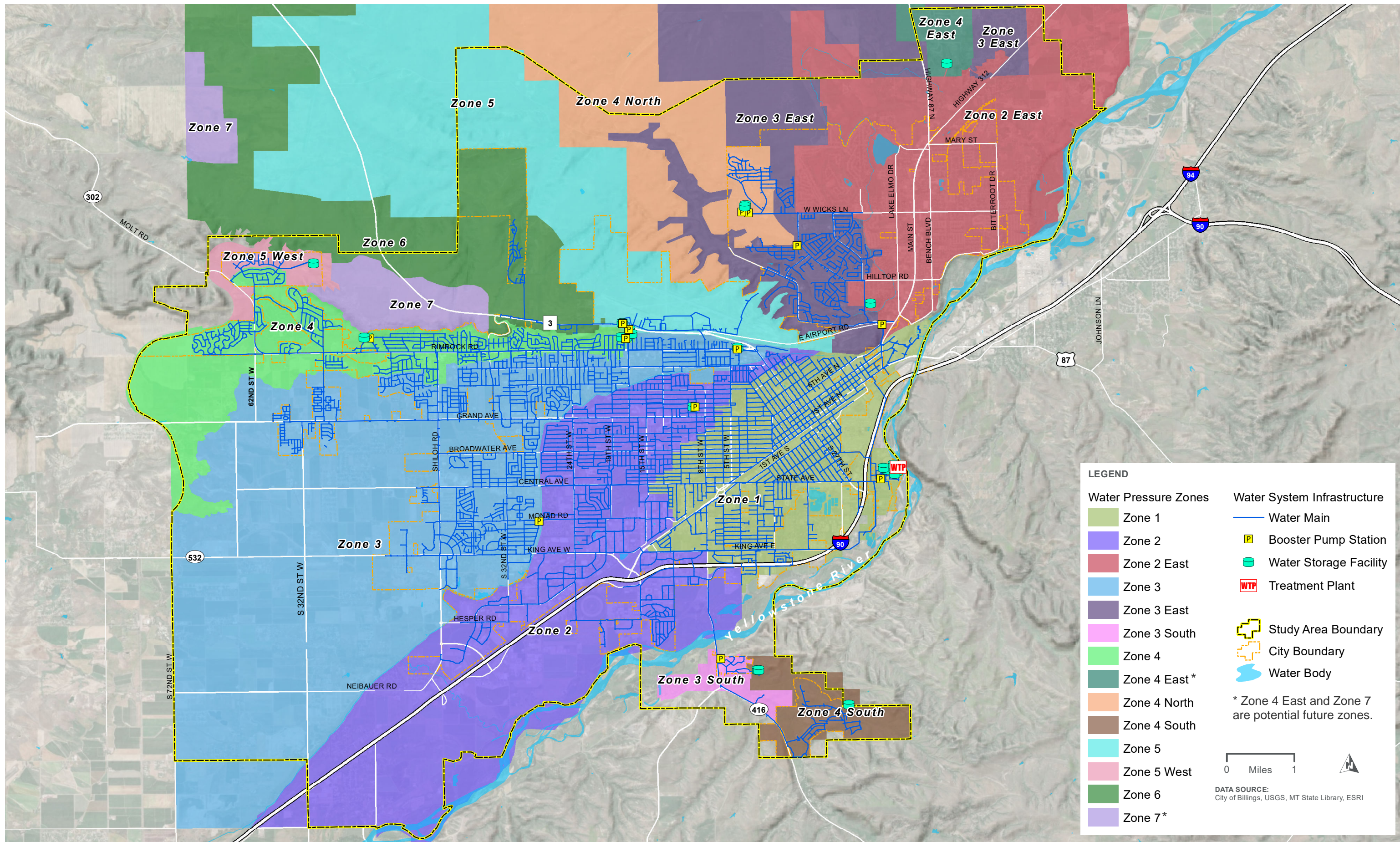
ZONE 2

This portion of the system includes a large portion of Billings, including the 24th Street West Corridor, Grand Avenue, the lettered streets, and King Avenue and associated development, and industrial development along Gabel Road and the Interstate. This zone is roughly bound by Zone 1 to the east, the BBWA Canal and includes both sides of I-90. Water is supplied from the HSPS, Willet Pump Station, and Staples (9 MG) storage facilities. Zone 2 and Zone 3 have the second highest demands in the system.



EXISTING WATER DISTRIBUTION SYSTEM
FIGURE 2-2





LEGEND

Water Pressure Zones	Water System Infrastructure
Zone 1	Water Main
Zone 2	Booster Pump Station
Zone 2 East	Water Storage Facility
Zone 3	Treatment Plant
Zone 3 East	Study Area Boundary
Zone 3 South	City Boundary
Zone 4	Water Body
Zone 4 East*	
Zone 4 North	* Zone 4 East and Zone 7 are potential future zones.
Zone 4 South	
Zone 5	
Zone 5 West	
Zone 6	
Zone 7*	

0 Miles 1

DATA SOURCE:
City of Billings, USGS, MT State Library, ESRI

ZONE 2 EAST (HEIGHTS WATER DISTRICT)

The Zone 2 East Pressure Zone is operated by the County Water District of Billings Heights (HWD), and is one of the City of Billings' largest customers. This zone is master metered at Main Street and Airport Road near Walter Pump Station. The HWD maintains their own distribution system and billing collection. The HWD is roughly bound to the east by the Yellowstone River, to the West by the BBWA Canal, to the south by Zone 1, and on the north end by Zone 3 East and a potential future pressure zone, Zone 4 East.

The HWD planning boundary extends north to Oxbow Subdivision, east to the BBWA Canal and west to Alexander/Sindelar Ranch. HWD includes 140 miles of water mains, seven pump stations, three water storage facilities including Hilltop (2 MG), Lanier (2 MG), and Oxbow (4 MG), and 5,600 customer service connections. All water comes from the City of Billings via the HSPS and Walter Pump Station.

ZONE 3

Zone 3 serves the majority of residential development in the central portion of the valley. The zone is roughly bound by Zone 2 to the east and south, the Hi-Line Ditch and Zone 4 to the north, and S 62nd Street to the west. Zone 3 demands include Montana State University - Billings and Rocky Mountain College, the Shiloh Road corridor, and development on King Avenue west of 32nd Street West. Zone 3 is served by Leavens, Staples and Voelker pump stations, as well as Chapple (5 MG and 2 MG), and Staples Standpipe (0.5 MG) water storage facilities.

ZONE 3 EAST

Zone 3 East includes portions of the Billings Heights area west of BBWA canal and south of Wicks Lane, with the exception of High Sierra. The zone is served via Walter pump station and Fox (2 MG and 2 MG) water storage facilities.

ZONE 3 SOUTH

Zone 3 South includes the Cedar Park subdivision, and the Meadowlark properties mobile home park. This zone is served by the Thomas Pump Station and the three Cedar Park reservoirs (0.062 MG total).

ZONE 4

Zone 4 is bound by the Hi-Line ditch to the south and the Rimrocks to the north from 17th Street West to Yellowstone Country Club, and includes southern portions of the Ironwood Subdivision and onto 70th Street West. The zone is served by Chapple and Staples pump stations and Waldo (0.25 MG) and Ironwood (2.0 MG) reservoirs.

ZONE 4 NORTH

Zone 4 North serves the High Sierra subdivision and Skyview High School. It is served by the Fox Pump Station.

ZONE 4 SOUTH

Zone 4 South includes the Briarwood subdivision and Country Club, and borders Zone 3 South. This zone is served by the Thomas Pump Station and Briarwood Reservoir (0.75 MG).



ZONE 5

Zone 5 includes the Billings International Airport and nearby industrial developments. The zone is bound to the south by the Rimrocks, to the north by Zone 4 North and Zone 3 East and to the west by Zone 6.

ZONE 5 WEST

Zone 5 West includes the upper portion of Ironwood subdivision and the Copper Ridge and Falcon Ridge subdivisions on the west side of Molt Road. It is supplied by the Ironwood Pump Station located in the stem of Ironwood Reservoir.

ZONE 6

Zone 6 sits west of the airport and includes the Rehberg Ranch subdivision and the residential area along the top of the Rims east of Zimmerman Trail. Water is supplied via the Christensen Pump Station.

FUTURE ZONES

Zone 4 East could be developed to serve north of Zone 2 East. Zone 7 could extend along the Rims west Zone 6 from Zimmerman Trail west including the Indian Cliffs subdivision.

Table 2-1. Pressure Zone Summary

Pressure Zone	HGL	Approximate Elevations Served		Approximate Static Pressures	
		High	Low	High	Low
1	3285	3222	3104	81	31
2	3376	3295	3156	147	35
2 East	3379	3191	3123	94	52
3	3480	3406	3181	132	36
3 East	3484	3322	3187	90	32
3 South	3400	3390	3180	140	20
4	3617		3283	148	30
4 North	3516	3424	3300	122	69
4 South	3625	3492	3492	149	48
5	3753	3651	3651	84	72
5 West	3630	3537	3537	67	40
6	3880	3750	3750	112	47

Water Supply

The City of Billings currently relies upon a single water source, the Yellowstone River. Raw water is diverted directly from the river to the WTP. While the WTP itself is robust and has redundant components, if the Yellowstone River water source were to become unusable for any reason, the City of Billings wouldn't be able to provide water beyond a few hours during peak demands.

In recent years, oil pipeline spills, ice jams, and drought, have highlighted concerns about the single source of supply and the City of Billings is in the process of moving forward with a new open earthen water storage reservoir which would provide months of water storage. The reservoir and a new WTP would provide a second potable water supply to the water system. The project will add capacity and resiliency to the City's water supply, treatment, and distribution system for decades to come.

Pump Stations and Water Storage

There are twelve (12) booster pump stations in the existing system plus the HSPS located at the WTP that pumps water into Zone 1, Zone 2, and Zone 2 East. There are eighteen (18) water storage facilities in the existing system including the two clearwells at the WTP. The characteristics of the City's existing pump stations are summarized in Table 2-2. Summary information of the City's existing storage facilities is provided in Table 2-3.



Table 2-2. Pump Station Summary

Pump Station	Pressure Zone Served	Total Capacity (MGD)	Firm Capacity ³ (MGD)
High Service	1	46.2	26.2
High Service	2/2 East	68.	47.2
Willett	2	10	5
Leavens	3	15.2	8
Staples	3	11	6
Staples	4	9	6
Voelker	3	21.3	14.3
Walter ¹	3 East (2 East)	12.55	7.5
Walter ²	3 East	5	0
Thomas	3 South	0.6	0.3
Thomas	4 South	4.1	1.9
Chapple	4	9	6
Terrace Estates	4 North	1.5	0.8
Fox	4 North	3.8	1.4
Waldo	5	5.7	2.1
Christensen	6	4.0	1.6
Ironwood	5 West	3.9	1.4
System Wide Total		209	124
¹ Capacity for pumping from Zone 2 East to Zone 3 East of Zone 1 to Zone 2E ² Capacity for pumping from Zone 1 to Zone 3 East ³ Firm Capacity = Total Capacity with largest pump out of service.			

Table 2-3. Water Storage Summary

Water Storage	Pressure Zone Served	Year Built	Size	Side Water Depth (ft)	Bottom Elevation (ft)	Overflow Elevation (ft)	Capacity (MG)	Comments
Clearwell No. 1	-	1975	125 FT (DIA)	58	3112	3170	5.2	Located at the WTP
Clearwell No. 2	-	1998	125 FT (DIA)	58	3112	3170	5.2	Located at the WTP
Total Clearwells							10.4	
Leavens	1	1940	160' (DIA)	20	3265.45	3285.28	3.0	
Willett	1	1955	83.5' (DIA)	80		3285	3.25	To use lower portion Leavens would be drained.
Total Zone 1							6.25	
Staples Tank No. 1	2	1970	188' (DIA)	30.5	3346	3376.5	6	To use lower portion Staples No. 2 would be drained
Staples Tank No. 2	2	1955	206'x116'	16.5	3360	3376.5	3	
Total Zone 2							9.0	
Staples Standpipe	3	1955	50' (DIA)	34.5	3449.5	3484	0.5	
Chapple No. 1	3	1989	220'x90'	35	3445	3484	5	
Chapple No. 2	3	2015	101' (DIA)	35	3449	3484	2	
Total Zone 3							7.5	
Fox 1	3 East	1982	84' (DIA)	49.1	3434.31	3483.42	2	
Fox 2	3 East	2014			3434.31	3483.42	2	
Total Zone 3 East							4	
Cedar Park No. 1	3 South		15'x27'	6.5	3393.5	3400	0.02	
Cedar Park No. 1	3 South		15'x27'	6.5	3393.5	3400	0.02	
Cedar Park No. 1	3 South		15'x27'	6.5	3393.5	3400	0.02	
Total Zone 3 South							0.06	
Waldo	4	1955	56' x 56'	12	3605	3617	0.25	
Ironwood	4		93' (DIA)	Varies	Varies	3617	2	
Total Zone 4							2.25	
Briarwood	4 South		60' (DIA)		3601.10	3637	0.75	
Total Zone 4 South							0.75	
Logan	5	1963	Varies	28	3725	3753	0.1	
Total Zone 5							0.1	
Total System Storage							40.3	



Pump Station and Storage Sites Descriptions

High Service Pump Station

The HSPS is located at the WTP, and includes five vertical turbine transfer pumps, seven high service bottom suction horizontal split case pumps, 170,000 gallon concrete wetwell, and two steel above ground storage tanks or clearwells with a combined capacity of 10.4 million gallons. The transfer pumps lift the water from the wetwell, through ultraviolet disinfection and into the clearwells. The typical method of operation for the clearwells is in series, which allows for the longest contact time for chlorine. The seven high service pumps supply the entire distribution system through Zone 1, Zone 2 East, and Zone 2.

Chlorine is not routinely added at the HSPS, however, the capability exists to inject chlorine into the transfer wetwell.

Transfer Pumps:

◆ H-1 (VFD)	15 MGD
◆ H-2 (VFD)	25 MGD
◆ H-3	20 MGD
◆ H-4	20 MGD
◆ H-5 (VFD)	15 MGD

Zone 1 pumps:

◆ Pump H1-1 (VFD)	16.2 MGD
◆ Pump H1-2 (VFD)	10 MGD
◆ Pump H1-3	20 MGD

Zone 2 East and West pumps:

◆ Pump H2-1 (VFD)	21.2 MGD
◆ Pump H2-2 (VFD)	21.2 MGD
◆ Pump H2-3	11.5 MGD
◆ Pump H2-4	14.4 MGD

Willett

Willett Pump Station and Reservoir are located at the corner of Avenue C and 9th Street West, and the pump station boosts water from Zone 1 to Zone 2. The reservoir is a circular, 3.25 MG above ground steel tank that was constructed in 1955. The reservoir has an 80 foot maximum water depth and floats on Zone 1 with Leavens Reservoir, but since Leavens has a 20 foot maximum water depth only the top 20 feet of Willett (0.82 MG) is useable without completely dewatering Leavens. In an emergency all of the water from Willett Reservoir could potentially be delivered to Zone 1 at less than optimal pressures. Willett Reservoir is typically taken out of service from October to April.

The Willett pump station is available year-round but is not typically used much in the winter. The pumps are used with the Zone 2 pumps in the HSPS to supply Zone 2 and maintain adequate storage in Staples 3 MG and 6 MG reservoirs.

- ◆ Pump 1 (VFD) 5 MGD
- ◆ Pump 2 (VFD) 5 MGD

Leavens

Leavens Pump Station and Reservoir are located at the corner of Yucca and Rimrock Road, and three vertical turbine pumps boost water from Zone 1 to Zone 3. Pumps can be operated manually or set to turn on and off based upon the water level in Staples Standpipe. Leavens Pump Station is typically used during periods of high demand (May – October) and normally only Pump 1 is used.

- ◆ Pump 1 3 MGD
- ◆ Pump 2 5 MGD
- ◆ Pump 3 7.2 MGD

Leavens Reservoir is a 3 MG cylindrical concrete tank built in 1940. Leavens is the only reservoir floating on Zone 1 year-round. The City is planning a rehabilitation project at Leavens reservoir including new inlet and outlet piping and valves, new overflow piping, and various repairs on the interior and exterior concrete surfaces.

Chlorine residual may be boosted in either Zone 1 or Zone 3 using the chlorinator at Leavens but it is rarely used.

Staples

The Staples Pump Station and reservoirs are located at 3116 17th Street West. The six horizontal split case pumps boost water from Zone 2 to Zone 3 and 4 as shown below.

Zone 3 pumps:

- ◆ Pump 2 (VFD) 3 MGD
- ◆ Pump 3 3 MGD
- ◆ Pump 4 5 MGD

Zone 4 pumps:

- ◆ Pump 2 (VFD) 3 MGD
- ◆ Pump 3 3 MGD
- ◆ Pump 4 3 MGD

The three reservoirs have a total storage capacity of 9.5 million gallons. Staples 6 MG and 3 MG are the only reservoirs that float on Zone 2. The two reservoirs have the same overflow elevation but the 6 MG is 14 feet deeper. Therefore, to use all the volume of the 6 MG the 3 MG would be completely drained. Since the 6 MG is only 14 feet deeper (6 psi) it would be feasible to operate on the lower portion of the 6 MG. The Staples standpipe floats on Zone 3, it is an above ground steel storage tank with a 0.5 MG capacity.

Chlorine residuals in either Zone 3 or 4 can be boosted with the chlorination facilities at Staples Pump Station.



Voelker

Voelker Pump Station is located at the corner of Monad Road and South 29th Street West, and pumps water from Zone 2 to Zone 3. Voelker is used year-round. There are four horizontal split case pumps as listed below. Voelker is used along with Leavens and Staples to meet demands in Zone 3 and maintain storage to Chapple reservoirs and Staples Standpipe. Voelker can also be used to boost chlorine residual in the western end of Zone 3.

◆ Pump 1	4.3 MGD
◆ Pump 2	5 MGD
◆ Pump 3 (VFD)	7 MGD
◆ Pump 4	5 MGD

Walter

The Walter Pump Station is located in the intersection between Airport Road, the 6th Avenue North Bypass and the Main Street Connector, and it can pump water from either Zone 1 or Zone 2E to Zone 3 East (Fox Reservoir) and Zone 2 East (HWD Hilltop and Lanier Reservoirs). Normal operation is water pumped from HSPS into Zone 2E flows through Walter Pump Station, is metered, and then flows into the HWD distribution system. Prior to the meter water is pumped from Zone 2E to Zone 3E. In backup mode the pumps at Walter Pump Station can pump from Zone 1 into Zone 2E and 3E. Walter Pump Station is in service year round and is the only normal supply to the HWD (there is an interconnection between Zone 3E and Zone 2E that is normally closed and could only be used manually in an emergency).

◆ Pump 1 (VFD)	5 MGD
◆ Pump 2 (VFD)	5 MGD
◆ Pump 4	5 MGD
◆ Pump 6 (VFD)	3.75 MGD (current project)

Thomas and South Hills

The Thomas Pump Station is located at 2085 Santiago Drive, and was completed in 2003. It supplies water from Zone 2 to Zone 3 South and Zone 4 South. There are six centrifugal pumps; pumps 1 through 4 supply water to Zone 4 South (Briarwood Subdivision) while pumps 5 and 6 supply water to Zone 3 South (Cedar Park) as shown below. Thomas Pump Station is the only supply to Zones 4 South and 3 South, so it remains in service year round. Thomas Pump Station has facilities to provide supplemental chlorine in Zone 3 and Zone 4.

◆ Pump 1	2.16 MGD
◆ Pump 2	0.86 MGD
◆ Pump 3	0.86 MGD
◆ Pump 4	0.216 MGD
◆ Pump 5	0.288 MGD

- ◆ Pump 6 0.288 MGD

Cedar Park Reservoir floats on Zone 3 South and consists of three above-ground concrete cells, each having a storage capacity of 20,600 gallons for a total capacity of 61,800 gallons. Briarwood Reservoir floats on Zone 4 South and it is an above-ground concrete reservoir with a total storage capacity of 750,000 gallons.

Chapple

The Chapple Pump Station and reservoirs are located at the corner of Rimpoint and Pine Cove Road. The pumps boost water from Zone 3 to Zone 4 with three vertical turbine pumps. Supplemental chlorine is available at the pump station to boost residuals in Chapple reservoirs or directly into Zone 4. Chapple operates year-round and is the primary supply for most of Zone 4 and operates in conjunction with the Ironwood Reservoir.

- ◆ Pump 1 (VFD) 3 MGD
- ◆ Pump 2 (VFD) 3 MGD
- ◆ Pump 3 (VFD) 3 MGD

The original 5 MG reservoir floats on Zone 3 and has two cells that can be used independently or together. Cell one (Reservoir No. 1) is 150 feet by 90 feet with a depth of 30 feet and storage capacity of 3.5 MG. Cell two (Reservoir No. 2) is 70 feet by 90 feet with a depth of 29 feet and a storage capacity of 1.5 MG. Reservoir No. 3 was completed in 2015 and is a round concrete tank and was a capacity of 2 MG. It has the same overflow elevation and floor elevation as the original reservoir.

Fox

The Fox Pump Station and reservoirs are located south of Skyview High School, at the west end of Wicks Lane. The pumps draw water from the reservoirs and supply water to Zone 4 North. This station operates year-round and is necessary to meet Zone 4 North pressure demands and flows since the zone does not have storage. Pumps 1, 2, 3 and 4 are primarily used to meet the normal flow and pressure demands of the zone. Pumps 5 and 6 can be used in an emergency situation to meet fire demands or other events requiring unusually high demands.

- ◆ Pump 1 (VFD) 0.09 MGD
- ◆ Pump 2 (VFD) 0.18 MGD
- ◆ Pump 3 (VFD) 0.36 MGD
- ◆ Pump 4 (VFD) 0.79 MGD
- ◆ Pump 5 (VFD) 2.34 MGD
- ◆ Pump 6 (VFD) 2.34 MGD



Figure 2-3. Fox Reservoir

The two Fox reservoirs are above ground storage tanks each with a capacity of 2 MG and are filled via the Zone 3E pumps at Walter Pump Station and float on Zone 3 East.



Reservoir No. 1 is the original reservoir and is a welded steel tank. Reservoir No. 2 is a pre-stressed concrete tank. Both reservoirs have a diffused air system in the floor of the reservoir. A blower in an adjacent building supplies the air. A photo of the newer Reservoir No. 2 is provided as Figure 2-3.

Waldo

The Waldo Pump Station and reservoir are located above the Rims adjacent to State Highway 3, southwest of the airport. The pump station pumps water from Zone 4 (Waldo Reservoir) to Zone 5 and the Logan Reservoir via four vertical turbine pumps. Pump 3 would only be used in a fire situation in Zone 5 or 6. This station remains in service year-round and has the ability to boost chlorine in Zone 5 by using a small hypochlorite generator.

Waldo reservoir is a below-ground storage reservoir with a capacity of 250,000 gallons and based on system operation can float on Zone 4 with the Ironwood Reservoir. However, typical operation is for a Waldo Reservoir to essentially serve as an extended wetwell for Waldo Pump Station. A control valve on the feed line to the reservoir is closed as the reservoir is pumped down by the Waldo pumps. When the reservoir level drops to a designated operating level, the control valve is opened and a Staples Zone 4 pump is turned on (if not already on) to fill the reservoir. The control valve is then closed when the reservoir is full.

◆ Pump 1	1.5 MGD
◆ Pump 2	0.5 MGD
◆ Pump 3	3.6 MGD
◆ Pump 4	0.36 MGD

Christensen

The Christensen Pump Station was built in 2003 to supply Zone 6. It is located across from Waldo Pump on the north side State Highway 3 and Southview Drive. Pumps 1 through 4 are end-suction centrifugal pumps with VFDs, pump 5 is a constant speed horizontal split-case used as an emergency fire pump. Christensen Pump Station is the only source of water for Zone 6 and operates continuously. If there were a fire in Zone 6, both the high capacity pumps in Christensen and Waldo would need to operate simultaneously.

◆ Pump #1 (VFD)	0.14 MGD
◆ Pump #2 (VFD)	0.5 MGD
◆ Pump #3 (VFD)	0.5 MGD
◆ Pump #4 (VFD)	0.5 MGD
◆ Pump #5	2.4 MGD

The Logan Reservoir is located adjacent to Christensen Pump Station and floats on Zone 5. The reservoir is an elevated steel tank.

Ironwood

The Ironwood Pump Station is located in the stem for the Ironwood Reservoir which is located northeast of Ironwood Subdivision at the end of a coulee. The pumps station installed in 2013 includes 5 pumps listed below. The pumps pump into Zone 5 West which is a closed system and so the pump station needs to operate continuously to meet flow and pressure demands. Pump 5 is available to meet a fire demand.



Figure 2-4. Ironwood Reservoir

◆ Pump 1 (VFD)	0.13 MGD
◆ Pump 2 (VFD)	0.25 MGD
◆ Pump 3 (VFD)	0.5 MGD
◆ Pump 4 (VFD)	0.5 MGD
◆ Pump 5	2.5 MGD

The Ironwood reservoir is an elevated composite tank. The stem is concrete and the water holding tank is welded steel, as shown in Figure 2-4. The 2 MG reservoir floats on Zone 4.

Terrace Estates

Terraces Estates Pump Station, brought online in 2011, is located just west of the intersection of Governors Boulevard and Constitution Avenue on the north side of Constitution Avenue (805 Constitution Avenue). The station was built to boost pressure in Terrace Estates portion of Zone 3E which is at a higher elevation and experienced low pressures. The pump station pumps from Zone 3E into what is now called Zone 4 North. The pumps are set to run based on a minimum discharge pressure of 60 psi. Terraces has three end suction close-coupled pumps as shown below. Terraces does not have supplemental chlorine.

◆ Pump #1 (VFD)	0.72 MGD
◆ Pump #2 (VFD)	0.72 MGD
◆ Pump #3	0.09 MGD

Valves

Pressure Reducing

There are pressure reducing stations at four of the pump stations. In a current project, a sleeve valve is being installed in HSPS to allow flow to go from Zone 2 to Zone 1. At Willett Pump Station a pressure reducing valve (PRV) was replaced with a manual butterfly valve to also allow flow from Zone 2 to Zone 1. Staples Pump Station's two PRVs are designed to enable flow to move from Zone 4 to Zone 2 and from Zone 3 to Zone 2. The Thomas



Pump Station also has a PRV enabling flow to transfer from Zone 4 South to Zone 3 South. In addition to these specific locations, there are a number of other locations in the distribution system where flow can be manually allowed to go from a higher zone to a lower zone.

Air Release

Air release valves are located at high points throughout the distribution system.

Pressure Zone Isolation

Isolation valves are typically two consecutive gate valves or butterfly valves used to isolate pressure zones. These sets of valves are located at various places throughout the distribution system.

Transmission and Distribution

The City's water distribution includes approximately 500 miles of pipelines ranging in size from 4-inch to 42-inch. Water main characteristics are shown in Figure 2-5 and Figure 2-6. As shown in Figure 2-5, the primary pipe material types in the City's distribution system are cast iron, ductile iron, and PVC. In contrast, Figure 2-6 is provided to indicate the general age of the existing pipeline network system. This City-provided data indicates that over 70% of the piping system is less than 60 years old, with 27% of the system built in the last 20 years alone.

To address long-term system reliability, the City developed a robust water main rehabilitation and replacement program many years ago. The City currently invests approximately \$4 million per year in its water main renewal program. In addition, the City has adopted new technologies such as pipe bursting that they can do internally to increase efficiency and minimize construction impacts.

Customer Service Lines

Service lines bring water from the City's main water lines to the building and are owned by the property owners. However, the City started a program in 2018 to replace all 800-900 lead customer service lines from the main to the property line. The entire project is expected to take about four years. Those homes with the lead service pipes are clustered in the neighborhoods west of Division Street between Broadwater and Grand and east Pioneer Park.

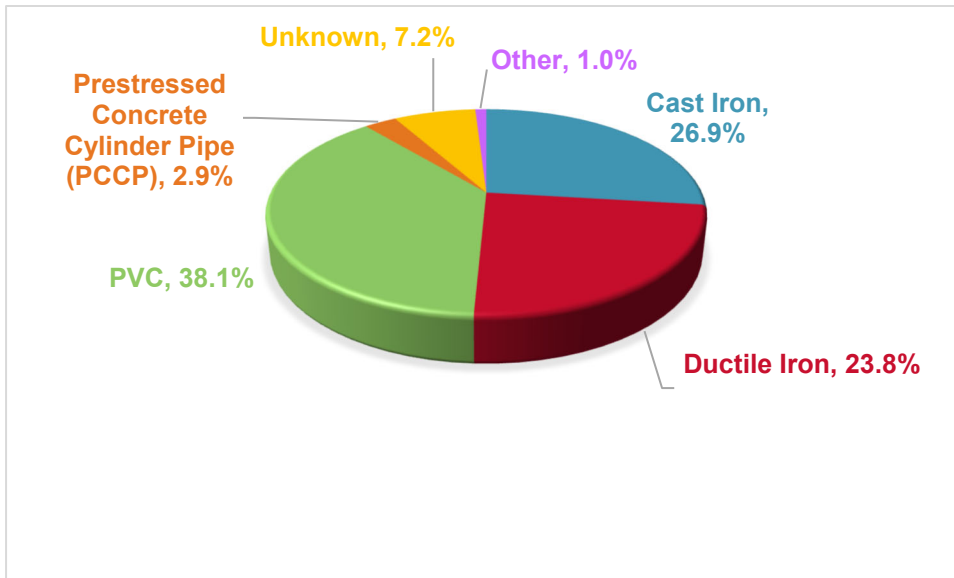


Figure 2-5. Water Main by Type

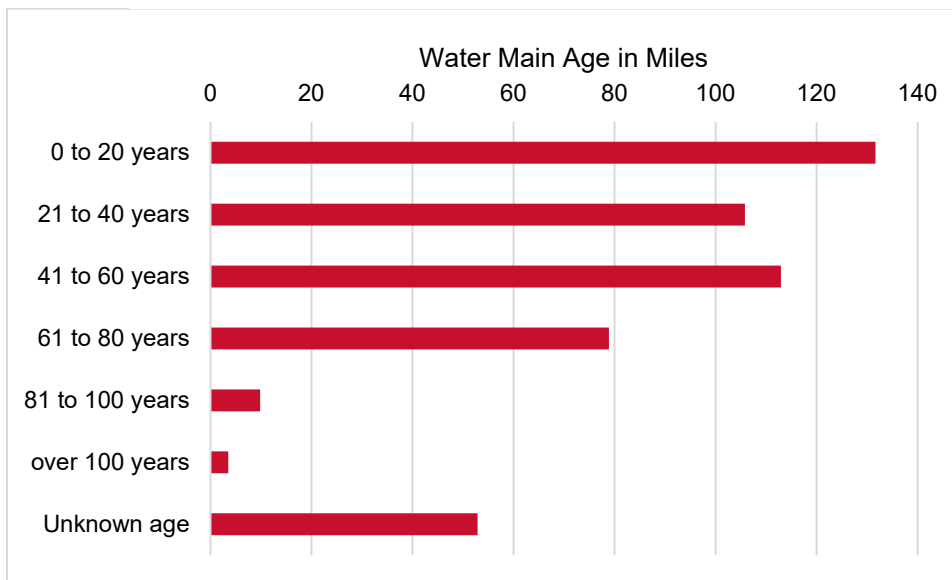


Figure 2-6. Water Main Age Miles

Customers

A breakdown of the demands by customer type is shown in Figure 2-7. As shown, the majority of the demand is from the residential customer class. Table 2-4 summarizes the number of customer types served in each pressure zone.

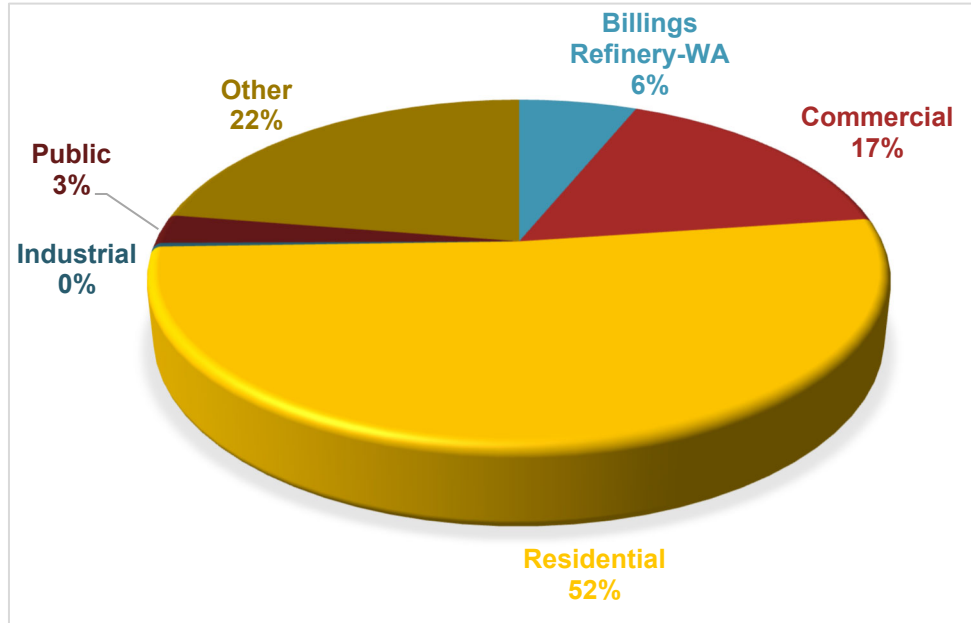


Figure 2-7. Customer Type by Water Demand (2018)

Table 2-4. Customer Summary by Zone

	Billings Refinery-WA	Commercial	Industrial Water Inside	Public	Residential	Total Customers
Zone 1	1	1,071	2	35	7,012	8,121
Zone 2		894		19	6,502	7,415
Zone 2 East		1				1
Zone 3		205		18	7,244	7,467
Zone 3 East		22		4	2,537	2,563
Zone 3 South		1			79	80
Zone 4		12		2	3,155	3,169
Zone 4 East						0
Zone 4 North		3		1	398	402
Zone 4 South		3		0	293	296
Zone 5				1		1
Zone 5 West					90	90
Zone 6		2		1	177	180
TOTAL	1	2,144	2	81	26,836	29,785

Large Users

The City has a number of large water users who's current and future water demands can have a significant impact on the City's water system. The water demand data for these large water users over the last five years is shown in Table 2-5. The information in this table is sorted from high to low 2018 water usage. It should be noted that the water demand at the Phillips 66 refinery has been steadily increasing over this time period.



Table 2-5. Large Customers (sorted by 2018 demand)

Customer	2018 GPMAD	2017 GPMAD	2016 GPMAD	2015 GPMAD	2014 GPMAD	2018 Rank	2017 Rank	2016 Rank	2015 Rank	2014 Rank	5-Year Average (GPM)	5-Year Rank	5-Year GPD (ave)
PHILLIPS 66	2012	1680	1678	1530	1139.05	1	1	1	1	1	1607	1	2,314,764
JUPITER SULPHUR	114	52	48.19	52.39	49.37	2	4	5	6	8	63	2	90,829
FISHER WATER SERVICE	58	57	56.63	54.72	54.82	3	3	3	3	7	56	4	80,836
GOLDEN MEADOWS	56	50	47.45	52.51	57.33	4	5	6	5	5	53	5	75,769
ROCKY VILLAGE ASSOCIATION	55	46	5.36	5.20	41.49	5	6	43	42	14	31	10	44,126
CITY OF BLGS-MUNICIPAL AIRPORT	41	70	63.44	66.66	54.91	6	2	2	2	6	59	3	85,177
BILLINGS CLINIC	40	43	48.29	53.71	70.30	7	8	4	4	3	51	6	73,668
WESTERN SUGAR CO	37	44	34.84	30.71	35.64	8	7	9	9	15	37	9	52,668
YELLOWSTONE COUNTY JAIL	35	34	17.43	8.10	47.74	9	10	19	37	9	28	13	40,838
CROWNE PLAZA/SHERATON	30	27	27.27	24.08	32.15	10	12	11	12	16	28	14	40,438
MSU BILLINGS	30	36	42.96	35.26	41.85	11	9	7	7	13	37	8	53,576
CASA VILLAGE	29	6	28.93	30.93	150.40	12	43	10	8	2	49	7	70,696
ST VINCENT HOSPITAL SCL HEALTH	29	29	39.26	25.44	23.93	13	11	8	10	20	29	12	42,271
ALSCO LINEN SERVICE	28	25	22.26	15.09	10.85	14	13	13	21	33	20	19	29,019

Customer	2018 GPMAD	2017 GPMAD	2016 GPMAD	2015 GPMAD	2014 GPMAD	2018 Rank	2017 Rank	2016 Rank	2015 Rank	2014 Rank	5-Year Average (GPM)	5-Year Rank	5-Year GPD (ave)
SHILOH VILLAGE	23	22	19.71	20.71	63.02	15	15	18	17	4	30	11	42,711
WASTEWATER TREATMENT PLANT	22	12	12.68	13.78	24.72	16	33	29	23	18	17	25	24,478
OLYMPIC VILLAGE (IRET PROPERTIES)	22	21	21.05	23.06	25.99	17	16	15	13	17	23	17	32,509
HUNTERS POINT APT	20	22	21.58	21.15	23.17	18	14	14	16	21	22	18	31,069
ROCKY MOUNTAIN COLLEGE	19	18	12.10	5.83	0.51	19	21	32	41	44	11	33	15,987
BIGHORN RESORT	19	14	15.65	21.67	44.24	20	26	24	14	11	23	16	32,954
FOX MEADOWS APTS	19	19	19.94	20.35	19.64	21	19	17	18	24	19	21	28,052
MIDWEST HOTELS (COMFORT INN)	19	21	20.76	24.99	43.41	22	17	16	11	12	26	15	37,006
BEATRICE DAIRY/DEAN FOODS	18	15	13.76	14.94	16.14	23	23	25	22	28	15	26	22,215
SHILOH GLEN WELSHIRE ARM N LLC	16	14	12.72	11.23	10.05	24	25	28	28	36	13	31	18,576
PONDEROSA ACRES	16	15	17.03	13.76	13.94	25	22	22	24	29	15	27	21,836
WAVE CAR CARE CENTER	16	19	17.13	19.16	18.84	26	20	21	20	25	18	22	25,746
RELIABLE WATER SERVICE	15	20	22.80	19.75	20.84	27	18	12	19	23	20	20	28,347
BIG SKY LINEN AND UNIFORM	15	14	12.32	9.91	13.13	28	28	30	31	30	13	32	18,302
HOSPITAL LAUNDRY SERVICES	14	13	13.28	13.46	16.96	29	31	26	26	27	14	29	20,252



Customer	2018 GPMAD	2017 GPMAD	2016 GPMAD	2015 GPMAD	2014 GPMAD	2018 Rank	2017 Rank	2016 Rank	2015 Rank	2014 Rank	5-Year Average (GPM)	5-Year Rank	5-Year GPD (ave)
INDUSTRIAL GAS DISTRIBUTORS	14	8	7.92	8.48	7.36	30	42	42	36	38	9	42	13,232
RADISSON HOTEL	14	15	17.23	21.17	21.70	31	24	20	15	22	18	23	25,430
NO CASH WATER	12	13	12.31	11.63	24.17	32	29	31	27	19	15	28	21,243
BEST WESTERN KELLY INN & STE	12	11	9.03	8.58	9.10	33	34	40	35	37	10	37	14,515
HAPPY HOMES PROPERTY MANAGEMENT	12	12	11.81	7.89	5.05	34	32	33	38	41	10	41	13,981
STOCKLAND PROPERTIES	12	10	10.30	4.97	0.64	35	40	37	43	43	8	43	10,847
BILLINGS HOTEL AND CONVENTION CENTER	12	13	12.81	13.56	18.58	36	30	27	25	26	14	30	20,155
BONAVENTURE SENIOR LIVING	11	10	8.79	9.42	46.95	37	38	41	34	10	17	24	24,932
MISSION RIDGE	11	11	10.76	10.57	11.12	38	35	34	30	32	11	34	15,632
YELLOWSTONE MEDICAL CENTER	11	14	10.66	7.16	6.09	39	27	35	39	39	10	40	14,025
HOLIDAY CO #87	11	11	9.96	9.75	10.82	40	36	38	33	34	10	36	15,014
PUBLIC AUCTION YARD	11	1	0.77	0.64	1.07	41	44	44	44	42	3	44	4,009
SWEETHEART BAKERY	10	10	16.77	7.10	5.95	42	39	23	40	40	10	38	14,478
ALTERNATIVES INC	10	10	10.49	10.81	11.17	43	37	36	29	31	11	35	15,260
WILLOWBEND	10	9	9.73	9.85	10.19	44	41	39	32	35	10	39	14,155