CHAPTER 4

EXISTING WATER SYSTEM

Chapter Outline

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4.1 INTRODUCTION

The City of Junction City operates and maintains the water system that provides potable water service to customers within the city limits. The City's municipal water system utilizes a series of groundwater wells to supply water into an elevated reservoir that serves a single pressure zone within the City.

This chapter provides an inventory of the existing water system components—sources of supply, water treatment, distribution system, storage reservoirs, and instrumentation and control. The evaluation of these specific systems and the development of improvement alternatives is performed in other chapters of this study.

4.2 WATER SUPPLY

Water supply for Junction City is comprised entirely of groundwater sources. The City holds groundwater rights for approximately 7.84 mgd, owns nine municipal wells, and currently operates four of these for water production. Of the remaining five wells, three (identified as the Fire Department wells) were inactivated as newer wells were developed, and two (8^{th} & Front and 11^{th} & Elm) have been taken out of service due to poor water quality. Locations of the wells are identified on Figure 4-1 that appears at the end of this chapter for formatting reasons.

Groundwater in the area is characterized by moderate to elevated levels of dissolved mineral content that, in addition to nitrate, is primarily comprised of iron, sodium and sulfate. The presence of nitrate in the 8^{th} & Front and 11^{th} & Elm Street wells is a significant limiting factor for the production of water from these facilities.

Over the last 20 years, numerous studies and sampling programs have documented the rise of nitrates in the groundwater of the Southern Willamette Valley. The City currently lacks a water treatment method to remove this contaminant from their groundwater sources. The rising trend of this contaminant in the geographic area, and the poor success rate of developing high yield nitrate-free wells, puts the City at risk for being unable to deliver suitable water to its service area over the coming planning period. An evaluation of the City's historical and future water needs is presented in Chapter 5. Chapter 6 evaluates the City's available water rights in light of these anticipated demands.

4.2.1 Well Facilities

The City's wells are each identified by the street names that intersect near the facility. All the wells deliver water directly into the distribution grid and indirectly fill the single elevated reservoir in town that 'floats' on the grid. The elevated reservoir calls for the activation of each well as the liquid level in the tank drops. The pump start sequence is staggered to give each previously activated pump a chance to replenish reservoir volumes. Additional pumps are activated as needed. The pump sequence steps forward and backward, and the lead well manually alternates between the well at 13^{th} & Elm and the well at 8^{th} & Deal, based on the water system operator's selection. Table 4-1 lists the operating points for the four active wells as reported by City staff. Total pumping capacity is 2,050 gpm and the firm capacity, defined as the City's pumping capacity with the largest source out of service, is 1,350 gpm. In recent years the pumps have been unable to meet maximum day demand and the level in the elevated tank drops to a point that requires the activation of one of the fire pumps.

Table 4-1 | Well Pumping Capacity

Well Facility	Current Operating Rate (gpm)
3rd & Cedar	300
5th & Maple	700
8th & Deal	500
13th & Elm	550
Total	2,050

Static water levels for each well are recorded weekly and utilize a pressure gauge and an air line that extends below the water surface inside the well casing. Selected well construction details are summarized in Table 4-2, presented at the end of the chapter for formatting reasons. Well logs for each well appear in Appendix C.

Only one of the wells is provided with emergency backup power, a condition that would reduce net production to roughly 550 gpm should the City experience an area-wide power outage. The City has recently completed upgrades to two of its wastewater pump stations and plans to redeploy the automatic transfer switches and emergency generators from these stations to two of the well facilities. The City's telemetry system is not capable of notifying the system operators of alarm conditions at the well facilities.

The City conducts periodic rehabilitation programs for each of the well facilities. These programs include inventorying the pumps, rehabilitating them as needed, and performing TV inspections of the well casings. The casing inspections have not documented any significant problems with the condition of the casings.

Improvement projects were completed in 2006 and 2007 for the 13th & Elm and 8th & Deal wells respectively. Improvements are currently underway for the 5th & Maple facility, and are planned for the 3rd & Cedar well in late 2009 or early 2010. The City is in the process of incrementally re-roofing each of the structures as part of its ongoing maintenance program.

The following sections summarize the existing well facilities in the order they were constructed. The summaries include an inventory of the two off-line wells, 11th & Elm, and 8th & Front. It is anticipated that these two wells will be of service to the City once a treatment plant capable of removing nitrate is operational.

4.1.1.1 11th and Elm Well

This well is believed to have been constructed in 1966, and has been offline since 1998 due to elevated nitrate levels. With an installed depth of 30 feet, the well is the shallowest of all the City wells. The well house is a cement masonry unit (CMU) structure and is in marginal condition.

The pump is a 30 hp constant speed pump. The 4-inch discharge line is equipped with a check valve, isolation valve, and a pump to waste bypass line. A 4-inch Sparling impeller flow meter records flow rate onto a circular chart.

This well does not have a backup power generator, or a transfer switch, so a portable generator cannot be used to power the pump station in the event of a power failure.

4.1.1.2 3rd and Cedar Well

This well is the oldest of the City's currently functioning wells. Records show that a well by this same name was originally constructed in 1952; however, a new well was constructed in the current location in 1971 and the facility name was retained. The well house is a CMU structure and is in satisfactory condition.

The pump is a 40 hp constant speed vertical turbine pump. The X-inch discharge line is equipped with an air release valve, pressure gauge, check valve, isolation valve, and a pump to waste bypass line. A X-inch Sparling impeller flow meter records flow rate onto a circular chart. Chlorination at this well is achieved with the use of sodium hypochlorite and a LMI chemical feed pump. This well is typically utilized during peak summer demand and during these periods the City records residual chlorine manually. A Hach Cl-17 has been purchased for this well but has not yet been installed. This well does not have a backup power generator or the ability to connect to a portable generator in the event of a power failure.

Production from this well is generally limited to 300 gpm. Pumping rates greater than this result in a draw down to the pump bowls. The well log indicates that this well has a relatively short 19' screen section that likely contributes to the problem. A facility inventory and periodic maintenance project has been scheduled for this well in late 2009 or early 2010 following the maintenance improvements at the 5th & Maple facility.

4.1.1.3 8th and Front Well

This well was constructed in 1968. The building is a CMU structure and is in satisfactory condition. The pump is a 60 hp constant speed 7 stage vertical turbine pump. The 6-inch discharge line is equipped with an air release valve, pressure gauge, check valve, isolation valve, and a pump to waste bypass line. A 6-inch Sparling impeller flow meter records flow rate onto a circular chart.

Chlorination at this well is achieved with the use of sodium hypochlorite and a LMI chemical feed pump that doses into the discharge line. A Hach Cl-17 chorine residual analyzer records residual chlorine.

This well does not have a backup power generator, or a transfer switch, so a portable generator cannot be used to power the pump station in the event of a power failure.

4.1.1.4 5th and Maple Well

This well was constructed in 1978 and is located west of all the other wells near the geometric center of the city limits. The pump house is a CMU structure and is in satisfactory condition.

The pump is a 60 hp constant speed 7 stage vertical turbine pump with a design point of 675 gpm at 279 feet of TDH. The 6-inch discharge line is equipped with an air release valve, pressure gauge, check valve, isolation valve, and a pump to waste bypass line. A 6-inch Sparling impeller flow meter records flow rate onto a circular chart. Chlorination at this well is achieved with the use of sodium hypochlorite and a LMI chemical feed pump that doses directly into the well. A Hach Cl-17 chorine residual analyzer records residual chlorine.

Recent observations by City staff show that this pump is performing below its design point. This is likely the result of a worn impeller and wear rings, as the pump has had very little preventative maintenance performed over the past 10 years. The pump and motor for this facility are currently being evaluated for replacement with the intent of having the new pump operational in advance of the peak summer demand season.

This well does not have a backup power generator or the ability to connect to a portable generator in the event of a power failure. It is anticipated that one of the two available generators from the recent wastewater pump station upgrade projects will be installed at this facility.

4.1.1.5 8th and Deal Well

This well was constructed in 1992. The well house is a CMU structure and is in satisfactory condition. The pump is a 50 hp constant speed 6 stage vertical turbine pump with a design point of 500 gpm at 275 feet of TDH. The 6-inch discharge line is equipped with an air release valve, pressure gauge, check valve, isolation valve, and a pump to waste bypass line. A 6-inch Sparling impeller flow meter records flow rate onto a circular chart. Chlorination at this well is achieved with the use of sodium hypochlorite and a LMI chemical feed pump that doses into the discharge line. A Hach Cl-17 chorine residual analyzer records residual chlorine. A second LMI feed pump doses orthophosphates when this well is operated as the lead pump in the pumping sequence.

This well has had a history of sand problems and was operated with a mechanical screening unit for a period of time. This unit is no longer in service and the problem appears to have stabilized. The pump for this well was replaced in the summer of 2007 and production from this well increased from 300 gpm to 500 gpm.

This well does not have a backup power generator, or a transfer switch, so a portable generator cannot be used to power the pump station in the event of a power failure. As with the 5th & Maple well, this facility has been identified to receive an automatic transfer switch and emergency generator from one of the recently upgraded wastewater pump stations.

4.1.1.6 13th and Elm

This well, constructed in 1993 is the newest of the City's wells. The well house constructed in 1994 is a cement masonry unit structure and is in good condition. The pump is a 75 hp constant speed vertical turbine pump with a design point of 800 gpm at 250 feet of TDH. The 6-inch discharge line is equipped with an air release valve, pressure gauge, check valve, isolation valve, and a pump to waste bypass line. A 6-inch Sparling impeller flow meter records flow rate onto a circular chart.

Chlorination at this well is achieved with the use of sodium hypochlorite and a LMI chemical feed pump. A Hach Cl-17 chorine residual analyzer records residual chlorine. A second LMI feed pump doses orthophosphates when this well is operated as the lead pump in the pumping sequence.

This well is equipped with a 225 ampere automatic transfer switch and a 135 KW Kohler generator. This is the only well with an emergency power source.

4.2.2 Fire Pump Station

The City relies on the existing 1.25 MG ground storage reservoir and three fire pumps for fire protection. The pumps are housed in a cement masonry unit structure near the storage reservoir. Constructed in 1962, the structure is in satisfactory condition with no obvious sign of distress, leakage, or water damage on the roof or walls.

All three pumps are Allis-Chalmers horizontal split case centrifugal pumps and are identified as the south, middle, and north fire pumps. All pumps are provided with diesel motors and the south pump is also equipped with an electric motor. Table 4-3 summarizes the key performance information of these pumps.

Table 4-3 | Fire Pump Capacity

Pump No.	Design Point	Motors
South	500 gpm @ 150 ft. TDH	Diesel 47 HP, Electric 40 HP
Middle & North	1,500 gpm @ 150 ft TDH	Diesel 107 HP

The fire pumps are controlled by a pre-set pumping program driven by system pressure. The program activates the south pump when system pressure drops below 48 psi. The middle and north pumps are activated at 46 psi and 44 psi respectively, if pressures continue to fall. The pumps are exercised for five minutes three times weekly.

4.3 WATER TREATMENT

4.3.1 Chlorination

Water from each of the wells is chlorinated at the well facilities for residual maintenance only. No contact time is currently required with the exception of the 8th & Front well which, although currently offline, utilizes a large diameter detention pipe installed in 2005 in response to positive tests for bacteria.

The City currently uses a neat sodium hypochlorite solution delivered in 55-gallon drums. The LMI chemical feed pumps are in satisfactory working condition. Each well is equipped with an on-line chlorine residual analyzer (HACH CL-17) utilized to monitor the chlorine residual at the point of entry to the distribution system.

In 2006 the City switched from gas to liquid chlorination. According to results from the recent sanitary survey, the City did not secure Plan Review approval from ODWP and will be required to do so in the near future.

4.3.2 Corrosion Control

Orthophosphates are currently utilized for iron sequestration and corrosion control. Dosing occurs at either the 13th & Elm or the 8th & Deal well depending on which well is operating as the lead pump in the operation sequence. The orthophosphate system was implemented in 1994 after a violation of the action level for copper. The City has been in compliance with the Lead and Copper rule since the installation of this system.

4.4 DISTRIBUTION SYSTEM

4.4.1 Pipe Network

The City's original water distribution system was installed in 1938 and underwent a major expansion in 1963. The system is predominantly a looped network and is constructed largely within the public road rights-of-way. The system is comprised of 37 miles of pipe inventoried by pipe material diameter as shown in Figures 4-2 and 4-3. The cast iron and asbestos cement pipe is primarily located in the downtown core between 1st and 15th Avenue and from Rose Street eastward.

Figure 4-2 | Pipe Inventory by Material Type

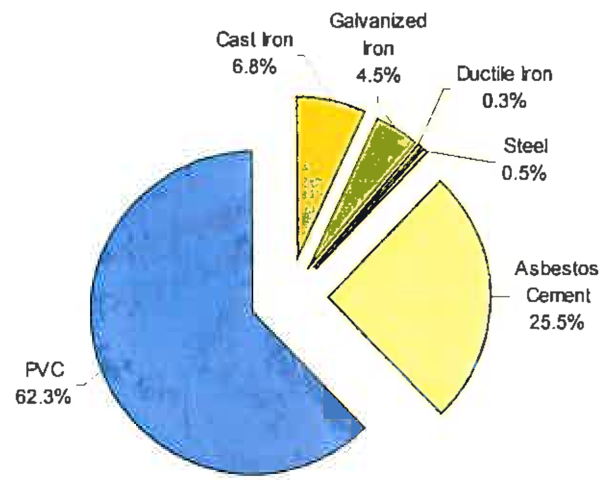
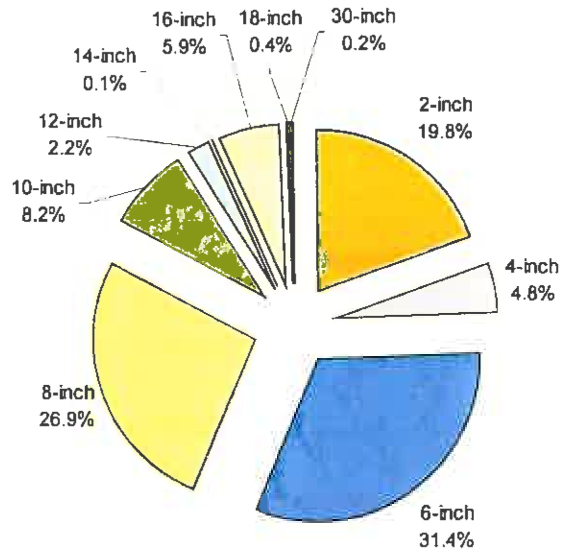


Figure 4-3 | Pipe Inventory by Diameter



The City's Public Works Design Standards have been developed to standardize the type and size of piping materials used for the expansion or rehabilitation of the distribution system. These standards specify PVC C-900 for all distribution piping 6 to 12-inches in diameter and C-905 for pipe 14 to 24-inches in diameter. The standards require that new waterlines be looped such that the removal of any single line segment from service will not result in more than one fire hydrant being taken out of service.

Much of the older pipe in the distribution system does not meet the current standards. As shown in Figure 4-3 the City has a large installed base of small diameter pipe with roughly 25% of the distribution comprised of 2 to 4-inch pipe, and 56% comprised of pipe with a 6-inch diameter or smaller. The lack of larger diameter distribution pipes is significant. As extensions, repairs or alterations are made to the undersized portions of the distribution system, it is advisable that the new components conform to the current standards and that a larger percentage of 8, 10, and 12-inch pipe be installed. Future distribution improvement projects are evaluated and presented in Section 8.5.2.

4.4.2 Water Meters

Of the roughly 2,040 water meters in service 84% are residential meters, 13% are commercial, and 3% are multi-family meters. Table 4-4 summarizes the service connections by billing category within the City for fiscal year 2007/08.

Table 4-4 | Water Meter Population

Meter Size	Residential	Commercial	Bulk	Total
5/8-inch	1,692	136	27	1,855
3/4-inch	6	2	—	8
1-inch	19	64	23	106
1-1/2 inch	2	25	—	27
2-inch	2	25	9	36
3-inch	—	3	1	4
4-inch	—	2	1	3
6-inch	—	1	—	1
8-inch	—	1	—	1

The City currently utilizes an automatic meter reading system initiated in 2003, with the system-wide replacement of residential water meters with radio-read units.

4.4.3 Fire Hydrants

A review of existing records shows that the City has approximately 250 fire hydrants. Mueller and Kennedy hydrants each comprise roughly 40% of the total hydrant count, M&H comprises roughly 12% and the remaining 6% are comprised of various styles. The Mueller Super Centurion hydrant with two 2½-inch ports and one 4½-inch port has been adopted as the City standard hydrant. Hydrants in the distribution system are generally well distributed around the system providing some level of coverage to nearly all of the developed areas. As with any municipality there are a number of instances where hydrant spacing exceeds the recommended spacing.

The City's Public Works Design Standards require that all new hydrants be connected to the distribution main with a minimum 6-inch diameter lateral. It is recommended that as hydrants are replaced that the lateral diameter is also evaluated to ensure compliance with the standard.

4.5 WATER STORAGE

The City's water system has two reservoirs comprised of a single elevated reservoir and a ground storage reservoir with a total storage capacity of 1.35 million gallons. This section provides an inventory of these two facilities. The evaluation of storage capacity and hydraulic performance is presented in Chapter 8.

4.5.1 Ground Storage

The City's existing 1.25 MG ground storage reservoir is located west of Elm Street mid-block between 13th and 14th Avenues. The reservoir was constructed in 1962 and is a welded steel tank with a diameter of 75 feet, a bottom elevation of 324.0 and an overflow elevation of approximately 360.0.

The reservoir has a common inlet and outlet piping configuration. Overflow piping is internal to the reservoir and is connected to a drain line that discharges to the drainage swale immediately north of the reservoir. The water level in this reservoir is monitored with the use of a mechanical half-travel level indicator. There are no alarms for high or low liquid levels.

A rehabilitation project in 1992 made minor welding repairs along with a complete interior and exterior coating replacement. The most recent inspection of the reservoir performed in Month, Year showed that the reservoir is in satisfactory condition.

Significant changes have been made to the seismic code since this tank was constructed; however, no evaluations or upgrades have been performed to bring it into compliance with current seismic code. The tank does not utilize any form of cathodic protection.

4.5.2 Elevated Storage

The City's elevated reservoir is located at the intersection of 7th and Front Street. The exact year of construction is unknown, but is estimated to have been around 1960. The reservoir utilizes a 100,000 gallon 30 foot upper bowl filled with a single riser column and supported by four pipe columns that bear on concrete footings and form the corners of a 60 foot square footprint. The overall structure height is approximately 150 feet.

The reservoir has a common inlet and outlet piping configuration and the overflow line discharges to the storm water system. The interior of this tank was recoated in 1992 and the most recent inspection of the tank performed in September of 2000, showed that the reservoir was in satisfactory condition.

Liquid levels in this reservoir drive the well pump activation sequence. The reservoir calls for the activation of each well in a staggered sequence as the liquid level in the tank drops. Additional pumps are called in the event the previously activated pumps cannot replenish reservoir volumes.

This reservoir, like the ground storage reservoir was constructed in an era where a structural seismic code was essentially non-existent. Given the age of this reservoir it is unlikely that the structure meets the current seismic code. Continued use of the facility will require a seismic evaluation followed by structural improvements—expenditures that will likely result in the replacement of this facility rather than its rehabilitation.

4.6 Instrumentation and Control System

The existing well control system was constructed in 1962 and consisted of a cam and lever control assembly driven by a pressure transducer installed at the existing elevated reservoir. Changes in water levels were transmitted to the cam system, which rotated, and triggered a series of relays. The activated relays generated a DC signal that was transmitted across a telephone line to a corresponding relay at each of the well facilities, which in turn activated the required number of well pumps.

This was an aging system and required frequent maintenance and repair. In December of 2008 the system failed. The cam and lever system and the pressure transducer were removed and replaced with an interim system consisting of a new pressure transducer and a programmable logic controller (PLC) located in the same control building at the site of the existing elevated tank. The new PLC still relies on the existing relay system and phone lines to transfer the start/stop signals to the individual wells. Well sequencing is controlled by the use of a jumper patch panel between the PLC and the relays. System operators can modify the well activation sequence by switching the cables on the patch panel.

4.7 WATER LOSS

Oregon Administrative Rule (OAR) 690-086-0150(4)(a) requires municipalities to conduct annual water loss audits. Leak repair programs are required when net system leakage exceeds 10%. In 2007, Junction City provided oversight for a waterline leak location study. The two week study utilized sonic detection equipment to locate and quantify distribution system leaks at 873 discrete points comprised of hydrants, valves and water services. The study surveyed approximately 6 miles of pipe in the older portions of the distribution system in the downtown core. Water loss for the survey area was determined to be 10% to 12%.

4.8 WATER SYSTEM OPERATOR LICENSING

Water Distribution level 2 and Water Treatment level 1 certifications are currently required for the operation of the water system. Given the anticipated population trends, a distribution system level 2 status is likely to be sufficient for the duration of the planning period. Additional water treatment licensing levels will be required to operate the proposed water treatment plant.

4.9 WATER SYSTEM FUNDING MECHANISMS

Funding for the City's existing water system comes from two major sources, user fees and system development charges (SDCs).

4.9.1 User Fees

User fees are monthly charges to all residences, businesses, and other users that are connected to the water system. User fees are established by the City Council and are typically the sole source of revenue to finance water system operation and maintenance. The City's Water Rates and Charges Ordinance #709, revised and adopted with Resolution #981 on February 10, 2009, provides the basis for assessing water user fees. A copy of the resolution and rate structure appears in Appendix D.

Residential and commercial monthly user rates are determined by the combination of a fixed base rate, and a variable rate based on the volume of water consumed. The fixed base rate is assigned on the basis of meter size with a common usage rate for the two classes. Assuming a typical residential meter size of 5/8-inch, an average per capita consumption of 160 gallons per day and an average household size of 2.57 residents per household, the typical monthly user charge is approximately $18.05 for a single family residence. Multi-family residential units such as apartments, condominiums, duplexes, and Public Utility Districts are billed at a higher base rate, but at the same usage rate, as residential and commercial accounts.

The City's water fund must provide sufficient revenues to properly operate and maintain the water system and provide reserves for normally anticipated replacement of key system components such as pumps, motors, hydrants, valve and waterlines. Although the City relies exclusively on water fees for operation and maintenance costs, the water fund cannot typically finance major capital improvements without outside funding sources.

4.9.2 System Development Charges

A system development charge (SDC) is a fee collected by the City as each piece of property is developed. SDCs are used to finance necessary capital improvements and municipal services required by the development. SDCs can be used to recover the capital costs of infrastructure required as a result of the development, but cannot be used to finance either operation and maintenance, or replacement costs.

SDC fees are set by resolution of the Council. The City updated its SDC fees on April 12, 2005 by approving Resolution #851 and reviews the resolution annually. The current SDC fee based on a 3/4-inch meter for a typical residential unit is $1,100. A copy of the City's SDC resolution appears in Appendix D.

4.10 ANNUAL OPERATION AND MAINTENANCE COSTS

Annual operations and maintenance costs are recurring costs typically funded through user rates. The fiscal year 2008/09 budget identifies a total of $64,000 for operating materials and supplies, and system repair and maintenance. Tables 4-5 and 4-6 present the City's budgeted expenditures for the 2008/09 fiscal year. Operating costs for the two funds totals $1,012,426.

Table 4-5 | Water Fund Costs

Item	2008-2009 Cost
Personnel Services	$ 330,049
Materials and Services	$ 271,227
Capital Outlay	$ 1,000
Transfers	$ 21,000
Debt Service	$ 0
Operating Contingency	$ 35,000
TOTAL	$ 658,276

Table 4-6 | Water System Improvement Fund Costs

Item	2008-2009 Cost
Materials and Services	$ 2,100
Capital Outlay	$ 330,000
Debt Service	$ 22,050
TOTAL	$ 354,150

4.11 RECOMMENDATIONS

The intent of this chapter is to provide an inventory and summary of the existing water system. Subsequent chapters of this report, as detailed in the table of contents, evaluate the various components of the water system and present detailed improvement plans for the system as a whole.

The single recommendation of this chapter is that the City should prepare and submit a set of record drawings documenting the liquid chlorination installation at each of the well facilities to the ODWP in order to complete their plan review obligation.

Table 4-2 | Well Construction Summary

Well Name	Completion Date	Total Depth (feet)	Casing		Seal		Liner		Screen	
			Depth (ft)	Material	Depth (ft)	Material	Depth (ft)	Material	Depth (ft)	Material
Fire Dept. South	1938	120/140/250 [1]	+1 - 250	Steel	No data	No data	No data	No data	No data	No data
Fire Dept. North	1940	120	+1 - 120	Steel	No data	No data	No data	No data	No data	No data
Fire Dept. Middle	1942	79	+1 - 79	Steel	No data	No data	No data	No data	No data	No data
3rd & Cedar (original)	1952	32	+1 - 32	Steel	No data	No data	No data	No data	No data	No data
8th & Front	8/23/68	135	GL – 88	Steel	0 - 30	Cement	none	none	85-125	Stainless
3rd & Cedar (current)	5/29/71	128	+3 - 108	Steel	0 - 31	Cement	none	none	109 – 128	Stainless
5th & Maple	8/10/78	190	+3 - 150	Steel	0 - 30	Cement	none	none	150-190	Stainless
11th & Elm	8/13/66	30	0 - 30	Steel	0 - 6	Bentonite	none	none	24 – 30	Perforated Steel
8th & Deal	10/13/92	252	+3 – 245	Steel	0 - 88	Cement	none	none	106 – 236	Stainless
13th & Elm	12/30/93	262	+2 - 108	Steel	0 - 70	Cement	256.5 – 262	Steel	105.5 – 256.5	Stainless

[1] Records vary