CHAPTER 6

WATER SUPPLY EVALUATION

Chapter Outline

WATER SUPPLY EVALUATION

6.1 INTRODUCTION

This chapter builds on the inventory of the City's water supply infrastructure as presented in Chapter 4. It discusses the City's water sources and history of water supply development, presents the regulatory framework for water rights and details the water rights secured by the City to date. It also evaluates the pumping capacity available to exercise those rights and concludes with improvement recommendations. Though originating in water supply, groundwater quality is presented in Chapter 7 along with water treatment. Capital costs for the recommendations presented in this chapter appear in Chapter 10.

6.2 EVALUATION CRITERIA

Available water rights, redundant sources of supply, and redundant pumping facilities are some of the factors used to evaluate the suitability of existing and planned water supply. The parameters presented in this section will be utilized in the analysis and recommendations of this chapter.

6.2.1 Water Rights

In Oregon, all water is publicly owned. The Oregon Water Resources Department (OWRD) regulates the use of both surface and groundwater throughout the State of Oregon. Over the years as greater demands have been placed on limited water resources, OWRD has exercised increasing control over water use. A water right will not guarantee water for the appropriator. Under the prior appropriation doctrine, a water right authorizes diversions of water only to the extent water is available. Water rights establish a hierarchy utilized by OWRD to adjudicate water in times of water shortages. Accordingly, it is paramount that the City secure and maintain suitable water rights to meet long term municipal needs.

6.2.2 Source Reliability

Interruptions to water production can occur due to problems with a given well. Shallow wells can be subject to a higher contamination potential than deeper wells. Contamination may be the result of a commercial or industrial accident, or a well that is determined to be groundwater under the direct influence (GWUDI) of surface water. Changes in water quality independent of well depth can also jeopardize water production and in the absence of suitable water treatment may require a given well to be taken off-line.

6.2.3 Pumping Reliability

Interruptions to water production can also occur due to a failure of the equipment used to deliver water from the well—primarily the well pump and/or the electrical service to the pump.

The following standards are recommended to ensure a high level of system reliability:

- Two or more sources of water supply should be developed with a total capacity to replenish depleted fire suppression storage within a 72-hour period while concurrently supplying MDD.
- When the largest source is out of service the remaining sources (firm capacity) should be able to satisfy MDD. The outage or maintenance period may last from several days to several weeks. The remaining pumps in the system should have the capacity to provide MDD. In the event of an extended outage, it is not uncommon to assume that a public notification process to conserve water will be utilized.
- Well pumps should be provided with power connections to two independent primary public power sources, or auxiliary power.

6.3 WATER SOURCE

The City currently owns nine groundwater wells. The locations of these wells appear on Figure 6-1 presented at the end of this chapter for formatting reasons. The first three wells developed by the City were constructed between 1938 and 1942, are located in the vicinity of the existing elevated reservoir and are described as Fire Department wells. These wells were reportedly last used in 1965.

A fourth early-period well was installed at the 3rd & Cedar location circa 1951. Also, as will become clear in the discussion of water rights to follow, a second 3rd & Cedar well was drilled in a new location.

Six other wells were developed in the period from 1957 to 1992 and comprise the wells located at 8th & Front, 3rd & Cedar, 5th & Maple, 11th & Elm, 8th & Deal (originally identified as well #5), and 13th & Elm Streets. As with the 3rd and Cedar well, the 8th & Deal well was replaced in 1992 with a new well bearing the same name constructed in a new location. Selected well construction details are summarized in Table 6-1 at the end of this chapter. Well logs for current versions of all wells appear in Appendix X.

The Fire Department wells were the first three wells developed by the City and have been inactive in excess of 30 years. In 2004 and 2005 these wells were filled with grout and were taken off-line. Two of the remaining six wells have been taken out of production in recent years due to poor water quality. The four remaining wells supply daily municipal demands and deliver water directly into the distribution grid. Figure 6-1 at the end of this chapter identifies these wells.

Previous studies and reports indicate the presence of two aquifers in the study area. These sand and gravel aquifers are generally described as two overlaid alluvial water bearing sections separated by a 50 to 75 foot thick clay and silt dominated layer. The upper shallow water bearing layer generally terminates 50-feet below ground level and is comprised of sands and gravels. A low permeability lens of clay and silt loosely separates the second deeper aquifer from the upper. The deeper aquifer comprised predominantly of sand is highly productive but thins to the south and southwest[15]. All of the operable municipal wells draw from the deeper aquifer with the exception of the 11th & Elm Street well.

[15] Kalakay et al, 1998

6.4 WATER USE REGULATIONS

On February 24, 1909, the State of Oregon enacted the Water Rights Act, a comprehensive surface water code. This act made prior appropriation the sole method of acquiring water rights in Oregon. Prior appropriation utilizes the priority date of a water right to establish the order in which water rights are satisfied in times of shortage. A senior water right is entitled to full delivery of all water under their right before any junior rights are served. Oregon adopted a parallel groundwater code on August 3, 1955. Together, these codes establish a regulatory scheme under which the OWRD exercises jurisdiction over the right to use the State's waters.

As with many other municipalities, Junction City has water uses that were established and fully vested prior to enactment of these laws. As a result the statutes include a process by which these prior vested water rights may be registered and ultimately adjudicated. These are referred to as "groundwater registrations". Under the law, OWRD is directed to undertake a process of reviewing and approving groundwater registrations filed after 1955. To date, however, the State has not had the resources to begin such efforts, and it is unlikely that adjudication will occur at anytime in the foreseeable future. Even without formal adjudication, and especially for municipalities, a groundwater registration has historically been viewed as equivalent to a state-issued water right, and the holder is entitled to continue using water up to the maximum amounts declared in the registration.

Water rights issued after the adoption of the 1955 groundwater code are issued in two stages: the issuance of an initial water right *permit*, and upon full development, the issuance of a final water right *certificate*. The permit stage serves as the initial authorization for a water user to develop the source and begin making beneficial use of the water. The permit typically describes the source, source location, priority date, the amount of water that can be used, and documents any water use conditions. Water use permits are issued for a five-year period. If the use has not been developed to the full-intended extent within the five-year period, an extension may be requested. When evaluating the request, OWRD considers whether or not the applicant has shown due diligence in development of the water right, and whether the right is likely to be necessary considering other rights the applicant may hold. Important legal distinctions exist between the permit and certificate stages. Failure to develop the source during the permit period may subject the permit to cancellation by the State.

The second stage involves the issuance of a water right certificate, issued after the source is fully developed and put to use. At such time a Certificate of Beneficial Use (COBU), prepared and submitted by the permit holder, is filed with OWRD. Approval of this document results in the issuance of a water right certificate. Once issued, the final certificate serves as evidence of a fully vested water right. At this stage the water right is treated as a property right held by the water user. A certificated right remains valid indefinitely unless it is unused for a period of five or more years, in which case the user may forfeit the water right. The forfeiture process is not automatic. Oregon law has historically protected municipal water supplies by preventing forfeiture for non-use.

6.4.1 Water Rights

Since the first four wells were constructed and were in use prior to the 1955 groundwater code, the water rights are identified as groundwater registrations and are subject to future adjudication by OWRD. These registrations are summarized in Table 6-2. Current Oregon Statues provide significant protection to municipal rights on the issue of forfeiture for non-use. In the particular case of these four wells that have claim registrations on-file with OWRD, the statute will likely recognize a water right equivalent to the registered rate.

Table 6-2 | Groundwater Registrations

Source Name	Claim No.	Registered Rate	Priority Date
Fire Dept. South	GR-4122	160 gpm	12/31/1938
Fire Dept. North	GR-4123	160 gpm	12/31/1940
Fire Dept. Middle	GR-4124	300 gpm	12/31/1942
3rd & Cedar	GR-4125	350 gpm	12/31/1951
TOTAL		970 gpm (2.16 cfs)	

The City currently holds three water right certificates representing final and permanent water rights issued as a result of applications filed by the City after the 1955 groundwater laws took effect. These rights are summarized in Table 6-3. Note that for the facility at 3rd & Cedar a second right was established supplementing the original registration. The first 8th & Deal well was constructed and put into service in 1957 and in 1992 a new well by the same name in a new location was constructed. The water rights assigned to the original well were transferred in-kind to the new well. Hence the priority date for this right predates the construction date of the current well by a significant margin.

Table 6-3 | Certificated Water Rights

			Permitted Rate		
Source Name	Permit No.	Certificate No.	cfs	gpm	Priority Date
8th & Deal	G-1749	G-65071	0.92	413	2/15/1961
8th & Front	G-4329	G-41697	1.83	821	9/20/1968
3rd & Cedar	G-5487	G-46412	1.11	498	11/15/1971
TOTAL			3.86	1,732	

The City also holds three water rights permits for which final certificates have not yet been issued. These rights are itemized in Table 6-4 on the following page. As shown, groundwater extraction at the 8th & Deal facility is authorized by a certificated right in Table 6-3 above and by a permitted right in Table 6-4. These rights are deemed to be additive.

Oregon's water code provides that a water right may be issued only for the quantity of water that is beneficially used. In 2004 and 2006, in compliance with the groundwater statute, the City prepared and submitted claims of beneficial use (COBU) for the three wells in Table 6-4 to OWRD. These reports establish the beneficial use rate at the time of application and were based

on the pumping capacity available at these sources. Procedurally the COBU pumping rate defines the final certificate rate. Note that for the wells at 8th & Deal and 13th & Elm, the COBU rate is less than the permitted rate. From a regulatory perspective, once OWRD approves the certificates, the permits for a given source are closed out and the difference in permitted pumping rate vs. COBU rate is cancelled. The permitted remainders are recoverable in the event the City applies for a permit extension on the remainders prior to OWRD's approval of the COBUs. The remainders will continue to have a permit status until such time as the City can demonstrate beneficial use. Approval of new COBUs will convert the remainders to certificated rights. At the time of this writing the permits itemized in Table 6-4 were still under review.

Table 6-4 | Water Right Permits

			Permitted Rate		COBU Rate		
Source Name	Permit No.	Priority Dale	cfs	gpm	cfs	gpm	Certificate No.
8th & Deal	G-12121	6/13/1991	2.23	1,000	2.01	902	Pending
5th & Maple	G-12123	1/17/1992	1.67	750	1.67	750	Pending
13th & Elm	G-12057	12/4/1992	2.23	1,000	1.96	880	Pending
TOTAL			6.13	2,750	5.64	2,532	

Construction details and water rights for the 11th & Elm Street well are poorly documented and the status of the rights for this well remain unclear. Available records indicate that this facility was constructed in 1966. A search of State and City records has not identified any documentation identifying a permit or certificate. The well has been included in the water rights summary in Table 6-5 at the end of this chapter. Future investigative efforts will be required to prove out the rights for this well.

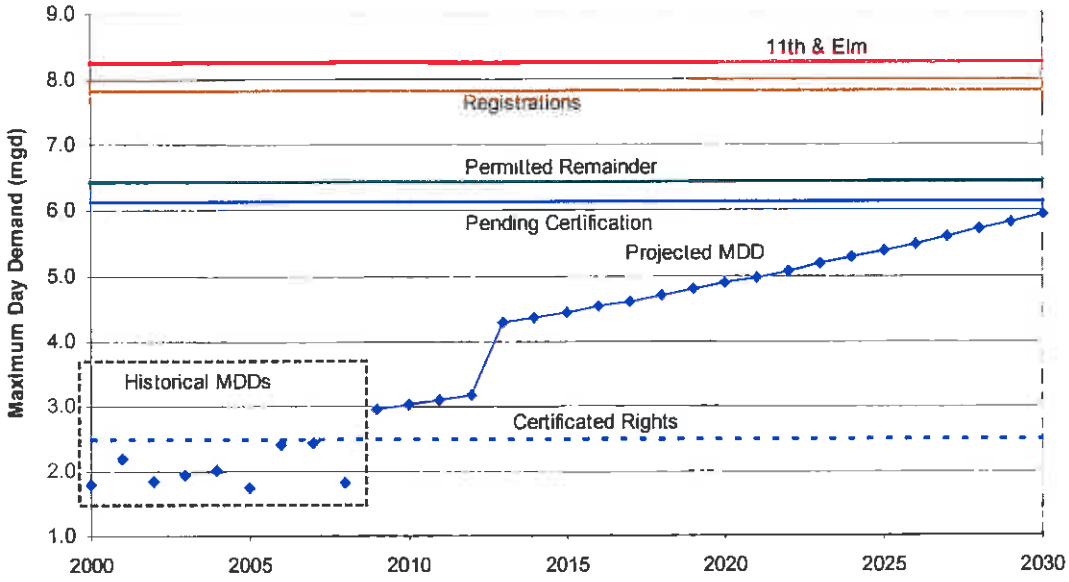
6.4.2 Water Rights Strategy

Junction City has certificated rights totaling 2.49 mgd and pending certificated rights totaling 3.65 mgd. These rights are the most certain of those held by the City and together total 6.14 mgd. There are no apparent obstacles to recovering the permitted remainder on the 8th & Deal and 13th & Elm wells and converting them to certificates at some future date. A review of the forfeiture statute with regard to the four groundwater registrations indicates it is unlikely that these registrations are subject to forfeiture. The status of the roughly 300 gpm yield of the 11th & Elm Street well remains unclear. Figure 6-2 depicts the various tiers of City held water rights with respect to projected MDD across the planning period.

From a baseline vantage point—without consideration of the DOC and DHS developments—the City has adequate existing and emerging water rights to serve its core municipal needs to the year 2045. The addition of DOC and DHS demands create an accelerated need for developing new sources as they add nearly 1.0 mgd to MDD.

The best-case water rights scenario is that all of the claims shown in the figure below can be proved out and ultimately converted to certificated rights. Under such circumstances, and with the current population projections—inclusive of DOC and DHS—8.27 mgd of rights converge with projected MDD in the year 2045.

Figure 6-2 | Water Rights vs. Water Demand



A worst-case scenario assumes that the pending certifications of Table 6-4 are approved, that extensions on the remainders are denied or contested, that the groundwater registrations remain off-line and the 11th & Elm Street right is non-existent. This results in 6.14 mgd of water rights, a level that meets MDD just beyond 2030. The next logical step in this worst-case scenario would be to develop an entirely new source, or sources, to capture the groundwater registrations of record. If the registrations are put into service, it is recommended that the City convert the registrations to certificates. This amounts to an administrative process with OWRD. Under this scenario the 7.53 mgd of available water rights converge with MDD in the year 2041.

Several development options exist for the 11th & Elm Street well. In the event water rights do not exist for this well, the City should consider an application process to begin securing or transferring the rights. The shallow depth of the well makes it the most vulnerable to contamination. The City should strongly consider deepening and reconstructing this well. OWRD will require an in-depth review of the request to deepen the well particularly if water rights for this well are found to exist and are assigned to the upper shallow aquifer. The benefit of this improvement approach, should the deepening prove successful in terms of yield and nitrate reduction, is the preservation of a centralized well location that affords economical access to the new water treatment plant.

6.5 WATER SUPPLY RELIABILITY

6.5.1 Source Reliability

As discussed, the 11th & Elm Street well is the only municipal well that draws water from the upper aquifer. Given the shallow nature of this aquifer, the prevalence of high seasonal groundwater and the permeability of local soils, this source should be considered highly susceptible to contamination from the surface[16]. This well has been removed from production for

[16] Kalakay et al, 1998

several years due to elevated nitrate levels. Additionally, in 2005 the ODWP notified the City that this well is potentially GWUDI. Further study will be required to conclusively resolve this concern. Until such investigations are performed the potential for contamination either from man-made or surface water influences, the presence of elevated nitrate levels, and the unclear status of this well's water rights makes it an unreliable source.

In 2004 in response to regulatory disinfection requirements the City constructed a chlorine contact chamber at the 8th & Front Street well. The addition of this chlorination facility permitted the source to remain in service, however in recent years the well has remained off-line due in part to other water quality issues and the reliance on other well sources to meet demands. Two items regarding this well bear noting. In 200X the ODWP notified the City that this well was potentially GWUDI. In the 2009 sanitary survey conducted by ODWP an entry under the category "Sanitary Seal & Casing Watertight" was marked as "unknown". This notation bears correction or clarification as the previous 2005 sanitary survey marked this same line item as satisfactory and a review of the well log shows the well to be sealed to 30 feet below grade with concrete.

As witnessed by these two examples, the City's quality and quantity of water sources stands to be improved. The proposed water treatment plant will immediately capture flow from three wells; 13th & Elm, 8th & Front, and 8th & Deal. Flow from the 11th & Elm facility will also be directed to the water treatment plant (WTP) once the water rights for this facility are resolved. As depicted on Figure 6-1 at the end of this chapter, these four wells are all centrally located and can reasonably be piped directly to the treatment plant. The proposed water treatment plant will allow previously off-line sources to resume operation thereby improving the current source operating base.

Several factors should be considered with regard to the classification of the City's aquifer as a groundwater source. A public water system is required to evaluate their groundwater source(s) for the potential of direct influence of surface water against the list of risk factors published in OAR 333-061-0032(7). This regulation requires an evaluation of groundwater sources if "through the Source Water Assessment the source(s) have been determined by ODWP to be highly sensitive as a result of aquifer characteristics, vadose zone characteristics, monitoring history or well construction". Junction City's Groundwater Protection plan completed in 1998 included findings from a Source Water Assessment, prepared for the City by ODWP, in which it identified the aquifer as sensitive. Subsequent to this report in 2005, the ODWP issued two letters identifying the 11th & Elm and 8th & Deal Street wells as potential GWUDI sources and requesting further investigation of the wells. These developments appear to voice uncertainty on the part of ODWP as to whether the City's aquifer will remain classified as a groundwater source or be reclassified as GWUDI. This is a critical determination that has significant implications for the development of the water treatment plant. It is recommended that the City perform an initial set of groundwater tests on three wells (13th & Elm, 8th & Deal, and 8th & Front) to determine the whether GWUDI indicators are present. It appears unlikely that this issue can be definitively resolved within the design and construction deadlines for the new treatment plant as defined in the intergovernmental agreement (IGA) between the City, DOC and DHS. There will accordingly be some ownership of risk on the part of the IGA members with regard to additional water treatment levels that may be required should this classification change within the design life of the plant.

A review of water-level trends in the wells was performed to identify whether groundwater levels are stable or declining. Static water levels are recorded weekly in each of the operating wells and while the groundwater levels exhibit slight seasonal fluctuations, they also demonstrate periods of subsequent recharge. There has been no historical evidence for a threat to source reliability due to declining groundwater levels.

6.5.2 Pumping Reliability and Capacity

The City relies heavily on the hydraulic capacity and mechanical reliability of the well pumps to deliver water into the distribution grid for consumption. Unlike many municipalities that utilize topographic relief to utilize gravity-fed water sources, all of the water in Junction City must be pumped.

The current well system operates with each well pumping directly into the distribution grid and the 300,000 gallon elevated reservoir that 'floats' on the grid. As Chapter 9—Water Storage Evaluation—will demonstrate, Junction City has traditionally operated with storage volumes below recommended levels. This approach has been successful in part because net pumping capacity has historically exceeded system demand by a good margin and because of redundancies afforded in a multiple pump system.

Future supply constraints are not imposed by water rights but by current infrastructure. These constraints include the lack of pumping capacity and redundancy in light of future growth, as well as a lack of treatment facilities to 'recover' wells that have been inactivated due to water quality issues.

6.5.2.1 Pumping Reliability

The failure of a well pump whether stemming from mechanical or electrical causes, diminishes the availability of water for municipal needs. Three criteria for evaluating pumping reliability were presented in Section 6.2.3. Each are addressed in turn.

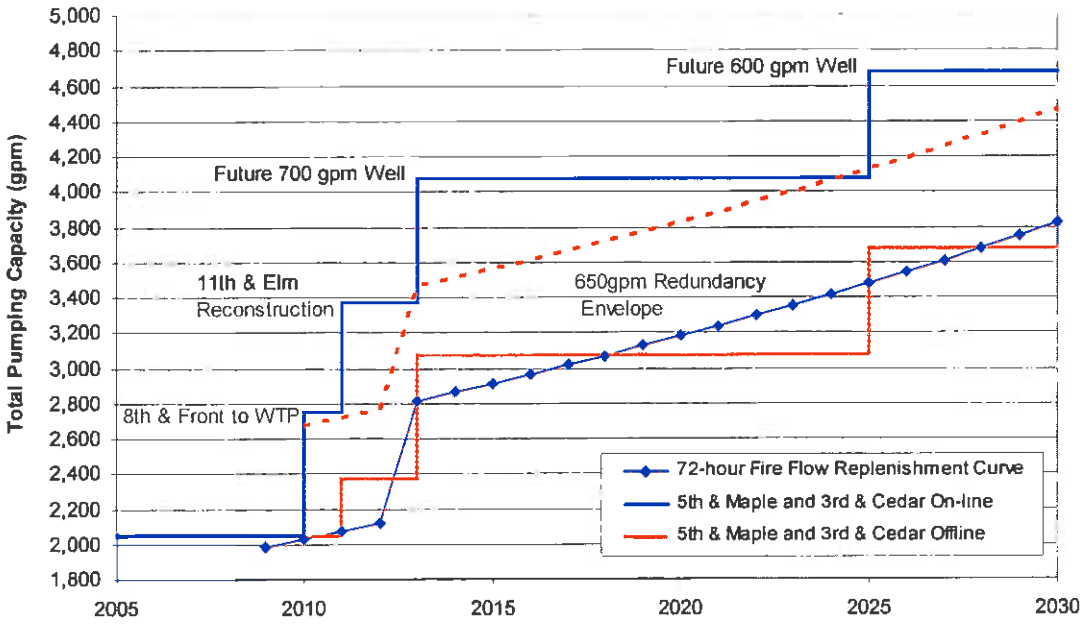
- *Two or more sources of supply should be developed with a total capacity to replenish depleted fire suppression storage within a 72-hour period while concurrently supplying MDD.*

Under the existing system, fire flows of 4,000 gpm for a 4-hour duration (960,000 gallons) are satisfied immediately from the existing 1.25 MG ground storage reservoir. If the system is operating at year 2008 MDD levels, the diurnal use curve permits a complete recharge of this volume in roughly 40 hours.

Under the future system, as will be addressed in Chapter 9, water storage will be expanded with the addition of a new 2.25 MG ground storage reservoir near the existing ground storage facility. This increase in storage capacity improves overall system reliability by providing a buffer for short duration well pump or power outages. Planning criteria for the DOC development also stipulates a fire flow condition of 4,000 gpm for 4 hours. Fire flow will again be immediately satisfied from storage, this time from the new ground storage facility. The recharge of this fire protection volume was evaluated by reviewing a historical 72-hour window around the calendar day with MDD. It was determined that total demand for the other two days on either side of the maximum day averaged 80% of that year's MDD. By this method a 72-hour recharge volume (and required pump flow rate) was established and forecasted across the planning period. Figure

6-3 shows a 72-hour replenishment curve. This is the required pump rate to re-fill the fire flow depletion within 72-hours. The figure also shows two pump capacity curves, one that includes the pumps at 5th & Maple and 3rd & Cedar, and a lower offset curve calculated with these two pumps off-line. A redundancy envelope is also shown for sensitivity comparisons assuming the loss of a hypothetical 650 gpm source.

Figure 6-3 | Total Pumping Capacity Required for a 72-hour Fire Flow Replenishment



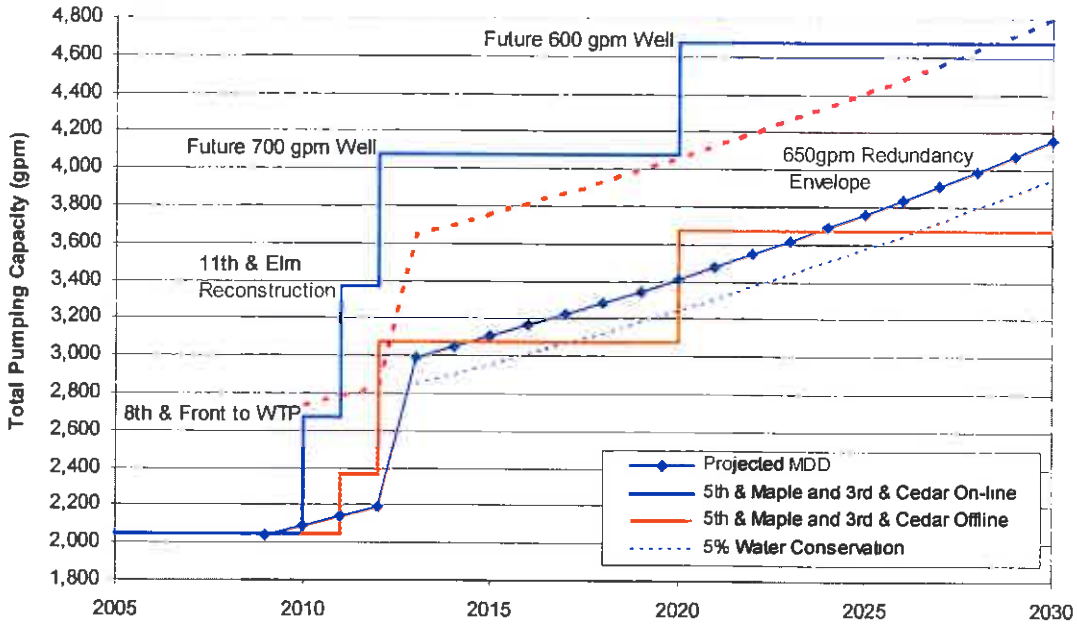
This figure shows that at the very least the City will be required to bring the 8th & Front Street well on-line to the new WTP and reconstruct the well at 11th & Elm in the near-term development period. It is assumed that the redevelopment of the 11th & Elm Street well can provide a yield of 700 gpm. In the event that this cannot be achieved, the development of future wells will be accelerated or operating margins reduced. The figure also shows that the goal of operating the 5th & Maple and 3rd & Cedar wells as off-line redundant sources comes with a trade-off. Failure to operate one or both of these wells after a significant fire event will extend the recharge window beyond 72-hours. The management of this risk is an operational decision that the City will need to consider. Bear in mind that other design benchmarks must be also be evaluated before an overall well development sequence can be recommended.

- *When the largest source is out of service, the remaining sources (firm capacity) should be able to satisfy MDD.*

The four wells currently in production (13th & Elm, 8th & Deal, 5th & Maple, and 3rd & Cedar) produce a maximum of 2,050 gpm (2.95 mgd). This rate is roughly equivalent to the 2009 MDD and does not allow for the failure of the largest source. Figure 6-4 shows that the activation of the 8th & Front well, utilizing the new water treatment plant, remedies the immediate redundancy issue, but leaves zero reserve for future growth beyond 2009.

This figure is similar to the previous figure with the exception that it shows projected MDD instead of the fire flow recovery curve. The pump capacity curves represent the same pump sets and have been prepared with the assumption that the 5th & Maple and 3rd & Cedar wells will be operated as off-line redundant sources. The figure also assumes that the 8th & Front well is connected to the future WTP and that the 11th & Elm well can be successfully reconstructed.

Figure 6-4 | Total Pumping Capacity vs. Water Demand



The uppermost line of Figure 6-4 shows that the firm capacity criterion is satisfied as long as the 5th & Maple and 3rd and Cedar wells remain operable and on stand-by. It also shows that if the City defers the construction of the first 700 gpm well in 2012, there is diminished pump redundancy from 2012 to 2020 and total pump capacity (with 5th & Maple and 3rd & Cedar on-line) falls below MDD in 2020. In other words, without the new 700 gpm well, the 5th & Maple and 3rd & Cedar wells will be activated on an increasingly frequent basis during peak demand periods as MDD outpaces total pumping capacity. Similar analogies can be made for the deferral of the second 600 gpm well.

This confirms the feasibility of keeping these wells off-line with the recognition that they may be called into service during short periods of MDD or during the failure of another primary source.

Clearly the goal of the above design criterion is to ensure the uninterrupted supply of drinking water during periods of maximum use; however, there are other standards and operating modes that can be applied to achieve the same outcome. As future storage reservoirs come on-line, the ability to buffer or ride-out short period MDD demands is improved. As previously noted historical demand for the two days on either side of the maximum day is 80% of MDD which indicates a reasonable recovery period given suitable storage reserves. Water conservation is another approach that can be used to reduce the demands placed on a utility during periods of maximum use. A 5% conservation curve has been shown below the projected MDD to illustrate this point.

- *Well pumps should be provided with power connections to two independent primary power sources, or auxiliary power.*

An important measure of reliability is the provision of an emergency power source for each well. In some instances, municipalities have the ability to connect to a redundant source of power with their local utility. This is often achieved by connecting to a second power feed served by a different transformer at the power utility's substation level. Frequently this infrastructure does not exist and requires the reliance on on-site power generation.

The 13th & Elm well is the only municipal well currently provided with emergency backup power. As discussed in Section 7.7, the construction of the new finished water pump station at this location will allow this generator to be relocated to serve another well facility. The City is currently completing upgrades at two sanitary pump stations and anticipates the re-deployment of two existing diesel powered generator units to the 5th & Maple and 8th & Deal well facilities. Additional generators should be considered for the remaining well facilities.

6.5.2.2 Pumping Capacity

Figure 6-4 shows the importance of reconstructing the well at 11th & Elm and integrating the currently off-line 8th & Front well to the new WTP. The recovery of these two sources is important due to their proximity to the WTP. The figure also demonstrates that the DOC and DHS demands require roughly 1.0 mgd of pumping capacity. This will require the development of a new well on the order of 700 gpm. It is recommended that the development of this well be completed before 2013. The development of the second new well can likely be deferred until 2020 with limited reliance on the 5th & Maple and 3rd & Cedar sources. Successful development of this well will allow the 5th & Maple facility to be held as a redundant source and only used on a limited basis until 2030. In the absence of the second new well the 5th & Maple source will be required to operate roughly 5-10 days of the year beginning in 2021 increasing to 50-55 days during peak demand periods in 2030. Prolonged use of this source may require treatment to improve water aesthetics given the history of hydrogen sulfide at this well.

December 31, 2009 marks the implementation of the Ground Water Rule. As discussed in Section 3.4.1 this rule has important implications for the 5th & Maple and 3rd & Cedar wells. The GWR will require triggered source water monitoring for all groundwater sources that do not provide 4-log virus treatment. The long term use of these wells as redundant sources may require future treatment improvements however it appears that these wells can be utilized in the near-term under a monitored status without treatment improvements.

It is recommended that the yield and mechanical pumping capacity of each existing well be reevaluated. Pumping rates should be increased as much as mechanically possible to maximize the calculated yield. This approach is viewed as an economical method of expanding pumping capacity. If a given well yield exceeds pumping capacity by a significant margin, an upgrade to the well pump may be in order.

In the event that the wells are already pumping at the maximum yield, the underutilized water rights from these wells should be consolidated and transferred to a new well. A comparison of existing pumping capacity with water rights at each well site is summarized in Table 6-6. The well at 11th & Elm has been omitted from this comparison since the water rights for this facility have not been established. The largest pumping deficiency occurs at 8th & Deal where water

rights exceed pumping capacity by approximately 475 gpm. The magnitude of the water right to pumping disparity at this site makes the case for these rights to be transferred to a new well where they can be fully developed. Likewise, the fractional water rights associated with 13th & Elm and 3rd & Cedar may be more efficiently recovered with a transfer.

Table 6-6 | Well Pumping Capacity

Well Name	Water Right / Permit (gpm)	Current Operating Rate (gpm)	Theoretical Pump Capacity (gpm)	Theoretical Pumping Deficit (gpm)
3rd & Cedar	498	300	330 [1]	168
5th & Maple	750	700	750 [2]	0
8th & Deal	1,293 / 1,413	500	500 [4]	793 / 913
8th & Front	821	625	690 [1]	131
13th & Elm	902 / 1,000	550	902 [3]	0 / 98
Total	4,264 / 4,482	2,675	3,172	1,092 / 1,179

[1] Based on a 10% estimated increase over current operating rate
[2] Based on 2004 COBU Report calculations
[3] Based on 2006 COBU Report calculations
[4] 880 gpm pump capacity per 2004 COBU Report Calculations but limited by sand problems

6.5.3 Groundwater Protection

The federal Safe Drinking Water Act of 1986 requires that every state have a drinking water protection program in place to guard against contamination of groundwater. In 1998 the City voluntarily developed a Drinking Water Protection Plan[17] to meet the DEQ and Oregon Health Department administrative rules. This plan was subsequently certified by DEQ. The plan is a valuable source of information as it relates to the management of municipal lands overlaying the groundwater aquifers in general, and to the identification of potential sources of contamination and municipal emergency responses in particular. The reader is encouraged to review the report.

6.6 RECOMMENDED IMPROVEMENTS

6.6.1 Water Rights and Regulatory Issues

Recommendations for clarifying and protecting Junction City's municipal water rights follow:

- Begin investigative efforts and work with ODWP to resolve the potential issue of GWUDI in the City aquifer(s). Additionally the City should make a careful evaluation of previous and on-going studies that may point to a future reclassification of the City's groundwater sources. It is unlikely that an investigation of this issue can be definitively resolved within the design and construction deadlines for the new treatment plant as defined in the intergovernmental agreement (IGA) between the City, DOC and DHS. There will accordingly be some

[17] Kalakay et al, 1998.

ownership of risk on the part of the IGA members with regard to additional treatment levels that may be required should this classification change within the design life of the plant.

- Apply for permit extensions on the permitted remainder for the 8th & Deal and 13th & Elm wells. The difference in the original permitted rate and the certificated rate established by the COBU should be preserved for future recovery.
- Continue to track the OWRD review process for the water rights that are currently under review and are pending certification. At the City's election an additional fee of roughly $1,000 per well may be submitted to expedite the review process.
- Prove out the 11th & Elm Street water right and priority date. In the event water rights do not exist for this well, the City should begin the process of evaluating the role of this well in future water production and begin securing the water rights.
- Clarify that the original Fire Department registrations can be converted to certificates utilizing a new well. Evaluate whether the development of a new well at the same general physical location (or on other property already held by the City) is feasible. The goal of this step is to retain the water rights and priority dates.
- As discussed, pumping capacity is less than available water rights at several wells. In lieu of pump improvements to capture the additional marginal water rights at a given well, it may be more practical to consider a transfer or consolidation of such fractional rights to a new well.
- Existing underutilized water rights should be transferred to new sources as they are developed.
- Development of a long-term water conservation program. As the City faces growing demands and limited resources, water conservation will play an increasingly important role in managing water resources. Conserved water becomes a new and relatively inexpensive source of water for the City.

6.6.2 Existing Water Supply Improvements

Recommended improvements to improve and/or restore the City's existing water supply infrastructure follow.

- The well at 11th & Elm is in need of significant rehabilitation. A deepening or reconstruction of the well should be evaluated to determine if such measures would resolve GWUDI concerns, mitigate nitrate levels and increase yield.
- Construct the necessary piping to connect the 8th & Front, 8th & Deal, 13th & Elm and 11th & Elm wells to the proposed WTP. This will allow these sources to contribute their full pumping capacity once the future treatment plant comes on-line.
- Provide auxiliary power sources for each of the wells. After the relocation of the generator serving the 13th & Elm Street well, two additional diesel generators will be required to ensure complete auxiliary power coverage. Providing auxiliary power at all existing well facilities is viewed as an essential step in maintaining current pumping levels during times of emergency.
- Reevaluate the yield and mechanical pumping capacity of each existing well. In particular the 13th & Elm and 8th & Front Street wells. Pumping rates should be increased as much as

mechanically possible to maximize the calculated yield. This approach is viewed as an economical method of expanding pumping capacity. If a given well yield exceeds pumping capacity by a significant margin, an upgrade to the well pump may be in order.

- Relocate the sanitary line that crosses within 40 feet of the 5th & Maple well. This issue was identified on the City's recent sanitary survey and should be corrected in the near term.
- Consider long-term improvements to the 5th & Maple and 3rd & Cedar wells to allow these facilities to deliver water into the distribution grid following the enactment of the Ground Water Rule in December of 2009. This may consist of disinfection facilities configured to provide a 4-log virus inactivation or a willingness to comply with triggered monitoring should the sources be required in an emergency condition.
- Complete the improvements identified in the 2009 Sanitary survey to include the provision of raw water sampling ports on the discharge piping at the 5th & Maple and 3rd & Cedar wells and the relocation of the chlorination feed points to be downstream of the sampling ports. This will allow the collection of raw water samples without interruption of the chlorination feed. These wells should also be provided with pressure gauges.

6.6.3 New Source Development

Recommended responses to the City's capacity and redundancy shortfalls:

- Develop a new groundwater source on the order of 700 gpm prior to 2013 to offset the increased demand from the DOC/DHS development.
- The City should begin evaluating a site for a second future well. Development of this new source should occur no later than 2020.

Table 6-1 | 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

Table 6-5 | Water Rights Summary

Source Name	Claim No.	Permit No.	Permitted Rate	Certificate No.	Priority Date	Authorized Rate cfs	gpm	mgd
Groundwater Registrations								
Fire Dept. South	GR-4122	—	—	—	12/31/1938	0.36	160	0.23
Fire Dept. North	GR-4123	—	—	—	12/31/1940	0.36	160	0.23
Fire Dept. Middle	GR-4124	—	—	—	12/31/1951	0.67	300	0.43
3rd & Cedar	GR-4125	—	—	—	12/31/1951	0.78	350	0.50
					Sub-total	**2.17**	**970**	**1.39**
					Cumulative Total	2.17	970	1.39
Certificated Rights								
8th & Deal	—	G-1749	0.92 cfs	G-65071	2/15/1961	0.92	413	0.59
8th & Front	—	G-4329	1.83 cfs	G-41697	9/20/1968	1.83	821	1.18
3rd & Cedar	—	G-5487	1.11 cfs	G-46412	11/15/1971	1.11	498	0.72
					Sub-total	**3.86**	**1,732**	**2.49**
					Cumulative Total	6.03	2,702	3.88
Permitted Rights (Pending Certification)								
8th & Deal	—	G-12121	2.23 cfs	under review[1]	6/13/1991	1.96	880	1.27
5th & Maple	—	G-12123	1.67 cfs	under review[1]	1/17/1992	1.67	750	1.08
13th & Elm	—	G-12057	2.23 cfs	under review[2]	12/4/1992	2.01	902	1.30
					Sub-total	**5.64**	**2,532**	**3.65**
					Cumulative Total	11.67	5,234	7.53
Permitted Rights (Future Certification)								
8th & Deal	Permitted remainder		0.27 cfs	—	—	0.27	121	0.17
13th & Elm	Permitted remainder		0.22 cfs	—	—	0.22	99	0.14
11th & Elm[3]	Current operating rate		0.67 cfs	—	—	0.67	300	0.43
					Sub-total	**1.16**	**520**	**0.74**
					Cumulative Total	12.83	5,754	8.27

[1] COBU and Site Report submitted to OWRD on 8/30/04
[2] COBU and Site Report submitted to OWRD on 7/11/06
[3] This tabulation assumes 11th & Elm was originally permitted through OWRD