Chapter Four

Water Requirements

Water Requirements

Existing System Demands

Unallocated water losses placed on the City of Independence Water System have dropped in recent years due to a systematic pipeline replacement program resulting in a lowering of water loss from 25% in 1997 to a rate of 20% in 2014. The lowering of water loss through these pipeline improvements have been timely and needed as they have offset any potential increase in the system water use. The water system is entirely metered and meters are read and billed monthly. The following table outlines the monthly and yearly water produced during the Years 2010-2013.

Table 4-1A
Years 2010-2012 Total Source Production

Month/Year	Total Water Pumped (in gallons)
January, 2010	29,425,000
February, 2010	29,523,000
March, 2010	35,585,000
April, 2010	29,871,000
May, 2010	29,164,000
June, 2010	33,006,000
July, 2010	55,748,000
August, 2010	53,262,000
September, 2010	35,869,000
October, 2010	30,126,000
November, 2010	30,170,000
December, 2010	29,025,000
TOTAL 2010	**420,774,000**
January, 2011	32,528,000
February, 2011	28,772,000
March, 2011	29,319,000
April, 2011	29,480,000
May, 2011	29,066,000
June, 2011	33,501,000
July, 2011	43,055,000
August, 2011	43,038,000
September, 2011	35,786,000
October, 2011	23,650,000
November, 2011	21,648,000
December, 2011	27,082,000
TOTAL 2011	**376,925,000**

January, 2012	23,073,000
February, 2012	21,494,000
March, 2012	22,346,000
April, 2012	22,295,000
May, 2012	25,532,000
June, 2012	26,453,000
July, 2012	39,118,000
August, 2012	43,023,000
September, 2012	35,320,000
October, 2012	27,099,000
November, 2012	23,398,000
December, 2012	23,955,000
TOTAL 2012	**333,106,000**

Table 4-1B
July, 2013- December, 2014
Historical Total Source/Metered Values

Month/Year	Total Water Pumped (in gallons)	Total Water Sold (in gallons)	Difference	Percent (%) of Unaccounted for Water
July, 2013	37,398,630	31,785,750	5,612,880	15.0%
August, 2013	44,747,242	36,824,250	7,922,992	17.7%
September, 2013	30,190,550	24,453,000	5,737,550	19.0%
October, 2013	25,837,400	19,040,250	6,797,150	26.3%
November, 2013	17,363,900	13,706,250	3,657,650	21.1%
December, 2013	21,707,350	15,917,250	5,790,100	26.7%
Six-Month Total 2013	177,245,072	141,726,750	35,518,322	20%
January, 2014	23,251,620	15,935,250	7,316,370	31.5%
February, 2014	27,243,876	17,865,000	9,378,876	34.4%
March, 2014	20,995,207	14,474,250	6,520,957	31.1%
April, 2014	20,134,119	15,618,000	4,516,119	22.4%
May, 2014	20,948,281	15,732,750	5,215,531	24.9%
June, 2014	30,526,782	26,511,000	4,015,782	13.2%
July, 2014	33,041,269	29,367,750	3,673,519	11.1%
August, 2014	37,856,761	33,224,250	4,632,511	12.2%
September, 2014	33,983,100	28,545,450	5,437,350	16.0%
October, 2014	23,464,120	18,742,500	4,721,620	20.1%
November, 2014	18,617,080	14,802,750	3,814,330	20.5%
December, 2014	18,990,280	14,159,250	4,831,030	25.4%
Six-Month Total-2014 (July-December)	165,952,610	138,841,950	27,110,660	16.3%
JANUARY-DECEMBER, 2014 TOTALS	309,052,495	244,978,200	64,073,995	20.7%

Note: These calculations are corrected to account for unmetered water loss due to backwash/rinsing of iron filters at the Polk Reservoir/Treatment Plant.

Analysis of Water Statistics

Table 4-2
2014 Sales Statistics

	Industrial	Commercial	Residential/Multi Family	Total
2014 Population	N/A	N/A	8,605	8,605
Average Month Demand	551,227	4,412,863	15,317,386	20,281,476
Average Day Demand	18,374	147,095	510,579	676,048
Average Day Demand	13 GPM	102 GPM	355 GPM	470 GPM

The original analysis of the water system statistics for Years 2013 and 2014 was initially performed based on the PSU estimated city population of 8600. As the analysis proceeded, however, it became very evident that the resultant per capita water usages were markedly lower than expected and considerably lower than the 2010 values and the comparable values from the 1997 Master Plan and 2007 Master Plan Update. As outlined in Chapter Two, additional research of the population and verification of water sales and production figures were performed. While a more exacting analysis of the flat population growth between 2010-14 and the projected population growth for Years 2015-2035 resulted in a slight adjustment for each intervening year, of marked interest and note is the substantial drop seen in the per capita water production and sales since 2010. In 2010, the total produced volume of water was 420,774,000 gallons (134 GPCD). This value has steadily dropped in subsequent years to the 2014 value of 310,000,000 gallons (98.7 GPCD), a decrease of 26.4% in just 5 years however, the maximum day production demand has remained relatively flat during this same 5-year period, averaging 223.4 gallons per capita day, indicating a common characteristic of the maximum water use within the city on its maximum day in each year. During this period, the Independence population has also remained relatively flat, therefore, the substantial drop in the average per capita water use in just five years cannot be attributed to population loss changes (migration out of the city). Several reasons are believed to account for this substantial drop in the average per capita use, including higher water rates, better control of lost water, the greater use of water conserving devices, zonal sprinkler systems on new housing, more accurate water accounting, and water conservation planning and implementation. Although water system pressures can play a role in reduced water consumption volume, verification with system operators confirmed that the typical delivery pressure to customers has not markedly changed up or down during this same 5-year period, eliminating this possible cause from consideration. Although the figures were initially thought to be incorrect and challenged, a reaudit of the population and water production and usage verified the 5 year decline. Regardless of the actual reason(s) for the decline in the per capita water use, the steady and significant drop, observed over five consecutive years, effectively eliminates any anomaly or other unusual cause common to a 1 or 2 year event where weather factors, changes in the aesthetic water quality, or other similar phenomena could be the determined cause. Although the per capita or maximum daily water use may return to the higher former levels in future years, provisions for redundancy and surplus flow and volume have been factored into this master plan update, primarily in water storage, to cover this potential.

Table 4-3
Comparison of City of Independence Per Capita Water Demands to 1997 Master Plan and 2007 Master Plan Update

Parameter	1997 Master Plan	2007 Master Plan Update	2014 Actual Values	5 Year (2010-2014) Average Values	Typical Ranges	2015 Planning Values
Production:						
Average Day Demand	141 GPCD	114 GPCD	98.4 GPCD	116.4 GPCD	75-150 GPCD	110 GPCD
Maximum Day Demand	320 GPCD	352 GPCD	216 GPCD (Sept 14th)	223 GPCD	200-400 GPCD	225 GPCD
Sales:						
Average Day Demand	103.5 GPCD	98 GPCD	78.5 GPCD	90 GPCD	50-125 GPCD	90 GPCD
Maximum Day Demand	240 GPCD	299 GPCD	171.28 GPCD	175 GPCD	150-400 GPCD	180 GPCD

The lower average day demand displayed for 2014 is reflective of the drop in the percentage of unallocated water from 1997, water conservation, as well as the improvement in tracking utility (backwash, street flushing, etc) use of water by the city.

Types and Percentages of City Water Usage

The City of Independence records and bills water monthly to four separate types of accounts. These accounts are Commercial, Industrial, Residential/Multi-Family, and Utility. The City tracks and records each of these accounts individually. Utility use is a small volume and only recorded internally. For Year 2014, the total volume and percentage of water billed for each type of usage is as follows:

Table 4-4
Consumption by usage type for February 2014 through December 2014

Month/Year	Industrial (Gallons)	Commercial (Gallons)	Residential/Multi Family (Gallons)
February 2014	327,750	3,927,000	13,480,500
March 2014	236,250	3,278,250	10,766,250
April 2014	165,750	3,399,750	11,931,750
May 2014	259,500	3,486,750	11,822,250
June 2014	561,750	5,916,000	19,176,000
July 2014	1,491,750	5,640,750	20,724,000
August 2014	1,114,500	6,782,250	23,775,750
September 2014	597,750	6,064,500	20,639,250
October, 2014	469,500	3,906,750	14,022,750
November, 2014	208,500	3,288,750	11,159,250
December, 2014	190,500	2,850,750	10,993,500
Total	**5,623,500**	**48,541,500**	**168,491,250**
Percentage Of Usage (11 months)	**2.5%**	**21.8%**	**75.7%**
Water Meter Connections	**34**	**160**	**2,160**
Average Day/Connection	**500 GPD**	**908 GPD**	**234 GPD**

As seen by the preceding table, commercial and industrial use accounts for 24.3% of the total water volume billed for the year and combined residential uses account for 75.7% of the total use. When the Commercial/Industrial use is deducted from the total volume, average per capita use falls to 54 GPCD.

Table 4-5a
2010-2014 Maximum Day Demand

Date	Water Pumped (in gallons)	Population	Per Capita
August 13, 2010 (Max Day)	2,179,000	8,600	253.37 GPCD
August 25, 2011 (Max Day)	1,780,000	8,600	206.98 GPCD
July 25, 2012 (Max Day)	1,661,000	8,585	193.48 GPCD
August 22, 2013 (Max Day)	2,112,000	8,585	246.01 GPCD
September 14, 2014 (Max Day)	1,867,000	8,605	216 GPCD
5-Year Average	1,919,800	8,595	223.36 GPCD

Table 4-5b
3 Day Projected Water System Demand

	2014	2015	2020	2025	2030	2035
3 Day Maximum Demand (in gallons)	4,947,875	5,071,500	5,737,925	6,491,750	7,345,625	8,107,500
Maximum Day Demand (in GPM)	1,344 GPM	1,378 GPM	1,559 GPM	1,764 GPM	1,996 GPM	2,203 GPM
72 Hour (3 Day) Demand (in GPM)	1,145 GPM	1,174 GPM	1,328 GPM	1,503 GPM	1,700 GPM	1,877 GPM
Factored GPCD	192.0	192.0	192.0	192.0	192.0	192.0

A different component of water system analysis has been factored and included in this Master Plan Update, that for a projected "3-Day Demand". Experience has shown that peak water system demands do not substantially decline during the days immediately preceding or following a maximum day water use event. Rather, the two days immediately before or after such an event typically involve a water demand slightly lower than the maximum day demand but still higher than the typical summer day, i.e., what is termed as the 3 Day Demand. This demand has been estimated to provide an understanding of the relationship between the long-term source capacity and/or water storage volume required to satisfy this demand in case the source capacity cannot handle the longer burden alone.

Future Water Requirements

As stated in Chapter Three, the population of Independence is projected to increase to 14,450 by the Year 2035. Specific improvements will need to be implemented during this period to accommodate the shortage of source water against growth. Since most of the growth that will occur over the next twenty years is expected to result from mostly residential increases, a uniform value of 110 GPCD will be used for planning purposes and applied to all user classes. This provides an approximate 10% reserve over the 2014 actual per capita use of 98.7 gallons per day to accommodate the inevitable growth of commercial/industrial usage as well as potentially new commercial/industrial accounts in addition to system leakage. This value is representative of current losses and will most likely decline as additional older piping throughout the system is replaced in the future. A Maximum Day Demand of 225 GPCD, which closely matches the current and historical past 5-year average maximum day values, will be used for forecasting purposes. Any unusual year with a higher per capita value up to 275 GPCD will be supplanted from active water storage. If the source supply is unable to satisfy this increased demand, this would result in approximately 500,000 gallons in study Year 2035 needed (drafted) from water storage, a draft of only 10% of the available water storage. This value represents a 2.50 multiplier over the actual average day demand, which remains slightly higher than normal but is in accordance with city historical values.

The City, however, should continue a program to recognize, locate and correct system loss and endeavor to lower the water leakage and loss value to 10% - 12% over the next 10-15 years. In addition to pipeline replacement, this shouldp include auditing and the planned replacement of services and service meters and production meters. Future expansion of the system and probable water conservation legislation may require this type of control over system loss as correction of the water losses to this value will conserve up to 5%-10% of the maximum source requirement shown in Table 4-6. The city is also cautioned that any potential commercial or industrial facility with a projected water demand of 150,000 GPD (100 GPM) or greater will required a separate analysis to verify system adequacy for daily volume requirements, location, and distribution system hydraulics before proceeding.

Table 4-6
Projected Water System Demands (in gallons/day and GPM)

	2014	2015	2020	2025	2030	2035
Average Daily Demand (GPD)	846,719	970,200	1,097,690	1,241,900	1,405,250	1,589,500
Average Summer Day Demand (GPD)	1,247,725	1,323,000	1,496,850	1,693,500	1,916,250	2,168,000
Maximum Day Demand (GPD)	1,936,125	1,984,500	2,245,275	2,540,250	2,874,375	3,250,250
Peak Hour Demand (GPM)	2,576 GPM	2,641 GPM	2,989 GPM	3,381 GPM	3,826 GPM	4,671 GPM

Although there are various methods available to project the operating/pumping hours per day needed to provide the daily demand of water from a source, the most frequent time span used is generally between 12-24 hours per day. Obviously, delivering a given volume of water over a 12 hour period will require twice the size of production facilities than required with a 24 hour interval, however, continuous pumping of a source does not provide any margin for equipment failure, source depletion, or unusually high water demands. The key, therefore, is to identify a reasonable and safe compromise, one that will not require an undue or extreme capital investment, but will still provide an adequate reserve for the unexpected failures or events, or extremely high water consumption. Experience and similar applications have indicated that using an interval of 16-18 hours per day of maximum source pumping is a reasonable value for most municipal water system planning. Although this is a prudent value for the average day and "typical" summer daily demands, the value used for the more infrequent maximum day demands is generally higher. The 1997 report included consideration of two maximum day operating periods: 24 hours and 20 hours per day of source pumping. Given the planned distribution of flow, the Monmouth to Independence intertie, future presence of several redundant wells and well pumps of reasonably uniform capacity, as well as planned standby power provisions at the well sites, using 18 hours per day of source pumping for the average and summer day demands and extending the operation to 22 hours per day for the maximum day demands is felt to provide a reasonable, equitable, and safe balance, especially given the fact that the maximum daily demands occur for only 2-3 days per year, on average, and could be supplanted from active storage, if needed. Following consideration of all relevant factors, therefore, the production values shown in Table 4-7 will be used for this report:

Table 4-7
Required Source Production

	2014	2015	2020	2025	2030	2035
Average Daily Demand (1)	876 GPM	900 GPM	1,016 GPM	1,150 GPM	1,300 GPM	1,472 GPM
Average Summer Day Demand (1)	1,155 GPM	1,225 GPM	1,386 GPM	1,568 GPM	1,803 GPM	2,007 GPM
Maximum Day Demand (2)	1,467 GPM	1,503 GPM	1,700 GPM	1,925 GPM	2,178 GPM	2,462 GPM

(1) Based on 18 hours/day of source pumping
(2) Based on 22 hours/day of source pumping

From Table 4-7, the maximum values shown for 18 and 22 hours per day of source pumping provides reserve well (source) flow necessary for possible pump failure or coincidental fire/high demand and will be used for forecasting purposes.

High Volume Pumping

The Independence Water System utilizes water storage and booster pumping to deliver the finished water to customers. Source water is typically pumped from individual wells from 1 of 2 wellfields, disinfected with gas chlorine, and delivered to water storage reservoirs at the South or Polk sites. A parallel arrangement of booster pumps at both sites, plus a reservoir/pump station at the Monmouth Street site, extracts water from the respective reservoir for repumping to the water system. In order to handle all of the potential system demands, particularly high volume demands, booster pumping is normally accommodated by an "on-demand" scenario of aggregate capacity by using a flow assortment of booster pumps, ranging from 200 GPM to a high of 1800 GPM per unit. This is somewhat analogous to an electrical system where power is delivered based on demand. In the case of Independence, the sizing of the total booster pumping capacity is determined by evaluating 1 of 2 flow conditions. These conditions, shown in Table 4-8, are peak-hour demand or maximum day demand coincident with a large fire. Rarely is the peak-hour demand factored with maximum fire flow as the likelihood of a large conflagration occurring during the summer peak-hour demands is fairly low.

Table 4-8
Projected Peak Hour/Maximum Day with Fire Flow Demand Versus Booster Pump Capacity

	2015	2020	2025	2030	2035
Peak-Hour Demand	2,641 GPM	2,989 GPM	3,381 GPM	3,826 GPM	4,671 GPM
Maximum Day with Fire Flow	4,880 GPM	5,360 GPM	5,765 GPM	6,000 GPM	6,257 GPM
Combined Booster Pump Flow (1)	7,300 GPM	7,500 GPM	7,800 GPM	7,800 GPM	7,800 GPM

(1) Total Pump Capacity @ approximately 50 psi

An analysis of the available booster pumping capacity has determined that the existing equipment can handle all of the expected demands, however, increasing the size of one of the South Booster Pumps will be performed during the later years of the study period for additional capacity and redundancy and to provide a greater pump station capacity for the increased water storage available from the two (2) South Reservoirs by 2025. Interestingly, even though not designed for, the combined booster pump capacity is projected to be adequate to handle even the peak-hour demands combined with the projected fire flow at 30-40 psi throughout most of the study period except for the very last 3-4 years.

Fire Flow

The City of Independence is located within the Polk County Fire District No. 1 for fire protection and is served from the main station located between Independence and Monmouth. The City currently has a Class 3/9 Fire Protection Rating as established by the Insurance Services Office (ISO). Past fire hydrant flow testing performed by ISO (September 12, 2012) indicated a maximum deliverable flow rate of 3,100 GPM @ 20 psi residual pressure in the downtown area (Main Street). After careful analysis, however, it is believed that this deficiency in flow was not a function of the distribution system but of the delay in activating automatically operable booster pumps. Following the September, 2012 ISO Fire Hydrant tests, follow up flow testing was conducted at two (2) of the ISO sites to verify the difference of available flow based on the time delay associated with starting and engaging of booster pumps. These tests, performed on December 17, 2012 verified the increase of flow from 2,000 GPM to 2,370 GPM at sites #6 and #6R and 3,567 GPM from 3,100 GPM at site #3 (see enclosed tests results and certification letter). These results also verified the response time required for full activation of the booster pumps within the water system and were forwarded to ISO for further action. This occurrence underscores the need for all booster pumps, including the three back-up engine driven or generator units and SCADA system, to be equipped and maintained for automatic starting and operation.

Discussions with Jason Cane, former Fire Chief/Marshall for the Polk County Fire District, indicate that Independence has been included with Monmouth, Rickreall, and the rural Luckiamute Water Cooperative to create an aggregate classification. The majority of the criteria used to classify the Polk County Fire District is based on response time, dispatch, and equipment as well as water supply. During this discussion, the Fire District expressed the desire for up to 5,000-5,500 GPM supply in Independence, particularly in the downtown commercial core area in order to be able to simultaneously provide water to a large ladder nozzle and two pumpers. Since ISO does not improve the rating of a city for fire flow above 3,500 GPM, this flow was felt to be the highest practical flow available in Independence. Actual flow based on ISO population equivalents and storage requirements are calculated below and will be used for booster pump capacity and storage requirements.

This level of rating provides the same insurance premium to homeowners of residential property for all Class 3, 4, and 5 ratings (the lower the number relates to a better class rating). Drastic improvements to the water system to lower the City's Fire Protection Rating from Class 4 to 3, therefore, will not result in an appreciable reduction in fire insurance premiums. During evaluation of the system, the highest projected instantaneous fire flow demand would most likely occur within the downtown core area, particularly in the area of the Simplot fertilizer plant on 3rd Avenue. Due to the large amounts of chemical storage at this site, a small fire could rapidly develop into a large or hazardous fire. Since many of the existing structures in the downtown area consists of older wood frame buildings with close spacing between structures, a very high fire flow (> 3000 GPM) could feasibly be required to fight a large conflagration in this area. Other potential locations for a large fire include all of the grade, middle, and high schools, Pacific Marquis spas, mills, automobile wrecking yards, North Main Street, and mobile home parks. Assumed fire flow demand, in the absence of specific criteria, is based upon total population numbers. For planning and hydraulic modeling purposes, the following equation will be used to approximate the present and future fire flows and volume (values will be used for both present and future population equivalents).

$$Q(GPM) = 1020\sqrt{P}\,(1 - .01\sqrt{P})$$

Where P = Population in Thousands

For 2,035 Projected Population of 14,450

$$Q(GPM) = 1020\sqrt{14.45}\,(1 - .01\sqrt{14.45}) = 3{,}730 \text{ GPM} \cong (\text{round up to } 4000 \text{ GPM})$$

Fire Flow duration: 4 hrs - Total Volume: 4000 GPM X 60 mins/hr X4 hrs = 960,000 gallons.

Chapter Five

Future Water Sources

Future Water Sources

Groundwater

The current permitted capacity under valid groundwater rights permits and certificates (2,803 GPM) is adequate to supply all of the projected water demands through the Year 2035, however, the existing aggregate source capacity (1,400 GPM) does not fulfill this requirement. Before 1992, the wells in the South Well Field were operated continuously to maintain an adequate volume of water in the Main Street reservoir. In 1992, an automatic control (SCADA) system was installed that allowed the wells to automatically shut-off upon reaching a high level in the Main Street reservoir. This same control arrangement was used when the South Reservoir was built to replace the Main Street Reservoir in 2004. This control scenario has had a positive effect on the well field as the wells are presently not pumped beyond their total reliable daily yield. A more recent improvement of the control system in 2004, as well as the more recent replacement of South Wells 1-3, has also been very beneficial to the water system.

The South Well Field also produces the highest quality of water of all the existing sources, with moderate to low levels of iron, manganese, and hardness. Unfortunately, the past discovery of a regulated volatile organic contaminant, i.e., tetrachloroethylene (PCE), in two of the wells (Wells #4 and #5) in this wellfield formerly raised a concern of continued high rate pumping from this well field. This concern, however, must be tempered with the fact that more recently testing, conducted since 2005, has not revealed PCE levels in excess of the mcl. These tests results tend to indicate that the contaminant may have been flushed through the wellfield. A careful reappraisal of the possible reactivation of the New Wells #4 and #5 is therefore proposed in the early stages of this study period. The potential increase in wellfield flow rate is believed to be as high as 150 GPM.

For planning purposes, each of the three existing wells in the South Well Field will be limited to an average flow of 133 GPM (400 GPM total) along with the previously stated addition of 150 GPM from Wells #4 and #5. This will raise the total projected flow rate from the South Wellfield to 550 GPM. This total and distributed flow rate will be used for planning even though the actual flow distribution is not uniform. As time goes on, and with adequate monitoring of the water quality from each well and observation wells, as well as adequate recharge of the aquifer each year, it may be possible to increase the total flow from the wellfield to 600-650 GPM.

Old Wells #4 and #5, located behind the former Main Street Pump Station (315 Main Street) had unacceptable levels of iron and iron bacteria as well as past detections of regulated and unregulated organic contaminants[1] and were fully abandoned in 2008 with the water rights from these two wells fully transferred to the Polk Well Field. The only other ground water source currently available to the city is the Polk Street wellfield. This shallow wellfield has good yield (over

(1) In 1991, traceable levels of 1,1 Dichloromethane, 1,1,1 Trichoroethane and Methylene Chloride were detected in Old Wells #4 and #5. Both of these wells have not been used since.

1,500 GPM), but also contains elevated levels of iron and sporadic past occurrences of coliform bacteria. Chlorination followed by filtration at the Polk Reservoir site has largely eliminated these concerns.

Adjacent to the Polk Street wellfield are two existing 16" wells under city ownership, however, the properties on which these wells are physically located are not currently owned by the City and will not be included for use in this plan. In order to protect the water quality from the existing Polk wells, however, the city should attempt to gain legal control of both wells and either insure they are properly capped or sealed or earmark abandonment of these two wells as soon as possible.

In 2009, an 8" diameter production well (Park Well) with a safe yield of 180 GPM, was constructed on city-owned land at the end of Grand Avenue within the confines of a city park adjacent to the Polk Well Field. Due to limitations associated with the local distribution system and water quality issues, pumping water from this well directly into the water system is not feasible. Plans call for using this well site to irrigate the 15 acre ballfield complex adjacent to the Polk Wellfield.

Recent discoveries of available groundwater on city owned land adjacent to the Willamette River, along with three wells drilled for Independence and Monmouth, provide a potential for additional yield from the southern region of Independence. The Willamette River Well Field, which is located to the immediate southeast of the South Well Field, consists of three (3) individual wells with a combined capacity of 1200 GPM. At this juncture, only water from Wells #1 and #2, the highest producing wells, will be planned for use. This lowers the total wellfield production to approximately 1000 GPM. The well field is a cooperative venture between the cities of Independence and Monmouth and the well field is located approximately one-half mile south/southeast of the South Well Field on a former Oregon State Parks strip of property, between Corvallis Road and the river. If needed, and with proper planning it is believed that additional wells can be drilled at this site to produce a projected total of 1500-2000 GPM. Depending on need, a portion (500 GPM) of the water available from this wellfield will be included in this plan for implementation sometime between Years 2025-2030 although the wellfield is planned to be developed by Monmouth for their use well before this period.

Work at the Polk Street Well Field will entail installation of an 8" parallel raw water transmission line between 2015-17. The addition of a parallel 8" transmission main from the Polk Wells to the Polk treatment facility is projected to lower the operating head enough to increase the available flow from these four wells from 1,000 GPM to approximately 1,450 GPM, an increase of 45%. This work is planned for Phase I (2015-17) in this plan, which will delay activation and use of the Willamette River wells until the later years of the study period. For planning purposes, therefore, the following implementation schedule is recommended:

Table 5-1
Recommended Groundwater Source Development Schedule

	2014	2015	2020	2025	2030	2035
Existing South Well Field	400 GPM	400 GPM	550 GPM	550 GPM	550 GPM	550 GPM
Total South Field Capacity	**400 GPM**	**400 GPM**	**550 GPM**	**550 GPM**	**550 GPM**	**550 GPM**
Willamette River Wellfield	**N/A**	**N/A**	**N/A**	**N/A**	**500 GPM**	**500 GPM**
Polk Street Well Field	925 GPM	925 GPM	1,400 GPM	1,400 GPM	1,400 GPM	1,400 GPM
River Drive Well	50 GPM	50 GPM	50 GPM	50 GPM	50 GPM	50 GPM
Total Polk Street Capacity	**975 GPM**	**975 GPM**	**1,450 GPM**	**1,450 GPM**	**1,450 GPM**	**1,450 GPM**
Total Source Capacity	1,375 GPM	1,375 GPM	2,000 GPM	2,000 GPM	2,500 GPM	2,500 GPM
Total Required Source Capacity	1,467 GPM	1,503 GPM	1,700 GPM	1,925 GPM	2,178 GPM	2,462 GPM
Net Reserve Capacity	(-) 92 GPM	(-) 128 GPM	(+) 300 GPM	(+) 75 GPM	(+) 322 GPM	(+) 38 GPM

Considerations of Higher Maximum Day Use

During this analysis, additional consideration was applied towards the possibility of a single use day or 3-day demand with a higher than projected per capita demand. During this scenario, it was assumed that the normal 225 GPCD could conceivably rise to a higher value of 275 GPCD on an unusually hot summer day or during a prolonged dry spell. Under this scenario, the maximum day at the end of the study period would rise to: 275 GPCD x 14,450 (2035 population) = 3,973,750 gallons (2,760 GPM from sources). The differences from available source capacity is:

2,760 GPM-2,600 GPM = 160 GPM x 1,440 (24 hours @ 60 min/hr)= 230,400 gallons from storage (4.6% of 5,000,000 gallons).

Even the projected 3-day demand would result in a total water storage draft of approximately 350,000 gallons (approximately 7% of the total available).

In future years, however, source expansion may need to occur at the Polk Street Well Field as the city population increases. Concerns of water quality from this wellfield will also need to be addressed as dependence on this wellfield increases. In fact, the likelihood of encountering elevated Nitrate levels from neighboring agricultural property is actually quite high. To avoid the high cost associated with Nitrate removal, water from the newer wells will need to be blended with water with naturally lower levels of nitrates from the Polk Well Field. This procedure will be limited to the higher demand periods, such as summer and maximum day demands, only. The target goal is delivering a final blended water with Nitrate levels at or less than 7.5 mg/L. See Table 5-2:

Table 5-2
Polk Wellfield Blending Requirement (in GPM) to Lower Nitrate Levels

		Nitrate Concentration in New Well				
New Well Flow Rate (GPM)	**Desired Finished Nitrate Levels (mg/L)**	**5 mg/L**	**7.5 mg/L**	**10 mg/L**	**12.5 mg/L**	**15 mg/L**
150	5 mg/L	0	150 GPM	300 GPM	450 GPM	600 GPM
	7.5 mg/L	0	0	75 GPM	150 GPM	225 GPM
	10 mg/L	0	0	0	50 GPM	100 GPM
300	5 mg/L	0	300 GPM	600 GPM	900 GPM	1200 GPM
	7.5 mg/L	0	0	150 GPM	300 GPM	450 GPM
	10 mg/L	0	0	0	100 GPM	200 GPM
500	5 mg/L	0	500 GPM	1,000 GPM	1,500 GPM	2,000 GPM
	7.5 mg/L	0	0	250 GPM	500 GPM	750 GPM
	10 mg/L	0	0	0	170 GPM	325 GPM
750	5 mg/L	0	750 GPM	1,500 GPM	2,250 GPM	3,000 GPM
	7.5 mg/L	0	0	375 GPM	750 GPM	1,125 GPM
	10 mg/L	0	0	0	255 GPM	488 GPM

Note: Above table is based on Polk Well Field Raw Water Nitrate Level of 2.5 mg/L

The proposed development of the Willamette River Wells adjacent to the South Well Field will not necessarily lessen the potential of contaminant migration to the South Wells given the close proximity. The City is advised to continue monitoring of these wells as well as observation wells toward and into the contamination plume and if necessary, adjust the flow from the wells to avoid any additional well field contamination. Additional treatment, such as "pump and treat" methods, may be needed to remove the contaminants from the aquifer. Given the hydrogeology of this area, however, it is believed that lowering the yield from each well and combining more wells to produce the total water required, will lessen this potential as well as provide long-term advantages to the wells and well pumps. A discussion of local hydrogeologic characteristics and recommended well construction standards can be found in this chapter.

Water Right Implications

To satisfy the proposed groundwater development schedule, the City will need to obtain and secure additional water rights as well as modify or transfer existing rights. The South Well Field currently operates under a GR registration which, until recently, did not allow transfer or perfecting a water right until adjudicated by the Courts. As replacement wells were constructed for South Wells 1-3, the city will need to amend the permit currently recorded with the Water Resources Department. In order to retain the pumping rate priority date of Old Wells #4 and #5 (March 8, 1984), the City transferred these perfected rights (422 GPM) to the Polk wells in 2012. In the case of the Polk Street Wellfield, the permitted flow (897.6 GPM) of Polk Well #1, combined with the transfer from Wells 4 and 5 (421.8 GPM-Total 1,319.4 GPM), is adequate for all current needs, however, new water rights will have to be procured for all future demands. This will be accomplished by transferring existing water rights from the former Valley Concrete site. This water right addition will create an aggregate water right of 1,570 GPM at the Polk wellfield, just above the projected use of 1,450-1,500 GPM. Water rights for the new Willamette River Wellfield (1,200 GPM) is tentatively planned for a transfer of water from the unusable City of Monmouth's

Duck Slough wells. In all cases, the City should endeavor to retain any and all previous priority dates on pre-existing groundwater permits.

Surface Water Development

In response to concerns that future surface water rights from the Willamette River may not be available, the Cities of Monmouth and Independence combined in 2005 to procure water rights for future use. Each city applied for and were granted a flow rate of 4.46 CFS (2000 GPM) with a priority date of August 10, 2005 (Permit #S-86398). A further review of this plan will be conducted in a 10-20 year interval to verify the acceptability and feasibility of this scenario.

Local Hydrogeology

The City of Independence is located in a broad synclinal trough (valley) known as the Willamette Valley. The Willamette Valley was formed 30-60 million years ago through a downward folding of the subsurface layered rock formation. The material at the surface over much of the valley is a sandy to clayey silt that settled from ponded water. This silt, known as Willamette Silt, is comprised of a permeable fine-grained deposit that transmits water readily to the underlying alluvium formation. The alluvial deposits underlying the Independence area were largely derived due to erosion and runoff from surrounding mountains. These deposits consist of layers of clay, silt, and sand and gravel. This alluvium material, chiefly consisting of sand and gravel, is also referred to as unconsolidated material and provides the available groundwater for Independence and nearby agricultural wells. Water percolates through the pores within the sand and gravel mixtures by head (or pressure) created from the recharge point. Sand and gravel, due to its available pore spacing, is a much better conveyor of water to a well than clay or sandstone which have smaller pore spaces and do not permit water to transmit easily.

Near Independence, the sand and gravel beds are hydraulically continuous and can exceed a saturated thickness of 10 - 45 feet covering tens of square miles generally within the Willamette River floodplain. Properly constructed wells in these deposits can typically obtain yields of 100 up to 1,000 gallons per minute. The yield of an individual well, however, can vary significantly depending on the distance from the Willamette River, available head, and amount of cementation (binding together) that occurs within the formation. The alluvium in the immediate Independence area is often referred to as "younger or older alluvium". The terms "younger" or "older" alluvium refer to the relative geologic age of deposition of each of these types of alluvium. Younger alluvium has been more recently deposited and is constantly subject to washing and regrading of material due to the action of the Willamette River during floods. The older alluvium is more established alluvium that underlies the younger alluvium and/or Willamette silt.

The younger alluvium in Independence bounds the Willamette River to the east and extends roughly to Main Street to the west. This type of alluvium is characterized by high production wells due to a good hydraulic connection with the Willamette River and lack of cementation. Water from the younger alluvium, however, also generally has higher levels of iron, manganese, and hardness and is more susceptible to contamination due to the shallower depth and lack of overlying sealing material. The Polk Street wells and Old Wells #4 and #5 are examples of wells constructed in the younger alluvium. The older alluvium is located generally west of Main Street and underlies virtually all of the City including the South Well Field and River Drive. This type of alluvium does not yield the high flows common to the younger and shallower alluvium but it does generally have better aesthetic water quality. The older alluvium is dependent on direct precipitation and inter-zonal leakage from the younger alluvium for recharge. The older alluvium is known to be at its thickest and most extensive point in the vicinity of the South Well Field which accounts for the higher proportional yield from these wells as opposed to other nearby wells in the same, older alluvium. In the area around Independence, sand-and-gravel beds in younger alluvium are continuous and hydraulically connected with sand-and-gravel beds in the adjacent older alluvium. When pumping is applied, the two units respond as a continuous aquifer. Discontinuity, cementation, and hydraulic losses, however, account for much of the difference in yield between these two formations. The older alluvium is typically overlain by 15 to 45 feet of clay and silt that provides good wellhead protection when proper well construction practices are employed.

Underlying the younger and older alluvium are semi-consolidated and consolidated shale (claystone), sandstone, and basalt materials. Wells in these formations are not productive ($\leq$ 50 GPM) in this area for municipal use purposes and encountering salt water is a definite potential, particularly in wells as they are located further to the west and those below 100' in depth. For these reasons, exploration of groundwater below 100' in depth is not recommended in the Independence area.

Well Interference Potential

Given the close proximity of the Independence South Well Field and the nearby City of Monmouth's Fourth Street Well Field (Wells #4 and #5), the possibility of well interference between the two certainly exists. Fortunately, the Monmouth 4th Street wells are not frequently used, but if an emergency at Monmouth's two Marion County wells occurred, the potential exists for prolonged pumping from the Fourth Street Wells. If this occurred for an extended period of time, the South Well Field would most likely incur a drop in production of 15% - 50%. The high variable in drop of production would be related to the time of year (summer greater than winter), available water stored in the aquifer from recent recharge, and the rate and duration of pumping from both well fields.

The potential for drawing the suspected contaminant plume at a faster rate toward both well fields would also present more of a concern. Both cities would be well advised to discuss these scenarios and prepare an operational plan in the event both well fields would need to be used for an extended period of time. Well interference between the South Well Field and Monmouth's Marion County Wells is not believed to be of concern given the different aquifers, the separation provided by the Willamette River, and distance between these sites. Even though the potential exists for interference between the Polk Street Wellfield and nearby agricultural wells, the possibility of direct interference is low when considering the actual capacity of the Polk Street Wellfield versus the available yield, the experience gained over 25 years in operating the Polk Wellfield, distribution of flow between several wells, and the separation distance to actively used nearby irrigation wells.

The greatest potential for well interference actually occurs within the South Well Field itself. Experience of operation has shown that with proper balancing of flows from each of the five wells and pumping hours of less than 22-24 hours per day over the year, the wells can operate together with minimal interference. To prevent long term problems, however, the City should perform routine static (SWL) and pumping water levels (PWL) on each well on a monthly basis. The static water level tests should be taken after the wells have been shut down and allowed ample time to recover, typically up to 3-4 hours. Conversely, the pumping water level tests should be taken at the same flow rate each test. These recordings will provide the data necessary to optimize individual well and total well field yield and will also supply data necessary to track future well decline so that rehabilitation procedures can be implemented before the decline in well efficiency is too severe to remediate.

Recommended Well Construction Standards

In order to optimize future well production, the following recommendations should be considered when constructing new wells:

1. New wells should be a minimum of 8" diameter, with a 10" up 12" diameter well recommended at any new Willamette River well sites to allow well screen installation, if feasible. Filter or gravel packing may require larger well bores.

2. New wells shall be cement grout sealed to a minimum depth of 25', 5' into an impervious layer such as clay, if possible.

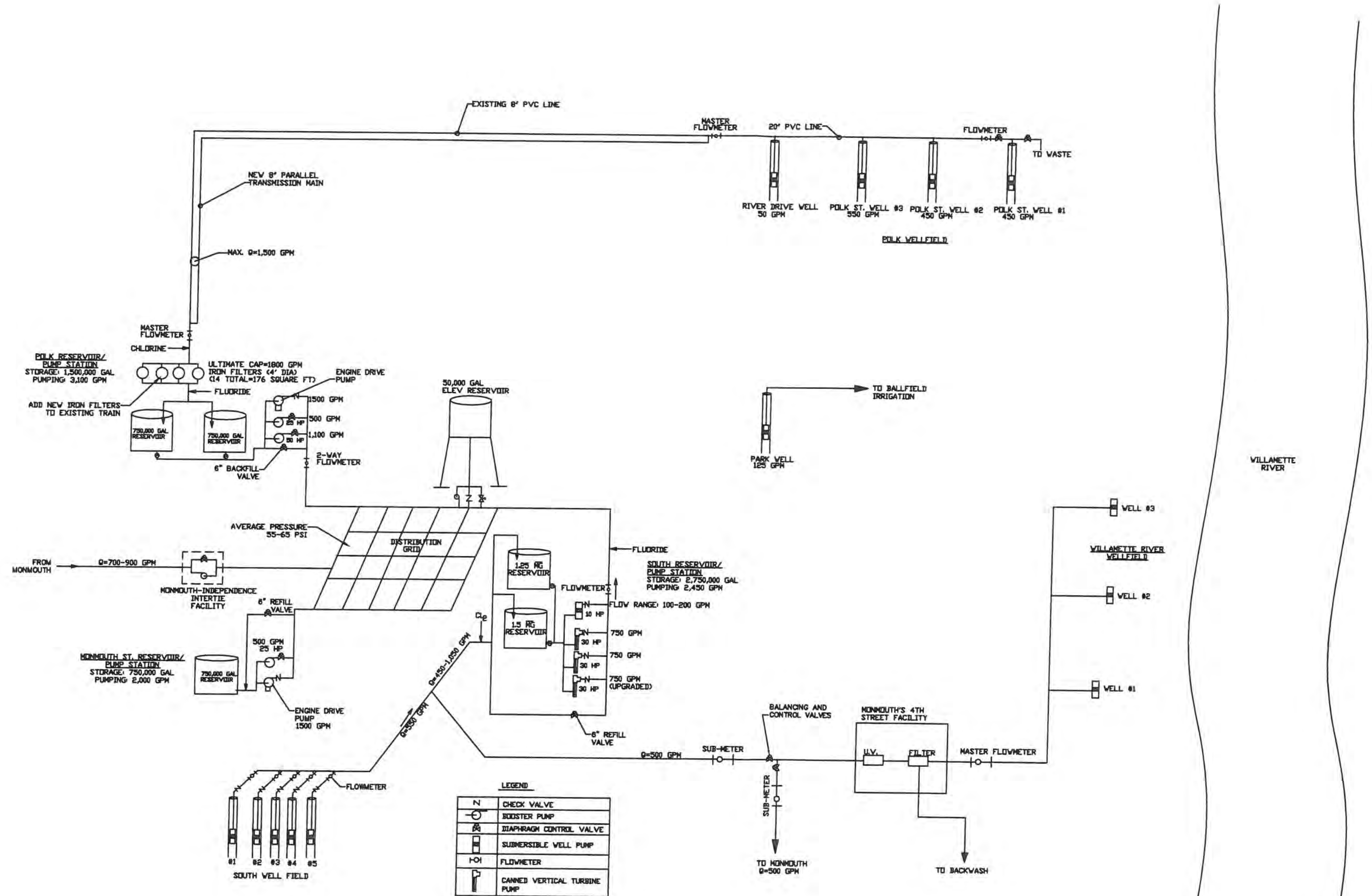
3. Formation sampling shall occur at no more than 5' intervals and at every change in formation to facilitate well screen selection.

4. New wells shall be drilled through the water-bearing formation to a minimum of five feet below the bottom of the aquifer. This five foot extension below the aquifer shall remain and be used for accumulation of sand in a tail pipe below the well screen.

5. Due to the thin and discontinuous nature of the local aquifer, the use of a continuous, wire-wrapped, stainless steel well screen is highly recommended over perforations.

6. New wells shall be properly test pumped for a minimum of twelve consecutive hours. During this period, any existing city wells within ¼ mile shall also be operated and monitored to determine the interference potential.

7. Generally, the well construction shall comply with Water Well Construction Standards as issued by the State of Oregon Water Resources Department.

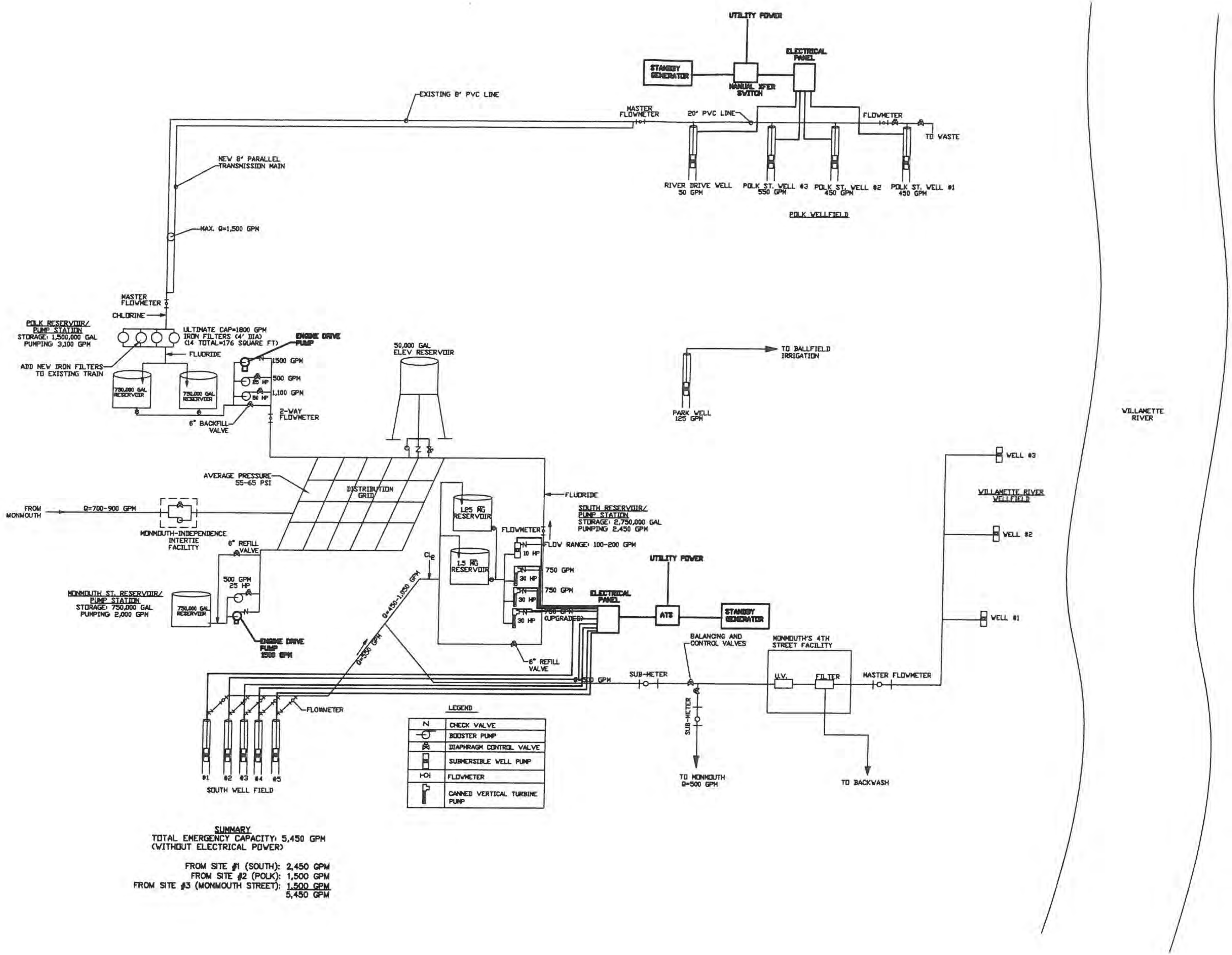


SUMMARY
TOTAL MAX. SOURCE CAPACITY: 2,500 GPM
TOTAL MAX. ELECTRICAL BOOSTER CAPACITY: 4,550 GPM
TOTAL MAX. ALL BOOSTER CAPACITY: 7,550 GPM @ 65 PSI
8,800 GPM @ 40-45 PSI
TOTAL MAX. STORAGE VOLUME: 5,000,000 GALLONS

NOTE: BOOSTER PUMP DISCHARGE FLOWS ARE SHOWN AT 65 PSI

CITY OF INDEPENDENCE
MASTER PLAN UPDATE
WATER SYSTEM SCHEMATIC-CONCEPTUAL
2035
NOT TO SCALE

FIGURE 5-1



CITY OF INDEPENDENCE
MASTER PLAN UPDATE
WATER SYSTEM SCHEMATIC-CONCEPTUAL
EMERGENCY FACILITIES
2035
NOT TO SCALE
FIGURE 5-2

Chapter Six

Water Quality

Water Quality

Water quality issues will continue to significantly impact both surface and groundwater sources over the next 20 years. Strict new regulations and monitoring requirements are either presently in effect or due to be enacted during the next 2-5 years. Many of these new regulations apply to both surface and groundwater sources while some only apply to one type of source. A more complete and detailed background and discussion of the Safe Drinking Water Act and its provisions can be found in the 1997 Master Plan or on the OHA/EPA websites. The water quality discussion in this update will be limited to the current and projected contaminant issues expected to impact the City of Independence. As the City of Independence currently utilizes only groundwater sources, the impact of proposed groundwater regulations will primarily be discussed.

Background

In 1974, the U.S. Congress passed the Safe Drinking Water Act (SDWA) with the purpose of establishing a uniform set of regulations and water quality standards. These regulations and standards applied to all "Public Water Systems" throughout the United States with the Environmental Protection Agency (EPA) providing the primary role in setting and enforcing the standards. The intent of the SDWA was for individual states to assume "primacy" and provide implementation and enforcement of these standards. Oregon was one of the last states to accept primacy for the SDWA, assuming this role in 1986. The 1986 SDWA amendments were passed by Congress at the same time Oregon assumed primacy. These amendments, at that time, provided the most stringent regulations and standards in the history of the United States with all public water systems impacted in some form. Under those amendments, the number of individual contaminants regulated totaled 111 by 1995 with 25 new contaminants regulated every three years into the future. In addition, new regulations were enacted which provided for mandatory filtration of surface water, disinfection requirements, and lead and copper testing. The current monitoring requirements are outlined in Table 6-1. The City of Independence by virtue of its population and number of services is classified as a "Community Water System" serving greater than 3,300 people but less than 10,000.

The SDWA, in 1996, underwent considerable changes that will effect virtually every public water system in the country. The 1996 amendments, as opposed to previous SDWA laws, were prepared with assistance and input from the regulated community. This law was passed by Congress and signed into law by President Clinton on August 6, 1996 as Public Law 104-182. As expected, the SDWA revision included some relaxation in some areas and increased enforcement in other areas. A summary of the current SDWA is as follows:

Current Status of Oregon Drinking Water Quality Standards

Drinking water contaminants are defined as any substance present in drinking water that could have an adverse impact on human health if present in sufficient concentrations. Although water systems are required to routinely monitor water quality, the simple presence of a single or several contaminants does not necessarily mean that the water presents a health risk. There are currently (2015) 92 different regulated contaminants established by the United States Environmental Protection Agency (EPA). They are typically grouped into five basic categories:

1) Microbial Contaminants-8

   This group includes contaminants such as viruses, bacteria, and parasites; which usually result from sewage or septic system activity, agricultural and livestock operations, and/or wildlife. Turbidity is also included in this group.

2) Disinfectants and Disinfectant By-Products-7

   Chemicals used in water disinfection and the by-products that are formed as the result from the reaction between the chemicals and natural substances in the water.

3) Inorganic Chemicals-16

   This group includes such chemicals as metals and salts, which can be naturally occurring or can result from stormwater runoff, industrial or domestic wastewater discharge, and other types of industrial and commercial activity.

4) Organic Checmicals-56

   This group includes the volatile (VOC) and synthetic (SOC) organic contaminants, such as pesticides and herbicides, that originate from a variety of sources, such as agricultural, urban stormwater runoff, industrial, commercial, and even residential uses. Frequently, the organic chemicals detected in groundwater come from industrial processes and/or petroleum production, distribution, or storage. This class of contaminants often has a high affinity of "sticking" to water molecules in transit to groundwater settings and then traveling many miles down gradient to a pumping well, where they are ultimately detected. Due to that characteristic, many organic contaminants "age" and form into "daughter" products when ultimately discovered. Facilities such as gasoline stations, dry cleaning, and agricultural operations are often the originating source of organic contaminants.

5) Radiological Contaminants-5

This category includes naturally occurring radioactive contaminants, or those that form from oil and gas production or mining operations. This class includes Radon, a radioactive gas that is often present in older, hard rock groundwater formations, such as granite.

Health Authority Classification

The City of Independence water system is regulated by the State of Oregon Health Authority (OHA) Drinking Water Section (DWS) and the EPA. The identification number for the water system is PWS ID: 4100399 (41 refers to the State: Oregon). The information contained on the OHA database is generally accurate and up to date (Figure 6-1). The state's database classifies the city's water sources as two wellfields with identifying nomenclature; The South Well Field is a single source and consists of five wells with an ID of "EP-A" and the Polk Well Field, also a single source, consists of four wells with an ID of "EP-B". ("EP" refers to Entry Point).

Table 6-1
Community Water Systems Routine Chemical Monitoring (1)

Chemicals	Ground Water	Last Test	Next Test Due
Inorganics	Every 9 Years (4)	2011	2020
Arsenic	Every 3 Years	2011	2014 (past due)
Nitrate	Annually (2)	2014	2015
Nitrite	Every 9 Years (3)	2011	2020
Asbestos AC Pipe	Every 9 Years	2010	2019
Source Asbestos	Every 9 Years	2010	2019
Organics (SOC & VOC)	Every 3 Years	2011	2014 (past due)
Total Trihalomethanes	Every 3 Years	2014	2017
Lead and Copper	Every 3 Years	2014	2017

(1) This table describes the routine monitoring currently required for the City of Independence waivers, reductions, wellhead protection programs, or detections will affect the sampling requirements. You will find details on number, location, and timing of samples in the OHA rule book.
(2) Nitrate: testing for systems can be reduced to annually after 4 consecutive quarters of sampling below 5 mg/L and a reduction is requested in writing. Some wells require quarterly monitoring of Nitrates.
(3) Asbestos: routine monitoring is one sample every nine years. Monitoring will go to one sample every 3 years if the system exceeds Lead or Cooper action levels.
(4) Reflects a Modified Schedule based on a Monitoring Reduction from 3 to 9 years.

Inorganic Contaminants

Inorganic contaminants, commonly referred to as "Primary" or metal contaminants, include 15 regulated metals and minerals such as Arsenic, Barium, Cadmium, etc. Inorganics can be either naturally-occurring or present due to agricultural or industrial uses. Inorganic contaminants most often originate from the source of water supply, but can also be present due to water contact with pipeline and storage tank materials. For most inorganic contaminants, health concerns are related to long-term or lifetime exposures with the exception of Nitrates and Nitrites. These two contaminants can seriously affect infants in short-term exposures by interfering with the transfer of oxygen from the lungs to the bloodstream. Due to the historical lack of detection of inorganic contaminants, the City of Independence has been granted a monitoring reduction, which essentially extends the sampling and testing interval from 3 years to 9 years. The City of Independence is currently in compliance for Inorganics with the most recent tests performed during 2011.

Arsenic

Arsenic is a regulated inorganic contaminant that has recently been under increasing scrutiny by the EPA. The current maximum contaminant level of .05 mg/L is easily met by Independence's source water. Monitoring for the Arsenic Rule began in January, 2006 when the rule lowered the MCL to 0.010 mg/L. This is expected to create a severe hardship on many utilities. The most recent tests for Arsenic were conducted on August 2, 2011. There was no detection of arsenic. Currently, all of the city's tests for Arsenic show levels less than .005 mg/L. Increased or more precise monitoring may be required in the future, however, as of the date of this plan, this potential is not known.

Nitrates

A separate discussion regarding Nitrates is warranted due to the past history of elevated levels of this contaminant, particularly from the Polk Street wells. Nitrates in drinking water can cause elevated Nitrogen levels in blood, especially in infants and young children occasionally resulting in "blue baby" syndrome. Until recently, the Nitrate level present from the Polk Wellfield averaged the highest level since the Polk Well #1 original activation in 1990, although recent tests indicate an elevated level of Nitrates from the South Well Field as well. The most recent test, performed on June 26, 2014 indicated a Nitrate level of 2.59 mg/L from the South Well Field and 1.20 mg/L from the Polk Well Field, both are still well below the maximum contaminant level of 10.0 mg/L. This increase in Nitrate levels observed during the winter and spring months from the South Wells raises concerns in regard to sustained higher capacity pumping from this wellfield. Levels of Nitrates in water from the wells have been observed for several years. This occurrence may be due to the transportation of recent applied nitrogen fertilizer (reverted to Nitrates) from nearby agricultural operations or dilution of water within the aquifer due to normal season recharge. Since groundwater in this area generally moves from the west towards the river, Nitrates can easily be transported to both well fields due to an induced pumping effect as well as ordinary groundwater movement. As the wells are pumped and the Nitrates are flushed through the aquifer due to ordinary groundwater movement, Nitrate levels often lower to acceptable levels until the next cycle begins. Currently, the data is not adequate to conclusively verify or dispute this theory. The city should complete a well field delineation as soon as possible, classify the recharge zone, and develop a Groundwater Management Plan using all available data. Due to the levels of Nitrates now observed, as well as concerns associated with the Groundwater Rule, continued monitoring of Nitrates, on a quarterly basis, should be preformed to develop a tracking history of Nitrate levels and future strategy for dealing with elevated levels. Another concern related to Nitrates is the potential elevation of Nitrate levels from the possible use of new wells in the Polk Street region. During the later 1990's-early 2000, two test wells were drilled on agricultural properly owned by Setnicker

Farms, just off of Hanna Road. Although the production from these wells was adequate, both wells exhibited levels of Nitrates above the MCL. Due to the relative cost of treatment and transmission, a decision to expand the Polk Street Well Field was made rather than development of the Setnicker wells. Although this was the prudent decision for the time, further population growth in the city will necessitate re-consideration of purchasing property (and possible agricultural water rights) for future development, even if Nitrate treatment will be required.

Trihalomethanes (Disinfection-By-Products)

Common disinfection treatment used to kill micro-organisms in drinking water, such as chlorine, can react with naturally occurring organics and inorganic material in water to form disinfection by-products. These disinfection by-products are suspected carcinogens over a lifetime of exposure. Total trihalomethanes (TTHM) testing is required for cities with population greater than 10,000. Although the City of Independence routinely adds chlorine to the water for "polishing," the constituents generally needed in water to generate THM's (tannic and humic acids) are not present in the existing groundwater sources, therefore, the current potential of generating excessive THM formation is also low. This is partly indicated from recent test results on July 28, 2013, that show a TTHM level of .0081 mg/L at South Well Field and .0055 mg/L at Polk Well Field, well below the MCL of .08 mg/L. The city is cautioned, however, that further use of the Willamette River Well Field and/or surface water supplies, such as the Willamette River, may lead to higher levels of TTHM that may exceed the MCL. To avoid this potential, careful monitoring of raw water quality is recommended along with a consideration of adjusting the design of the water treatment process.

Synthetic Organics (SOC's) and Volatile Organics (VOC's) (Phase II/V)

Synthetic organic contaminants (SOC) are also referred to as Phase II Regulated SOC's. The Phase II rule established MCL's for 38 contaminants including 10 VOC's (Volatile Organic Contaminants), 17 pesticides, PCB's, inorganic contaminants, and where applicable, 2 water treatment chemicals. The primary impetus of the Phase II/V rule is to determine the presence of organic (carbon) based and inorganic contaminants in potable water supplies such as pesticides, solvents, and metals commonly used in present-day and past industrial and agricultural practices. Typically, levels of volatile and synthetic organic contaminants have been in the "non-detect" range, or too low to measure in water from both wellfields. A short-term groundwater contamination of Pentachlorophenol during the mid 1990's from a former wood processing facility west of the South Well Field created enough of a concern to implement the installation of activated carbon filters at all five of the South Wells, however, overtime this situation has apparently become less of a concern. A more recent issue began in 2005 with the discovery of Tetrachloroethylene (PCE), a regulated organic contaminant, at the South Well Field. Although, at the time of publication of this report, the exact source of this contaminant has not been determined, it is believed that it may have originated from a former dry cleaning establishment north of the wellfield. Additional testing and investigation will be needed to confirm or refute this early assumption. To date, the presence of PCE has only occurred at South Wells 2 and 3 and at fairly low concentrations. The contaminant is easily "absorbed" through the use of the activated carbon pressure filters that were originally installed to combat the Pentachlorophenol situation. Based on the results from several lab tests, there is no PCE present in the drinking water delivered to consumers as the filters are removing the contaminant at the source. The city, as directed by OHA, is conducting a series of tests each year to verify the continued removal of PCE. The concentration of the organic contaminants detected in the South Well Field aquifer has steadily declined since their first discovery and it is believed that continued pumping will eventually lower the levels to non-detectable ranges without treatment. During the replacement of South Wells 1-3 in 2006, the presence of DI (2-Ethylhexyl Phthalate) was detected in a routine lab sample. Subsequent tests conducted on water from both wellfields, however, have not detected this contaminant.

Future avoidance of contamination from Phase II/V elements and compounds will require monitoring and control of nearby agricultural and industrial practices. Generally, application of pesticides should be discouraged or forbidden within 500' - 1,000' of all well heads. The City is advised to contact all farms and industrial facilities in close proximity to the well fields and implement a Memorandum of Understanding (MOU) with potential contaminant producers or users as to the application and control of any possible sources of contamination.

Coliform Bacteria

The Total Coliform Rule affected all public water systems in Oregon beginning in 1991. Coliform Bacteria is the primary measure of the microbial quality of drinking water. Coliform are bacteria that are naturally present in the environment and are used as an indicator that other, potentially harmful, bacteria may also be present. All Oregon water suppliers, within the population ranges of Independence, are required to test for coliform bacteria according to the following monitoring guidelines:

Table 6-2
Coliform Monitoring Frequency

Population	Samples per Month
7,601-8,500	9
8,501-12,900	10
12,901-17,200	15

Currently, the City of Independence by virtue of a population of 8,585 (OHA database) must test for coliform bacteria ten times per month. Information obtained from the Oregon Health Authority indicates consistently negative coliform bacteria tests since 2000 in all wells except for Polk Well #1 which randomly tests positive for total coliform only. Regular chlorination at all well sites is performed to control coliform bacteria. The city routinely injects gas chlorine into the raw water with a finished water residual generally between .30-.50 mg/L.

Consumer Confidence Report

The City of Independence was initially required to issue consumer confidence reports (CCR) to all water consumers by June 10, 2004 for Year 2003 and by July 1st each year thereafter for subsequent calendar years. The most recent 2013 CCR (Figure 6-2 A-D) is included for reference within this report. The CCR is basically an annual report card between 3-5 pages, which informs water customers whether or not their water system meets federal guidelines.

In the case of Independence, specific information regarding source quality, susceptibility, and additional water quality data must be evaluated and incorporated into the CCR. The water supplier must mail or otherwise deliver a water bill and must make a good faith effort to deliver to non-bill paying consumers. The following information must be included in the CCR:

1. The source(s) of drinking water (springs, wells, rivers, etc.)

2. A brief summary of the susceptibility to contamination of the source water based upon the source water assessments as they are completed by the states over the next 3 years.

3. Instructions on obtaining a copy of the water system's source water assessments.

4. A table showing the highest level of any contaminant detected in their drinking water plus EPA's health based standard (maximum contaminant level) for that contaminant for comparison and the probable source of the contaminant.

5. The water system's compliance with other drinking-water-related rules including monitoring.

6. An educational statement for vulnerable populations. Individuals who have suppressed immune systems caused by chemotherapy, organ transplants, AIDS, etc. fall into this category.

7. Educational information on nitrate, arsenic, or lead where the contaminants are detected above 50 percent of EPA's maximum contaminant levels.

8. The phone numbers for additional sources of information available from the water system's staff or EPA's Safe Drinking Water Hotline (800) 426-4791.

9. The rule specifies how the data is to be presented, with specific instructions for reporting and explaining results for turbidity, lead and copper, total and fecal coliform, cryptosporidium, radon, arsenic, nitrate, and any other contaminants.

Complete information regarding preparation and distribution of the CCR is available from the Oregon Health Authority.

Lead and Copper Rule

The primary purpose of this rule is to address possible lead and copper contamination from materials commonly found in customer services. The rule was promulgated by the EPA on June 7, 1991 and the City has performed eleven rounds of testing to date. The rule established "Action" levels of .015 mg/l for lead and 1.35 mg/l for copper. None of the sources has naturally occurring lead or copper. Since the City's distribution system does not contain any known lead, copper would be the most expected element to occur (See Figure 6-3 for past test results).

The first round of Lead and Copper testing was performed in 1993. The 90^{th} percentile Copper level observed in this first round was .961 mg/L, below the action level of 1.35 mg/L. Ten additional rounds of testing have been performed since 1993. The most recent testing, performed August 11, 2014, indicated levels of .0033 mg/L for lead and 1.20 mg/L for copper, both are still below the appropriate action levels. Due to the consistency of low lead and copper levels during the early rounds of testing, the city was able to obtain a monitoring extension to a 3 year cycle in 1996.

Radiological (Gross Alpha)

The current federal rule for radiological sampling (Radionuclides) requires 1 sample every 4 years. All past tests that have been performed have not indicated the presence of any Radionuclides. Radioactivity is uncommon from shallow ground water sources and is generally found in deeper groundwater sources that are subject to a much longer and greater natural radioactivity exposure such as basalt or granite. Independence has no history of any significant radiological contamination.

Secondary Contaminants

Secondary contaminants are not regulated contaminants but do include water quality parameters that can affect aesthetic conditions and cause taste and odor concerns. Because aesthetic water quality conditions are often the most apparent to customers, a discussion of their impact is included.

Table 6-3
Secondary Contaminants

Parameter	Suggested Limit	South Wells Typical Values	Polk Wells Typical Values
pH	6.5-8.5	7.28	7.30
Alkalinity	None	207	160
Calcium	None	15	20
Chloride	<250 mg/L	14.3	10
Hardness	<250 mg/L	192	250
Iron	.3 mg/L	<.1	.50
Manganese	.05 mg/L	<.01	<.01
Sodium	10 mg/L	14.0	18
Sulfate	250 mg/L	14.6	12
Total Solids	500	310	200
Zinc	5	<.01	<.01

The only secondary water quality constituent that causes concern at this time is the elevated iron level present in several wells. As outlined in other chapters of this report sustained pumping of the aquifer is planned to hopefully lower these levels to acceptable values. Iron removal filtration using a proprietary media, is in place to filter all water from the Polk Wellfield.

Fluoride

The City of Independence adds Sodium Fluoride at the Polk and South Reservoirs. Finished water fluoride levels average .5-1.4 mg/L throughout the system. Original fluoride injection was started in 1994.

Aesthetic Concerns

Given the characteristics of the Independence source water and in-place water treatment currently conducted, aesthetic (taste, odor, and staining) problems are currently believed to be of slight concern. The city's finished water from the combined wells does not presently contain appreciable levels of iron, manganese, or hardness which are the primary causes of staining. Long detention periods in pipelines or reservoirs can cause isolated incidences of taste and odor complaints that can usually be remedied by line flushing or tank drain/refill cycles. To lessen the effect of iron and manganese, water produced from the Polk and River Drive wells is routed through an oxidation bed filtration system (ATEC Systems) located at the Polk Reservoir/Booster Pump Station site. This system has a current design flow rate of 1000 GPM, however, a peak flow of up to 1200 GPM can be handled during periods of favorable raw water quality (low iron levels). It is projected that the current filtration configuration can handle the Polk Well Field pumping rate until the approximate Year 2016. At this juncture, additional filters will be needed to handle the ultimate flow rate of 1800 GPM as capacity is increased from the Polk Well Field around 2015-17.

Groundwater Specific Issues

In addition to the previously outlined observations and recommendations regarding VOC, SOC, bacteria, and other water quality concerns, new regulations will affect the use and treatment of groundwater. The Groundwater Rule is expected to have a significant impact on Independence since many of the sources have been deemed potentially vulnerable to viral contamination.

The Ground Water Rule is one of the many outcomes from the 1996 Amendments to the 1974 Safe Drinking Water Act. The Amendments required the EPA to develop regulations that required an adequate level of disinfection of public ground water systems to a degree "as necessary" to protect public health. Obviously, this wide-open term of "as necessary" provided the EPA with a great deal of latitude they could use while actually formulating and developing the proposed and final rules. Initially, the Ground Water Rule was commonly referred to as the Ground Water Disinfection Rule (GWDR), however, the term was shortened to the current version to more closely define the actual intent of the rule. The rule was developed as the result of several ground water studies and disease outbreak data that repeatedly showed that pathogenic (harmful) viruses and bacteria can occur in public water systems that use ground water, particularly ground water delivered to consumers without treatment of any kind.

Viral and/or bacterial pathogens, often found in fecal contamination from animal and human feces, can readily reach ground water, and in turn, drinking water supplies, through shallow or even deep wells via a route of inadequate or defective well depth or sanitary seals, broken or corroded well casings, wellhead flooding, failed septic systems, and/or wells constructed too close to a septic drainfield, in addition to other means. Waterborne disease caused from viral or bacterial pathogens often results in gastrointestinal symptoms, such as diarrhea and/or vomiting, that usually does not require medical attention for healthy adults, but can be very serious or even fatal to high-risk groups of the population, such as young children, the elderly, and people with compromised immune systems. Although the available data does not indicate that any more than a small percentage of wells or aquifers actually have the presence of fecal contamination, the severity of the possible health impacts, and the number of affected water consumers potentially exposed to the pathogens, indicated that some type of regulatory response was needed. The GWR applies to more than 150,000 public water systems serving more than 100 million consumers in the United States and is also applicable to water systems where ground water supplies are mixed with surface water supplies in which the ground water system is not treated to the same level as the surface water supply. The rule was originally proposed by the EPA on May 10, 2000, signed into law on October 11, 2006, published in the Federal Register on November 8, 2006, and took effect on January 8, 2007.

The Science of the GWR

A basic understanding of the Ground Water Rule requires some discussion of the science and logic behind the reasons for the rule. As previously indicated above, the GWR has been promulgated to provide for an increased level of protection against viral and bacterial pathogens in public water systems that use ground water. Specifically, the EPA is concerned with ground water systems that are exposed or susceptible to fecal contamination because these systems are at a far greater risk of passing harmful pathogens into a water supply. Several viral pathogens are known to exist in ground water aquifers, such as Hepatitis A and E, Coxsackie viruses, Echovirus, and Noroviruses, while bacterial pathogens found in ground water include the well-known strain of Escherichia coli (E. coli), in addition to other lesser-known bacterial pathogens such as Salmonella and Shigella.

Due to the known relationship between the possible coincidental presence of fecal contamination and pathogenic viruses and bacteria in a water supply, and the fact that presumptive and rapid laboratory tests for viruses are not readily available, the EPA has established the presence of fecal contamination in a ground water supply as the prime indicator for the possible presence of pathogenic viruses or bacteria. In addition, fecal contamination is presumed to be present when one or more specific fecal indicators in the water are present. The three fecal indicators that have been selected for use in the Ground Water Rule are: E. coli, enterococci, and coliphage. Each of these indicators can be easily detected via various analytical methods commonly available through approved testing labs. Although fecal indicators, by themselves, are not typically harmful when ingested, their presence in ground water is a presumptive indication that fecal contamination is also present, which, in turn, provides a strong indication that viral and/or bacterial pathogens, or at the very least, a pathway for these pathogens, may also be present into the ground water supply. This, in a nutshell, forms the basis of the science of the Ground Water Rule.

In order to identify ground water systems at risk to fecal contamination, the EPA has established a "risk-targeted" approach to identify these systems. The risk targeted approach relies on and evaluates four major components:

1) Periodic Sanitary Surveys of ground water systems that require the evaluation of eight critical elements: 1. source, 2. treatment, 3. distribution system, 4. finished water storage, 5. pumps, pump facilities, and controls, 6. monitoring, reporting, and data collection, 7. system management and operation, and 8. operator compliance with state requirements. States have until December 31, 2012 to complete the initial sanitary survey cycle for community water systems and until December 31, 2014 for all non-community water systems and systems that already meet the performance criteria. The sanitary surveys will be used to identify water systems with significant deficiencies or systems that already have source water problems;

2) Source water monitoring that is triggered when a water system identifies a confirmed positive coliform sample during its routine Total Coliform Rule monitoring as well as state optional assessment monitoring at high risk systems;

3) Corrective action is required when a water system is identified to have a significant deficiency or confirmed source water contamination, and;

4) Compliance monitoring to ensure that an adequate level of treatment is provided to reliably treat drinking water to achieve at least 99.99% (4-log) inactivation or removal of viruses.

The projected average cost to implement the GWR is less than $5.00 per year for 90% of the U.S. households served by public ground water systems. Over $3.6 billion dollars has been earmarked to ensure that drinking water systems comply with the Safe Drinking Water Act. Much of these funds are already available for low-interest loans to qualified water systems.

Annual Drinking Water Quality Report 2013

City of Independence

This report was written 05-23-14

Este reporte es disponible en Espanol en la Presidencia municipal.

We're pleased to present to you this year's Annual Quality Water Report. This report is designed to inform you about the quality water and services we deliver to you every day. Our constant goal is to provide you with a safe and dependable supply of drinking water. We want you to understand the efforts we make to continually improve the water treatment process and protect our water resources. We are committed to ensuring the quality of your water. Our water source is ground water; we have seven wells that we draw water from.

We're pleased to report that our drinking water is safe and meets federal and state requirements.

The City of Independence routinely monitors for contaminates in your drinking water according to Federal and State laws (The City of Independence is guided by Oregon Health Authority for monitoring). These results of our monitoring are for the period of January 1st to December 31st, 2013. As water travels over the land or underground, it can pick up substances or contaminants such as microbes, inorganic and organic chemicals. All drinking water, including bottled drinking water, may be reasonably expected to contain at least small amounts of some contaminates. It's important to remember that the presence of these contaminates does not necessarily pose a health risk.

In this table you will find many terms and abbreviations you might not be familiar with. To help you better understand these terms we've provided the following definitions:

Parts per million (ppm) or Milligrams per liter (mg/l) - one part per million corresponds to one minute in two years or a single penny in $10,000.

Parts per billion (ppb) or Micrograms per liter - one part per billion corresponds to one minute in 2,000 years, or a single penny in $10,000,000.

Action Level - the concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Maximum Contaminant Level - (mandatory language) The "Maximum Allowed" (MCL) is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum Contaminant Level Goal - (mandatory language) The "Goal"(MCLG) is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

MCL's are set at very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water every day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.

FIGURE 6-2A

Contaminant	Violation Y/N	Level Detected	Unit Measurement	MCLG	MCL	Likely Source of Contamination
HAA5 Halo Acidics	N	.003	ppb	na	.06	This is a byproduct of water chlorination
73. TTHM's Total trihalomethanes	N	.0008	ppb	na	.08	This is a byproduct of water chlorination

Inorganic Contaminant	Violation Y/N	Level Detected	Unit Measurement	MCLG	MCL	Likely Source of Contamination
16. Fluoride	N	1.4	ppm	4	4	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories
19. Nitrate (as Nitrogen)	N	2.36	ppm	10	10	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
21. Selenium	N	ND	ppb	50	50	Discharge from petroleum and metal refineries; erosion of natural deposits; discharge from mines

Inorganic Contaminant	Units	Goal	Action Level (AL)	90th Percentile	Homes Exceeding AL	Complies?	Source of Contaminate
14. Copper	ppm	1.3	1.3	1.3	0	Yes	Corrosion of household plumbing
17. Lead	ppb	0	15	ND @ 0.002	0	Yes	Corrosion of household plumbing

Volatile Organic Contaminant	Violation Y/N	Level Detected	Unit Measurement	MCLG	MCL	Likely Source of Contamination
None						

Synthetic Organic Contaminant	Violation Y/N	Level Detected	Unit Measurement	MCLG	MCL	Likely Source of Contamination
None						

(14) Copper. Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short amount of time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years could suffer liver or kidney damage. People with Wilson's Disease should consult their personal physician.
(16) Fluoride. Some people who drink water containing fluoride in excess of the MCL over many years could get bone disease, including pain and tenderness of the bones. Children may get mottled teeth.
(17) Lead. Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure.
(19) Nitrate. Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.
(21) Selenium. Selenium is an essential nutrient. However, some people who drink water containing selenium in excess of the MCL over many years could experience hair or fingernail losses, numbness in fingers or toes, or problems with their circulation.
(73) TTHMs [Total Trihalomethanes]. Some people who drink water containing trihalomethanes in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer.

As you can see by the table, our system did not have any violations for exceeding the MCL. All samples tested within acceptable levels. We have learned through our monitoring and testing that some contaminates have been detected, but did not exceed maximum contaminant levels. We're proud that your drinking water meets or exceeds all Federal and State requirements.

FIGURE 6-2B

The City of Independence is required to test for many different categories of contaminates throughout the year; these categories include Bacteriological, Volatile Organic, Inorganic, Radiological, Halo Acidics, SOC's and Total Trihalomethanes. There are several dozen separate contaminates we test for; out of these, we had 7 contaminants detected; all 7 were at or below the Maximum Contaminant Levels.

The 90th percentile is the highest result found in 90% of the samples when they are listed in order from the lowest to the highest results. EPA requires testing for lead and copper at customers' taps most likely to contain these substances based on when the house was built. The EPA determined that if the sample results exceeded the Action Level (AL), the City must take action in reducing the risk of leaching of lead and/or copper. As you can see by the table above, your water was at the action level for copper, but it was not exceeded. Our next testing for lead and copper is scheduled for 2014.

Nitrates in drinking water at levels above 10 ppm is a health risk for infants of less than six months of age. High nitrate levels in drinking water can cause blue baby syndrome. Nitrate levels may rise quickly for short periods of time because of rainfall or agricultural activity. If you are caring for an infant you should ask advice from your health care provider.

Nitrates: As a precaution we always notify physicians and health care providers in this area if there is ever a higher than normal level of nitrates in the water supply.

Lead: Lead in drinking water is rarely the sole cause of lead poisoning, but it can add to a person's total lead exposure. All potential sources of lead in the household should be identified and removed, replaced or reduced.

Sodium: EPA and Oregon Health Division set standards for sodium at 20mg/l for water utilities. The sodium level for the City of Independence is approximately 20-25mg/l. At this level, take into account diet or health reasons; if needed, consult your physician.

All sources of drinking water are subject to potential contamination by substances that are naturally occurring or man made. These substances can be microbes, inorganic or organic chemicals and radioactive substances. All drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791.

Thank you for allowing us to continue providing your family with clean, quality water this year. In order to maintain a safe and dependable water supply we sometimes need to make improvements that will benefit all of our customers. These improvements are sometimes reflected as rate structure adjustments. Thank you for understanding. We also have a city water master plan available at City Hall for review; this plan was updated as of October, 2007. We have practiced well-head protection, and a water conservation program is adopted, if needed.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

The City of Independence Water Department works around the clock to provide the highest water quality as efficiently as possible to every tap. We ask that all our customers help us protect our water sources.

If you have any questions about this report or concerning your water utility, please contact Matt Carpenter or Nick Esch at 503-838-4781. We want our valued customers to be informed about their water utility. If you want to learn more, please attend any of our regularly scheduled City Council meetings; contact City Hall for dates and times.

Thank you for your time and interest
Independence Public Works

FIGURE 6-2D

Oregon Public Health
Drinking Water Data Online

Health

PWSID: 00399
PWSName: INDEPENDENCE WATER SYSTEM
Status: A
System Type: C
Population: 8600

Fact Sheets
Definitions
Public Notice
Alerts
Enforcements
Spreadsheet

Action Levels: Lead = 0.0155 mg/l Copper = 1.35 mg/l

Lead and Copper 90th Percentile Summary Results details for latest summary

Sample Date	Date Received	Sample Count	Duration	Lead (mg/l)	Copper (mg/l)
Jul 21, 2014 - Jul 24, 2014	Aug 11, 2014	22	3Y	0.0033	1.2000
Jul 27, 2011 - May 16, 2012	Aug 26, 2011	20	3Y	0.0000	1.3000
Jul 17, 2008 - Jul 17, 2008	Sep 15, 2008	23	3Y	0.0000	1.1000
Jul 21, 2005 - Jul 21, 2005	Aug 23, 2005	20	3Y	0.0058	1.0000
Jul 09, 2002 - Jul 09, 2002	Sep 05, 2002	20	3Y	0.0000	0.0710
Jan 01, 1999 - Jul 20, 1999	Sep 28, 1999	20	3Y	0.0000	0.8490
Jan 01, 1996 - Jun 13, 1996	Jul 16, 1996	20	YR	0.0000	1.0610
Jan 01, 1995 - May 17, 1995	Jun 28, 1995	20	YR	0.0000	0.6630
Jan 01, 1994 - Aug 03, 1994	Aug 19, 1994	20	YR	0.0054	1.2330
Jan 01, 1994 - Apr 06, 1994	May 06, 1994	40	6M	0.0031	0.7700
Jan 01, 1993 - May 09, 1993	Jun 09, 1993	40	6M	0.0000	0.9610

More Info

FIGURE 6-3

Chapter Seven

Water Storage Requirements

Water Storage Requirements

Background

Water storage is provided for several reasons:

1. To equalize supply and demand for daily flow variations, maximum day, and peak hour requirements:
2. To provide emergency reserve supply during pipeline breaks, mechanical failures, and power outages.
3. To provide water for fire protection.

As previously outlined, the estimated current and projected average day, maximum day, and peak hour demands are as follows:

Year	Population	Average Day (GPD) (1)	Maximum Day (GPD) (1)	Peak Hour (GPM) (1)
2015	8,820	970,200 GPD	1,984,500 GPD	2,760 GPM
2025	11,290	1,241,900 GPD	2,540,328 GPD	3,530 GPM
2035	14,450	1,589,500 GPD	3,251,250 GPD	4,671 GPM

(1) For water storage planning purposes, values reflect current non-revenue and unaccounted for water losses of 20%

In the determination of required storage volume, several factors must be evaluated. Among these are: operational storage (for normal daily fluctuations of demand), fire protection storage, source redundancy, reserve emergency storage and source reliability.

Operational Storage

Operational or equalizing storage provides reserve water during variations in system demand that occur within one day of normal operation. This reserve storage is used to allow the sources to pump at a reasonably continuous rate. Given the fact that Independence's water system consists of mostly residential loads along with a small percentage of industrial and light commercial demands, a factor of 25% of the average day demand will be used for operational storage. This value is commonly used for systems of this type and size.

Fire Protection Storage

As previously stated in this report under "Fire Flow," the quantity of water required for effective fire fighting varies according to population and type of development. Since the Independence water system consists of one single pressure zone, fire reserve will be provided for the equivalent of the total city population. The fire flow and duration will vary according to estimated population for Years 2015-2025 with a starting fire flow of 3,500 GPM for a 3 hour duration. The Year 2035 fire flow used for this study will be 4,000 GPM (booster pumps) for four (4) hours, which is typical for the projected population of 14,450 and is also felt to be adequate to accommodate a single large fire within the downtown area or at Central High School. Ultimate storage volume at Year 2035 will therefore be based on four (4) hours fire flow duration @ 4000 GPM = 960,000 gallons.

Reserve Emergency Storage

This requirement is dependent on several factors. Among these are: source reliability and redundancy (including pumping facilities), electrical power stability and reliability, pipeline integrity, and available standby facilities. In the case of Independence, all sources are located within one mile of each other and both source flow is transmitted through 2 separate transmission pipelines, one quite long (≥4000 feet) and the other very short, to their respective reservoirs and booster pump stations. In addition, all reservoir sites are equipped with water system backfeed valves that allow alternate operation and reservoir fill from one well system to the other. Failure of one wellfield or pipeline will allow alternate reservoir operation through the other system. The seven currently operating wells each contribute varying flows to the system and the greatest impact to the system would involve the total loss of the Polk Street Wells. The loss of this well field (1000 GPM) would require the South Wells to operate continuously to compensate for this loss of flow. The combined flow of the South Well Field after the Willamette River Wellfield addition is around 1050 GPM which easily satisfies the Year 2020 average day demands with 16-18 hour/day well and pump operation and the 2025 average day demands with 24 hour/day operation. As system growth occurs, however, beyond 2020, the ability of the South Wells alone to keep up with the average day demands will be compromised. The future addition of the Willamette River Well Field to the South Wells will adequately replace the deficit created by the loss of the Polk Street Wells for all but maximum day demands. In addition, the active intertie to the City of Monmouth is capable of providing up to 1.0 MGD (700 GPM) in emergency situations. With the consideration of these factors, proposed emergency planning, and present capacity; source reliability, particularly after Year 2025, is not felt to represent a major concern.

Power reliability is always a concern due to the fact that all wells are served by the same primary electrical power source (PP&L). A sustained outage, therefore, could allow a severe depletion of storage to occur before power restoration. This scenario was evident during an 11 hour power outage that impacted the entire city on August 2, 2012. During this event, engine-driven backup pumping equipment will automatically activate and the telemetry control at the City shops will notify system operators immediately upon power failure at any site which will significantly lessen response time. The addition of a standby generator, in 2004, at the South Pump station is a significant improvement and a step towards better reliability, especially since this unit is capable of operating all five South wells plus the booster pump station simultaneously. A deficit still exists at the Polk facility, however, as there is no standby power available at this site. Improvements performed during the summer of 2006, centralized the electrical service to a single location at the site of the River Drive well for all three wells in addition to the installation of a manual transfer switch for a portable generator. A new permanent standby generator with manual switch over is planned for this site by 2020. In regards to electrical power to the booster pumps, as previously indicated, the South Booster Pump Station already has an automatic standby generator capable of running all booster pumps and the Monmouth Street and Polk Pump Stations are each equipped with 1500 GPM engine-drive booster pumps. These provisions greatly decrease the concern over power reliability.

The typical volume of water provided for emergency storage for most municipal water systems ranges from 1-4 days of the average daily demand based on considerations of source, power, pumping system, and distribution system reliability and reserve capacity. As previously outlined, the diversity of wells and pumping units, both source and booster, combined with the provisions for standby electrical power, greatly lessens the need for a future extremely high level of emergency storage. Booster pumping facilities from water storage reservoirs to the system are felt to be adequate and diverse enough given the current presence of an engine-driven booster pump at each of the Polk and Monmouth Street Reservoir sites and an automatic start standby generator at the South pump station. For planning purposes, therefore, an ultimate reserve emergency storage equivalent to 2.25 days of average day demand ending with Year 2035 average daily demand will be used. This value is also equal to roughly 112% of a maximum day demand event, well over the desired minimum of one day of water storage for a maximum day, minimum. This reserve requirement has been increased to 2.25 from the value of 1.5 used in the 2007 Master Plan Update due to the severity, scope, and duration of the city-wide loss of electrical power experienced in August of 2012 and the obvious reliance on electrical power observed during this event. Interestingly, this future planning criteria will provide two or more days of average day reserve volume in the initial years of this study through the Year 2025 when the larger reserve volume is needed due to the lack of complete redundancy and source buildout not present until 2030-35. This is based on the proposed redundancy of pumping facilities. The original need for a stationary generator at the Polk wellfield has been modified to a portable generator with manual engagement due to the advantage gained from adding a second 750,000 gallon water storage reservoir at the Polk reservoir site in 2011. This added water storage at this site now provides 1,500,000 gallons of total water storage to the booster pumps, roughly 14-16 hours during Year 2035 maximum day conditions. This is more than enough time necessary to procure a portable generator, move it to the Polk wellfield, and connect/engage it to re-establish flow from the Polk wellfield to the reservoirs. The Cities of Independence and Monmouth currently have in place an emergency water connection and intertie agreement between their respective water systems. Since the City of Monmouth's operating water pressure is considerably higher than Independence, a pressure reducing device is now in place to allow transfer of water from Monmouth to Independence. This means that this intertie is completely independent of electrical power. With minor modifications to this device, water from Monmouth could easily be admitted into the Independence system automatically upon an extreme low pressure. Understandably, this type of arrangement can also impact Monmouth's water storage, however, if properly negotiated and operated, this emergency connection can give Independence the time it needs to implement backup power at the Polk wellfield or repair facilities. Alternately, this existing facility could also be used to provide water to Monmouth during the same extreme emergency with a standby generator. Conceivably, proper implementation of this inter-use facility can have economic and reliability benefits to both cities and conserve needed capital investment funds for alternate purposes.

Table 7-1
Storage Requirements-(in U.S. Gallons)
Years 2015, 2020, 2025, 2030, and 2035

	2015	2020	2025	2030	2035
Operational Storage (25% of Average Day)	242,000 Gal	274,425 Gal	310,485 Gal	351,285 Gal	397,375 Gal
Fire Reserve Storage (1)	630,000 Gal	630,000 Gal	960,000 Gal	960,000 Gal	960,000 Gal
Reserve Emergency Storage (2.25 x average day)	2,182,950 Gal	2,469,808 Gal	2,795,000 Gal	3,161,563 Gal	3,576,375 Gal
Total Required Storage	3,054,950 Gal	3,374,233 Gal	4,065,485 Gal	4,472,848 Gal	4,933,750 Gal
(-) Available Storage (Gallons)	3,750,000 Gal	3,750,000 Gal	5,000,000 Gal	5,000,000 Gal	5,000,000 Gal
Total (Deficit); Surplus (+)(Gal.)	(+) 695,050 Gal	(+) 375,767 Gal	(+) 934,515 Gal	(+) 527,152 Gal	(+) 66,250 Gal

(1) Fire Storage Requirement: 3500 GPM x 60 min/hr x 3 hrs duration = 630,000 gals for 2015-2025
4000 GPM x 60 min/hr x 4 hrs duration = 960,000 gals for 2025-2034

The proposed schedule for addition of water storage is shown below:

Table 7-2
Proposed Water Storage Addition Schedule

	2014	2020	2025	2030	2035
Polk Reservoir/Pump Station	1,500,000 Gal	1,500,000 Gal	1,500,000 Gal	1,500,000 Gal	1,500,000 Gal
Monmouth Street	750,000 Gal	750,000 Gal	750,000 Gal	750,000 Gal	750,000 Gal
South Well Field	1,500,000 Gal	1,500,000 Gal	2,750,000 Gal	2,750,000 Gal	2,750,000 Gal
Total	3,750,000 Gal	3,750,000 Gal	5,000,000 Gal	5,000,000 Gal	5,000,000 Gal

Based on the projected growth rate of 2.5% per year, an analysis has projected that the available water storage volume will decline yearly and ultimately fall below the needed water storage volume sometime around 2023-24. The addition of water storage at the South site, therefore, is planned for this interval, or by Year 2025.

As seen in Table 7-2, between Years 2020-2025, a second reservoir (1.25 million gallon) is proposed to be placed at the South Well Field adjacent to the existing 1.5 million gallon reservoir. This reservoir will supplement the existing reservoir at this site to provide a total of 2,750,000 gallons of water storage.

Reservoir and Booster Pump Station Relationship

When planning for future conditions with a "closed loop" type of pressurized water system, where source water is pumped and stored in a ground-level water storage vessel then repumped to the distribution system using one or more booster pumps, it is necessary to examine two (2) critical factors:

1) That the storage vessel contains adequate volume to handle the daily storage requirements;

and

2) The booster pumps have adequate capacity and head (GPM x Pressure) to accommodate all required conditions.

In the case of Independence, it is vital that the booster pumps must be capable of either peak hour or maximum day demand coincident with fire flow. This was discussed previously in Chapter 4: "High Volume Pumping".

The second criteria is to insure adequate storage volume exists in this water storage system for all projected water system demands. A common target for this relationship used in planning is between 750-1,500 gallons of water stored per every GPM of electric pump capacity. This relative value is shown below in Table 7-3:

Table 7-3
Water Storage/Booster Pump Station Capacity (in Gallons/GPM)- Electric Only

Reservoir/Pump Station	2015	2020	2025	2030	2035
South Pump Station (2,200 GPM to Year 2025) (2,500 GPM in Year 2025-2035)	682 GPM	682 GPM	1,250 GPM	1,100 GPM	1,100 GPM
Polk Pump Station (1,800 GPM)	833 GPM	833 GPM	833 GPM	833 GPM	833 GPM
Monmouth Street Pump Station (550 GPM)	1,364 GPM	1,364 GPM	1,364 GPM	1,364 GPM	1,364 GPM

(Total Electric Pump Station Capacity = 4,850 GPM after 2025-2030)
(Year 2035 Peak Hour Demand approx. 4671 GPM)

This table indicates a reasonable relationship for all three sites with a fairly good balance during the later years of the study period. The relative balance between the three sites indicates that the three sites have fairly equal importance and capacity against the water volume at each site and the total electric capacity of 4,850 GPM is greater than the projected 2035 peak hour demand of 4671 GPM. The engine drive units are therefore kept in reserve for pump failure and/or fire flow demands.

The information contained within this table indicates that the capacity of water storage to pump station capacity ratio is acceptable and within the desired range for all of the sites and increasing the water storage volume commensurate with the pump station capacity in the later study years at the South Reservoir/Pump Station is in-line with typical range values and appropriate for this facility when factoring the location within the water system and the initially higher values of water from the Polk Street site as opposed to the South site. Proportionally, the Monmouth Street site contains the highest storage volume per electric driven pump capacity, however, the relative total pump station capacity is the lowest and the fact that outlet capacity is limited to 550 GPM across only one booster pump greatly limits the effectiveness of this facility on a daily operational scenario as opposed to the versatility apparent at the South Pump Station with four units or the Polk Pump Station with two units of vastly different capacities. This is also a consideration when factoring the delivered cost of water per gallon as water from this facility must be pumped three times. This relationship also factors well when considering both Monmouth Street capacities against the potential fire flow and volume at Central High School, which is adjacent to this facility.

Water Storage Rotation

Under normal circumstances and operation, chlorinated water with a low-midrange residual of chlorine (.20-.50 mg/L), should be rotated and delivered from storage vessels within 7-8 days. Commonly, one full week or seven days is used as an operational maximum to avoid water stagnation or taste and odor issues in addition to an excessive loss of germicidal effect provided by the disinfecting agent (chlorine). In the case of Independence, since all water delivered from the sources (wells) must pass through a storage tank before delivery to consumers, the storage volume created by all water storage tanks provides a 100% relationship of stored water/average day conditions. For current conditions, or the longest projected residence time in a reservoir is:

$$\frac{\text{3,750,000 gallons (Total water storage volume)}}{\text{850,000 GPD (Average day demand)}} = \text{4.41 days} < \text{7 days maximum}$$

The future conditions for 2035 are:

$$\frac{\text{5,000,000 gallons (Total water storage volume)}}{\text{1,589,500 GPD (Average day demand)}} = \text{3.14 days} \leq \text{7 days maximum}$$

Theoretically, over 1 day of less residence time will be accomplished in future conditions of Year 2035 than the current conditions of 2015. This will help avoid future water quality complains by delivering water that is slightly fresher and with a more stable chlorine residual. This is an important consideration when dealing with groundwater sources known to contain elevated levels of iron and/or manganese. This relationship also assures the city of maintaining greater than 2-3 days of storage at average day conditions, a minimum planning level of water storage, throughout the study.

Chapter Eight

Hydraulic Analysis

Hydraulic Analysis of the Water System

General

Extensive hydraulic analysis has been performed on the City of Independence's water distribution system. These analyses included evaluation of the existing (2015) system at maximum day with coincidental fire flow and peak hour demands and future 2035 maximum day with coincidental fire flow and peak hour demands. Recommendations for specific distribution system improvements are based on data obtained from the computer modeling. Due to the drop in per capita usage since 2007 along with a fairly flat growth of population, the 2007 modeling results previously obtained were deemed adequate for 2015.

Analysis of the water system was performed using computer modeling simulation via the Pipe 2006, Version 3.011, computer modeling program, manufactured by KY Pipe LLC. The actual modeling procedure was performed by Brooke Saltarello of 4B Engineering. The Program has a maximum limitation of 2,000 pipes, 16,000 junctions (nodes), 16,000 pumps, and 16,000 tanks. The Hazen-Williams formula was used to calculate friction losses. Coefficients of friction (C values) used in the model ranged from 110 for all steel pipe, 115 for Asbestos-Cement pipe, and 130 for PVC. These values are typical and appropriate for the respective pipe material and age and were previously confirmed through field testing. All pipe sizes were entered as nominal sizes, i.e. 6 inch inside diameter for all 6" sizes, regardless of type. Minor losses such as tees, ells, and valves have been disregarded.

System Models

To be effective, system models must evaluate four system components: the supply system (sources, pumps, and reservoirs); water demands; the distribution system; and the variations of the system; such as pressure elevation; and friction factors. Variations in each of these four components were used in computing the existing and future scenarios and represented expansions or additions to the system.

Assumptions of the Computer Modeling Analysis

1. Elevations of all nodes were based on topographical information obtained from USGS maps. Elevations were ascertained at City pipeline locations, *not* from individual residences. Residual pressures are determined at pipelines, therefore, losses due to elevation and friction head through the service and meter set to each individual residence must be determined separately. Although elevations within the city range between 161-173, the vast majority of elevations average around 168-172, therefore, all node elevations were set at a uniform value of 170' MSL USGS.

2. The following beginning hydraulic grade line elevations were used for the system modeling to determine inlet head to the booster pumps:

A. South Reservoir: 190' MSL (20' of water in reservoir-2/3 full)
B. Polk Reservoir: 192' MSL (22' of water in reservoir-2/3 full)
C. Monmouth St. Res: 200' MSL (30' of water in reservoir-75% full)

3. Actual operating points from all pump curves for each booster pump were inserted into the model.

4. Because of the uncertainty of a day to day water-use agreement with the City of Monmouth, this physical intertie was not included during any simulations. Use of this intertie, during an emergency or high-use period, however, would have a great impact on these simulations and both cities are encouraged to pursue implementation of an exchange agreement.

5. Contributions and losses from smaller pipes (2" and smaller) were disregarded from this model. Residual pressures were calculated only at major pipeline points. Additional losses due to service meters, service lines, elevational increases, and smaller distribution lines must be calculated and subtracted from original residual pressures to obtain residual pressures at individual residences.

6. Minimum required residual pressure during simulations at all node locations was 40 psi during all flow conditions. Minimum desired residual pressure was 45 psi at all flow conditions. Minimum allowed residual pressure during fire flow conditions was 30 psi.

7. Node demands were based on estimates for specific areas. Individual residences were grouped together at nodes based on number of residences in close proximity to the node.

8. Each of the 345 system nodes (existing and future) was assigned a flow value to approximate the estimated flow to each node under varying conditions. Flow conditions for future (2035) scenarios were simulated through the addition of specific increases of flow at selected nodes in areas of the city projected for growth. Uniform node flow values were used in all simulations since actual water usage throughout the regions of the city already built will not substantially increase over time. The proposed future demands were distributed through the system, primarily in the northern, southern, and western regions of the city. The following flow values were used for each individual simulation:

	System Wide	Southwest Independence Concept Area
A. Maximum Day: (Year 2035 with Fire Flow)	6.17 GPM/Node	50 GPM distributed over 4 nodes = 200 GPM
B. Year 2035 Peak Hour:	11.8 GPM/Node	150 GPM distributed over 4 nodes = 600 GPM

Future year simulations incorporated all currently known proposed developments at their respective locations as well as estimated future demands at critical nodes. These demands varied from 50 GPM to 150 GPM and were placed to simulate expected demands during extreme maximum day and peak hour conditions. Future demands were placed based on areas of projected future growth and the most logical entry of water into that area. Fire flow was simulated during the maximum day computer run only.

9. The Independence water system is unique as it has no fixed hydraulic gradeline, such as an elevated reservoir, to establish a beginning pressure value. In order to accurately determine "real world" operating conditions, pumps are selected to operate or not operate as needed to maintain pressures as close as possible to the city's normal operating range of 60-70 psi, similar to how the telemetry system would control pumps. Flow from all three reservoirs and pump stations was equally generated as much as possible in order to provide a close approximation of the actual long-term operating conditions as well as evenly distribute flow throughout the water system.

10. Future improvements slated in the CIP were included in both 2035 computer simulations.

2007 Distribution System Modeling Data

Since the per capita use of water has declined over 25% since 2007, additional modeling for current conditions was not deemed to be warranted to determine the adequacy of the current system in delivering the estimated required flow with adequate residual pressures. For Year 2007 and 2015, computer modeling was performed for 3 specific scenarios:

A. Peak Hour Demand
B. Maximum Day Demand with 3500 GPM fire flow @ Third and "D" Street (downtown core area)
C. Maximum Day Demand with 3500 GPM fire flow @ Central High School

1. Peak Hour Demand (Total Flow = 3141 GPM): Peak hour demand for 2007 is approximately 225% greater than the projected 2015 maximum day demand and 119% greater than the 2015 Peak-Hour demand of 2,641 GPM. Pressures throughout the system ranged from 55 psi to 60 psi but in all cases was greater than the desired minimum of 45 psi. Pipeline velocities were well distributed and below the recommended limit of 5 FPS. While somewhat less than the normal operating level of 60 PSI, this reflects the selected booster pumps, not the distribution system. The residual pressures of 55-60 psi are adequate for comparison to ordinary domestic and commercial purposes and improvements to improve this situation are not warranted. The distribution of flow from each pump station was balanced and within projected ranges.

2. Maximum Day Demand (2140 GPM) with Fire Flow (3,500 GPM) at Third/D Street: This model assumed a coincidental large fire within the downtown core area during the maximum projected daily demand. The total flow during this simulation is 5,638 GPM in which all but two of the total available pumps within the system are operating. During this simulation, residual pressures throughout the system averaged between 53-65 psi with the lowest observed pressure occurring at the fire demand withdrawal junction (50 psi). This stimulation confirmed the ability of the distribution system to accommodate a coincidental fire within the downtown area during maximum day demand. The only excessive velocities observed were in pipelines in the direct area of the fire flow, however, the values are not excessively high as to warrant substantial improvements to the distribution system.

3. Maximum Day Demand with Fire Flow at Central High School: With the knowledge of adequate flow and pressures available during a coincidental fire within the downtown area during maximum day demand, a similar fire at the western end of the system (high school) during the same maximum day was simulated. This simulation was performed to verify the ability of the water system to deliver a higher fire flow than determined in the 1997 Master Plan. At that time, computer modeling, combined with actual flow testing, determined the maximum deliverable flow to the High School to be 2,000 GPM. Specific improvements, including extension of a new 12" waterline on Monmouth Street to the High School and an additional 1500 GPM booster pump at the Monmouth Street Pump Station was proposed to alleviate this condition. This work was subsequently performed between 1998-2005. The 2007 simulation indicates the present ability to deliver 3,500 GPM at a residual pressure of 35 psi to the High School, a marked improvement from 1997. During this simulation, flow from the Monmouth Street Pump Station was 1,956 GPM, proving the value of this improvement. Assuming a beginning reservoir volume of 500,000 gallons (2/3 full), the remaining tank volume would be adequate for a fire duration of 4.26 hours, over the planned duration of 4 hours. This indicates that most of the water provided for fire protection at Central High School will likely operate using "local control" and originate from the Monmouth Street Reservoir and Pump Station. Additionally, residual pressure throughout the remainder of the water system ranged from 45-63 psi, well within allowable and expected values.

Year 2035 Hydraulic Modeling Data

For Year 2035, 2 distinct computer simulations were performed to verifty system capacity and determine any required improvements.

These were: Peak Hour (4671 GPM)
Maximum Day with 4000 Fire Flow in the downtown area (6309 GPM total)

As previously stated, values obtained from the computer simulations were retained from the 2007 models, with the addition of higher demands in selected areas. These areas were deemed to be representative of the regions within the city slated for future growth. This included flow factors for both Peak Hour and Maximum Day coincident with fire flow for the Southwest Independence Concept Plan (200 GPM at Maximum Day and 600 GPM during Peak Hour).

Peak Hour (4671 GPM)

Simulated Year 2035 peak hour flows are 212% higher than the projected maximum day flow of 2,200 GPM. This simulation indicated well balanced velocities throughout the system with the vast majority of pipeline velocities below 5 FPS and all velocities below 7 FPS. Pressures throughout the system were well balanced with residual pressure averaging between 65-70 psi at most nodes. A peak demand value of 600 GPM (150 GPM/node) was placed at the sites adjacent to the Southwest Independence Concept Area.

Maximum Day with 4000 GPM fire flow at Third/D Streets (6309 GPM total)

This simulation also verified the benefits of the pipeline improvements and, in addition, illustrated the need for efficient transmission of flow from all booster pump stations. Pressures averaged 45-65 psi with the lower pressures in the immediate region of the fire flow delivery averaging 32 psi, above the minimum of 30 psi. Pipeline velocities were generally acceptable and the flow distribution to the three fire flow nodes was within normal limits. Even with the higher fire flow, residual pressure at the delivery point remained above 30 psi.

This model indicates that the water system is very capable of delivering up to 4000 GPM of fire flow to the general downtown region of Independence, providing the flow is distributed over 3-4 hydrants and the booster pumps are maintained and automatically operable in a continuously ready state.

Hydraulic Analysis Summary

1. The existing distribution system is adequate in capacity, size, and reinforcement to handle all current (2015) average day, maximum day, and peak hour demands.

2. The Year 2035 average day, maximum day with fire flow, and peak hour demands can be met by the water system after the proposed improvements in the Master Plan Update.

3. Since the City of Independence has no appreciable gravity storage available, it is imperative that all booster pumps be designed, installed, and maintained for automatic starting and operation. This requirement must be independent of telemetry control and should be backed up by local pressure activation, if necessary, to insure local operation. Proper maintenance and operational "readiness" of both engine-driven booster pumps is of particular importance. The planned reactivation of the 50,000 gallon elevated reservoir in Phase II will provide reserve pressurized water to allow the activation of all needed booster pumps.

Chapter Nine

Capital Improvement Program

Capital Improvement Plan

The revised capital improvement program for the City of Independence has been divided into four phases of construction. These phases have been divided into three priority phases over Years 2015-2017, 2017-2020, and 2020-2030, with the fourth phase a variable phase planned through years 2015-2035 to accommodate available funding and need. The priority construction during the initial period between Years 2015-2020 reflect the minimum improvements believed to be required to provide for the presently proposed residential development. Construction proposed during mid-later years of the study period may require reassessment of system development charges and possible alternate sources of financing in addition to revenue funding.

Phase I Improvements (2015-2017)

Priority #	Projected Year	Description	Estimated Cost
1a	2015-17	Parallel 8" transmission main from Polk St wells to Treatment Plant	$346,000.00
1b	2015-17	Expand iron filtration facilities and building extension at the Polk Reservoir site (tied to Priority 1a)	$215,500.00
1c	2015-17	Provide and install standby generator at Polk Street Wellfield	$75,000.00
		SUBTOTAL-PHASE I	$636,500.00
		(+) 10% Contingency	$63,650.00
		(+) 15% Engineering, Inspection, and Administration	$95,475.00
		TOTAL--PHASE I	**$795,625.00**

Phase II Improvements (2017-2020)

Priority #	Projected Year	Description	Estimated Cost
2a	2017-20	New 10" intertie pipeline from South Pump Station to "I" Street	$145,500.00
2b	2017-20	Reactivate 50K Overhead Reservoir-Engineering Study Only	$20,000.00
2c	2017-20	Estimated Cost to Reactivate Overhead Reservoir with Control Vault, Booster Pump, Check Valve, and SCADA Revisions	$100,000.00
2d	2017-20	Systematic program begins to replace average of 100 water meter/year	$30,000.00
2e	2017-20	Begin Pilot Testing Program for Willamette River Wellfield	$26,000.00
		SUBTOTAL-PHASE II	$321,500.00
		(+) 10% Contingency	$32,150.00
		(+) 15% Engineering, Inspection, and Administration	$48,225.00
		TOTAL--PHASE II	**$401,875.00**

Phase III Improvements (2020-2030)

Priority #	Projected Year	Description	Estimated Cost
3a	2020-25	Add additional 1.25 Million Gallon Storage Reservoir at South Well Field	$750,000.00
3b	2020-25	Provide and install 10" raw water main from the Willamette River Wellfield to Monmouth 4th Street Facility, new water filtration plant and ultra violet disinfection (Independence share assumed at 50% of total cost)	$333,350.00
3c	2020-30	Install 8" water main from Monmouth 4th Street Water Treatment Building to South Wellfield with control valves	$174,000.00
3d	2020-30	Continue replacement program of 100 meters/year in distribution system	$50,000.00
3e	2020-30	Monmouth Street Pipeline replacement, Replace 1200' of 4" C.I. with 8" from Main Street west to 4th Street	$187,500.00
3f	2020-30	Increase capacity of 20HP South Booster Pump Station to 30 HP with related electrical (capacity = 750 GPM @ 130' TDH)	$28,000.00
		SUBTOTAL-PHASE III	$1,522,850.00
		(+) 10% Contingency	$152,285.00
		(+) 15% Engineering, Inspection, and Administration	$228,428.00
		TOTAL--PHASE III	**$1,903,563.00**

Phase IV (2015-2035)

Priority #	Projected Year	Description	Estimated Cost
4a	Variable	Replace Remaining Service Lines in System Est.: 2,000 left @ $750.00/each (on average)	$1,500,000.00
4b		Program to Replace All Remaining Steel Pipe	
	2015-35	A) 10th Street. Monmouth South to "D" Street 300'-8"	**$40,000.00**
	2015-35	B) "D" Street. East 10th to 7th 1200'-8", 1-Railroad bore, 1-creek crossing	**$150,000.00**
	2015-35	C) 9th Street. South from Monmouth to "F" South 680'-6"	**$91,000.00**
	2015-35	D) "F" Street. 10th to 8th Street, 840'-6", 1-railroad bore, 1-creek crossing	**$105,000.00**
	2015-35	E) "D" Street. Between Main and 3rd. 760'-8", 1-railroad bore	**$88,000.00**
		TOTAL PRIORITY 4b	**$474,000.00**
4c	2015-35	Other Waterline Replacements of Steel Pipe	
	2015-35	A) Polk Street: 320'-6", Walnut to Log Cabin, 300'-North from Polk Street	$75,000.00
	2015-35	B) Marsh St: 1200'-8", Boat Landing South to Oak Street	$135,000.00
	2015-35	C) Log Cabin: 300'-8", Boat Landing South to Picture Street	$40,000.00
	2015-35	D) Butler Street: 620'-6" Ash to Walnut	$62,000.00
		TOTAL PRIORITY 4c	**$312,000.00**
4d	2025-35	Continue replacement program of 100 meters/year in distribution system	$90,000.00
		SUBTOTAL PHASE IV	$2,376,000.00
		(+) 10% Contingency	$237,600.00
		(+) 15% Engineering, Inspection, and Administration	$356,400.00
		TOTAL PHASE IV	**$2,970,000.00**

TOTAL of PHASES I-IV: $6,071,063.00 (2015 Estimate)

Conditions of Estimates

1. Construction costs are based on an average of similar local municipal projects completed between 2010-2014 and adjusted for 2015 cost using an ENR Construction Cost Index of 9668 (December, 2014). Unless otherwise indicated, estimates do not include the costs of land acquisitions, right-of-way or easement purchase, or costs associated with funding or financing. Service line replacement and new hydrants are included on applicable new mains and sub-mains. New pipeline costs are based on the use of AWWA C-900 Class 150 PVC pipe with minimal asphalt removal and restoration. While substantial effort has been performed to prepare accurate estimates, the City is cautioned that additional factors such as: rock excavation, specific design criteria; inflation, and local work and economic conditions can have a substantial impact on actual construction costs. Caution should be employed when using these estimates. Construction estimates are subject to +30% to –15% variation in accordance with criteria established by the American Association of Cost Estimating Engineers.

Phase I Improvements (2015-2017)

Priority #	Projected Year	Description	Growth/ Operation and Maintenance
1a	2015-17	Parallel 8" transmission main from Polk St wells to Treatment Plant	40% Growth 60% O&M
1b	2015-17	Expand iron filtration facilities and building extension at the Polk Reservoir site (tied to Priority 1a)	40% Growth 60% O&M
1c	2015-17	Provide and install standby generator at Polk Street Wellfield	100% O&M

Phase II Improvements (2017-2020)

Priority #	Projected Year	Description	Growth/ Operation and Maintenance
2a	2017-20	New 10" intertie pipeline from South Pump Station to "I" Street	100% Growth
2b	2017-20	Reactivate 50K Overhead Reservoir-Engineering Study Only	100% O&M
2c	2017-20	Estimated Cost to Reactivate Overhead Reservoir with Control Vault, Booster Pump, Check Valve, and SCADA Revisions	100% O&M
2d	2017-20	Systematic program begins to replace average of 100 water meter/year	100% O&M
2e	2017-20	Begin Pilot Testing Program for Willamette River Wellfield	100% Growth

Phase III Improvements (2020-2030)

Priority #	Projected Year	Description	Growth/ Operation and Maintenance
3a	2020-25	Add additional 1.25 Million Gallon Storage Reservoir at South Well Field	100% Growth
3b	2020-25	Provide and install 10" force main from Willamette River Wellfield to Monmouth 4th Street Facility, new water filtration plant and ultra violet disinfection (Independence share assumed at 50% of total cost)	100% Growth
3c	2020-30	Install 8" raw water main from Monmouth 4th Street Water Treatment Building to South Wellfield with control valves	100% Growth
3d	2020-30	Continue replacement program of 100 meters/year in distribution system	100% O&M
3e	2020-30	Monmouth Street Pipeline replacement, Replace 1200' of 4" C.I. with 8" from Main Street west to 4th Street	100% O&M
3f	2020-30	Increase capacity of 20HP South Booster Pump Station to 30 HP with related electrical (capacity = 750 GPM @ 130' TDH)	100% Growth

Phase IV (2015-2035)

Priority #	Projected Year	Description	Growth/ Operation and Maintenance
4a	Variable	Replace Remaining Service Lines in System Est.: 2,000 left @ $750.00/each (on average)	100% O&M
4b	2015-35 2015-35 2015-35 2015-35 2015-35 2015-35	Program to Replace All Remaining Steel Pipe A) 10th Street. Monmouth South to "D" Street 300'-8" B) "D" Street. East 10th to 7th 1200'-8", 1-Railroad bore, 1-creek crossing C) 9th Street. South from Monmouth to "F" South 680'-6" D) "F" Street. 10th to 8th Street, 840'-6", 1-railroad bore, 1-creek crossing E) "D" Street. Between Main and 3rd. 760'-8", 1-railroad bore **TOTAL PRIORITY 4b**	100% O&M
4c	2015-35 2015-35 2015-35 2015-35 2015-35	Other Waterline Replacements of Steel Pipe A) Polk Street: 320'-6", Walnut to Log Cabin, 300'-North from Polk Street B) Marsh St: 1200'-8", Boat Landing South to Oak Street C) Log Cabin: 300'-8", Boat Landing South to Picture Street D) Butler Street: 620'-6" Ash to Walnut **TOTAL PRIORITY 4c**	100% O&M
4d	2025-35	Continue replacement program of 100 meters/year in distribution system	100% O&M

Chapter Ten

Financial Planning

Financial Planning

The proposed improvements outlined in the preceding sections of this study will require substantial sums of money to implement. This portion of the study will provide information on various funding sources and options the City can pursue to finance the improvements.

A complete revenue analysis is beyond the scope of this study. The City should employ the services of a rate analyst to evaluate current operating costs, depreciation, and improvement program to assist in establishing revised systems development charges or water rates before the City begins extensive improvements.

Financing Capital Improvements

If the city requires funding there are several options that exist to adequately fund the proposed capital improvements outlined in this study. These include the sale of General Obligation, Bancroft, or Revenue Bonds; government loans or grants; use of system development charges and system revenue. Each type will be addressed separately.

General Obligation (G.O.) Bonds

This form of debt is backed by the "full faith and credit" of the taxing entity and as the name implies, is a general obligation of the entity. Generally, these types of bonds are obtained at a slightly better interest rate than Revenue Bonds. Issuance of these types of bonds must be approved by a simple majority of the registered voters within the City. Current Oregon statute places a ceiling limitation of G.O. debt which is based on the size of the City as well as the total valuation within the City.

Financing by General Obligation bonds is accomplished by the following procedure:

1. The City's engineer prepares a detailed cost estimate to determine the total funds required for construction.
2. An election is held within the City.
3. When voter approval is granted, bonds are offered for sale and the money for actual design and construction is obtained prior to preparation of final engineering plans and the start of construction.

General Obligation Bonds are usually retired through ad valorem taxation and/or water use revenues. Ad valorem taxation affects all property within the City that will ultimately benefit by the water system, whether the property is presently developed or not. Taxes levied from G.O. Bonds are outside the limits imposed by Measure Five. Construction costs are more equally distributed among all property owners and the program does not impose a penalty on existing residential or business development if they are not benefited. General Obligation Bonds are typically issued for repayment within 20 - 40 years.

Bancroft Act (Improvement Bonds)

Under an Oregon law known as the Bancroft Act, cities and districts may assess a portion of the cost of water lines against the property directly benefited. All property within the assessment area is assessed on an equal basis, regardless of whether it is developed or not. Many communities will assess and allow repayment on a deferred basis. Assessments are applied as a property lien against benefited properties and must be repaid through non-taxing revenues. Many times, cash payments are made by affected property owners and the City issues bonds and levies assessments only on the unpaid balance. If the Improvement Bond Option is taken, the City sells Bancroft Bonds to finance construction costs and the property owner may repay the assessment in 20 semi-annual installments with simple interest. This option is limited by the *effect* of Measure Five that limits assessments to *$10/$1000* assessed value without voter approval. Given the limitations of Improvement Bonds, this type of financing is generally not advantageous for improvements of this type.

Revenue Bonds

This type of debt is backed by the revenues generated by proceeds from the system itself. These bonds constitute a lien against earnings of the utility, which they are financing. Bonds may be issued for varying periods of time and at interest rates depending upon the bond market. Bonds are repaid by revenue (after operation and maintenance expenses) derived from the City. The City protects the bond purchasers by agreeing to establish and maintain water rates sufficient to pay the annual bond payment plus a 30 - 50% reserve.

Limited Tax Bond

Under current Oregon law, bonds may be issued and sold up to one-half of one percent of
Real Market Value (RMV) of the affected entity without election or vote. Taxes which are levied to meet the debt service, however, are subject to the limits of Measure Five.

Government Loans or Grants

Several government agencies, both state and federal, are available for possible financing of water system improvements:

1. **Rural Economic & Community Development:** The RECD provides financial assistance for water supply and waste disposal facilities in rural areas and towns up to 10,000 people. Borrowers must be unable to obtain needed funds from other sources at reasonable rates and terms; have legal capability to borrow and repay loans, pledge security for loans, and operate the facilities;

and be financially sound through taxing, assessments, revenues or other forms of income to pay 0 & M costs an retire the debt. Maximum term on a loan is 40 years and loan rates reflect the current market.

2. **Oregon Community Development Block Grant Program (CDBG):** Preference to these grants is given to projects which primarily benefit low and moderate income persons and projects needed to resolve violations of health standards. The maximum grant amount is $500,000 which can include costs relative to right-of-way, engineering, construction, and grant administration.

3. **Special Public Works Fund:** This program provides loan and grant assistance to eligible municipalities or districts for the construction of publicly owned infrastructure needed to create or retain permanent jobs or improve the community's ability to keep or attract business and industry. This type of funding would most likely not be as attractive as others due to the minimum interest rate of 6.5% and documented job creation requirement.

4. **Drinking Water State Revolving Fund (DWSRF):** The primary purpose of this fund is to make loans to water systems for construction projects to improve health and to meet safe drinking water standards. After State legislative approval, the Oregon Economic Development Dept. (OEDD) will assume administrative responsibility for this program in Oregon.

Also available for financing consideration are: Water Resources Department Water Development Loan Fund and Economic Development Administration Public Works Grant.

Systems Development Charge (SDC)

Oregon law allows municipalities and service districts the ability to charge a reimbursement system development charge, an improvement system development charge, or a combination of the two. The methodology and implementation of SDC's in Oregon is regulated by Oregon Revised Statues 223.297-314 which became effective on July 1, 1991. The reimbursement SDC's is developed to recover the costs of existing capital improvements or improvements under construction. An improvement SDC's is designed to recover the costs associated with planned capital improvements. Under current Oregon law, local governments are allowed the ability to assess SDC's for the following types of improvements:

1. Water supply, treatment, and distribution

2. Wastewater collection, transmission, treatment, and disposal.

3. Drainage and flood control

4. Transportation

5. Parks and Recreation

Guidelines for the calculation and implementation of SDC's must follow specific criteria outlined in the Statute and administrative rules. The legislation requires the reimbursement SDC's to be established by an ordinance or resolution setting forth the methodology used to calculate the charge. This procedure must consider the cost of existing facilities, prior contributions by existing users, the value of unused capacity, and other relevant factors. The primary objective of the methodology must be that future system users contribute no more than an equitable share of the capital costs of existing facilities.

Additional provisions of the law require the deposit of SDC's revenues into dedicated accounts; annual accounting of revenues and expenditures, creation of an administrative appeals procedure to allow a citizen or other interested part the opportunity of challenging an expenditure of SDC's revenues, and expenditure of reimbursement fees only on improvements associated with the specific system that the fees were assessed.

REFERENCES

City of Independence, Water System Master Plan Update
4B Engineering & Consulting, LLC (Edward Butts, Principal Author), 2007

City of Independence, Water System Master Plan,
Stettler Company (Edward Butts, Principal Author), 1997

City of Independence
Water System Master Plan Update "Draft"
4B Engineering & Consulting, LLC (Edward Butts Principal Author), 2012-14

City of Independence
Water System Evaluation and Master Plan
Westech Engineering; November, 1985

Independence Wastewater Master Plan,
David Evans & Associates, 2005

Independence Sanitary Sewer System Facilities Plan

Sanitary Survey Report, City of Independence, 2014
Oregon Health Authority

Oregon Office of Economic Analysis, 2007, 2014

Portland State University, Center for Population Research, 2007, 2015

United States Census Bureau, 2007, 2015

Contents of File, City of Independence Water System
Oregon Health Authority (1980-2014)

Water Systems Improvements, Feasibility Report
Stettler Supply Co., Inc., Edward Butts, P.E.; 1991

City of Monmouth, Water System Master Plan,
Stettler Company, February, 2000

Regional Water Needs Assessment,
Economic Engineering Service, Inc, June, 2004

Regional Water Supply Plan, Phase I
CH2MHill, 1996

Regional Water Supply Plan, Phase II
CH2MHill, 1999

Water Use in Lincoln, Polk and Yamhill Counties

Tri-County Study - Mid-Willamette Council of Governments; January, 1991

Willamette Basin Plan
Oregon Water Resources Department, 1994