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City of Banks
Water System Master Plan

24 June 2009

Amended

1 November 2011

Prepared for

City of Banks
100 S. Main Street
Banks, OR 97106

K/J Project No. 0791015.10

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Executive Summary

The purpose of this plan is to provide the City of Banks (City) with a comprehensive water master plan (WMP) for the future development of their water system. The plan includes a description of the existing water system, the planning criteria, a water system analysis, and a capital improvement plan.

Amendment #1

In April 2011 the City authorized Kennedy/Jenks Consultants (Kennedy/Jenks) to perform a more in-depth evaluation of the flow control in the water system starting at the springs and going through to the Carsten Reservoirs. This does not include raw water originating from the Behrman Well. The evaluation was accepted by the City and adopted as an amendment to the water master plan. It has been included as Appendix C. The study is referenced in certain locations in the water master plan in order to clarify the modifications that were made to the plan.

Section 1, Water System Description

This section contains a discussion of the existing water system in 2008.

Water Supply

The City of Banks owns three sources of water supply.

- The Large Green Mountain Springs can reliably supply 110 gallons per minute (gpm).
- The Small Green Mountain Springs can reliably supply 20 gpm, but this is high turbidity water and has not been used recently.
- The Behrman Well can reliably supply 230 gpm.

Well No. 2, a second well at the Behrman Well site, has been drilled and tested and is being evaluated for implementation as either a backup groundwater source or an additional water supply. Further testing of the well and its impact on the aquifer will conclude the available capacity.

Water Rights: Table ES-1 shows a summary of Banks' water rights.

Table ES-1: Summary of Water Rights Held by the City of Banks

Application Number	Permit Number	Certificate Number	Transfer Number	Priority Date	Type of Use	Source
S-9207	S-6516	5353	--	3-Oct-1923	Municipal	Spring (Large Spring)
S-65611	S-48173	83138	--	25-Aug-1983	Municipal	Spring (Small Springs)
G-8476	G-7593	--	T-10055	29-Sep-1977	Municipal	A well (Behrman Well)
G-15887	G-16312	--	--	5-Dec-2002	Municipal	A well (Well #2)

Application Number	Authorized Use	Max Use To Date	Average Daily Diversion			Authorized Date for Completion of Development
			2005	2006	2007	
	cfs	cfs	cfs	cfs	cfs	
S-9207	0.42	0.42	0.25	0.27	0.29	Certificated
S-65611	0.18	0.18	0	0	0	Certificated
G-8476	0.67	0.61	0.15	0.15	0.12	Pending Extension
G-15887	1.00	0.00	0	0	0	28-Apr-2028

Note: these water rights specify a maximum rate, and do not have an associated maximum duty.

Banks has water rights totaling 2.27 cubic feet per second (cfs), or 1,020 gpm.

Treatment

The City constructed a slow-sand filter treatment plant (SSFP) in 1997 to treat the raw water from the Green Mountain Springs supply. It has a capacity of 300 gpm. In 2002, a flocculating clarifier was constructed for the Small Green Mountain Spring to pre-treat the incoming flow before the slow-sand filter. It has a capacity of 80.8 gpm based on the water right of the Small Springs.

Water from both the surface and groundwater source is chlorinated for disinfection using gas.

Treated Water Storage

The City has four storage reservoirs for a total storage capacity of 1.79 million gallons (MG).

Table ES-2: Summary of Existing Water Storage Facilities and Pressure Zones

Name	Capacity (MG)	Pressure Zone(s) Served	Overflow Elevation (ft)	Maximum Service Elevation (ft)	Minimum Service Elevation (ft)	Service Pressure (Static) Range (psi)
High Zone Reservoir	0.22	N/A	666.4	N/A	N/A	N/A
North Star Reservoir	0.07	High	578	520	240	43 – 135
Carsten Reservoirs 1 & 2	1.50	Main	414.5	320	200	41 - 93

Notes:

N/A = Not Applicable

Distribution Pipelines, Service Areas, and Telemetry

The transmission and distribution system has approximately 55,470-feet of pipe that ranges from 2-inch to 14-inch. The pipe material includes ductile iron, poly-vinyl chloride, cast iron, steel, and asbestos cement.

There are two pressure zones. The High Zone serves customers between the SSFP and the pressure sustaining/reducing valve (PSV/PRV) on Sellers Road. The Main Zone serves the remainder of the customers, which are predominately in the City Limits.

The City's water system is controlled primarily by altitude valves, a PSV/PRV, and automatic pump start-up based on reservoir levels.

Flow Control (Amendment #1)

Flow through the facilities from the springs to the Carsten Reservoirs is by gravity. The design plans for the various facilities show flow control elements that were either never installed or taken out of service. Therefore, the flow from the springs through the treatment plant, clearwell, North Star Reservoir, upper pressure zone and into the Carsten Reservoirs is done by manually adjusting valves.

Section 2, Water Requirements

This section contains a discussion of the planning data used in developing population and water demand projections for the years 2008 to 2028. The results are shown in Table ES-3 below.

Table ES-3: Population, Demands, and Water Use Characteristics

Year	2008	2028
Population in UGB	1,875	3,739
Population Served outside the UGB	305	305
Potential population in UR	N/A	unknown
Per capita daily water use	152 gpcpd	152 gpcpd
Peaking factor from ADD to MDD	2.3	2.3
Average Day Demand (ADD)	184 gpm 265,000 gpd	428 gpm 620,000 gpd
Maximum Day Demand (MDD)	414 gpm 600,000 gpd	984 gpm 1.4 mgd
Average Water Loss	27%	

Currently the City of Banks is at buildout conditions with regard to its City Limits boundary (which is the same as its urban growth boundary [UGB]). Banks is in the process of expanding its UGB. The land to be added has not yet been determined, however the amount of land is intended to provide for a specified population increase at noted in Table ES-3. The City is also in the process identifying Urban Reserve Areas (URAs), but has not determined where or how large this may be.

There are three large-volume water users in Banks that use at least 2.0 MG of water per year: the Home Owners Association (HOA) at Arbor Park (irrigation), the Quail Hollow Apartments (residential), and the Banks Lumber Co. (industrial).

The fire flows used for Banks are 1,500 gpm for 2 hours for the High Zone (rural low-density residential) and 3,000 gpm for 3 hours for the Main Zone (commercial, industrial, or institutional developments) and 1,000 gpm for 2 hours for the residential area within the City limits..

A Water Management and Conservation Plan (WMCP) is being prepared concurrently. The results of that planning effort will expound upon how Banks can curtail its water use, institute conservational measures, and capture more source availability to meet the water requirements of its growing population and demands.

Section 3, System Analysis Criteria and Hydraulic Model

This section contains a discussion of the criteria used to evaluate the adequacy of the water system to provide for the existing and projected demands.

Source, Storage, and Pipeline

The source capacity is required to supply the MDD. Demand greater than the MDD are served from the reservoir storage.

The storage requirements are split into three components: peaking equalization (25 percent of the MDD), emergency (twice the ADD), and fire flow storage (described in the previous section).

The distribution pipeline network must be able to meet the MDD plus fire flows. The minimum pressure in the distribution system at all times is 20 psi. The maximum targeted water velocity in the distribution system is 10 feet per second (fps) during fire flow.

Hydraulic Model

H2ONet is the selected software program used to simulate the hydraulics of Banks' water system.

Section 4, Water System Analysis

This section contains a discussion of the evaluation performed regarding the various components of the water system and how they will meet existing and future buildout demands. The proposed capital improvement projects fall out of the recommendations made in the water system analysis.

Water Source and Supply

The minimum reliable water delivery rates of Banks permitted and certificated water supplies is a total of 340 gpm. The existing average MDD is 414 gpm, meaning that there is an existing deficiency of 74 gpm. At the build out condition there is a deficiency of 644 gpm.
The existing source facilities are in adequate condition.

Water Storage and Service Areas

Under current conditions, the High Pressure Zone can only rely on the 0.07 MG available in the North Star Reservoir, leaving a deficiency of 0.20 MG of storage. The North Star tank is in poor condition, and the high zone tank is in adequate condition.

The Main Pressure Zone has sufficient storage to meet existing needs, but as the community expands additional storage will be required. The existing tanks are in adequate condition.

Table ES-4: Summary of Future Water Storage Facilities and Pressure Zones

Name	Capacity (MG)	Pressure Zone(s) Served	Overflow Elevation (ft)	Maximum Service Elevation (ft)	Minimum Service Elevation (ft)	Service Pressure (Static) Range (psi)
High Zone Reservoir	0.22	High & Intermediate	666.4	520	240	63 – 133
New Reservoir	1.0	Main	UNK	UNK	UNK	UNK
Carsten Reservoirs 1 & 2	1.50	Main	414.5	320	200	41 - 93

Notes:

UNK = Unknown

Pipelines

The distribution system evaluation shows that the City has an adequate distribution system to serve the existing population, and it provides a good backbone to expand as the UGB expands.

The amount of water loss in the system is considered high enough that measures should be taken. It is assumed that much of the water loss comes from the 3-mile tar-wrapped steel treated water transmission pipeline from the North Star Reservoir to the City's distribution system.

Treatment and Disinfection

The SSFP is in good operating condition and contains adequate hydraulic capacity to treat flows within the aggregate water rights. The flocculation equipment installed in 2002 be used to treat the 20 gpm of water available from the Small Springs is not in operation.

Controls and Telemetry, Site Security, and Meter Reading

The Banks water system would benefit from enhancements that linked the activity at the SSFP, Carsten Reservoir site, and Behrman Well site to a central control center. A comprehensive telemetry system is recommended, with the new Public Works building being the point of operations.

Each component of the water system should be evaluated from a security and accessibility standpoint. Based on the evaluation, which is often in the form of a Vulnerability Assessment, additional site security measures should be taken which coincide with the level of protection desired.

Public Works staff manually reads all meters in the water system on a monthly basis. Therefore, the system would benefit from the installation of automatic meter reading (AMR) technology. Different levels of technology are available, and the selected method should be based on criteria such as cost, operator requirements, and desired level of automation of the system.

UGB Expansion

The existing distribution system will support expansion of the UGB in any and/or all directions under the growth projections provided. To the northeast where the ground elevation rises, a new pressure zone would likely be required.

Regardless of the direction of the expansion, the new areas should be served by a 12-inch major loop that tie into the existing 12 and 14-inch pipe. The rest of the distribution grid can likely be 8-inch (verify with modeling).

Flow Control (Amendment #1)

The flow control from the springs to the Carsten Reservoirs could be automated in order to provide a more reliable system with regard to chlorine contact time, and a more efficient system with regard to water use. This can be accomplished through the installation of a series of control valves located at the: clearwell outlet, clearwell inlet, Carsten Reservoirs and the Sellers Road PRV station.

Section 5, Regulatory Evaluation

This section contains a discussion of the regulatory requirements enforced on water distributors in the State of Oregon. The details and findings of a Sanitary Survey and a Tracer Study are also located in this section. In short, the City is in compliance with regulations.

Section 6, Capital Improvement Plan

This section contains the recommended Capital Improvements to the Banks water system over the next 20 years. The following Table ES-5 contains an overview of each Capital Improvement Project.

Either 1A or 1B will be constructed based upon the outcome of the hydrogeological evaluation that is now in progress. The total assumes 1A will be selected.

The improvements for additional source will need to be updated as more information is developed such as the exact location of the new wells, negotiations between owners and agencies, and the outcome of further hydrogeotechnical studies.

Items 7, 8 and 9 are optional.

Amendment #1

Table ES-5 is replaced by Table 2 in section 5 of Amendment #1 found in Appendix C.

Table ES-5: Summary of Capital Improvement Projects

Project	Description	Total Project Cost	Schedule	SDC Eligible Cost
1A –	Well No. 2 – Additional Source	$670,000	2009	$670,000
1B –	Well No. 2 – Backup Supply	$540,000	2009	$540,000
2 –	Transmission Pipeline Replacement	$2,750,000	2009 - 2010	$530,000
3 –	SSFP Site Upgrades, Creation of Intermediate Pressure Zone	$270,000	2010 - 2011	$0
4 –	BW Site Upgrades	$220,000	2012 - 2013	$0
5 –	1.0-MG Main Zone Reservoir	$2,200,000	By 2024	$2,200,000
6 –	Distribution System Looping and Upgrades	$620,000	2010-2024	$0
7 –	SCADA System Upgrades	$450,000	optional	$0
8 –	Automatic Meter Reading	$420,000	optional	$0
9 –	Security System Upgrades	$100,000	optional	$0
10 –	Leak Detection Survey	$10,000	2009	$0
11A	Quail Valley Golf Course Study	$40,000	2010	$40,000
	Design & Construction	$1,200,000	2011	$1,200,000
11B	Sellers Road Wellfield Study	$150,000	2011	$150,000
	Design & Construction	$2,400,000	2012	$2,400,000
11C	Southwest Well Field Study	$300,000	2013	$300,000
	Design & construction	$1,500,000	2014	$1,500,000
11D	Alternative Water Providers	$0	2010	$0
	CIP Total:	**$13,300,000**		**$8,990,000**

Section 7, Funding Sources

This section contains an overview of the standard funding agencies and programs available for public works infrastructure projects. Specific funding packages for projects would need to be developed as the City proceeds. It is suggested that the City start any funding process by calling for a "one stop" meeting with the State and Federal funding agencies.

Section 1: Water System Description

1.1 Purpose

The purpose of this plan is to provide the City of Banks (City) with a comprehensive water master plan (WMP) for the future development of their water system. This plan is comprised of six sections: Section 1 includes the purpose and scope of the plan and a description of the existing water system; Section 2 provides an analysis of existing water use, population projections, and future water use projections; Section 3 summarizes the water system planning criteria; Section 4 provides a hydraulic and capacity analysis of the existing and future water system; Section 5 contains a brief regulatory evaluation of the water system; Section 6 provides a detailed Capital Improvement Plan through 2028 that includes order-of-magnitude cost estimates; and Section 7 provides information on funding sources for reference purposes.

Banks has previously prepared a water system master plan in 1995 (Robert E. Meyer Consultants, 1995), with an update to that document in 1998 (Bookman-Edmonston, 1998). This 2009 comprehensive WMP will account for the changes made to the water system since the previous planning efforts and will serve as a stand-alone document. This document has been prepared in conjunction with a Water Management and Conservation Plan (WMCP), which will serve as an update to the most recent WMCP written in 2001.

1.2 Scope

The City of Banks owns and operates the potable water system that provides water to its residents, commercial and industrial facilities, and 305 patrons living outside city limits. The Public Works Department performs the daily maintenance and operations of the water system.

Kennedy/Jenks Consultants (Kennedy/Jenks) was commissioned by Banks to develop a master plan addressing the state of the current water system. Components of the water system that have been analyzed and discussed are the water supply sources, treatment facilities, storage facilities, and the distribution and transmission systems within Banks and outside city limits. Following a thorough analysis of the existing systems, alterations and improvements to the water system are recommended, and a capital improvement plan is provided.

Figure 1-1 shows the existing water system, city limits, contours, and property lines. Figure 1-2 provides a more detailed view of the City's existing distribution system, highlighting the city limits, which is identical to the urban growth boundary (UGB), and those facets of the water system that are either inside the UGB or in close proximity.

1.3 Water Supply

The City of Banks owns three sources of water supply: the Large Green Mountain Springs, the Small Green Mountain Springs, and the Behrman Well. The Green Mountain Springs, tributaries of the West Fork of Dairy Creek, are located approximately 4 miles north of the City. The City has owned approximately 117 acres of land surrounding the Green Mountain Springs as a water source protection measure since the 1930s and 1940s. The Oregon Health

Department prepared a draft delineation of the recharge area for the springs indicating infiltrated water contribution from approximately 1,000 acres surrounding the spring sites. The third source, the Behrman Well, is located south of Banks Road. The locations of the Green Mountain Spring water sources are shown on Figure 1-3. The City has no emergency intertie with any other water systems and no intergovernmental agreements pertaining to the water system. Beginning at the supply sources located North of Banks, Figure 1-4 provides a schematic representation of the hydraulic profile of the Banks water system.

Large Green Mountain Springs

The Large Springs have been the primary source of water for the City since the 1920s, and provides a minimum flowrate of 110 gallons per minute (gpm). The Crippen Intake Structure was built in 1997 to collect raw surface water from the Large Spring, creating an impoundment that reliably feeds the City's water system. Excess water spills over a v-notch weir and into a creek, remaining within the watershed. Raw water is conveyed by gravity through 4,000 feet of 6-inch-diameter ductile iron pipeline to the slow-sand filter treatment plant (SSFP), where it is treated and dispersed into the City's drinking water system. The City recently replaced the raw water transmission pipeline, substituting an aging 6-inch-diameter steel line with a 6-inch-diameter ductile iron pipeline in May of 2005.

Small Green Mountain Springs

The Small Springs are an extremely turbid water source with a minimum flowrate of 20 gpm. A diversion dam has been constructed to contain this water source. However, because the slow-sand filters are sensitive to high turbidity, these springs are not used on a sustained basis. Raw water collected in the small springs is conveyed by gravity through 1,500 feet of 4-inch-diameter PVC pipe to the SSFP for treatment and inclusion in the City's water system.

Behrman Well

The Behrman Well was drilled in the Columbia River Basalt and the well house was constructed in 1979. The pump installed within the production well has a design pump capacity of 250 gpm and consistently produces water at a flow rate of 230 gpm. However, the Behrman Well is allowed to operate by the water right permit at a peak pumping rate of 300 gpm. The depth of the well is 450 feet, with a well casing diameter and depth of 8 inches and 210 feet, respectively.

The well pump motor, piping and valves, chlorination equipment, and the control system are located in a secure facility on the south side of Banks Road, east of Sellers Road. The pump is controlled automatically by the City's telemetry system, which signals the pump to start when the water level in the Carsten Reservoirs is low, and to stop automatically at preset maximum water levels in the tanks. The chlorine disinfection system involves the injection of chlorine gas from 150-pound cylinders into the discharge piping from the well. The gas is injected under a vacuum and allowed to mix with the raw groundwater via its detention time in the discharge piping from the wellhead facilities to the Carsten Reservoir site.

Based on records kept by the City's Public Works Department, over the period from 2005 to 2007 the well drew an average of 91,100 gallons of groundwater into the City's system per day. Assuming the pump operates at 250 gpm (the capacity rating for the well pump), the pump averaged 6 hours of operating time per day over the three year period. The pump withdraws considerably more water into the Banks water system in the summertime, drawing a maximum of 412,400 gallons in one day over the three year period.

Well No. 2

The City drilled and completed a second production well, Well No. 2, at the Behrman Well site in 2005. Well No. 2 has not been outfitted with pump and transmission infrastructure to develop the well as a supply source.

Well No. 2 needs to undergo further testing before it is permanently installed as a fixture in the City's water system. Once the new well is developed as a production source, it will function as either a backup or an additional water supply source. Testing conducted in November 2005 resulted in the determination that long-term water yield in Well No. 2 is available, but has a significant effect on the capacity of the aquifer. This in turn affects the available water from the Behrman Well. Further testing will define the extents to which the two Wells can be used concurrently for water production.

1.4 Water Rights

The City holds two certificated surface water rights providing for water diverted from the Green Mountain Springs and two permitted groundwater rights providing for appropriation from the Behrman Well and Well No. 2. A summary of the City's water rights and historical water use is provided below in Table 1-1.

The City's water sources do not contain listed species, are not water quality limited, and do not occur in a critical groundwater area. Diversion and appropriation of water from the City's existing sources does not present potential issues for species habitat or resource protection related concerns.

Table 1-1: Summary of Water Rights Held by the City of Banks

Application Number	Permit Number	Certificate Number	Transfer Number	Priority Date	Type of Use	Source
S-9207	S-6516	5353	--	3-Oct-1923	Municipal	Spring (Large Spring)
S-65611	S-48173	83138	--	25-Aug-1983	Municipal	Spring (Small Springs)
G-8476	G-7593	--	T-10055	29-Sep-1977	Municipal	A well (Behrman Well)
G-15887	G-16312	--	--	5-Dec-2002	Municipal	A well (Well No. 2)

Application Number	Authorized Use cfs	Max Use To Date cfs	Average Daily Diversion 2005 cfs	2006 cfs	2007 cfs	Authorized Date for Completion of Development
S-9207	0.42	0.42	0.25	0.27	0.29	Certificated
S-65611	0.18	0.18	0	0	0	Certificated
G-8476	0.67	0.61	0.15	0.15	0.12	Pending Extension
G-15887	1.00	0.00	0	0	0	28-Apr-2028

Note: these water rights specify a maximum rate, and do not have an associated maximum duty.

1.5 Water Treatment

The City constructed a water treatment plant in 1997 to treat the raw water from the Green Mountain Springs supply. The SSFP was built in order to comply with the Federal Surface Water Treatment Rule.

Slow Sand Filter Plant

The SSFP treats raw water from the Green Mountain Springs by filtration through a sand media, producing an effluent that meets drinking water standards. The plant consists of a sedimentation basin, two filter basins, and a filter gallery. Each filter basin has a surface area of 1,650 square feet. Flow into the SSFP is metered and monitored through a connection to the telemetry system, with both “East” and “West” Filter outflows being recorded daily. Compilation of the daily data for the years 2005 through 2007 shows that the SSFP produced an average daily flow of approximately 121 gpm. The maximum water surface elevation of the plant is at approximately elevation 673 feet.

The SSFP was initially designed to treat incoming flows up to 100 gpm per filter, based on the inserts of the effluent flow control valves. The 1998 Water System Master Plan Update indicated that if the inserts to the valves were changed, a higher flowrate of incoming water could be treated without compromising water quality. The filter basins are now able to treat 150 gpm each, resulting in a total capacity of 300 gpm.

A flocculation/clarification facility was built in conjunction with upgrades to the SSFP pipe gallery in 2002 in order to provide pretreatment for the water collected from the small springs. The system involves chemical addition to the small springs flow stream, where it is piped through the flocculation treatment facility, into the sedimentation basin, with final treatment joining the large spring’s water in the filter basins. The flocculation equipment was sized to treat the flowrates of the two small springs, and designed to be used during wet-weather periods when the small springs’ source water experiences high levels of turbidity (WMCP, 2001).

The treated plant effluent flows by gravity into the 220,000 gallon steel reservoir, the High Zone Reservoir, located adjacent to and south of the SSFP. From there, treated water flows due South by gravity through a 6-inch-diameter PVC transmission main to the North Star Reservoir.

Disinfection

Water from both the surface and groundwater source is chlorinated for disinfection and to maintain a disinfection residual within the distribution system. The water withdrawn from the Green Mountain Springs receives chlorine gas injection just upstream of North Star Reservoir and the Behrman Well receives injection in the wellhead facilities building. Currently, the North Star Reservoir, with a storage capacity of 70,000 gallons, serves as a Clear Well to allow for chlorine contact time for the surface water sources. The 1998 Water System Master Plan Update indicated that the gaseous chlorination equipment at the North Star Reservoir Site is at the end of its useful life, and recommended new disinfection equipment be installed at the SSFP site. The groundwater pumping source uses the 6-inch-diameter discharge pipe for chlorine contact time before the water is distributed to the first customer.

1.6 Water Storage Facilities

The City of Banks has three water storage facilities: the High Zone Reservoir located at the SSFP; the North Star Reservoir; and Carsten Reservoirs No. 1 and 2. The three storage facilities are described below.

High Zone Reservoir

The reservoir located just downhill (to the southwest) of the SSFP is a 220,000 gallon (0.22-MG) bolted steel tank that receives treated water from the SSFP. The tank measures 25 feet in diameter, has a finished floor elevation of 650.4 feet, and an overflow elevation of 666.4 feet. It was built in 2002 along with the treatment plant additions discussed to provide extra storage and higher operating system pressure for supplying water to the high-zone customers. Also, the high zone reservoir was constructed as a clear well to allow for the relocation of the chlorine injection facilities to immediately downstream of the SSFP and to provide chlorine contact time, resulting in consolidated storage and treatment.

The High Zone Reservoir is in good condition, with no known history of leaks. However, the reservoir is not being used as it was intended. The 1998 Water System Master Plan Update proposed construction of the reservoir in conjunction with a sodium hypochlorite building at the SSFP site. This would result in onsite hypochlorite generation, and the ability to disinfect the treated surface water with a proven and safe disinfection system. Having a clear well at the treatment plant site would allow for the eradication of the North Star Reservoir and the consolidation of the filtration and disinfection of the water being treated from the Green Mountain Springs.

North Star Reservoir

The 70,000-gallon (0.07-MG) North Star Reservoir is a circular, reinforced-concrete tank measuring 30 feet in diameter with a 14-foot side water depth. This tank was built in 1981 to store accumulated flow for the Green Mountain Springs. The floor of the tank is at elevation 564 with an overflow elevation of 578 feet. The North Star Reservoir currently serves as a contact chamber for chlorine injection and disinfection.

A Tracer Study was recently completed that concluded the amount of chlorine contact time between water entering the North Star Reservoir until water reached the first customer was sufficient but borderline. This, coupled with the need for all water to travel through North Star for disinfection purposes (thereby not utilizing the storage capacity of the High Zone Reservoir), does not allow for the system to operate most efficiently. Therefore, as the North Star Reservoir is currently experiencing visible deterioration, it should be taken offline and abandoned. The High Zone Reservoir would then doubly serve as both a clear well for disinfection and storage volume for the High Zone (see Section 4).

Carsten Reservoirs No. 1 and No. 2

The 500,000-gallon (0.50-MG) Carsten Reservoir No. 1 is a circular, welded-steel tank measuring 60 feet in diameter with a 24-foot side water depth. This tank was constructed in 1993 and accumulates water from both the North Star Reservoir and the Behrman Well. The finished floor elevation is at 390 feet with an overflow elevation of 414 feet. The Carsten Reservoir No.1 is the northern tank at the Carsten Reservoir site.

The 1,000,000-gallon (1.0-MG) Carsten Reservoir No. 2 is a circular, welded-steel tank measuring 81 feet in diameter with a 26.5-foot side water depth. This tank was constructed in 1999 and accumulates water from both North Star Reservoir and Behrman Well. The finished floor elevation is at 388 with an overflow elevation of 414.5 feet. The Carsten Reservoir No. 2 is the southern tank at the Carsten Reservoir site.

Carsten Reservoirs 1 and 2 are in good operating condition and fit for continued service. Regular maintenance, including washdowns and visual inspections, should be performed on each tank in order to spearhead potential problems and lengthen their useful life.

1.7 Pump Stations

The City of Banks' water system relies heavily on gravity flow from one end to the other. Water is collected from the Green Mountain Springs at the foothills of the Coast Range, north of the City, and gravity is utilized to transport the water to (in order) the SSFP, High Zone Reservoir, North Star Reservoir, Carsten Reservoirs No. 1 and No. 2, and into the central distribution system.

As described previously, the Behrman Well pumps groundwater out of the underlying aquifer at a consistent flow rate of 230 gpm. The water is injected with chlorine gas and is used for two purposes. The first is to supplement the water flowing down the hill from Carsten Reservoirs No. 1 and No. 2 and into the main service zone for distribution. The second purpose is to augment the storage in the Carsten Reservoirs when their water surfaces are below the operating set point.

1.8 Transmission and Distribution Pipelines

Once the surface water sources are filtered at the SSFP, water flows by gravity into the High Zone Reservoir, through the North Star Reservoir, and then continues south toward Banks via 15,300 feet of 6-inch-diameter steel pipeline. A 4-inch pressure sustaining / pressure reducing valve (PSV/PRV) was installed along the path of treated water, intended to sustain high operating pressure upstream of the valve and reduce the pressure to the customers downstream of the valve. The act of regulating upstream pressure by setting the valve at the desired operating point creates two pressure zones. The two zones are designated “High” and “Main”, corresponding respectively to upstream and downstream of the PSV/PRV. In order to attain the desired pressure regulation, the valve restricts flow across the pressure zones (Robert E. Meyer Consultants, 1995). To achieve maximum operating pressure in the High Zone, the North Star Reservoir water level is maintained nearly full. The PSV/PRV is set to maintain an operating pressure of 135 pounds per square inch (psi) at the lower end of the High Zone. Once water passes through the PSV/PRV and into the Main Zone, water continues south into the Carsten Reservoirs and main distribution zone within the city limits.

Banks has approximately 11 miles of pipelines comprising the water transmission and distribution system. A breakdown of the pipe diameters and lengths is included in Table 1-2 below.

Table1-2: Existing Distribution and Transmission Pipe Inventory

Purpose of Section	Pipe Size (inches)	Approximate Length (feet)	Material	Description
Transmission				
	6	4,000	Ductile Iron	Raw Water from Large Spring Intake Structure to SSFP
	4	1,500	PVC	Raw Water from Small Spring Diversion Dam to SSFP
	6	1,800	PVC	Treated water from SSFP to North Star Reservoir
	6	15,300	Tar-wrapped Steel	Treated and chlorinated water from North Star Reservoir to Carsten Reservoirs
Distribution				
	2	3,900	Steel	-
	6	5,400	Steel-PVC	-
	8	9,900	Ductile Iron	-
	10	700	Ductile Iron	-
	12	8,900	Ductile Iron	-
	14	4,700	Ductile Iron	-

The pipelines which make up the distribution system are located in public rights-of-way and are predominantly looped. The pipelines comprising the transmission system are not always as easily accessible due to the topography of the land in the hills near the Green Mountain Springs and SSFP. The majority of the distribution system serving downtown Banks and the Banks Estates Subdivision consists of 6” and 8” ductile iron (DI) pipe, with 12” and 14” DI pipelines on the east- and west-most periphery of the distribution system (aligned north-south), as well as the main arterial connectors (aligned east-west).

The 15,300-foot transmission pipeline was installed in 1953 and is in poor condition. The 1995 Water System Master Plan indicates that the line leaks and also constricts flow into the Main Zone. The pipe should be replaced with a 10-inch line in order to decrease system losses and provide greater capacity. Although the remainder of the distribution system is believed to be in good operating condition and fit for continued service, a Leak Detection Survey should be performed on the entire distribution and transmission system in order to pinpoint locations of high priority for replacement.

1.9 System Controls and Telemetry

The City's water system is controlled primarily by altitude valves, a PSV/PRV, and automatic pump start-up based on reservoir levels.

The altitude valve at the North Star Reservoir controls the flow into the SSFP. The opening of the valve cause the water to flow from the Green Mountain Springs intake structures, through the SSFP, and to the reservoir. Flow in the plant is stopped when the reservoir is full and the altitude valve closes. With the altitude valve closed, the raw water continues to flow from the intake structure to the SSFP and overflows at the filter basins.

When high raw water turbidity is measured at the plant, flow through the plant is stopped automatically by a valve in the plant influent line.

The PSV/PRV was installed on the main treated water transmission line approximately 1,000 feet north of US Highway 26. The purpose of this valve is to maintain functional operating pressure for the customers connected to the pipeline in the high zone (upstream of the PSV/PRV), and ensure excessive pressure is reduced for the main zone customers (downstream of the PSV/PRV).

The water level of the Carsten Reservoirs is maintained by the Behrman Well. The well pump is automatically activated when the water level in Carsten Reservoir No. 1 drops to a level set point. The pumps serve to boost the distribution system pressure and to fill the reservoirs. When Carsten Reservoir No. 1 is filled the pump automatically shuts off.

Chlorine residual is monitored by City Staff throughout the day and the feed rate is adjusted manually at the North Start Reservoir and the Behrman Well.

The existing telemetry system serves to monitor the filter plant, including raw and filtered water turbidity levels. Additionally, the water levels in the High Zone Reservoir, the North Star Reservoir, and the Carsten Reservoirs are monitored. Information is communicated to the monitoring computer located at City Hall.

1.10 Water Audit System

Banks has implemented a water audit program to track and maintain key water system information. The primary function of the software, which comes complimentary from the American Water Works Association, is to generate an Infrastructure Leakage Index. The water utility will continue to utilize this tool on a regular basis for monitoring overall system activity.

1.11 Service Areas

The City of Banks' water system contains two distinct service areas: the High Zone and the Main Zone. The zones are split by the PSV/PRV on Sellers Road, with the valve creating sustained pressure upstream of the valve, in the High Zone, and attempting to reduce excessive pressure downstream of the valve, in the Main Zone. Figure 1-4 shows the elements of the Banks water system that are present in each distinct pressure zone.

Public Works staff at the City report that the PSV/PRV is set to sustain an upstream pressure of 135 pounds per square inch (psi), and reduce the pressure across the valve to 85 psi. Therefore, the High Zone is served at approximately 312 feet of head, with the Main Zone being served with a head of 196 feet.

Amendment #1

1.12 Water System Flow Control

Refer to section 1 of Amendment #1 found in Appendix C.

Section 2: Water Requirements

This section contains the planning data and analyses used in the development of the population and water demand projections for the City of Banks Water Master Plan from 2008 through 2028.

2.1 Definition of Terms

The following definitions are used in this section:

Demand:	The total quantity of water supplied for a given period of time to meet the various required uses, including: residential, commercial, industrial, non-residential, fire fighting, system losses, and other unaccounted-for and miscellaneous uses.
Residential Demand:	Single-family home uses.
Non-Residential Demand:	Multi-family dwelling units, commercial, and industrial applications.
Unaccounted-for Demand:	The difference between the total amount of water withdrawn from the source supplies and the total amount of water billed to customers.
Fire Flow:	Flowrate requirements for buildings and structures fire suppression.

The different levels of water demands are designated as average daily demand (ADD), maximum monthly demand (MMD), maximum daily demand (MDD), and peak hourly demand (PHD).

Average Daily Demand:	The total volume of water delivered to the system in one year, divided by 365 days.
Maximum Daily Demand:	The maximum volume of water delivered to the system in any single day of the year, divided by one day.
Maximum Monthly Demand:	The maximum volume of water delivered to the system in any single month of the year, divided by the number of days in that month.
Peak Hourly Demand:	The maximum volume of water delivered to the system in any single hour of the year.

The different units to be used in this section include: gallons per minute (gpm), gallons per capita per day (gpcpd), and million gallons (MG).

2.2 Historical Population and Water Usage

In order to assess the future needs of the water system, an investigation into the historical water usage, historical population, and expected population has been conducted. Historical water use consumption was provided by the City in the form of meter records taken monthly for each customer. Water production information (system demand) was provided by the City in the form of recorded flows leaving the SSFP and Behrman Well. Historical population figures were obtained from the Population Research Center at Portland State University. Population projections through the 20-year planning period were provided by KJ Won, the City Planner for Banks.

Historical water use information and population data are used to estimate per capita usage rates and peaking factors relative to usage. These values, in conjunction with population projections, are used to estimate future water use.

In 2007, the City of Banks Water System served a population of 1,435 within the City limits and 305 outside the City limits, totaling 1,740 people. The City Planner estimates that City buildout will occur in 2024, with a total population served of 3,739 within city limits, and 305 outside (no further service connections outside City limits are allowed). City buildout will follow the expansion of the Urban Growth Boundary (UGB) and City limits, as well as the establishment of Urban Reserves. However, Banks is currently at buildout with regard to the available land inside the UGB. Therefore, the UGB needs to be expanded before any further City growth becomes available. The City is in the process of expanding the UGB, and it is anticipated that the process will culminate in mid to late 2009.

The City has also begun the process of identifying urban reserve areas outside of the UGB expansion. However, the size of the urban reserve has not been identified therefore a projected population cannot be estimate with any degree of accuracy.

The resulting total population served at final buildout will be 4,044 in the year 2024. However, this planning effort takes into account the planning for the City through 2028, four years after buildout. Therefore, the assumed population for the period 2024 through 2028 will remain at 4,044. A summary of the historical population and water usage information for the City's water system is included below in Table 2-1.

Table 2-1: Historical Population and System Demands

	Banks Water System Service Area Population			Total System Demands				
Year	Population Within City Limits [(a)]	Population Outside City Limits [(b)]	Total Service Area Population	ADD (gpm)	ADD (gpcpd)	MDD (gpm)	Peaking Factor [(c)]	MMD (gpm)
2005	1,430	305	1,735	179	149	392	2.2	304
2006	1,435	305	1,740	187	155	393	2.1	292
2007	1,435	305	1,740	185	153	457	2.5	261
						Average:	2.3	

Notes:

(a) 2005 - 2006 data from PSU-PRC "2006 Oregon Population Report". 2007 data provided by KJ Won, City Planner.
(b) Data provided by KJ Won, City Planner
(c) Peaking factor is calculated as MDD/ADD
ADD = Average Daily Demand
MDD = Maximum Daily Demand
MMD = Maximum Monthly Demand
gpm = Gallons per Minute
gpcpd = Gallons per Capita per Day

Throughout the years 2005 to 2007, 73 days of production data were not recorded, comprising 22 days in 2005, 29 in 2006, and 22 in 2007. The 73 days were representative of those days where either (or in some cases, both) the West or East Filter of the water treatment plant (WTP) was removed from service. To incorporate the missing data for averaging purposes, daily meter readings were interpolated where appropriate, and total water production averaged over the period of missing data. This analysis does not result in added water production, but rather distributes the recorded outflows over the missing days resulting in the ability to calculate daily averages (the ADD values reported in Tables 2-1 and 2-2) with confidence in their accuracy.

Of important note is that in 2006 each filter basin of the WTP was removed from service for an extended period of time in order to replace the sand media. This is a maintenance requirement that ensures the City's drinking water is treated at or above drinking water standards. The West Filter was offline from June 1st until June 6th; the East Filter was offline from October 19th until October 29th.

The Banks water system is split into two distinct pressure zones, as discussed in Section 1. The High Zone has appreciably lower demands because it has a significantly lower population. Splitting the total system demands into those required by each zone also allows for water supply and storage requirements to be determined for each zone, as discussed in Section 4. For this analysis, the per capita demands from Table 2-1 are unchanged and are used to estimate the demands in each service zone. The calculated historical average daily, maximum daily, and maximum monthly demands for each service zone in the Banks water system are presented in Table 2-2.

Table 2-2: Historical Population and System Demands in the Individual Service Areas

Year	High Zone Service Area Population: Population Within City Limits [(a)]	Population Outside City Limits [(b)]	Total High Zone Population	High Zone Demands: ADD (gpcpd)	ADD (gpm)	MDD (gpcpd)	MDD (gpm)	Peaking Factor [(c)]	MMD (gpcpd)	MMD (gpm)
2005	0	151	151	149	16	326	34	2.2	253	26
2006	0	151	151	155	16	326	34	2.1	241	25
2007	0	151	151	153	16	378	40	2.5	216	23

Year	Main Zone Service Area Population: Population Within City Limits [1]	Population Outside City Limits [2]	Total Main Zone Population	Main Zone Demands: ADD (gpcpd)	ADD (gpm)	MDD (gpcpd)	MDD (gpm)	Peaking Factor [3]	MMD (gpcpd)	MMD (gpm)
2005	1,430	154	1,584	149	164	326	358	2.2	253	278
2006	1,435	154	1,589	155	171	326	359	2.1	241	266
2007	1435	154	1589	153	169	378	417	2.5	216	238

Notes:

(a) 2005 - 2006 data from PSU-PRC "2006 Oregon Population Report". 2007 data provided by KJ Won, City Planner.
(b) Data for High Zone is calculated as the ratio of 47 (total connections in the High Zone) over 95 (total connections outside City Limits) times 305 (total population outside City Limits). Data for Main Zone is calculated as the difference between 305 total and 151 in High Zone.
(c) Peaking factor is calculated as MDD/ADD
ADD = Average Daily Demand
MDD = Maximum Daily Demand
MMD = Maximum Monthly Demand
gpm = Gallons per Minute
gpcpd = Gallons per Capita per Day

2.2.1 Peaking Factors

The relationships between the various water system demands are called peaking factors. For the years 2005 through 2007, the peaking factors are based on both treated water records supplied by the City as well as industry-standard peaking factor assignments. The peaking factor presented in Tables 2-1, 2-2, and 2-3 are calculated as the MDD divided by the ADD. The average of this peaking factor over the period from 2005 through 2007 is 2.3. Typical MDD/ADD peaking factors range from 2.0 – 2.5 (American Water Works Association [AWWA], 1989) with the higher end representing a greater variance from the average demand to the maximum. For the purposes of this report, the average value of 2.3 has been chosen to represent this variance and is used for demand projections in Table 2-3. Using a value of 2.3 results in a practical yet conservative estimate of the future demands on the water system.

Using historical data presented in Table 2-1, an average value of 1.7 was calculated for the MDD/MMD peaking factor. This value will be used for water demand projections for this study.

No PHD data were available for estimating the PHD/MDD peaking factor, therefore a typical value of 1.5 (AWWA, 1989) was assumed for this study. Estimated PHD values are included in Table 2-3.

2.3 Population and Water Demand Projections

Future water demand was projected based on the estimated per capita use presented in Table 2-1 and future population projections supplied by the City Planner. Figure 2-1 illustrates the population projections for the City throughout the 20-year planning period from 2008 through 2028. This analysis assumes that the rate of increase in water use for commercial and industrial users will follow the same pattern as for the residential population. The result of this assumption is a conservative projection of future water needs by applying the best available information. It is unknown whether or not the City will experience either the elimination or addition of large water users, and therefore this planning effort bases the projections for all future water use on the rate of increase of the permanent residential population. However, even with the incorporation of industrial and commercial water users in the per capita projections, the resulting values appear consistent with the national averages of approximately 100 – 150 gpcpd for residential use only.

The per capita water production over the years 2005 through 2007 was consistent and averaged approximately 152 gpcpd. Although this value is in line with the national averages, water conservation practices are recommended and are addressed further in the Water Management and Conservation Plan, a concurrent planning effort that elaborates upon recommended conservation efforts, including public education and conservation programs.

The City's water system ADD and MDD projections are summarized in Table 2-3, with Figure 2-2 illustrating the demand projections. The 2008 ADD and MDD are 198 and 456 gpm, respectively, while the 2028 ADD and MDD projections are 428 and 984 gpm, respectively. The MMD and PHD at the end of the planning period are 656 and 1476 gpm, respectively.

Population and demand projections throughout the 20-year planning period, in conjunction with the historical records analyzed from 2005 through 2007, are presented in Table 2-3 below.

Table 2-3: Population and Demand Projections

Year	Banks Water System Service Area Population: Population Within City Limits [(a)]	Population Outside City Limits [(b)]	Total Service Area Population	Total System Demands: ADD (GPM) [(c)]	ADD (gpcpd) [(c)]	MDD (GPM) [(d)]	Peaking Factor [(d)]	MMD (GPM)[(e)]	PHD (GPM)[(f)]
2005	1,430	305	1,735	179	149	392	2.2	304	-
2006	1,435	305	1,740	187	155	393	2.1	292	-
2007	1,435	305	1,740	185	153	457	2.5	261	-
2008	1,570	305	1,875	198	152	456	2.3	304	684
2009	1,705	305	2,010	213	152	489	2.3	326	734
2010	1,840	305	2,145	227	152	522	2.3	348	783
2011	1,975	305	2,280	241	152	555	2.3	370	832
2012	2,110	305	2,415	256	152	588	2.3	392	882
2013	2,245	305	2,550	270	152	621	2.3	414	931
2014	2,380	305	2,685	284	152	653	2.3	436	980
2015	2,515	305	2,820	298	152	686	2.3	458	1029
2016	2,650	305	2,955	313	152	719	2.3	479	1079
2017	2,785	305	3,090	327	152	752	2.3	501	1128
2018	2,920	305	3,225	341	152	785	2.3	523	1177
2019	3,055	305	3,360	356	152	818	2.3	545	1227
2020	3,190	305	3,495	370	152	851	2.3	567	1276
2021	3,325	305	3,630	384	152	883	2.3	589	1325
2022	3,460	305	3,765	398	152	916	2.3	611	1374
2023	3,595	305	3,900	413	152	949	2.3	633	1424
2024	3,739	305	4,044	428	152	984	2.3	656	1476
2025	3,739	305	4,044	428	152	984	2.3	656	1476
2026	3,739	305	4,044	428	152	984	2.3	656	1476
2027	3,739	305	4,044	428	152	984	2.3	656	1476
2028	3,739	305	4,044	428	152	984	2.3	656	1476

Notes:

(a) 2000 - 2006 data from PSU-PRC "2006 Oregon Population Report". 2007 - 2028 data provided by KJ Won, City Planner, assuming a uniform average growth rate over the period from 2007 to 2024, when expected full buildout will occur
(b) Data provided by KJ Won, City Planner
(c) Future projections assume the 3-year per capita average (years 2005-2007) for the year for the entire 20-year planning period
(d) Future projections assume an MDD/ADD peaking factor of 2.3 based on historical records and typical values
(e) Future projections assume the MMD is equal to the MDD divided by 1.5
PHD is assumed to be 1.5 times the MDD
ADD = Average Daily Demand
MDD = Maximum Daily Demand
MMD = Maximum Monthly Demand
GPM = Gallons per Minute
gpcpd = Gallons per Capita per Day
Note: The dotted line separating 2007 and 2008 represents when population and demand projections commence

Water demand projections are based on estimated per capita use and future population. Water use characteristics were obtained from the City's billing and production data. These data were used to approximate the general water usage characteristics for the City, which are presented in Table 2-4.

The population projections included in Table 2-3 culminate with a buildout population of 4,044 residents served by the City's water system, with 3,739 inside city limits and 305 outside. The total number of people served is significantly higher than that estimated in the 1998 Water System Water Master Plan Update (Bookman-Edmonston, 1998), due to a more conservative growth plan being adopted by the City in response to the opportunity to extend its UGB and annex nearby urban reserves. However, the 1998 Plan estimates that the number of service connections outside city limits will grow, while this planning effort leaves this total at 305 people. This directly results from a commitment by the City to not allow new service connections outside of city limits, and therefore not changing the amount of people served (as well as demand projections) in the High Zone service area throughout the 20-year planning period.

2.3.1 Potential Impacts of Urban Reserve Areas

Although population projections through 2028 were presented in Table 2-3 in conjunction with criteria developed by the City planner, it is possible that Banks could see even more expansion and growth through the planning period. Banks is currently looking for areas to expand beyond the proposed UGB expansion. These surrounding lots and parcels are being identified as urban reserve areas (URAs), which could accommodate growth beyond what has been predicted for buildout. No population totals have been developed in response to URA acquisitions, but it is important to note that there is a potential for substantial growth in Banks, and population totals eclipsing 6,000 residents.

As the potential population growth due to the URA cannot be identified with any accuracy at this time, it will not be used to evaluate water source, treatment or storage.

2.3.2 Unaccounted-for Water

Unaccounted-for water in the Banks' Water System is defined as the difference between the total water produced by the system and the total amount of water billed to customers. This difference between treated water records from the WTP and the Behrman Well and metered customer data results from leakage losses, meter discrepancies, hydrant and main flushing, street sweeping, operation and maintenance uses, unauthorized connections, fire flow uses, and other un-metered miscellaneous uses.

The average unaccounted-for water in the Banks Water System is 26.4 MG per year, or an average of nearly 27 percent of the total water treated. Table 2-4 displays a summary of the total water produced and consumed with the resulting unaccounted-for water, from the years 2006 and 2007, and the corresponding two-year averages. A realistic goal for unaccounted-for water for a water system of the City's size is between 10 and 15 percent. Ensuring that the City is metering all users and is aggressively detecting and repairing water system leaks will help to reduce the amount of unaccounted-for water. Additionally, water conservation by the City and water customers is an important and effective method of decreasing the amount of water lost from the City's Water System.

Unaccounted-for water rates greater than 15 percent could trigger more stringent management and conservation requirements in the Water Management and Conservation Plan, and may have an effect on Banks' ability to acquire more water rights.

Table 2-4: General Water Use Characteristics

	Units	2006	2007	Average
Total Treated Water Produced	(MG)	98.4	97.4	97.9
Water produced by the SSFP	(MG)	63.8	68.0	65.9
Water produced by the Behrman Well	(MG)	34.6	29.4	32.0
Percentage water produced by SSFP	(%)	64.8	69.8	67.3
Percentage water produced by Behrman Well	(%)	35.2	30.2	32.7
Total Metered Consumption	(MG)	74.4	68.7	71.5
Unaccounted-for water	(MG)	24.0	28.7	26.4
Unaccounted-for water	(%)	24.4	29.5	26.9
Service area population	(people)	1740	1740	1740
Per capita raw water usage	(gpcpd)	155	153	154

Notes:

MG = million gallons
SSFP = slow-sand filter plant
gpcpd = gallons per capita per day

2.3.3 Large-Volume Users

Large-volume users create high point loads on the system and need to be applied to the water system model to accurately analyze the system. The large-volume users for the City are comprised of various usage types; irrigation, residential, industrial, institutional, and commercial. The top 10 water users in the City were compiled from meter records and are represented in Table 2-5. It is important to note that the ADD is based on annual usage so that users who require large volumes of water for irrigation in the summer are included in this category. The actual daily and hourly peak use will vary depending on the specific use.

The City's top water user is the Arbor Park. The Park's service connections are used for irrigation purposes. These Park's services are owned and operated by the Northwest Community Home Owners Association and in 2007 the Park used 3.7 MG of water. The second-largest user is Quail Hollow Apartments, which required 2.1 MG of water for its residents in 2007. Currently, the only industrial service connection is Banks Lumber Company. The lumber producer has historically been one of the largest water users of the City's metered customers. In 2007, it consumed a total volume of 2.0 MG, which is the third-highest amount used by a single service according to the City's meter records.

Table 2-5: Current Large Volume Water Users

User	**Address**	**Description**	**Type**	**2007 Volume (MG)**	**ADD (gpm)**
NW Community – HOA	Arbor Village	Arbor Park Area	Irrigation	3.7	7.0
Quail Hollow	621 Morrison Street	East & West Apartments	Residential	2.1	4.0
Banks Lumber Co.	NW Banks Road	Lumber Mill	Industrial	2.0	3.7
Banks School District # 13	450 S. Main Street	High School, District Office	Institutional	1.7	3.2
Banks Sunset Park Assoc.	460 S Main Street	Privately-Owned Park	Irrigation	1.1	2.1
Banks School District # 13	42350 NW Trellis Way	Jr. High School	Institutional	1.1	2.1
Oak Village	660 S Main Street	Deli & Laundry	Commercial	1.0	1.8
Dale Evers	14735 NW Sellers Road	Dairy Farm	Commercial	0.6	1.1
Sunset Laundry Mat	180 S Main Street	Laundry	Commercial	0.6	1.1
Banks Billiards	111 N Main Street	Billiards	Commercial	0.4	0.8

While incorporating the large-volume water users into the system hydraulic analysis and planning for future water demands, the projected demands for the current large-volume users are not expected to change significantly. However, it is expected that new large-volume water users will be added to the system during the study period, resulting in the need to add additional large-volume water users to the distribution system hydraulic model for the purpose of the hydraulic analysis under buildout conditions.

2.3.4 Fire Flow Requirements

Fire flow demand is the amount of water required to fight a fire for a specified period of time. Fire protection for the City is provided by the Banks Fire Department (which serves the land within City Limits) and private fire suppression companies (which serve the residential areas lying outside of City Limits). One fire hydrant is available to the High Zone, while numerous hydrants exist in the Main Zone throughout the distribution system. To plan for necessary fire-suppression flows, the Banks Fire Department subscribes to the National Fire Protection Agency (NFPA), Standard 1142: Standard on Water Supplies for Suburban and Rural fire fighting outside of the City Limits. Within the city Limits the Oregon fire Code Appendix B is used as the guiding criteria that helps the Fire Department plan for fire fighting. Another common method of assigning fire flow rates is based on the Insurance Services Organization (ISO) classification rating that the water required to combat a fire is dependent on the specific characteristics of that building. These factors include site specific issues such as construction, occupancy, exposure, and communication.

Previous City water master plans have recommended fire suppression flow for the two service zones. The High Zone is rural and is assigned a fire suppression requirement that assumes a low-density residential setting with mostly single-family structures: 1,500 gpm for 2 hours. The Main Zone is assigned a commercial fire fighting requirement that allows for large commercial, industrial, or institutional developments: 3,000 gpm for 3 hours. The residential areas within the City Limit needs 1,000 gpm for 2 hours. These values are acceptable and appropriate for their respective applications in the City, and the overall system will be evaluated for fire flow capability assuming the same requirements.

2.3.5 Water Management and Conservation Planning

Concurrent with this water master planning effort, a Water Management and Conservation Plan (WMCP) is being completed that addresses the water supply and conservation needs for the City as population grows and higher demands are placed on the water system. Consult the WMCP for supply- and conservation-related plans and strategies heading into the future.

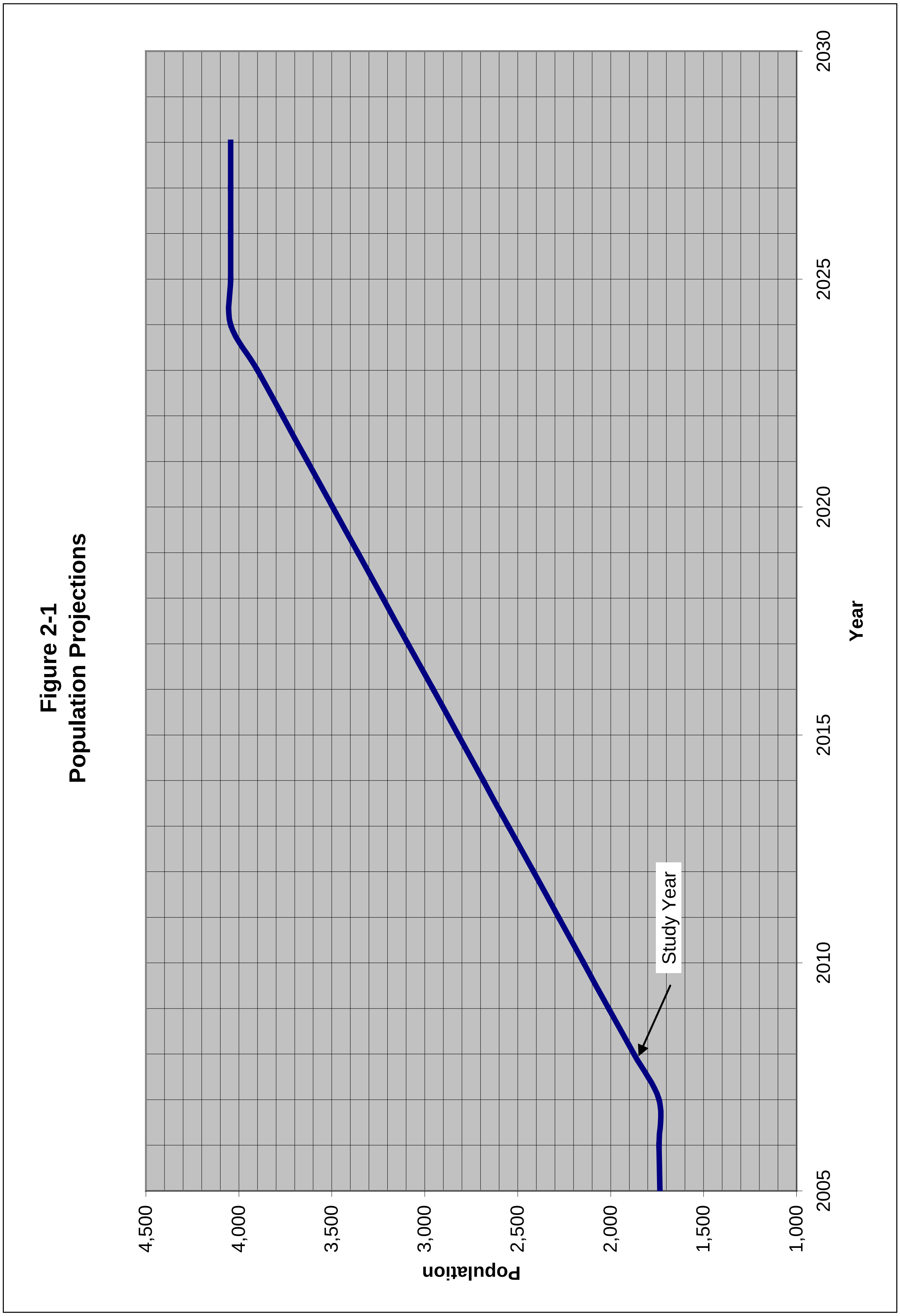
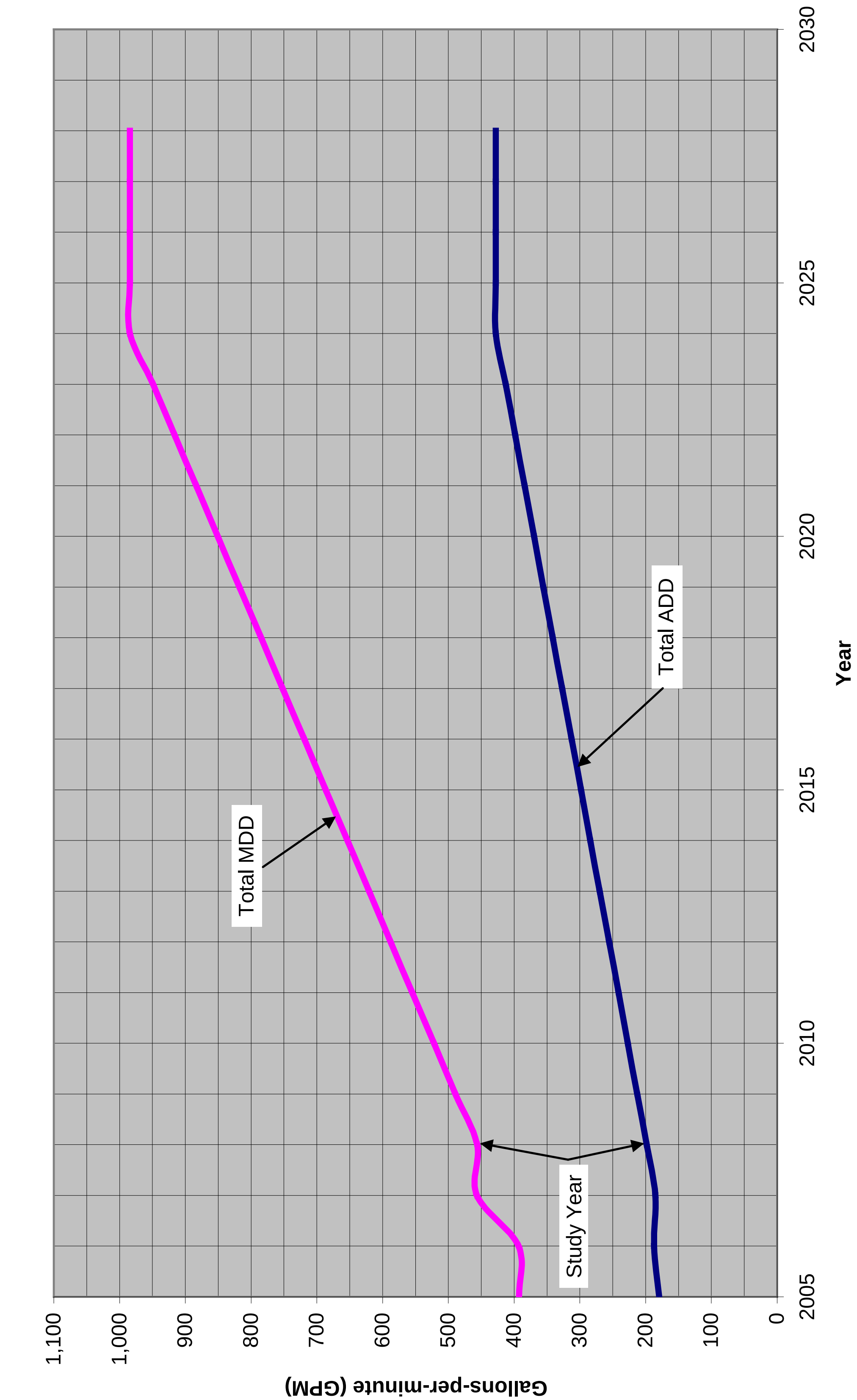


Figure 2-1
Population Projections

Figure 2-2
Demand Projections



Section 3: System Analysis Criteria and Hydraulic Model

This section presents the criteria used for the master plan system analysis of the existing and future water system presented in Section 4. This section also contains a discussion about the hydraulic model and its development and verification process.

3.1 Master Plan Analysis Criteria

The following criteria were used to evaluate the adequacy of the water system to provide for the existing (2008) and projected (2028) demands. All Oregon Department of Human Services Drinking Water Program (DWP) and Oregon Water Resources Department (OWRD) requirements are met through the proposed criteria, which are acceptable standards of practice in typical master plan studies. The analysis criteria contained in this chapter are intended for water system master planning analysis only and are not intended as specific development standards.

Table 3-1 presents a summary of the analysis criteria explained in the following subsections. Included in the summary is a comparison of criteria used in this WMP to those used in the 1995 WMP and the 1998 Update as well as the regulatory drivers for the criteria, where applicable.

Table 3-1: System Analysis Criteria

No.	Item	Criteria Used in Previous Master Plans (1995 and 1998)	Applicable Regulations	Recommended Value
1	Source	Source capacity shall meet peak weekly demands.		Source capacity shall meet the MDD.
2	Fire flow for single family residential areas	1,500 gpm for 2 hours, storage volume of 180,000 gallons	ISO recommends a minimum of 1,000 gpm for 2 hours Oregon DWP has no fire flow requirements. However, a minimum residual pressure of 20 psi must be maintained at all times.	Minimum of 1,500 gpm for 2 hours, storage volume of 180,000
3	Fire flow for multi-family commercial, industrial, and institutional areas	3,500 gpm for 3 hours, storage volume of 630,000 gallons	For other types of habitational buildings, ISO's maximum needed fire flow is 3,500 gpm.	Minimmum of 3,500 gpm for 3 hours, storage volume of 630,000
4	Residential piping: sizing and looping			12-inch-diameter for major loops 8-inch-diameter for internal grid 6-inch-diameter min. for dead-end mains (less than 250 feet in length). Maximum velocity should be 6 fps during PHD. Higher velocities are allowed for fire flow demands.
5	Transmission Mains: sizing			Size the pipelines for a maximum velocity of 8 to 10 fps during PHD.
6	Operating pressures		Oregon DWP requires a minimum of 20 psi at all times.	During normal operation (any time except during fire flows) the operating range shall be 35 to 100 psi at the service connection. During fire flow, the minimum shall be 20 psi.
7	Pressure reducing valves on customer services		Oregon Plumbing Code allows a maximum of 80 psi. If higher, the addition of a PRV is required	Customers shall provide a PRV for pressures above 80 psi. The City shall provide pressure reduction when changes to the water system result in pressures greater than 80 psi.
8	Equalization storage volumes			25% of the MDD
9	Emergency storage volumes	Supply peak weekly demand		Twice the ADD
10	Total storage	Sum of peak weekly demand and fire flow volumes		Sum of equalization, emergency, and fire storage volumes.
11	Pump station sizing			Provide MDD for 24 hours with the largest pump out of service.
12	Reservoir turnover			Depends upon water quality. Many systems do not experience water quality issues despite the water age being greater than AWWA recommendations.

3.1.1 Source

The source capacities must be adequate to supply water demand to each service zone. Both service zones contain storage facilities for peaking equalization, and therefore the source capacity required is the MDD. Demands greater than the MDD would be served from the reservoir storage.

3.1.2 Storage

As no storage criteria are set by the DWP, typical standards of practice for master plan studying have been applied. One such standard is to divide the total storage requirement into three components: peaking equalization, fire flow, and emergency storage. The total storage requirement for the City's water system is recommended to be the sum of these three components as follows:

- Peaking equalization storage is used when demands are greater than the MDD supply capability of the system. Storage for peaking equalization is calculated as 25 percent of the MDD.

- Fire flow storage volume is determined based on fire flows of 3,000 gpm for three hours in commercial and industrial areas, 1,000 gpm for two hours in urban residential areas, and 1,500 gpm for two hours in the rural residential areas.

- Emergency storage requirements have the most flexibility in sizing and depend largely on the individual system makeup, lengths of historical emergency outages, and the level of risk the utility is willing to take. This plan assumes an emergency storage volume requirement of twice the ADD.

3.1.3 Pipeline

The distribution pipeline network must be able to meet the PHD and maintain pressures greater than 35 pounds per square inch (psi) while maintaining water velocities in the pipeline no greater than 8 feet per second (fps). Additionally, pressures in portions of the distribution system where there are service connections should not exceed 80 psi without the use of individual pressure-reducing valves as dictated in the Uniform Plumbing Code for Oregon. Water mains should be looped wherever possible in order to prevent dead-ends, increase reliability in the system, and maintain high water quality. Water mains should be sized for maximum potential demands and fire flow requirements according to the city zoning or planning area.

The pipeline network must provide the required flows for fire and MDD with a minimum residual pressure of 20 psi, established by the DWP, and with a maximum pipeline flow velocity of 10 fps. The size of network pipes must also be sufficient to handle the refilling of reservoirs during low demand periods of the day. The pressures in the transmission system should not fluctuate by more than 20 to 30 psi from normal ADD pressures as sources refill the reservoirs.

3.2 Computer Simulation Model

The H2ONet network analysis software was selected to simulate the hydraulics of the City's water system. H2ONet is a private domain software program developed by MWH Soft, Inc. Version 6.0 of H2ONet is the AutoCAD-based modeling software program that was used in this master plan study. AutoCAD files provided by the City, Washington County, and Clean Water Services were used to develop the model, which contains pipe, node, pump, source, and reservoir data. Nodes are typically interconnecting points of the pipeline network; however, they may be placed at intermediate locations on pipes where demands are required.

Operational scenarios have been introduced into the water system model, which in turn provides an output indicating how the system will respond. The output lists the pressure and hydraulic grade line at each node, velocity and friction losses through each pipe segment, and the operating conditions of all the facilities in the model.

The fraction of the total system demand allocated to each service zone's piping network was estimated based on the fraction of total service connections lying inside of each respective pressure zone.

Section 4: Water System Analysis

This section contains an analysis of the City of Banks' (City) water system for existing and future buildout demands. The analysis includes the evaluation of the water source, treatment, disinfection, storage, transmission, and distribution components of the water system.

4.1 Demand Allocation and Growth

The population of Banks is expected to more than double over the 20-year planning period. As depicted in Table 2-3 in Section 2, this will result in a growing water demand. The elevated demands are all allocated to the lands within City Limits (or areas where the City is expected to expand into), as City staff expects to withhold new service connections to the water system that lie outside the City.

4.2 Water Source and Supply

The City has historically utilized water diverted from Green Mountain Springs as their dominant water source. However, reductions in minimum summer flow rates and high turbidity events in the winter may limit the reliability of the Green Mountain Springs as an adequate source of water for the City's growing population. Minimum summer flows from the large spring have reportedly decreased from approximately 110 gpm in the early 1980's to approximately 90 gpm presently.

Turbidity levels in raw spring water may increase during high flow events in wet winter months. Spring discharge at the surface flows some distance within a marine sedimentary bedrock channel before collecting in the concrete catchment basins, and high flow events often lead to increased channel erosion and higher turbidity. Because the water treatment plant slow-sand filters are sensitive to high turbidity levels in raw water, diversion to the plant is halted on occasion in the winter. The small springs are more prone to high turbidity due to the longer flow paths between the outlets and the catchment. The small springs are not currently utilized due to the regularity of high turbidity events.

The Behrman Well was installed in 1979 as a source of supplemental water supply during the summer months. As the population has grown and spring flows have decreased, the Behrman well has become the City's dominant water source, and is pumped up to 18-hours per day during the summer months. Production from the well has remained a fairly constant 230 gpm since the well was installed, and the well is assumed to be a reliable source of water over the long term. However, the well pump and motor are aging and heavily used, and may present a limitation to the mechanical reliability of the well.

Well No. 2 was drilled and completed in the Columbia River Basalt aquifer within 100 feet of the Behrman Well in 2005. Preliminary pump tests conducted at Well No. 2 indicated the presence of a negative flow boundary and drawdown interference at the Behrman Well (Golder, 2008). Due to these limitations, Well No. 2 has not been outfitted with pump and transmission infrastructure to develop the well as a supply source. Pending further testing, once Well No. 2 is put into production, it will serve as either a backup water supply for non-concurrent use or an additional water supply and could be used simultaneously with the Behrman Well. The development of Well No. 2 is listed in the Capital Improvements section as Project 1, and is shown on Figure 4-1.

Table 4-1 summarizes the limitations of the City's current water supply sources. The reliable water supply rate available to the City during summer peak use periods is an instantaneous 340 gpm, or approximately 490,000 gallons per day given current operational schemes.

Table 4-1: Use Limitations of Existing Permitted and Certificated Water Supplies

Application Number	Use Limitations	Current Reliable Minimum Rate
S-9207	Limited summer flow rate of 90 gpm, high potential winter turbidity levels	90 gpm
S-65611	Limited summer flow rate of 20 gpm, frequently high winter turbidity levels, currently not utilized	0 gpm
G-8476	Maximum pumping rate at Behrman Well limited to by pump size	250 gpm
G-15887	Well #2 installed, pumping and distribution infrastructure not currently in place	0 gpm

Based on historical water production data and the current reliable minimum rate of water supplies, the City is deficient in water supply. To meet the average MDD for the years 2005 through 2007, a supply of 414 gpm or 0.60 million gallons per day (mgd) is needed. As shown in Table 4-1, during the summer months when MDD is most likely to occur, the total water supply is 340 gpm or 0.49 mgd. This represents a deficiency of 74 gpm or 0.11 mgd that will continue to increase as the City's population increases.

In order to supply water for the projected 20 year population, the City will need to obtain an additional 644 gpm.

4.2.1 Identification of Source Options

It is recommended that the City plan to meet future system demands through conservation measures that will minimize water loss from the system, encouraging water conservation by customers, and developing additional sources of supply in line with the City's current water right holdings. Demand projections, outlined in Section 2.3, indicate the City cannot currently meet the 2008 Maximum Day Demand, and will not meet the Maximum Monthly Demand by 2013. In addition to conservation measures, additional water supply will be required to meet these demands. A number of supply options are reviewed in this section and are categorized under the general areas of near-term and long-term supply options.

In the short term, it is recommended that the City continue measured development and exploration of additional groundwater resources to ensure near-term municipal demands are met and to develop system redundancy to supply water in the event of primary water source disruptions. In the long term, it is recommended that the City continue to evaluate options to develop interconnections with regional water suppliers.

In order to compare the source options, relative opinions of probable construction cost will be provided for all the options in this chapter instead of only the recommended improvements. Note that some of these costs have not been rounded. In the recommended CIP in chapter 6 they will be rounded.

4.2.1.1 Near Term Options

Currently, several short-term source water alternatives exist for the City of Banks. These options include completing the development of the existing ground water right permits in Table 1-1, developing Well #2, exploring options for utilization of the Quail Valley Golf Course Well, and assessing options for the Southwest Wellfield. The City may also consider improving the delivery of water supplies on existing spring water right certificates by investigating options to transfer spring water rights to groundwater rights (Sellers Road Wellfield); thereby reducing or eliminating the need for filter treatment.

4.2.1.2 Behrman Well #2

This supply option will provide near term additional water supply to the City and act as a back up well to the Behrman Well #1. Development of the Well #2 option may yield up to 450 gpm of reliable water supply. If the well is found to have the capacity to sustain this amount of water for a sufficient period of time, the development of the pumping and conveyance system could increase the reliable supply by 220 gpm, assuming that the Behrman Well was not in operation.

This option will require a long-term constant-rate pumping test to prove out the pumping capacity and accurately size the pumping system. This work is already under way, but results are not in yet. Other infrastructure required will include the wellhead design and construction, a chlorine treatment system, and a short conveyance pipeline to intertie with the Carston reservoirs.

The Scope of Work to develop Well #2 is as follows:

1) Phase I - Hydrogeologic Feasibility Study
    a. Pump Test Well
    b. Analysis and Reporting
    c. Water Right Permit Amendments
    d. Engineering Design of Wellhead Improvements, Controls and Conveyance
2) Phase 2 –Design & Construction
    a. Construction of Wellhead Improvements, Controls and Pipeline

Cost Estimate

Hydrogeologic Feasibility Study parts A and B. This work is under way.

Water Right Amendment	$12,000	
Design & Construction -	$670,000	if additional source
	$540,000	if backup supply only

4.2.1.3 Quail Valley Golf Course Well

The Quail Valley Golf Course located to the east of the City of Banks has an existing groundwater well which could be a potential alternative source of water. Current water rights for this well are permitted for a maximum rate of 0.89 cubic feet per second (399 gpm) for supplemental irrigation. This well is presently pumped to storage ponds on the golf course. The irrigation water is then pumped from the pond to irrigate the golf course when Tualatin Valley Irrigation District cannot supply irrigation water to the course. If found to be hydraulically connected, this well could yield a significant municipal water supply under the City's existing water rights.

Use of this water supply option would require a Memorandum of Understanding (MOU) between the City and Quail Valley Golf course regarding emergency use, and annexation of part or all of the golf course and surrounding lands. A water supply pipeline would be constructed from the well to an intertie in the Behrman well to tie into the existing pipeline along NW Banks Road at the Behrman well (see Figure 5-3), which would be approximately 4000 feet long.

The scope of work to develop the Quail Valley Golf Course well as a City source is as follows:

3) Phase I - Hydrogeologic Feasibility Study
    a. Water Right Consultation with Oregon Water Resources
    b. Access Agreements and Right of Way Feasibility
    c. Pump Test Well
    d. Analysis and Reporting
    e. Engineering Design of Wellhead Improvements, Controls and Conveyance
4) Phase 3 –Design & Construction
    a. Land Acquisition and Right of Way
    b. Water Right Permit Amendments
    c. Construction of Wellhead Improvements, Controls and Pipeline

Cost Estimate

Hydrogeologic Feasibility Study	$37,000
Design & Construction parts a and b	$28,000
Design & Construction part c	$1,170,000

4.2.1.4 Sellers Road Wells

This water supply option would require a hydrogeologic feasibility study of the basalts above the existing spring sources north of the City. This would include drilling and pump testing a well, and would require a water right transfer of a portion of the spring water right to the new groundwater well.

The City maintains two spring intakes north of town, located off Sellers Road. The supply from the springs has experienced long-term reductions in production capacity over the last 20 years and the surface water captured requires expensive filtration and treatment to meet drinking water quality standards. If this option proved successful, the water drawn from the groundwater source in connection with the springs could be increased from the current 90 gpm to the full water right of 269 gpm, an increase of 179 gpm. The groundwater from the wells is unlikely to require filtration treatment. The potential improved water quality could greatly reduce or eliminate the cost of operating the City’s slow sand filter. The hydrogeologic feasibility study would include refining a hydrogeologic conceptual model, selecting a well location based on hydrogeologic features, legal access to Sellers Road, and then drilling a test well and completing a pumping test.

A successful outcome to the feasibility study could initiate the development of a well field along Sellers road. Two to five wells could be drilled to a depth of 50 to 350 feet, with an estimated production of approximately 50 to 150 gpm each. In addition to drilling the wells, other infrastructure would be required including; power supply, approximately 3500 feet of pipeline conveyance from the new wells to a tie-in at the existing spring intake, pumps and motors, and a control system for operations.

The scope of work to develop the Sellers Road Wellfield is as follows:

1) Phase I - Hydrogeologic Feasibility Study
   a. Water Right Consultation with Oregon Water Resources
   b. Geophysical Survey - Evaluation of Basalt Thickness
   c. Access Agreement and Right of Way Feasibility
   d. Drill Test Well (1-well to 200 ft.)
   e. Pump Test Well and Monitor Springs
   f. Analysis and Reporting
2) Design and Construction of Well Field (Assume 4-Wells to 200 ft.)
   a. Land Acquisition and Right of Way
   b. Drill 4-Wells, Pump Test, Analysis and Report
   c. Water Right Consulting for Transfer of Certificates
   d. Design for pumps and motors, wellhead, conveyance, and controls
   e. Construction of wellhead development and pipeline

Cost Estimate

Hydrogeologic Feasibility Study	$150,750
Design and Construction parts b and c	$450,000
Design and Construction parts a, d and e	$2,380,000

4.2.1.5 Southwest Wellfield

Located to the southwest of the City of Banks is an area of land that has been considered as a possible location for a new well field. The location is to the west of Nehalem Hwy between NW Wilson River Hwy and NW Dierick Road. This land is currently being used for agricultural purposes, but may be in a location which could produce significant quantities of groundwater.

It is proposed that two wells could be drilled in this area. A pipeline would be constructed to tie in to the existing water distribution system for the City to the north along S Main Street, and would be approximately 2500 feet in length.

The City's junior water right permit allows for development of up to 1cfs (~450 gpm) of additional water supply from the CRB aquifer. A 300-gpm portion of Permit G-16312 would be available for development after the successful development of Well #2. Similar production wells completed in the CRB aquifer in the area have production rates ranging from approximately 100 to 500 gpm (Squire, 1994). A new well located on the south side of town may encounter as much as 400 feet of overburden sediment, and would benefit from being drilled at least 400 feet into the CRB aquifer, for a total depth of approximately 800 feet.

The scope of work to develop the well field southwest of City center

1) Phase 1 - Hydrogeologic Feasibility Study
    a. Water Right Consultation with Oregon Water Resources
    b. Access Agreements and Right of Way Feasibility
    c. Drill Test Well (Assume 1-Wells to 800 ft.)
    d. Pump Test Well
    e. Analysis and Reporting
    f. Engineering Design of Wellhead Improvements, Controls and Conveyance
2) Phase 2 –Construction
    a. Land Acquisition and Right of Way
    b. Construction of Wellhead Improvements, Controls and Pipeline
    c. Water Right Permit Amendments
    d. Beneficial Use Survey

Cost Estimate

Hydrogeologic Feasibility Study parts a, c, d and e	$322,306
Design and Construction parts c and d	$20,000
Design and Construction parts f, a and b	$1,430,000

4.2.1.6 Long Term Options

Over the long term, the City will need to continue to evaluate options to develop interconnections with regional water suppliers. The City may also consider optimizing long-term production from the CRB aquifer by developing an Aquifer Storage and Recovery (ASR) Program. This program would allow the City to store excess winter water from the spring water right certificates into the CRB aquifer wells in and around the City Center (Behrman Well, Well #2, and potentially the Quail Valley Well and the proposed Southwest Wellfield).

4.2.1.7 Tualatin Valley Irrigation District (TVID)

The City has considered purchasing non-potable water from TVID in order to supply large-volume water customers with an alternative source of irrigation water. This arrangement has the potential to significantly reduce potable water use by these customers and thus provide “additional” potable water to meet residential water needs.

A purchase agreement with TVID would need to be accompanied by concurrent water rights amendments to allow use of TVID water to irrigate land serviced by the City, as well as a modest investment in infrastructure to allow delivery of non-potable water to large-volume irrigation users. Currently, there is a moratorium on new service agreements with TVID that is expected to last until the year 2015. However, Banks may begin planning and negotiations with TVID at this time in order to be ready to take advantage of a potential TVID connection when the opportunity arises.

The scope of work to pursue this option would include the following:

1) Phase 1 - Engineering Feasibility Study
    a. Water Right Consultation with TVID
    b. Access Agreement and Right of Way Feasibility
    c. Analysis and Reporting
    d. Land Acquisition and Right of Way
    e. Water Right Permit Amendments
    f. Project Design
2) Phase 2 - Construction of pipeline and other improvements

Cost Estimate

This option was not pursued at this time as there is a moratorium on new services. When the moratorium is lifted the requirements of this option should be discussed with TVID.

4.2.1.8 Interconnection with other Providers

Developing interties with neighboring water providers has the potential to provide a significant source of water to the City, as well as a reliable redundant supply in the event of a water supply failure from one or more of the system's major water sources. Intertie construction and purchasing water from outside sources is also the most expensive option for developing additional/redundant supply. Interties with the City of Forest Grove, the City of North Plains, the Joint Water Commission and/or the Tualatin Valley Water District may be considered. It is suggested that an intergovernmental agreement with one of these water providers be drafted before pipeline development is conducted.

The scope of work to pursue this option would include the following:

1) Phase 1 - Feasibility Study
    a. Consultation with potential Providers
    b. Determination of water quantity available
    c. Evaluation of cost (capital, connection fee, user rates)
    d. Develop an Intergovernmental Agreement
    e. Project Design

2) Phase 2 - Construction of pipeline and other improvements

Cost Estimate

Before estimates can be developed the City will need to begin discussions with potential providers. Depending upon the requirements of the potential provider, a feasibility study may range from $10,000 to $30,000.

Design and construction would include a pump station and at least 5.3 miles of transmission pipe. $4,000,000

Additional cost would include a connection fee that would be negotiated between providers.

4.2.1.9 Aquifer Storage and Recovery (ASR)

An ASR system requires an alternate source of water supply to recharge a subsurface reservoir. Banks has one near-term option and one long-term option for alternate water sources that could be used to recharge the CRB aquifer near the town center.

- Near-Term Source: Recovered water from the Water Treatment Plant or the groundwater developed under the Sellers Road well field concept could be used to develop an ASR project at the Behrman Well or Well #2.
- Long-Term Source: Water supply contracts with regional suppliers may include provisions for off-peak water delivery at a significantly reduced cost per gallon. If this is the case, the City may consider storing winter water purchased through such a contract for an ASR system utilizing Well #2 or the Behrman Well.

ASR is a water management approach that typically uses wells to store treated drinking water in a suitable aquifer system, and recovers that water through the same wells at a later date. Aquifer storage displaces the native groundwater and effectively creates an underground reservoir of water than can be recovered for a wide variety of applications. ASR systems have been designed and operated to meet a wide range of objectives at sites with many different physical and hydrological conditions and water sources. The number of active ASR projects in Oregon has increased from zero in 1995 to 10 in 2008, with at least 20 wells in use or in development.

ASR systems are usually operated to take advantage of available excess water volume, either from water treatment plant capacity during winter months or another acceptable source, to store treated water, and recover that water through wells during the summer months to help meet peak demands. Recovered water quality in most ASR systems generally reflects the source water, although some mixing with native groundwater does occur. In many cases, ASR systems can be designed to meet a primary objective as well as to provide several secondary benefits. In addition to providing a source option, the potential benefits of a Banks ASR system include:

- Taking advantage of “off-season” lower winter rates if available from a regional water provider under a conservation rate structure. This would allow the purchase and storage of cheaper water in the winter for later use at peak summer demand.
- Storage capacity can be added at locations within the water supply system where demand is increasing, where there is a benefit to enhancing chlorine residuals, or where there is a benefit to delivering water directly to different pressure zones;
- Creation of environmental benefits through reduction of stress on water-related habitats during drought periods.

An ASR well will deliver water at the rate associated with any appropriately designed water supply well. The target aquifer systems are usually confined systems both to provide a groundwater protection benefit, and to limit the potential for the interaction with nearby shallow domestic wells and surface water features. Consequently, Banks-area ASR wells would have the same location targets and potential yields as the groundwater supply well options. Based on the evaluation of the Behrman Well, Well # 2 and the Quail Valley Well, the most likely yield of any new ASR well would be near 300 gpm. The well log review indicates that where wells encounter greater thickness of higher permeability basalts, well yields are substantially higher.

Because recharge rates in ASR wells are typically held to 75% of the production rates, a 300-gpm production well would recharge in the vicinity of 225 gpm, if the excess water was available. Over a 6-month recharge period, approximately 58 MG would be stored in the subsurface. If 90% of this volume were recovered to the system with a single well, it would require approximately four months of pumping to recover. This option would require the development of a water system intertie with a neighboring community or regional water provider to acquire source water sufficient to beneficially operate the system.

Groundwater rights are not required for ASR well operations. The permitting process requires a valid water right to appropriate the source water for storage, and an assessment of the potential for impacts to nearby groundwater users. Because ASR systems typically operate in a fashion that has no net impact on the annual groundwater budget, it is more likely that an ASR system would be viewed as having less impact on nearby surface water and groundwater supplies than a groundwater extraction wellfield. Consequently, ASR permitting is likely to be less costly, require less stringent mitigation planning, and has a greater chance of success than obtaining a new groundwater right.

In order to evaluate the feasibility of developing an ASR operation to integrate with The City of Banks' water supply system, the city should evaluate the following conditions:

- Identify whether ASR development costs at Well #2 are higher or lower than the costs to build onsite reservoirs.
- Evaluate whether there are portions of the service area that could benefit from additional pressure, chlorine residual, or supply in addition to the benefit of having an additional source in the event of WTP shutdown or loss of another water supply sources due to some other system failure.

The scope of work to develop the ASR options would be:

Phase 1 - ASR Feasibility Study
  a. Pre-application consultation with Oregon Water Resources
  b. ASR Hydrogeological Feasibility Study, Monitoring Well Network and Report
  c. Pilot Test Work Plan Document
  d. Permit Application and three Additional OWRD Meetings

Phase 2 – Design and Construction
  a. Design of wellhead
  b. Construction of Wellhead
  c. First Year Pilot Testing and Reporting

Cost Estimate

ASR Feasibility Study	$132,500
Design and Construction parts a and b	$810,000
Design and Construction parts c	$125,000

Additional source is required for this option to work. Therefore, this option would need to be combined with one of the other source options, which significantly increases the cost of this option.

4.3 Storage

The Banks water system currently contains four storage facilities: the High Zone Reservoir, the North Star Reservoir, and Carsten Reservoirs 1 and 2. The North Star Reservoir provides storage volume for the High Zone customers and the Main Zone Customers. Carsten Reservoirs No. 1 and 2 provide storage volume for the Main Zone. Water storage for the High

Zone is provided solely by the high level storage, while the Main Zone is served both by the high level storage and the entirety of the Carsten Reservoirs.

Tables 4-2 and 4-3 illustrate the storage requirements and additional storage needs on a yearly basis throughout the planning period for the Main Zone, and the storage requirements in the High Zone for both current and 2028 conditions, respectively. The analysis conducted includes an effective volume consideration for the existing storage as well as recommended storage. Each reservoir is assumed to have an effective tank volume of 90 percent of its total capacity.

Table 4-2: Banks Water System Service Area Storage - Main Zone

YEAR	ADD (gpm) [(a)]	ADD (mgd)	MDD (gpm) [(a)]	MDD (mgd)	Required Storage (MG) [(b) (e)]	Existing Storage (MG) [(c)]	Additional Capacity Required (MG) [(d)]
2008	182	0.26	420	0.61	1.33	1.38	(0.05)
2009	197	0.28	453	0.65	1.39	1.38	0.01
2010	211	0.30	486	0.70	1.45	1.38	0.07
2011	225	0.32	519	0.75	1.50	1.38	0.12
2012	240	0.34	552	0.79	1.56	1.38	0.18
2013	254	0.37	585	0.84	1.64	1.38	0.26
2014	268	0.39	618	0.89	1.70	1.38	0.32
2015	282	0.41	650	0.94	1.75	1.38	0.37
2016	297	0.43	683	0.98	1.81	1.38	0.43
2017	311	0.45	716	1.03	1.87	1.38	0.49
2018	325	0.47	749	1.08	1.93	1.38	0.55
2019	340	0.49	782	1.13	1.98	1.38	0.60
2020	354	0.51	815	1.17	2.04	1.38	0.66
2021	368	0.53	847	1.22	2.10	1.38	0.72
2022	382	0.55	880	1.27	2.15	1.38	0.77
2023	397	0.57	913	1.32	2.21	1.38	0.83
2024	412	0.59	948	1.37	2.27	1.38	0.89
2025	412	0.59	948	1.37	2.27	1.38	0.89
2026	412	0.59	948	1.37	2.27	1.38	0.89
2027	412	0.59	948	1.37	2.27	1.38	0.89
2028	412	0.59	948	1.37	2.27	1.38	0.89

NOTES

(a) Main Zone ADD and MDD are based on the difference between the Total System ADD and the High Zone ADD.
(b) The required storage volume is equal to: (the sum of 25% of the MDD; twice the ADD; and the Commercial Fire Flow) * 1.1
(c) The existing storage in the Main Zone accounts for the full Carsten Reservoirs No. 1 and 2 volumes less 10% to account for only 90% effective volume in the reservoir.
(d) The additional storage volume needed is the difference between the required storage and the existing storage available.
(e) Commercial/Industrial Fire Flow = 3,000 gpm for 3 hours.

The Main Zone will experience population growth and increased water demand as the City expands its limits and connects more services to the water system, creating a need for greater volumes of stored water. Currently, the Main Zone is served by 1.5 MG of storage volume at the Carsten Reservoir site, of which the full volume is all available for use during a fire or other type of emergency. Also available to the Main Zone is 180 gpm of flow that can be withdrawn from the North Star Reservoir via the 6-inch-diameter transmission main through the PSV/PRV and to the Main Zone to recharge to water level in the Carsten Reservoirs as they are drawn down to address the storage requirement. This value was calculated based on the upstream setting of the PSV/PRV, the operating water surface elevation of the North Star Reservoir, and the flow characteristics of the 6-inch-diameter transmission pipeline. Water flowing in the transmission pipeline at 180 gpm for three hours results in 0.03 MG of High Zone water storage available to the Main Zone.

As shown in Table 4-2, the Main Zone will need an additional 1.0 MG (rounded) of storage by the year 2024 when population buildout is expected to occur. The new storage reservoir for the Main Zone is listed in the capital Improvements section as Project 5, and is shown on Figure 4-1. Once the location of the population growth becomes clear, the proposed storage facility will be sited and designed strategically in order to supply water within the desired pressure range to the new water customers.

Table 4-3: Banks Water System Service Area Storage - High Zone

YEAR	ADD (gpm) [(a)]	ADD (mgd)	MDD (gpm) [(a)]	MDD (mgd)	Required Storage (MG) [(b), (e)]	Existing Storage (MG) [(c)]	Additional Capacity Required (MG) [(d)]
2008	16.0	0.02	35.9	0.05	0.26	0.06	0.20
2028	16.0	0.02	35.9	0.05	0.26	0.20	0.06

(a) High Zone ADD & MDD are based on percentage of total system demands that correspond to the number of connections in the High Zone.
(b) The required storage volume is equal to: (the sum of: 25% of the MDD; twice the ADD; and the Residential Fire Flow) * 1.1.
(c) The existing storage in the High Zone for 2008 accounts for the North Star Reservoir alone less 10% to account for 90% effective volume in the reservoir. The existing storage in the High Zone for 2028 accounts for the High Zone Reservoir alone less 10%.
(d) The additional storage volume needed based on the criteria in (a) is the difference between the required storage and the existing storage available.
(e) Rural Residential Fire Flow = 1,500 gpm for 2 hours.

As shown in Table 4-3, the values for ADD and MDD are not projected to change during the planning period as no more service connections within the High Zone are anticipated. The High Zone is currently served only by North Star Reservoir, a total of 0.06 MG of stored water. This is because all treated water has to flow through North Star to achieve chlorine contact time. Once North Star Reservoir is taken offline, the storage available to the High Zone will be 0.20 MG, which is the capacity of the High Zone reservoir. The proposed use of the High Zone Reservoir as a clear well will entail additional chlorine contact time before the first customer, and the availability of its water storage capacity.

Based on the industry-standard criteria used to generate Table 4-3, the High Zone has insufficient storage to accommodate the anticipated demand throughout the 20-year planning period. The 1998 Water System Master Plan Update recommended taking North Star offline and building a new 0.30-MG reservoir at the SSFP site. However, a 0.22-MG tank was built, resulting in a storage deficiency.

After further consideration, we deem that the apparent lack of storage volume in the High Zone is not expected to harmfully impact the water system. A new storage facility that parallels the High Zone Reservoir (with the same overflow elevation) may eventually benefit the system, but this Master Plan recommends taking North Star offline, consolidating the disinfection and treatment, and then monitoring the system to ensure that the system is operating effectively without the additional 0.06 MG of storage that falls out of Table 4-3.

Concurrent with the removal of North Star from the flow path of treated water, the gaseous chlorination facilities used for disinfection at the reservoir site will be removed for health and safety purposes. The new disinfection facility at the SSFP is listed in the Capital Improvements section as Project 3, and is shown on Figure 4-1. Once the tank is removed from service, the total storage available to the High Zone from the High Zone Reservoir will be approximately 0.20-MG.

4.4 Service Areas (Pressure Zones)

By operating the High Zone off of the High Zone Reservoir overflow elevation, the pressure in the high zone transmission main line will significantly increase. As a result, a new PRV station will need to be added to the transmission line. The new PRV will reconfigure the existing pressure zone layout, and create another pressure zone in between the High and Main Zones. The recommended placement of the PRV is at the intersection of Sellers and Woolen Rds, just upstream of the 2-inch service line that tees off Sellers Rd. onto Woolen Rd. The new zone will be referred to as the Intermediate Zone,

In addition to a PRV station,all the services in the high zone will need review to conclude whether they have individual PRVs. If they do not have individual PRVs, and have excessive pressure (after the decommissioning of North Star), then they will need to be installed. This is included in the opinion of probable cost for the SSFP upgrades project. Also included is the estimated cost to furnish the new PRV Station. These improvements are all included in the Capital Improvements section with Project 3.

Service meters are best suited to be placed indoors (such as the garage) to preserve the longevity and accuracy. However, for the purposes of this report, each new individual PRV will be assumed to be housed in a new vault outside.

4.5 Pipeline and Fire Flow Analysis

4.5.1 Distribution System

Hydraulic modeling of Banks' transmission and distribution system was completed. There are 16 nodes within the distribution system that cannot deliver the fire flow required by the land use zoning category (see Section 4.3 for requirements) without exceeding one or both of the criteria shown in Section 3. The applicable criteria include a critical pipe velocity of 10 fps and a residual system pressure of 20 psi. The pipe velocity is a "rule of thumb". The higher the velocity, the higher the headloss through friction, which requires more energy to overcome. It is generally considered that it is more cost effective to increase the pipe size rather than increase the pump horsepower when velocities are above 10 fps. The system pressure is mandated by the OAR Chapter 333. However, six of these nodes are dead-end pipes where no fire hydrant is located. Figure 4-2 shows all node locations within City limits where the required fire flow is unavailable. Table 4-4 below summarizes the nodes serving nearby fire hydrants that do not meet all of the fire flow requirements.

Table 4-4: Banks Water System Modeling – Existing System Fire Flow Deficiencies

Location	Required Fire Flowrate (gpm) [(a)]	Flowrate at Critical Velocity (gpm) [(b)]	Modeled Maximum Fire Flowrate (gpm) [(c)]
Intersection of Market St. and Commerce St.	1,000	880	2,080
Intersection of Depot St. and Commerce St.	1,000	880	1,850
End of 8-inch line in Lumber Yard along Railroad	3,000	1,560	2,640
Intersection of Park St. and Woodman Ave.	1,000	880	1,170
Intersection of Woodman Ave. and Parmley Ave.	1,000	880	1,320
Intersection of Parmley Ave. and Wilkes St.	1,000	880	1,490
End of 6-inch line on Wilkes St.	1,000	880	1,200
End of 6-inch line in Sunset Park	3,000	880	1,900
End of 6-inch line at shopping center south of Oak Way	3,000	880	2,100

Notes:

(a) 1,000 gpm for residential zoning; 3,000 gpm for commercial and industrial zoning.
(b) Flowrate shown occurs when critical velocity in the pipe is reached.
(c) Indicates that critical residual pressure in the system is reached (20psi).
(d) Deemed borderline insufficient.

Each node where fire flow is unavailable presents a possible public safety hazard. Each dead end line presents both a potential water quality issue and a maintenance item as they need to be periodically flushed. The looping of these lines will address this concern, as well as bolstering the hydraulic capacity of the distribution network as a whole. The location and description of these lines are as follows:

A. Intersection of Woodman Ave. and Park St. – Upsize the existing 2-inch Park St. line (620 feet) to 8-inch and connecting it to the 6-inch line on Woodman Ave with approximately 30 feet of 8-inch pipe. Due to the fact that fire flows in this area are all lower than 1,500 gpm, this is recommended for high priority.

B. East of intersection of Woodman Ave. and Parmley Ave. – If adequate road or shoulder space is available to construct this addition to the distribution system, connect the dead-end line east of Woodman Ave. to the 6-inch line at the intersection with approximately 180 feet of 6-inch pipe. This project would bolster fire flow at the intersection of Woodman Ave. and Parmley Ave. and eliminate a dead-end to create more looping within the system. This is recommended for high priority.

C. End of 6-inch line on Wilkes St. – If an easement to construct a pipeline is available, install approximately 250 feet of 8-inch pipe and connect the 6-inch dead-end to the 12-inch main along the Railroad Right-of-way. This project would bolster fire flow at the hydrant on Wilkes St., and eliminate a dead-end to create more looping within the system. This is recommended for high priority.

D. Commerce St. from Market St. to Sunset Ave. – Install approximately 825 feet of 8-inch line along Commerce Ave., looping the 6-inch dead-end lines on Market St. and Depot St. with the 8-inch line on Sunset Ave. This project would eliminate two dead-ends and create more looping within the system, and is recommended for medium priority.

E. West end of Jarvis Pl. to west end of Elmhurst Ct. – Loop four dead-end lines and cross the 12-inch line along Trellis Way with approximately 680 feet of 8-inch pipe. This project would eliminate four maintenance areas in the distribution system, and is recommended for medium priority.

F. West from Highway 47 on Cedar Canyon Rd. – Upgrade the 2-inch line along Cedar Canyon Rd. that crosses a bridge over West Fork Dairy Creek (400 feet of 2-inch line on west side of Main St.) to 6-inch pipe until the point where it splits off into two 1.5-inch lines serving the western-most customers on Cedar Canyon Rd. This project would bolster the integrity of the service main that crosses the Creek, and is recommended for medium priority.

   If the UGB is expanded to the west in the vicinity of Cedar Canyon Road, then this pipe should be upgraded to a 12-inch back to the 14-inch pipe on Highway 47.

G. End of 8-inch line in Lumber Yard along railroad – Connect to the 12-inch main due east with approximately 480 feet of 8-inch pipe. Due to the fact that other hydrants are available at the lumber yard and construction may be difficult due to operations at the facility, this is recommended for low priority.

H. End of 6-inch line in Sunset Park – In order to loop this dead-end pipe to the 12-inch main along Highway 47 (Main St.), 180 feet of 8-inch pipe is recommended. This construction would need to be bored underneath Highway 47, which is expensive. Due to the fact that another hydrant is available on Highway 47 across from the park and the difficulties involved with construction, this is recommended for low priority.

I. End of 6-inch line at shopping center south of Oak Way – Loop two dead-end lines by connecting the 4-inch to the 6-inch pipe by crossing the shopping mall property with approximately 300 feet of 6-inch pipe. This addition would bolster fire flow at the nearby hydrant and eliminate two maintenance areas in the distribution system. However, as another hydrant is located nearby on a 10-inch line on Oak Way, this project is recommended for low priority.

In each location that fire flow is unavailable, the proposed alteration to the distribution system (pipe upgrade or system looping) has been added to the model for possible implementation.

Figure 4-3 shows all recommended distribution system changes to address deficiencies in the existing distribution system. Table 4-5 below summarizes the nodes serving nearby fire hydrants that still do not meet all of the fire flow requirements.

Table 4-5: Banks Water System Modeling – Future System Fire Flow Deficiencies

Location	Required Fire Flowrate (gpm) [(a)]	Flowrate at Critical Velocity (gpm) [(b)]	Modeled Maximum Fire Flowrate (gpm) [(c)]
End of 8-inch line in Lumber Yard along Railroad	3,000	2,680	4,300
End of 6-inch line in Sunset Park	3,000	1,920	4,400
End of 6-inch line at shopping center south of Oak Way	3,000	1,340	2,880

Notes:

(a) 3000 gpm for commercial and industrial zoning.
(b) Flowrate shown occurs when critical velocity in the pipe is reached.
(c) Indicates that critical residual pressure in the system is reached.

As can be seen in Table 4-5, after the proposed changes the system will still not receive fire flow and meet the critical velocity or critical residual pressure criteria at every fire hydrant in areas zoned for commercial or industrial use. However, as one can see from a comparison of Tables 4-4 and 4-5, the proposed changes do enhance the system's ability to respond to fire flow demands. Also, the number of dead-end lines in the distribution system will decrease from 21 to 7.

4.5.2 Expansion of Distribution System in Response to Growth

As previously discussed in Section 2, Banks will extend its City Limits and UGB in order to increase its population. The population growth must be met with the extension of the utilities Banks provides to its residents, including potable water. Although the geographical direction of the expansion is unknown, hydraulic modeling of Banks' water system pertaining to expansion in any one direction has been performed. The modeling looked at the adequacy of the existing distribution system to deliver the required flowrate (1,000 gpm fire flow for residential areas plus the increase in maximum daily demand presented in Table 2-3) to the new pipelines. Table 4-6 presents the modeling results, and Figure 4-4 shows the locations of the new pipelines for each "Buildout Scenario". It is important to note that the demands placed at the new nodes (dots of each assigned color represent the locations where the total demands were placed) are conservative in that the new nodes should not see the entire difference between 2008 and 2028 MDD plus the residential fire flow.

Table 4-6: Banks Water System Modeling – City Expansion Scenarios

Buildout Scenario	Color on Figure 4-4	Required Flowrate (gpm) [b]	Minimum Modeled Flowrate (gpm) [c]
Northeast [a]	Red	1,528	n/a
Northwest	Yellow	1,264	3,230
West	Green	1,264	4,350
South	Orange	1,264	4,070
East	Magenta	1,264	4,000
East Banks Rd. [a]	Cyan	1,528	n/a

Notes:

(a) Due to the existing ground surface elevation where demands were placed, the distribution system cannot deliver the required flowrate to the hypothetical nodes without residual system pressure dropping below 20 psi. A new pressure zone would be required.

(b) The required flowrate is the total demand assigned to any new node. This includes the 1,000 gpm residential fire flow and the difference between the 2008 and 2028 MDD.

(c) Flowrate modeled at any new node when residual pressure reaches 20 psi.

As can be seen from Table 4-6, most “Buildout Scenarios” can be accommodated by the existing distribution network. However, if growth was to occur either to the northeast (on the hill north of the Carsten Reservoir site) or east along Banks Rd (also up a hill), then the existing network cannot support the growth without the addition of a booster pump station. The pump stations would be designed to transmit treated water from the distribution system to the new development without residual system pressures dropping below 20 psi.

In summary, it has been verified that the distribution system can be expanded in any direction that the UGB is expanded. This expansion should connect to the main system loop within the City wherever possible, and depending on the elevation of the land that is developed, may need a booster pump station to serve a new pressure zone.

As development occurs in the expanded UGB the City will need to insure that the pipe includes a 12-inch loop tied into the existing 12 and 14-inch distribution pipe.

4.5.3 Transmission Pipeline

The 6-inch tar-wrapped steel transmission pipeline carrying treated and disinfected water from the North Star Reservoir to the City has reached the end of its service life and is believed to contribute heavily to Banks’ large unaccounted-for water volume. The transmission main should be abandoned following the entire 3.2-mile length. This includes a 0.3-mile stretch of 6-inch PVC pipe from the SSFP to North Star, and 2.9 miles of steel pipe traveling south from North Star to Sellers Rd., and following Sellers Rd. through the PSV/PRV and into the Main Zone. A 10-inch line should replace the existing line extending to the 14-inch line at Main St. (Hwy 47).

Another option is to install parallel lines, with one acting as a transmission main to the Main Zone, and the other acting as a distribution main through the High Zone and extending to the location of the PSV/PRV. The abandonment of the specialty valve would accompany this alternative option, which would cost substantially more than the option of upgrading and replacing the pipeline along the existing alignment. Therefore, the parallel line option has been deemed cost-prohibitive and is not being evaluated further.

The recommended option is the replacement of the 6-inch transmission main with a single 10-inch main along the same alignment. The existing 4-inch PSV/PRV is currently undersized, although it functions properly as a pressure sustainer for the High Zone customers and a pressure reducer for the Main Zone customers. When the transmission line is replaced, a new PSV/PRV station should replace the existing one. The expected size of this station is a 6-inch main valve setup with a 2-inch bypass line for existing flows from the SSFP. If additional source capacity is targeted in the area north of the city and the Sellers Rd. transmission line will transmit substantially higher flows, then an 8-inch main PRV setup with a 2-inch bypass line is recommended. This issue will need to be addressed during planning for detailed design of a new transmission pipeline.

Once the transmission line is replaced, and the existing line abandoned, the system should experience lower leakage loss and higher transmission capacity. Coupled with the abandonment of the North Star Reservoir, the customers in both pressure zones will continue to experience adequate system pressures so long as the system is designed correctly. The replacement of the treated water transmission pipeline and PSV/PRV station is listed in the Capital Improvements section as Project 2, and is shown on Figure 4-1.

Figure 4-5, a future system schematic hydraulic profile, shows the newly created pressure zone, along with the other proposed changes to the Banks water system.

4.5.4 Leak Detection Survey

In addition to the 3.2-mile transmission main that is believed to significantly contribute to the substantial water loss in the system, it is feasible that other pipelines in Banks also leak treated water. Due to the uncertainty regarding the exact location of water leakage, a detailed Leak Detection Study should be performed that covers all pipelines owned and operated by the Banks water utility (both distribution and transmission). This project is listed in the Capital Improvements section as Project 10.

4.6 Slow Sand Filter Treatment Plant

The SSFP treats incoming water from the Green Mountain Springs to the necessary water quality standards (pre-disinfection) outlined in Section 5. The plant is equipped with the hydraulic capacity necessary to treat the highest flows it receives, and all components of the treatment system are fit for continued use.

Due to the somewhat isolated location of the SSFP, backup onsite power generation is recommended. A generator could be sized to supply power via onsite fuel storage to all the components of the treatment plant, creating a redundant source of power generation that would allow for the system to continue fully operating during a spontaneous power outage.

4.7 Disinfection

Although the filter basins and existing equipment are fit for continued service, the SSFP site can be upgraded by outfitting the outlet portion of the plant with disinfection capabilities, and utilizing the High Zone Reservoir as a clear well. The chlorine gas disinfection system and equipment currently utilized at the North Star Reservoir site could then either be abandoned or left as a backup. Abandonment is recommended as the human and environmental health hazard a chlorine gas leak creates can therefore be eradicated.

Disinfection capabilities should be consolidated with treatment at the SSFP site. The proposed low-impact chemical solution is the addition of sodium hypochlorite. The sodium hypochlorite needed for the filter plant effluent could be generated onsite from a brine solution, electricity, and water. Having onsite generation capabilities, as opposed to purchasing a solution to be delivered, creates a situation where Banks would eliminate the need to rely on deliveries during the winter months, and the investment made by purchasing the equipment would be paid off by not needing to purchase gaseous chlorine cylinders or sodium hypochlorite solution.

Two options exist for locating the sodium hypochlorite generation system. A new building could be constructed to house the required system components, as shown in Figure 4-6, or the equipment could be placed in the existing filter gallery so long as the necessary space is available. The new disinfection facility at the SSFP is listed in the Capital Improvements section as Project 3, and is shown on Figure 4-1.

A new disinfection facility at the BW site is also recommended to disinfect the groundwater extracted from the existing well and Well No. 2. This facility would replace the existing chlorine gas storage facility that is piped into the groundwater before it is pumped into Carsten Reservoir No. 1. This project, coupled with providing onsite backup power generation for the electrical equipment at the BW site, is listed in the Capital Improvements section as Project 4, and is shown on Figure 4-1.

4.8 System Controls and Telemetry

The existing system controls utilized by Banks include altitude valves, the PSV/PRV, and automatic pump start-up based on the Carsten Reservoir levels. All other system parameters, such as SSFP levels and outflows, reservoir levels, Behrman Well outflows, and disinfection quantities used are either recorded manually or not recorded at all. A comprehensive system that remotely monitors all the desired system parameters and transmits them to a central location via radio waves would be beneficial for system oversight.

A system of antennas, coupled with the necessary monitoring equipment (instrumentation), would be installed at each facility. Radio waves would transmit signals to a central computer and software system in the new Public Works building. All system parameters would be recorded, and an alarm system could be installed in conjunction with the monitoring system to set off local alarms notifying personnel of the problem. Remote alarms could also be installed to notify other buildings.

In order to provide a comprehensive monitoring setup for the Banks water system, the following base equipment would be required:

- A Remote Terminal Unit (RTU), Programmable Logic Controller (PLC), and required level instrumentation at the Behrman Well site and the Carsten Reservoir site;

- An RTU, PLC, instrumentation, computer network, and software program at the SSFP site; and

- A computer and software program at the centrally located Public Works Building.

4.9 Site Security and Chemical Safety

The security of each individual site that makes up the Banks water system is essential. Ensuring that the raw and treated water, transmission systems, and capital infrastructure are all preserved is integral to the success of the water utility, and the safety of both customers and operators.

Three levels of potential security hazards exist: vandalism, theft, and terrorism. Although the likelihood of terrorist activity is small, it does not hurt to plan ahead for attacks on civilians through the water system. However, the more common security breaches at water utility infrastructure are through vandalism and theft. To protect from these threats, three levels of security are available: deterrents, activity detection through advanced technology, and onsite security personnel. Again, it is unreasonable to assume that full time security staff can be hired to protect pieces of the water system. At the same time, by using motion detection and live camera feed you are not providing means of stopping the vandalism or attack, but rather making provisions to be aware of the security breach when it occurs.

If a biological attack was to occur on the water system, it behooves the water utility to be prepared with an Emergency Action Plan (EAP) to address the situation. The EAP typically includes personal safety equipment, sample kits, and procedures to follow if this type of activity occurs. The EAP costs approximately $5,000 to develop, with the additional cost to train public works employees as to the elements of the plan. The next level of planning for an elevated attack is to conduct a Vulnerability Assessment (VA) on the water system as a whole. This is a comprehensive document that attempts to pinpoint the locations in the system where it could be amended in order to deter and/or eliminate potential attacks.

The simplest method to deter illegal trespassing, theft, and vandalism is to install fences around the perimeter of each facility. Kennedy/Jenks typically recommends 6-foot tall chain-link fencing with 3-strand barb wire over the top of a 90 degree bend in the fencing. This makes it extremely difficult to accomplish unauthorized access to facilities. The recommended safety installations at the various facilities in the water system are as follows:

- Green Mountain Springs Intake – Fencing, lock, and signage.
- SSFP and High Zone Reservoir – Lighting, fencing, locks, and motion detection. The reservoir should also have locks on hatches and ladder cages, and also a screen on the vent(s).
- PSV/PRV – Lock on the hatch to avoid tampering and vandalism.
- Carsten Reservoir Site – Fencing with locks around the perimeter and signage. Also locks on hatches and ladder cages, and screen on vents.
- Behrman Well – Fencing with locks, signage, and intrusion detection,

Chemical security is a major concern. Chlorine gas is a hazardous material that, if released to the atmosphere, can cause damage to both humans and the environment. Currently, two distinct chlorine gas sites are used in the Banks water system for disinfection: the North Star Reservoir and the Behrman Well. State regulations stipulate that no more than 2,500 pounds of chlorine gas can be stored at any one site, which is greater than the chemical storage provided by Banks. The general trend in the water industry shows the majority of water purveyors going away from chlorine gas storage and addition, and utilizing onsite chlorine generation.

The improvements recommended in this Master Plan include the decommissioning of both of these disinfection systems in favor of onsite chlorine production through generation of sodium hypochlorite. If onsite chlorine generation is provided for through the mixture of salt, water, and electricity, then there will be no more need for chlorine gas and the potential safety hazard will be removed. If the chlorine gas system remains in service, then a chlorine detection unit, gas scrubber system, and remote alarm system signaling the leak to City Hall is recommended for installation at each disinfection location. However, these alternative system upgrades are not listed in the Capital Improvement Program.

Oregon DHS does not mandate any specific security precautions. Therefore, the underlying factor in the discussion of site security is to find solutions that create a comfortable situation for Banks. The level of security at each site depends on the preference of the owner and operators.

4.10 Water Service Meter Reading

Customer water consumption is read manually on a monthly basis by Public Works employees. Another option exists for reading meters: Automatic meter reading (AMR).

AMR is a beneficial tool that can save time, money, and mistakes for a water purveyor like Banks. Once the specialty meter and hardware are purchased and in place, manual reading of meters will no longer be required except for verification that the automatic process is operating correctly. The meter will be equipped with a module that is capable of transmitting signals via cell phone, telephone lines, or Ethernet.

Two options exist for the implementation of an AMR system, with increasing degrees of capital cost and decreasing degrees of operator requirements. The first system is known as “Radio-Read” (Radio), while the second available system is referred to as “Fixed Network” (Fixed).

The Radio system involves installing a new meter and module at each existing and future connection, and purchasing a piece of handheld equipment which reads the radio signal up to a certain distance. The module constantly reads the flow volume recorded by the meter and transmits the information via airwaves, which is picked up by the reader device whenever it is active and within range. To read the meters, an operator drives by each meter once a month with the reader unit onboard. The reader is then brought in and connected to a central computer, which uploads the recorded flow data to proprietary software and interfaces with the billing software.

The Fixed system involves installing a new meter and module at each existing and future connection, as well as various “Collector” units that are mounted in strategic locations around the water system. The module at each meter reads the flow volume recorded by the meter twice a day, and transmits the information twice a day to the nearest collector. The local collector then transmits the recorded data to a central “head-end” unit that is located at Public Works headquarters. The central computer contains the software necessary to upload the recorded flow data, and interface with the billing software.

Two options exist for the execution of an AMR system. The first is to install the specialty meters at existing connections and new water services, and manage the software at the Public Works Building where the new equipment will be used in conjunction with customer billing and monitoring of the quantity of water flowing in the system. The second is to contract out the monthly labor, where an external agency would be responsible for the meter readings and providing the results to the City based on an agreement. It is not recommended that Banks contracts out this work, as it is cost-prohibitive for medium sized water systems, and either level of technology is user friendly so long as good training regimens occur from the onset of the system. Also, if the work is kept in-house, large levels of reporting flexibility are available to further monitor the activity throughout the water system.

Amendment #1

4.11 Water System Flow Control

Refer to section 2 and 3 of Amendment #1 found in Appendix C.

Section 5: Regulatory Review

5.1 Introduction

This section contains an overview of recent regulatory evaluations pertaining to the Banks water system, as well as a comprehensive discussion outlining the general regulatory requirements for water utilities on both the state and federal levels.

5.2 Recent Regulatory Evaluations

A Sanitary Survey was conducted on the Banks water system by the Public Health Division of the Oregon Department of Human Services (DHS) in April of 2008. The Survey mandated that, among other things, a Tracer Study be performed to calculate the product of the amount of chlorine contact time and free chlorine residual concentration, or concentration times time (CT), the water received before the first water service.

5.2.1 Sanitary Survey

The Drinking Water Program (DWP) of the DHS conducted the Sanitary Survey of the Banks Water Department in April of 2008, with the results and noted deficiencies being submitted to the City in the form of a letter on 12 May 2008. The DWP required that a corrective action plan be submitted within 45 days of the dated letter detailing out how and when the deficiencies will be addressed. A summary of the deficiencies noted as part of the Sanitary Survey is below:

- Violation of the Surface Water Treatment Rules as a result of not calculating CT values correctly. Tier 2 public notice issued to all customers every three months until accurate and acceptable CT values have been determined.

- Conduct a Tracer Study for the North Star Reservoir. DHS' circuit riders, HBH Consulting Engineers, is available to perform the study.

- The residual chlorine concentration must be measured and recorded at least three times per day at the outlet of the North Star tank. Maintain residual disinfectant concentration of 0.2 mg/L.

- The CT calculation is being done incorrectly. The method needs to be changed to follow the correct steps, and recorded on the Surface Water Quality Data Form each day.

- In order to create a physical separation between untreated and treated surface water, physically remove all bypasses around the North Star reservoir. This includes a valve and valve bypass.

- Install a turbidimeter on the combined filter effluent line as close to the filter effluent as possible, and record turbidity measurements daily.

- Calibrate all turbidimeters four times per year (quarterly), following manufacturer's recommendations.

- A Radiological Test must be performed at the outlet of the Behrman Well for two consecutive quarters, and two more consecutive quarters if radiologicals are detected in the groundwater.

- Perform an asbestos test for treated water. Collect water samples from the distribution system where Asbestos-Cement pipes are in place.

Banks is in the process of complying with all findings of the survey. The DWP plans to conduct a Sanitary Survey once every three years to ensure the water system is supplying safe drinking water to the public.

5.2.2 Tracer Study

A Disinfection Contact Time Tracer Study was performed by HBH Consulting Engineers on 15 May 2008. This study was conducted to comply with the DWP request in the Sanitary Survey, and in accordance with EPA standard methodology.

The study concluded that under the worst-case scenario conditions (when the water has a temperature of 5 degrees Celsius and a pH of less than 7.5) the CT should be 58. The contact time in the Tracer Study was 67 minutes, with a residual concentration of 0.8 mg/L, corresponding to a CT value of 53.6. This results in insufficient contact time for the worst-case scenario. However, the testers note that the temperature of the water is rarely lower than 8 degrees Celsius.

The overall conclusion of the Tracer Study was that when water temperature drops below 10 degrees Celsius, the residual chlorine concentration should be increased to 1.0 mg/L.

Should the North Star Reservoir be abandoned in the future, then the High Zone reservoir can be used as a baffled clearwell to provide ample CT for the water system prior to the first customer.

5.3 Regulatory Requirements

Drinking water quality is regulated by federal law, including the Safe Drinking Water Act (SDWA) and the 1986 amendments to the SDWA, and by State law, including OARs for public water systems. The U.S. Environmental Protection Agency (EPA) and State agencies enforce drinking water regulations. In Oregon, the Oregon Health Division is the primary agency in the enforcement of federal and state regulations for public water systems.

5.3.1 Federal Regulations

The SDWA, and the amendments thereof, provide the minimum treatment requirements for drinking water quality. The states have the opportunity to use these minimum requirements or develop requirements that are more stringent. OARs, developed for the State of Oregon, are the applicable drinking water quality requirements that meet federal regulations. The federal regulatory requirements on the treatment of drinking water are therefore addressed in the discussion on state regulations.

5.3.2 State Regulations

OAR Chapter 333 lists the applicable drinking water quality requirements for all public water systems in Oregon. These rules were developed by the Public Health Division of the Oregon

Department of Human Services and became effective in December 1992. OAR Chapter 333 sets maximum contaminant levels (MCLs) and action levels for various contaminants, outlines treatment requirements and performance standards, covers treatment requirements for corrosion control, provides sampling and analytical requirements, describes public notice guidelines, and presents other requirements related to the construction and operation of WTPs.

5.3.2.1 MCLs and Action Levels

OAR 333-61-020 defines MCLs as the maximum allowable level of a contaminant in water delivered to the users of the public water system and defines action levels as the concentration of lead or copper in water which determines, in some cases, the treatment requirements that a water system is required to complete. The required MCLs and action levels are presented in OAR 333-61-030. MCLs are set for inorganic chemicals, organic chemicals, turbidity, microbiological contaminants, and radioactive substances. Action levels are set for the inorganic chemicals, lead, and copper. The regulations further delineate these levels based on water source. In general, there are two types of sources considered: surface water and groundwater under direct influence of surface water (one type, referred to as surface water in this discussion), and groundwater. As indicated in the following discussion, the treatment requirements are generally much stricter for surface water sources.

MCLs and actions levels for various inorganic chemicals are summarized in Table 23 and apply to both types of water sources.

Table 5-1: MCLs and Action Levels for Inorganic Chemicals

Inorganic Chemical	MCL (mg/l)	Action Level mg/l)
Antimony	0.006	
Arsenic	0.05	
Asbestos	7 MFL[(a)]	
Barium	2	
Cadmium	0.005	
Chromium	0.1	
Copper		1.3
Cyanide	0.2	
Fluoride	4	
Lead		0.015
Mercury	0.002	
Nickel	0.1	
Nitrate (as N)	10	
Nitrite (as N)	1	
Total Nitrate + Nitrite (as N)	10	
Selenium	0.05	
Thallium	0.002	

Notes:

(a) MFL = million fibers per liter > 10 millimeters (mm)
mg/l = milligrams per liter.

Exceeding the MCL for fluoride requires public notice as discussed in OAR 333-61-042. The action levels associated with lead and copper are exceeded if the action level is exceeded by the concentration of the contaminant in more than 10% of the tap water samples collected during any monitoring period. If either of these action levels is exceeded as described, the treatment requirements for corrosion control must be addressed. These treatment requirements are covered in OAR 333-61-034 and discussed later in this section.

MCLs for organic chemicals apply to both types of water sources and include organics, trihalomethanes (THMs) volatile organics, and toxic organics. The listing of MCLs for organic chemicals is extensive and can be found in OAR 333-61-030 section (2).

The MCL for turbidity applies only to surface water sources. The required MCL for turbidity, measured as Nephlometric Turbidity Units (NTU), is dependent on whether filtration treatment is provided and on the type of different filtration systems.

MCLs for microbiological contaminants apply to both types of water sources, with specific treatment requirements for each. The MCL is based on the presence or absence of total coliform in a sample, as outlined in OAR 333-61-030 section (4). Table 24 outlines the total coliform requirements based on a number of samples.

Table 5-2: Maximum Microbiological Contaminant Levels

System Samples per Month	Maximum Number Total Coliform - Positive Samples per Month
>= 40	not to exceed 5.0 percent
< 40	not to exceed one sample

Radioactive substances are covered in OAR 333-61-030 section (5), and apply to both types of water sources.

OAR 333-61-020 defines secondary contaminants as those contaminants which, at the levels generally found in drinking water, do not present an unreasonable risk to health, but do have adverse effects on the taste, odor, and color of water, produce undesirable staining of pumping fixtures, and/or interfere with treatment processes applied by water suppliers. Table 25 shows the contaminant levels for secondary contaminants.

Table 5-3: Secondary Contaminants

Secondary Contaminant	Contaminant Level
Color	15 color units
Corrosivity	non-corrosive
Foaming agents	0.5 mg/l
pH	6.5 - 8.5
Hardness (as CaCO3)	250 mg/l
Odor	3 threshold odor number
Total Solids	500 mg/l
Aluminum	0.05 - 0.2 mg/l
Chloride	250 mg/l
Copper	1 mg/l
Fluoride	2 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Silver	0.1 mg/l
Sulfate	250 mg/l
Zinc	5 mg/l

Exceeding the contaminant level for fluoride requires public notice as discussed in OAR 333-61-042.

5.3.2.2 Treatment Requirements and Performance Standards

Treatment requirements and performance standards are presented in OAR 333-61-032. For surface water, the general requirements for this rule require treatment processes that reliably achieve both of the following:

- At least 99.9% (3-log) removal and/or inactivation of *Giarida lamblia* cysts between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer.

- At least 99.99% (4-log) removal and/or inactivation of viruses between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream before or at the first customer.

The specific treatment requirements to meet the above pathogen removal requirements for surface water are dependent on whether filtration is provided. For surface water systems with filtration, both filtration and disinfection are required to achieve the pathogen removal requirements. The filtration process must meet the turbidity removal requirements discussed earlier in this section. The disinfection process must be sufficient to ensure that the total treatment process will achieve the required pathogen removal. Additionally, the disinfectant concentration in the water entering the distribution system cannot be less than 0.2 mg/l for more than 4 hours, and the disinfectant concentration in the distribution system cannot be undetectable in more than 5% of the samples taken.

For systems that utilize groundwater as the source, continuous disinfection is required only when there are consistent violations of the total coliform rule.

5.3.2.3 Treatment Requirements for Corrosion Control

The treatment requirements and performance standards for corrosion control are set forth in OAR 333-61-034. All public water systems are required to monitor for lead and copper levels in the system. Monitoring guidelines are outline in OAR 333-61-034. When the concentration of lead and/or copper exceeds the action levels for these contaminants, as explained earlier in this chapter, the public water system is required to adhere to the subsequent treatment requirements for corrosion control.

5.3.3 Watershed Control

OAR Chapter 333 sets forth requirements for watershed control for surface water sources.

These requirements apply only to public water systems that do not provide filtration treatment. Non-filtering systems must conduct annual sanitary surveys of the watershed for review by the Oregon Health Division. The sanitary surveys include evaluation of the following man-made and natural features:

- Nature and condition of dams, impoundments, intake facilities, diversion works, screens, disinfection equipment, perimeter fence, signs, and gates.

- Nature of surface geology, character of soils, presence of slides, character of vegetation and forests, animal population, and amounts of precipitation.

- Nature of human activities, extent of cultivated and grazing land, zoning restrictions, extent of human habitation, logging activities, method of sewage disposal, proximity of fecal contamination to intake, recreational activities, and measures to control activities in the watershed.

- Nature of raw water, level of coliform organisms, vulnerability assessments of potential contaminants, algae, turbidity, color, mineral constituents, detention time in reservoir, and time required for flow from sources of contamination to intake.

- Type and effectiveness of measures to control contamination and algae, disinfection applications and residuals carried, monitoring practices, and patrol of borders.

5.3.4 Water Resources Department Water Conservation

The Oregon State Water Resources Department (WRD) has developed Oregon Water Management Program policies and principles for water resource issues, including water conservation and efficient water use. A WRD document dated December 1990 describes the policy on water conservation as a high priority for the WRD. Included in this policy is the improvement of water use efficiency through the implementation of voluntary conservation measures. Principles to promote conservation and efficient water use provided in the WRD document are as follows:

- Water users shall construct, operate, and maintain their water systems in a manner which prevents waste and minimizes harm to the waters of the state and injury to other water rights.

- Major water users and suppliers shall prepare Water Management Plans under the guidance of schedules, criteria, and procedures.

- The Commission (a governor-appointed citizens group that adopts water resources rules for the State of Oregon) shall encourage and facilitate the development of sub-basin conservation plans throughout the state by local advisory committees.

- When wasteful practices are identified in Water Management Plans and Sub-basin Conservation Plans, the Commission shall adopt rules prescribing statewide and sub-basin standards and practices.

- A conservation element shall be developed and included in each basin plan when a major plan review and update is preformed.

- The collection, analysis, and distribution of information on water use and availability are necessary to ensure that the waters of the state are managed for maximum beneficial use, and to protect the public welfare, safety, and health.

- The Commission shall support public education programs, research, and demonstration projects to increase citizen and water user awareness of water conservation issues and measures in the state.

- The Commission shall support programs to provide economic assistance to water users to implement desired conservation measures, particularly where the benefits of implementing the measures are high.

OAR Chapter 690 is the applicable water resource management rules developed by WRD. Division 18 of OAR Chapter 691 covers the allocation of conserved water. These rules describe a voluntary program intended to benefit a water right holder from water conservation and efficient water use.

5.4 General Water Quality

5.4.1 Turbidity Removal

As covered in OAR 333-61-030, the MCL for turbidity is applicable only to surface water sources, and is dependent on the type of treatment facilities employed. The requirements are shown in Table 26.

Table 5-4: Turbidity Removal Requirements

Filtration Systems	Criterion (MCL)	Monitoring	Compliance
Conventional or Direct Filtration	0.3 NTUs (up to 1 NTU)	Continuous or grab / 4 hours	95% monthly samples < MCL; none > 5 NTU
Slow Sand Filtration	1 NTU (up to 5 NTU)	Continuous or grab / 4 hours (one / day)	95% monthly samples < MCL; none > 5 NTU
Diatomaceous Earth Filtration	1 NTU	Continuous or grab / 4 hours	95% monthly samples < 1 NTU; none > 5 NTU
Other Filtration Technologies	1 NTU (up to 5 NTU)	Continuous or grab / 4 hours (one / day)	95% monthly samples < MCL; none > 5 NTU

5.4.2 Pathogen Removal

As covered in OAR 333-61-032, the pathogen removal (disinfection) requirements are dependent on the type of source water and whether the treatment facilities provide filtration.

For water from groundwater sources, continuous disinfection is not required by the regulations unless repeated violations occur. Typically, the regulations require that when chlorine is used as the disinfectant, the residual disinfectant concentrations cannot be less than 0.2 mg/l after 30 minutes of contact time under all flow conditions.

For surface water sources, pathogen removal requirements are dependent on whether the treatment facilities provide filtration. Maximum removal requirements are for 99.9% (3-log) inactivation of *Giarida lamblia* cysts. Additionally, the residual disinfectant concentration in the water entering the distribution system cannot be less than 0.2 mg/l for more than 4 hours. Disinfection of surface waters is evaluated by comparing the required and actual contact time (CT) values. Based on the removal requirements and water pH and temperature, a required contact time value can be found either in OAR or in the EPA document *"Guidance Manual for Compliance With the Filtration and Disinfection Requirements for Public Water Systems Using*

Surface Water Sources" dated October 1990. The actual contact time value is the known chlorine contact time (in minutes, including consideration for effectiveness) multiplied by the chlorine residual concentration (in mg/l, usually from plant operation records). Actual contact time must be greater than required contact time.

5.4.3 Contact Time

Contact time is required for all surface water systems, as outlined above, and for chlorinated groundwater systems. Actual chlorine contact time is highly dependent on the hydraulic efficiency of the contact chamber. For example, the hydraulic efficiency of a small diameter pipeline is much greater than that of an unbaffled reservoir. Table 27 shows various facility alternatives, estimated hydraulic efficiencies for each, and the volume required assuming 55 gpm for the High System, 89 gpm for the Lower System (peak hour, 20-year design), and a contact time of 30 minutes.

Table 5-5: Chlorine Contact Times

Chlorine Contact Facility	Hydraulic Efficiency	High System Required Volume (gallons)	Lower System Required Volume (gallons)
Small Diameter Pipeline (12-inch diameter or less)	90	1,800	3,000
Large Diameter Pipeline (greater than 12-inch diameter)	80	2,050	3,500
Baffled Reservoir	20	8,250	13,400
Unbaffled Reservoir	10	16,500	26,700

5.5 Lead and Copper Levels

The State places stringent limits on the lead and copper levels in drinking water and requires an intensive monitoring program for these contaminants. Because lead and copper in drinking water often come from the corrosion of residential plumbing, samples for lead and copper measurement are taken primarily from residences.

If not in compliance, the steps required of the water supplier to comply with State regulations are outlined in OAR 333-61-036 and begin with a Lead and Copper Water Treatment Study. The study will evaluate the effectiveness of the following treatment options:

- Alkalinity and pH adjustment
- Calcium hardness adjustment
- Addition of a corrosion inhibitor.

5.6 Other Water Quality Issues

Other water quality issues that are controlled by state regulations include organic and inorganic chemicals, radionuclides, and disinfection by-products. These water quality parameters are discussed below.

- Organic and Inorganic Chemicals – The State requires monitoring of many new chemicals including volatile organic chemicals, synthetic organic chemicals, and inorganic chemicals. Testing of the city water for these chemicals is required.

- Radionuclides – The State requires monitoring and control of specific radionuclides. Testing of the city water for radionuclides is required.

Disinfection By-Products – Compliance and testing for disinfection by-products includes both Maximum Residual Disinfectant Levels (MRDLs) for chlorine compounds and MCLs for disinfection by-products such as THMs. By January 2002, all surface water systems serving 10,000 people or more will be required to test for and control disinfection by-products. By January 2004, all surface and groundwater systems, regardless of size, will be required to test for and control disinfection by-products.

Section 6: Capital Improvement Plan

6.1 Introduction

In this section, specific improvements are identified and recommended for implementation over the 20-year planning period. The improvements are outlined in detail in the previous sections and Section 6.2 and provide for compliance with regulations, addressing system deficiencies, system reliability, and additional capacity.

Budget amounts are provided for improvements and they included the following:

- Opinion of probable construction cost
- 20% markup for contingency
- 25% markup for engineering, legal, and administrative costs.

Budget level estimates are considered reliable within a margin of plus or minus 20%. These estimates do not include costs associated with obtaining funding such as application preparation, bond council, interim financing, etc. These costs will be highly dependent on the funding source and requirements.

The opinion of probable cost has been rounded up to the nearest $1,000, $10,000, or $100,000 depending on the size of the project. For instance, a dollar value of $18,500 would be rounded up to $19,000; a dollar value of $86,000 would be rounded up to $90,000; and a dollar value of $386,000 would be rounded up to $400,000.

The improvements have been arranged into a capital improvements plan (CIP) which lists the improvements, the opinion of probable cost, and the time when the improvement will be needed. The schedule for improvements is dependent in large part on the actual growth within the existing service area and expansion of the service area. The schedule may accelerate or slow down based on growth. Therefore, the schedule should be used more as a guide.

When determining when to start a project, it is important to remember that larger projects will take a substantial amount of time to complete. It is reasonable to expect that a large project such as expansion of the treatment plant capacity could take 3 years to complete from inception through funding, land use planning and permitting, design, and construction.

6.2 Project Descriptions

In this section, specific improvements are discussed in an itemized fashion, summarizing the system needs identified in Section 4. Note that there is no particular order to the CIP numbering system. All CIP costs are presented in Table 6.1 following the individual project descriptions.

6.2.1 Project 1: Well No. 2

While initial testing has been conducted at the site of Well No. 2, further testing will determine whether the well will serve as an additional water source or a backup source to the Behrman Well. In either case, Well No. 2 will need to be outfitted as a production well with a pump, controls, a building, onsite power generation, and all associated valves and piping. The two possibilities are further outlined below.

6.2.1.1 1A: Additional Water Source

Should the expected influence of Well No. 2 on the Behrman Well water yield be deemed inconsequential, the new well will be put into production alongside the existing well. The two sources will then work together to feed the Carsten Reservoirs and supply water to the Banks system. In this scenario, two options exist for the piping connection into the water system: (i) Expand the 6-inch line that transmits water from the Behrman Well to Carsten Reservoir No. 1 to handle the additional capacity coming from Well No. 2, or (ii) install a parallel 6-inch line that only transmits the Well No. 2 water to the Carsten Reservoir site. Either option is feasible, but the second option is more practical from a cost standpoint.

6.2.1.2 1B: Backup Water Supply

If it is concluded that Well No. 2 dewaters the Behrman Well's aquifer such that both sources cannot be used simultaneously, the new well will be put into production with the intent that it will serve as a secondary source of groundwater extraction at the Behrman Well site. The two wells would be controlled by a central control panel that interfaces between each and communicates which well should be in operation at any given time. In this scenario, the Banks water system will not be receiving supplementary water to what it currently receives, but rather a redundant source of water will be put into production furthering the longevity of the City's assets and having backup pumping capabilities should the Behrman Well pumps fail. This option involves teeing off of the existing 6" line from the Behrman Well and adding a one-way check valve. The elimination of extensive trenching and piping needs greatly reduces the cost to put Well No. 2 into operation.

6.2.2 Project 2: Transmission Pipeline Replacement and Upgrade

The transmission main should be abandoned following the entire 3.2-mile length traveling south from the SSFP, to the North Star Reservoir, to Sellers Rd., along Sellers Rd. through the PSV/PRV, and into the Main Zone. Replace existing line with a 10-inch pipe extending to the 14-inch line at Main St. (Hwy 47). Also, upgrade the PSV/PRV by installing a new vault and valves. The new vault will be complete with a 6- or 8-inch main valve setup to accommodate periods of high flow, and a 2-inch bypass valve setup for normal operation.

6.2.3 Project 3: SSFP Disinfection Upgrades, Onsite Backup Power Generation, Decommission of North Star Reservoir, Creation of Intermediate Pressure Zone, and Addition of Individual PRVs

The gaseous chlorine disinfection system located at the North Star Reservoir should be decommissioned for safety and reliability purposes, and a new disinfection system should be installed and connected at the SSFP site. Once disinfection capabilities are relocated, the aging North Star Reservoir can be decommissioned and taken offline.

The recommended new disinfection system consists of a sodium hypochlorite feed system that injects sodium hypochlorite into the treated water flow stream. The High Zone Reservoir would then be utilized as a clear well (and a storage facility) to achieve appropriate disinfection contact time and consolidating the treatment and disinfection of the water coming from the Green Mountain Springs. The system with the highest reliability is *onsite* sodium hypochlorite generation. In this scenario, salt is stored onsite and provisions for generating the disinfectant are taken.

The third portion of this capital improvement project is to install an onsite backup power generator at the SSFP. This system would store fuel in order to power all the electrical equipment utilized in the treatment process. It is estimated that a 25 KVA backup generator would power the existing pad transformer during an emergency. A more detailed electrical analysis needs to be performed during pre-design in order to correctly size, locate, and connect the generator.

The fourth component of this project is to install a PRV station at the intersection of Sellers Rd. and Woolen Rd, creating a new pressure zone called the Intermediate Zone. This, coupled with an adjustment to the settings of the existing PSV/PRV station, will create more favorable pressures for the users in the High and Intermediate Zones. Internal pipe pressures will also be decreased, thereby reducing leakage of treated water.

The fifth component of this project is to add individual PRV's to each service in the high zone. This should be done prior to decommissioning the North Star Reservoir.

Amendment #1

Refer to section 2 and 3 of Amendment #1 found in Appendix C for a more detailed description of the improvements.

Project 3.1 – Clearwell Flow & Level Control

This includes three flow control valves.

- A modulating butterfly valve for flow control located downstream of the clearwell controlled by the flow rate into the clearwell.
- An actuated butterfly valve (on/off) located just upstream of the clearwell controlled by the level in the clearwell.
- A modulating butterfly valve located just upstream of the Carsten Reservoirs controlled by the operation at the water treatment plant.

Project 3.2 – SSF Capacity Controls

This includes two flow control improvements.

- A two way altitude valve with a pressure relief override located upstream of the Carsten Reservoirs.

- A low flow bypass (1-inch PRV valve) located in the Sellers Road PRV station.

6.2.4 Project 4: Groundwater Upgrades: Disinfection and Emergency Power

The gaseous chlorine disinfection system located at the Behrman Well should be decommissioned for safety and reliability purposes, and a new disinfection system should be installed and connected at the Behrman Well site.

Sodium hypochlorite is the recommended new disinfection system to replace the gaseous chlorine currently used. The chemical can either be generated onsite in the same manner as discussed above for the treatment plant site, or can be delivered due to weather not being a factor. In either case, the disinfectant will be connected to the discharge line of the Behrman Well (and Well No. 2 once it is put into production). The system will continue to utilize the transmission pipeline and Carsten Reservoir No. 1 to achieve appropriate disinfection contact time.

In addition, a backup generator set is recommended to store fuel and supply power to both groundwater wells. The generator can be sized to supply power to both wells simultaneously (Project 1A) or individually (Project 1B). In either case, automatic transfer switches will need to be installed on both pumps' control equipment to ensure that each starter can be fed from backup power.

6.2.5 Project 5: 1.0-MG Reservoir

In order to provide sufficient equalization, peaking, and emergency storage volume to the expanding population of Banks, a 1.0 million gallon reservoir needs to be constructed to serve more customers in the Main Zone. If space permits a third tank could be added to the Carsten Reservoir site, otherwise a location study will need to be undertaken and property acquired.

Independent of the location, the new reservoir overflow elevation will depend on the elevation of the new services to water users. If the growth of the City occurs at similar elevations to the existing users, then the overflow elevation of the new tank would be identical to the existing Main Zone (Carsten) reservoirs (+/- 414 ft) and feed the same pressure zone. If expansion occurs where it would be convenient to create a new pressure zone, then the overflow elevation of the reservoir will be raised or lowered to accommodate ideal operating pressure for the service connections and fire hydrants being fed by the additional storage volume.

The tank will be a 1.0-MG steel reservoir constructed on a concrete pad. An inflow pipeline sized to fill the reservoir from either the existing or new source capacities will be installed. An outflow pipeline sized to deliver adequate water to the expanded distribution system network will also need to be installed.

6.2.6 Project 6: Distribution System Looping and Upgrades

The location and brief description of the proposed projects to loop portions of the distribution system are in the following paragraphs. In total, roughly 2,750 feet of pipe is recommended to be added to the distribution network or to upgrade certain undersized lines.

None of the distribution system projects are high priority, but to assist the City they have been prioritized with regard to each other.

6.2.6.1 6A: Intersection of Woodman Ave. and Park St. - #1

Upgrade approximately 620 feet of 2-inch line on Park St. with 8-inch line and connect to 6-inch line in Woodman Avenue with 30 feet of 8-inch pipe.

6.2.6.2 6B: East of intersection of Parmley Ave. and Woodman Ave - #2

Connect 6-inch lines with approximately 180 feet of 6-inch pipe.

6.2.6.3 6C: End of Wilkes St. - #3

Connect dead-end 6-inch line to 12-inch main on Railroad Right-of-way with approximately 250 feet of 8-inch pipe.

6.2.6.4 6D: Commerce St., from Market St. to Sunset Ave. - #4

Construct 825 feet of 8-inch line to eliminate two dead-end lines.

6.2.6.5 6E: Jarvis Pl. to Elmhurst Ct. - #5

Construct 680 feet of 8-inch pipe to eliminate four dead-end lines.

6.2.6.6 6F: Cedar Canyon Rd - #6

Upgrade approximately 400 feet of existing 2-inch line to 6-inch line. If the UGB is expanded to the west, this line should be upgraded to a 12-inch back to Highway 47.

6.2.6.7 6G: Lumber Yard - #7

Connect the dead-end 8-inch line to the 12-inch main due east with approximately 480 feet of 8-inch pipe.

6.2.6.8 6H: Sunset Park - #8

Connect the dead-end 6-inch line to the 12-inch main along Main St. by boring underneath Highway 47 with approximately 180 feet of 8-inch pipe.

6.2.6.9 6I: Shopping Center south of Oak Way - #9

Connect the 4-inch and 6-inch dead-end lines with approximately 300 feet of 6-inch pipe.

6.2.7 Project 7: SCADA System Upgrades

In order to better provide automated monitoring of system variables and centralized access to controls, a telemetry system should be installed to monitor system information remotely and record and process it at the Public Works building. Instrumentation, software, and hardware will be required at the SSFP site, the Carsten Reservoir site, the Behrman Well site, and any new sites connected to the City's water system.

6.2.8 Project 8: Automatic Meter Reading

6.2.8.1 8A: Radio Read

One AMR system available is the Radio technology. This includes a new meter for each existing connection, the reading hardware, and a central computer with the applicable software.

6.2.8.2 8B: Fixed Network

The other option for AMR is the Fixed technology. This includes a new meter for each existing connection, the collector units placed strategically with a density of roughly one collector per square mile, and a central computer with the applicable software.

6.2.9 Project 9: Security System Upgrades

The cost to furnish and install equipment varies greatly depending on the level of security upgrades selected.

6.2.9.1 9A: Simple Security

If strictly fences, signs, and gates (deterrents) are opted for, then the proposed upgrades are estimated to cost roughly $50,000.

6.2.9.2 9B: Advanced Security

If more advanced security systems involving cameras and motion detectors are installed, the systems will cost approximately $100,000.

The CIP summary table is shown in Table 6-1. The costs shown are 2008 dollars. Therefore, the City will need to adjust the costs depending upon when the projects are actually undertaken.

6.2.10 Project 10: Leak Detection Survey

Prior to performing any major pipeline replacements, it is recommended that a comprehensive leak survey be carried-out. The purpose of the survey is to pinpoint the location of leaks within the City's distribution and transmission pipeline network, and target those areas first. Ultimately, by performing the Leak Detection Survey, Banks' high unaccounted-for water volume will be decreased by having a greater understanding of the source of water loss.

6.2.11 Project 11: Additional Source Development

This is a multi-step program that involves short and long term tasks.

6.2.11.1 11A: Quail Valley Golf Course

Begin discussion with the Golf Course owner with regard to the transfer of water rights to the City of Banks. If this proves feasible, then move forward with the hydrogeological Study, water rights transfer from the Golf Course to the City, design and construction. This would include approximately 4,000 feet of 8-inch pipe, land purchase, plus a new well pump, controls, standby generation and a building.

6.2.11.2 11B: Seller Road Well Field

Begin discussion with property owners to determine where test wells could be developed. If this proves feasible, then move forward with the hydrogeological Study, transfer of water rights from the springs, design and construction. This would include approximately 3,500 feet of 8-inch pipe plus four new, controls, standby generation and buildings.

6.2.11.3 11C: Southwest Well Field

Begin discussion with property owners to determine where test wells could be developed. If this proves feasible, then move forward with the hydrogeological Study, transfer of water rights from the Behrman wells, design and construction. This would include approximately 2,500 feet of 8-inch pipe plus two new wells, controls, standby generation and buildings.

6.2.11.4 11D: Alternative Water Providers

Begin discussion with alternative water providers. This would include the City of Forest Grove, and TVWD. Discussions can also begin with TVID for potential use of irrigation water in the future.

6.3 CIP

This section contains the recommended Capital Improvements to the Banks water system over the next 20 years. The following Table 6-1 contains an overview of each Capital Improvement Project described in Section 6.2.

Either 1A or 1B will be constructed based upon the outcome of the hydrogeological evaluation that is now in progress. The total CIP amount assumes 1A will be selected.

The improvements for additional source will need to be updated as more information is developed such as the exact location of the new wells, negotiations between owners and agencies, and the outcome of further hydrogeotechnical studies.

Items 7, 8 and 9 are optional.

Amendment #1

Table 6-1 is replaced by Table 2 in section 5 of Amendment #1 found in Appendix C.

Table 6-1: Water System Capital Improvement Plan

Project	Description	Total Project Cost	Schedule	SDC Eligible Cost
1A –	Well No. 2 – Additional Source	$670,000	2009	$670,000
1B –	Well No. 2 – Backup Supply	$540,000	2009	$540,000
2 –	Transmission Pipeline Replacement	$2,750,000	2009 - 2010	$530,000
3 –	SSFP Site Upgrades, Creation of Intermediate Pressure Zone	$270,000	2010 - 2011	$0
4 –	BW Site Upgrades*	$220,000	2012 - 2013	$0
5 –	1.0-MG Main Zone Reservoir	$2,200,000	By 2024	$2,200,000
6 –	Distribution System Looping and Upgrades	$620,000	2010-2024	$0
7 –	SCADA System Upgrades	$450,000	optional	$0
8 –	Automatic Meter Reading	$420,000	optional	$0
9 –	Security System Upgrades	$100,000	optional	$0
10 –	Leak Detection Survey	$10,000	2009	$0
11A	Quail Valley Golf Course Study	$40,000	2010	$40,000
	Design & Construction	$1,200,000	2011	$1,200,000
11B	Sellers Road Wellfield Study	$150,000	2011	$150,000
	Design & Construction	$2,400,000	2012	$2,400,000
11C	Southwest Well Field Study	$300,000	2013	$300,000
	Design & construction	$1,500,000	2014	$1,500,000
11D	Alternative Water Providers	$0	2010	$0
	CIP Total:	**$13,300,000**		**$8,990,000**

* If project number 4 is combined with project number 1 there is potential to reduce overall costs slightly.

Section 7: Funding Sources

This section contains a list of the standard funding agencies and programs for public works infrastructure construction projects with a general description of the program and contacts for further information. If the City wishes to fund a project it is highly recommended to attend a "one-stop" meeting in Salem. Representatives of all the funding agencies attend and will let you know what they have available for your project.

7.1 Federal Programs

7.1.1 Rural Utilities Service Water and Wastewater Loans and Grants

The U. S. Department of Agriculture's Rural Utilities Service (RUS) program provides funding for rural areas and towns with populations of up to 10,000. Assistance includes loans and grants. Funds may be used for installation, repair, improvements, or expansion of rural water distribution and treatment facilities. The costs of land acquisition and legal and engineering fees are eligible for funding if they are necessary to develop the facility.

7.1.1.1 Eligibility Requirements

Water and wastewater loans and grants are available to public entities including municipalities, counties, special purpose districts, Indian tribes and non-profit corporations. Applicants must be unable to obtain the required funds via commercial sources under reasonable terms. Entities must have legal capacity to borrow and repay the loans, must pledge security for the loans, and must be able to efficiently maintain and operate the proposed facilities. The facilities to be funded must be consistent with development plans of the state, multi-jurisdictional area, county, or municipalities where the projects are to be constructed. The facilities must also comply with all relevant local, state, and federal laws including zoning, pollution control, and health and sanitation standards. Because funds are scarce, existing compliance problems are essentially a requirement.

7.1.1.2 Terms

Borrowers of RUS loans must be able to demonstrate the following:

- They have monthly user rates higher than the "statewide average" as defined by RUS. This value changes so it should be verified before proceeding with an application.
- They have legal authority to borrow and repay loans, to pledge security for loans, and to operate and maintain the facilities and services.
- They are financially sound and able to manage the facility effectively.
- They have a financially sound facility based on taxes, assessments, revenues, fees, or other satisfactory sources of income to pay for all facility costs, including operations and maintenance, and to retire indebtedness and maintain a reserve.

The maximum loan term is 40 years but the term may not exceed statutory limitations on the agency borrowing the money or the expected useful life of the improvements. The debt reserve can typically be funded at 10 percent per year over a 10-year period. Loan interest rates and maximum grant amounts are based on median household income as shown in Table 43.

Table 7-1: RUS Grant Funds and Loan Interest Rates

Median Household Income	Maximum Grant (portion of total project cost)	Loan Interest Rate as of July 2000
Less than 22,205	75%	4.5%
$22,205 to $27,756	45%	5.25%
Greater than $27,756	0%	5.875%

Please note that median household income, grant amounts and interest rates fluctuate and should be verified prior to proceeding with an application.

7.1.1.3 Contact

Information on the RUS water loan and grant program is available at the following:

Rural Utility Service
Phone: 503 414-3360
http://www.rurdev.usda.gov/

7.1.2 Community Development Block Grants

The U.S. Department of Housing and Urban Development provides grant under the Community Development Block Grant (CDBG) program to facilitate economic development by revitalizing neighborhoods with improved community facilities and services. In Oregon, the Oregon Economic and Community Development Department (OECDD) administer this program.

7.1.2.1 Eligibility Requirements

The program is available to non-metropolitan cities and counties. Funding may be used for the construction, expansion, or rehabilitation of public water and sewer systems to meet federal and state mandates. They are not intended for capacity building. To be eligible, the applicant must be out of compliance with federal or state rules, regulations, or permits. The service area for the project must contain at least 51 percent low- and moderate-income residents.

7.1.2.2 Contact

Information on the CDBG grant program is available at the following:

OECDD
Phone: 503 986-0123
http://econ.oregon.gov.

7.1.3 Economic Development Act of 1965

The U.S. Economic Development Administration (EDA) authorizes grants and loans under this program to assist communities in areas certified by the Secretary of Commerce as areas of substantial unemployment. Direct grants of up to 50 percent and supplementary grants of up to 80 percent of costs are authorized for water improvements to alleviate economic hardship. The program is geared to projects stimulating permanent industrial and economic development, and communities qualify for funding of water and wastewater improvements that will help create new industry or maintain or substantially increase levels of employment. Eligibility is heavily weighted in favor of projects that will result in economic development. There is a $1 million maximum allowance per project. Actual funding limits are based on the number of jobs created. We recommend that this program not be pursed unless a large economic development opportunity is identified.

7.2 State Programs

7.2.1 Special Public Works Fund

The Oregon State Legislature created the Special Public Works Fund (SPWF) in 1985. The fund, administered by the OECDD, is capitalized through the issuance of state revenue bonds and through state lottery proceeds. The SPWF is intended to promote the creation of jobs for Oregonians. Loans and grants are issued to facilitate the construction of public infrastructure to support industrial / manufacturing development as well as commercial development that is marketed nationally or internationally and attracts business from outside Oregon.

7.2.1.1 Eligibility Requirements

Eligible municipalities are described in the SPWF Applicant's handbook and generally include cities, counties, water supply districts, water and wastewater authorities, sanitary districts, port authorities, water control districts, county service districts, and tribal councils of Indian tribes.

Eligible SPWF projects includes public infrastructure needed to enable the location or expansion of eligible businesses. Specific projects include: wastewater collection and treatment capacity, publicly owned railroad spurs and sidings, purchase of rights of way and easements necessary for infrastructure, airports, port facilities, storm drainage, roadway and bridges, and water source, treatment, storage and distribution. Program funds are not eligible for equipment, wetlands mitigation, general administrative costs, construction of privately owned infrastructure, or the purchase of property not related to infrastructure.

Funding levels are determined by a financial analysis based on demonstrated need. The basis for this analysis includes dept capacity, repayment sources, and applicants' ability to afford loans from additional sources. To be eligible for the program, applicants must document recent interest by eligible businesses looking to locate in the municipality. Moreover, the applicant must demonstrate ongoing marketing efforts relating to economic development of industrial lands.

7.2.1.2 Terms

The following terms apply for SPWF funding:

- Maximum loan term is 25 years. A 20-year term is typical.
- Loans are typically repaid with utility revenues, general funds, voter-approved bonds, or local improvement district revenue.
- The maximum loan is $15 million.
- Grant funding is typically unavailable unless the applicant is classified as "severely affected" or a "timber dependent" community. In such a case, up to $250,000 per project may be awarded to communities without a firm commitment for new business demand.
- Grants are available under the following conditions when there is a firm commitment from one or more eligible businesses:
  - Up to $5,000 in grant funds may be awarded for each full-time-equivalent job created, depending on demonstrated financial need. The total grant funding is limited to $500,000 or 85% of the project cost whichever is less.
  - Of the total jobs created, at least 30 percent must be "family wage" jobs.
  - Public and / or private investment must equal at least two times the infrastructure cost.

7.2.1.3 Contact

Information on the SPWF program is available at the following:

OECDD
Phone: 503 986-0123
http://econ.oregon.gov.

7.2.2 OECDD Water/Wastewater Financing Program

The Oregon State Legislature created the water / wastewater financing program in 1993. It is capitalized by the sale of state revenue bonds and by a portion of state Lottery proceeds. Its primary purpose is to provide financing for construction of public infrastructure required to ensure compliance with the federal Safe Drinking Water Act or Clean Water Act. Specifically, it is intended to assist local governments facing state and federal mandates relating to public drinking water systems and wastewater systems.

7.2.2.1 Eligibility Requirements

The program is available to cities, counties, water supply districts, water and wastewater authorities, sanitary districts, port authorities, water control districts, county service districts, and tribal councils of Indian tribes with populations of less than 15,000. Detailed application requirements are available in the Water / Wastewater Financing program Applicants Handbook.

Funding levels awarded to qualified applicants are determined by a financial analysis based on demonstrated need through the program:

- Water source, treatment, storage, and distribution
- Wastewater collection and capacity
- Storm system
- Purchase of rights of way and easements necessary for infrastructure
- Design and construction engineering.

Programs funds may not be used for privately owned facilities or infrastructure, general administrative costs or the purchase of property not related to infrastructure. Eligibility for program funding is contingent upon having received a Notice of Non-Compliance, from a regulatory agency regarding the Safe Drinking Water Act or the Clean Water Act.

To be eligible for grant funding, user rates must be above the statewide average as determined by the agency.

7.2.2.2 Terms

The following terms apply:

- The maximum loan term is 25 years; a 20-year term is typical.
- Maximum grant amount is $750,00, including issuance costs and any debt service reserves (if required).
- Borrowers that are deemed “credit worthy” may be funded through the sale of state revenue binds. Maximum bonded loan amount for this mechanism is $15,000,000.
- Loans are typically repaid with utility revenue, general funds, or voter approved bon issues.

7.2.2.3 Contact

Information on the WWF program is available at the following:

OECDD
Phone: 503 986-0123
http://econ.oregon.gov.

7.2.3 Safe Drinking Water Revolving Loan Fund

Each federal fiscal year, the USEPA makes funds (as grants) available to states for the Safe Drinking Water Revolving Loan Fund (SDWRLF), a low interest loan program designed to finance drinking water system improvements needed to maintain compliance with the Safe Drinking Water Act (SDWA). In Oregon, the fund is administered by the Oregon Health Division (OHD).

7.2.3.1 Eligibility Requirements

Community and nonprofit non-community water systems are eligible for this fund. Oregon's loan request process begins by identifying and collecting information about current Oregon drinking water system project improvement needs. A Letter of Interest from the water system describing drinking water system needs is required to be considered for this fund.

In order to qualify for this fund, water rates have to be greater than or equal to 1.75% of the mean household income.

Projects that are eligible for this fund are to plan, design, or construct drinking water facilities needed to maintain compliance with the current and future standards and to further public health protection goals of the SDWA and Oregon's Drinking Water Quality Act.

7.2.3.2 Terms

The following terms apply:

- The typical loan term is 20 years. .
- Maximum loan amount is $6,000,000.
- Loans are typically repaid with utility revenue, general funds, or voter approved bond issues.

7.2.3.3 Contact

Information on the SDWRLF loan program is available at the following:

DHS
Phone: 971 673-0422
http://oregon.gov/dhs/ph/dwp/srl.shtml
or

OECDD
Phone: 503 986-0123
http://econ.oregon.gov.

7.2.4 Drinking Water Protection Loan Fund

7.2.4.1 Eligibility Requirements

These are for source water protection projects to carry out elements of a Source Water Protection Management Plan. A community water system that have a delineated Drinking Water Protection Area and are able to demonstrate a direct link between the proposed project and maintaining or improving drinking water quality.

7.2.4.2 Terms

The following terms apply:

- The typical loan term is 20 years. .
- Maximum loan amount is $100,000.
- Interest rates fluctuate quarterly.
- Disadvantaged communities are eligible for a 30 year loan.

7.2.4.3 Contact

Information on the DWPLF loan program is available at the following:

OECDD
Phone: 503 986-0123
http://econ.oregon.gov.

7.3 Local Funding Alternatives

7.3.1 General Obligation Bonds

Entities with taxing authority under the laws of the State of Oregon have the option of issuing general obligation (GO) bonds. A GO bond is a bond backed by the full credit of the issuer for the payment of which the issuer can levy *ad valorem taxes*. The issuer can make the required payments on the bonds solely from the tax levy or may use revenues from assessments, user charges or some other source. Since the bonds are secured by the power to tax, they usually justify a lower interest rate than other types of bonds. Generally, GO bonds lend themselves readily to competitive public sale at a reasonable interest rate because of their high degree of security, their tax exempt status, and their general acceptance.

These bonds can be revenue-supported because a portion of the user fee can be pledged toward payment of the debt service. This can eliminate the need to collect additional property taxes to retire the bonds. Revenue-supported GO bonds have most of the advantages of revenue bonds, but also maintain the low interest rate and the marketability of GO bonds.

Oregon law does not limit the total amount or the percentage of GO bonds that a community can issue. This portion of the property tax is outside the state constitutional restriction limiting property taxes to a fixed percentage of assessed value. State law limits the maximum term of GO bonds to 40 years. The typical term for GO bonds is 20 to 30 years. Under the present economic climate, lower interest rates are associated with the shorter terms.

Financing of water system improvements by GO bonds is usually accomplished as follows:

1. The capital costs required for the proposed improvement are determined.
2. A general election is held to authorize the sale of the GO bonds.
3. Following voter approval, the GO bonds are offered for sale to banks and other investors.
4. The revenue from the bond sale is used to pay the capital costs associated with the project.
5. GO bond authorizations must be approved by a majority vote, and this generally limits proposals to projects benefiting all or the majority f a community. Some of the advantages of GO bonds over other types of bonds are as follows:
   - The laws authorizing GO bonds are less restrictive than those governing improvement bonds under the Bancroft Act (described below). Interest rates are not affected by the Bancroft limitations and costly assessment procedures are not required.
   - Taxes paid in the retirement of GO bonds are Internal Revenue Service deductible.
   - GO bonds can be sold prior to construction, providing funds before expenses must be paid.

The use of an *ad valorem tax* is a common method of repaying GO bonds for utility improvements. This method of financing results in the participation of all private property owners within the benefited area, whether the property is developed or undeveloped. The construction costs for the project are shared proportionally among all property owners based on the assessed value of each property.

7.3.2 Revenue Bonds

A revenue bond is a bond that is payable solely from charges made for the services provided. Such bonds cannot be paid from tax levies or special assessments, and their only security is the borrower's promise to operate the system in a way that will provide sufficient net revenues to meet the obligations of the bond issue. Revenue bonds are most commonly retired with revenue from user fees.

Successful issuance of revenue bonds depends on bond market evaluation of the dependability of the revenue pledged. Normally, there are no legal limitations on the amount of revenue bonds to be issued, but excessive amounts are generally unattractive to bond buyers because they represent high investment risk. In rating revenue bonds, buyers consider the economic justification for the project, the reputation of the borrower, methods for billing and collecting, rate structures, and the degree to which forecasts of net revenues are realistic.

7.3.3 Improvement Bonds

Improvement bonds can be issued under an Oregon law called the Bancroft Act. Cities and special districts are limited to improvement bonds not exceeding 3 percent of the true cash value. For a specific improvement, all property within the assessment area is assessed on an equal basis, regardless of whether it is developed or undeveloped. This assessment becomes a direct lien against the property, and owners have the option of either paying the assessment in cash or applying for improvement bonds to finance the construction, and the assessment is paid over 20 years semi-annual installments with interest.

With improvement bond financing, an improvement district is formed, the boundaries are established, and the benefited properties and property owners are determined. The engineer usually determines an approximate assessment, either on a square-foot basis or a frontage basis. Property owners are then given an opportunity to remonstrate against the project. The assessments against the properties are usually not levied until the actual total cost of the project is determined. Since this determination is normally not possible until the project is completed, funds are not available from assessments for the purpose of making monthly payments to the contractor. Therefore, some method of interim financing must be arranged, or a pre-assessment program, based on the estimated total costs, must be adopted.

The primary disadvantages to this source of revenue are as follows:

- The property to be assessed must have a true cash value at least equal to 50 percent of the total assessments to be levied.
- For projects that benefit the entire City, GO bonds can be issued in lieu of improvement bonds, and they are usually more favorable.

The construction of water and sewerage facilities through the formation of improvement districts is viable when the properties bordering or served by the improvements are specifically benefited. The establishment of an improvement district should be based on a thorough evaluation of the long-range plan for the entire area. Following is a summary of the development of water improvements by this method:

1. Receive written request or petition from affected property owners for the improvement. If there is any question regarding the feasibility or approval of the project, the petitioners should provide sufficient funds to cover engineering, legal, and administrative costs associated with preliminary planning and establishing the district.
2. Establish an assessment district and preliminary cost estimates. The cost estimates presented at this time will be the basis for projecting the assessment; however, some revision may be necessary depending on the scope of the project.
3. If the project meets with the approval of the petitioners, authorize the preparation of plans and specifications. Obtain interim financing.

4. Advertise for bids.

5. Award the construction contract.

6. Construct the project.

7. Sell the bonds and repay the interim financing.

7.3.4 Capital Construction (Sinking) Fund

Sinking funds are often established by budget for a particular construction purpose. Budgeted amounts from each annual budget are carried in a sinking fund until sufficient revenues are available for the needed project. Such funds can also be developed with revenue derived from system development charges or serial levies.

7.3.5 System Development Charges and User Rates

System development charges (SDCs) are fees the City collects from developers when they develop properties that will use the water system or other municipal service. Fees are collected when building permits are issued. SDCs can be used to finance capital improvements required to provide municipal services to the development. They can only be used on projects identified in the CIP that San Diego's are being collect for. Operation, maintenance, and replacement costs cannot be financed or repaid by SDC revenues.

As established in ORS 223, an SDC has two principal elements: reimbursement and improvement. The reimbursement portion of the SDC is the fee for buying into existing or under-construction capital facilities. The reimbursement fee represents a charge for using excess capacity in an already paid-for facility. The revenue from this fee is typically used to pay back existing loans for improvements. The improvement portion of the SDC is a fee to cover the cost of capital improvements required to provide increased capacity to serve new development. Initially, the City will be able to charge an improvement fee SDC. After the facilities are constructed, the City must convert the SDC to a reimbursement fee SDC.

Water user rates are monthly fees assessed to all users connected to the water system.

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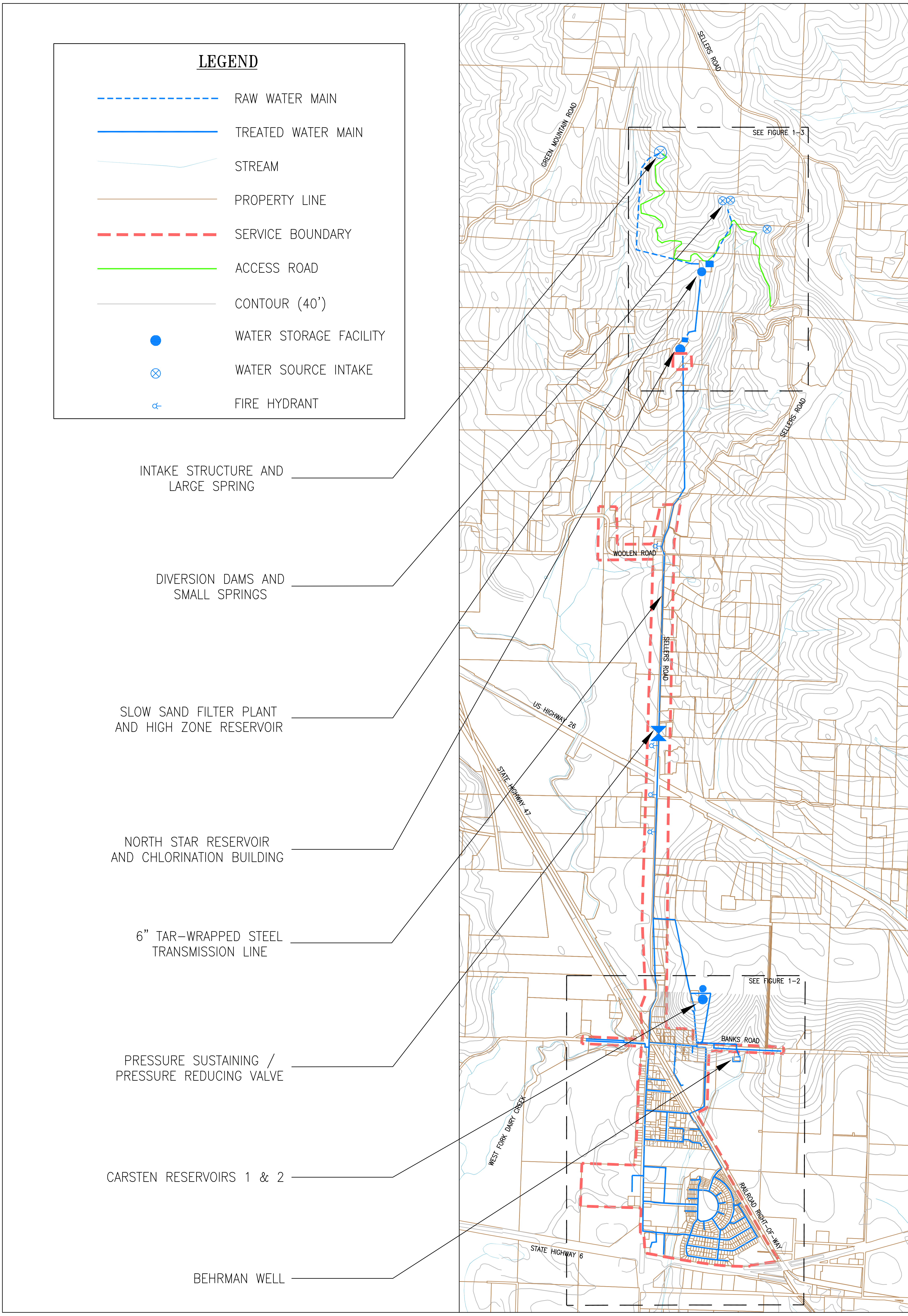
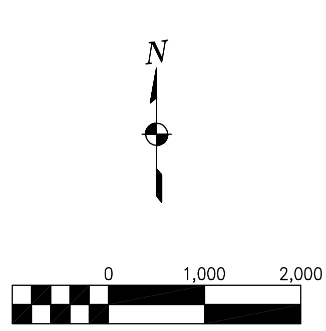
Figures





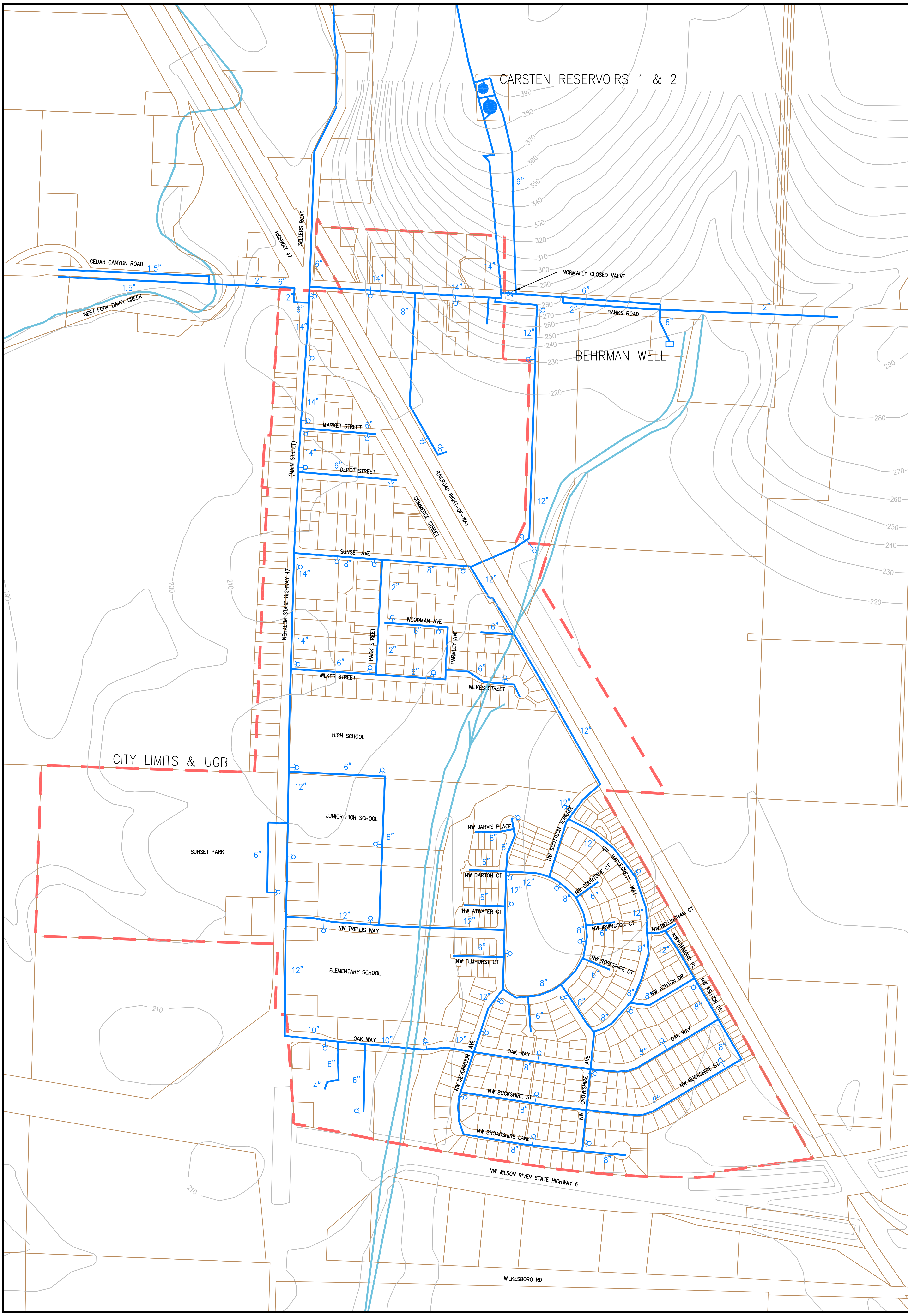
Kennedy/Jenks Consultants

CITY OF BANKS
WATER SYSTEM MASTER PLAN

WATER SYSTEM MAP

K/J 0791015.10

FIGURE 1-1



LEGEND

8"	DISTRIBUTION MAIN WITH PIPE DIAMETER
	STREAM
	PROPERTY LINE
	CONTOUR (10')
	FIRE HYDRANT

N

0 250 500

SCALE: 1" = 500'

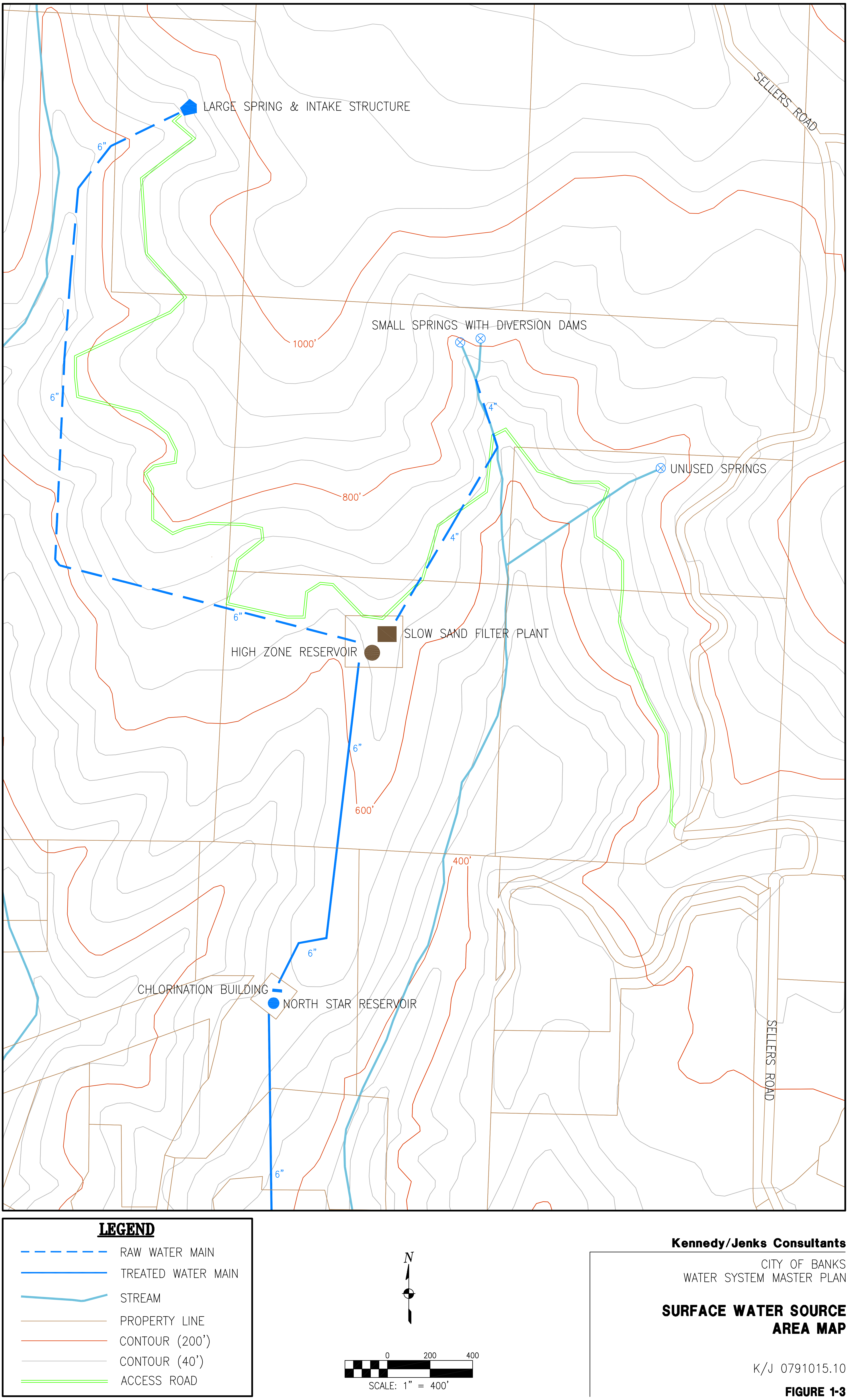
Kennedy/Jenks Consultants

CITY OF BANKS
WATER SYSTEM MASTER PLAN

DISTRIBUTION SYSTEM

K/J 0791015.10

FIGURE 1-2



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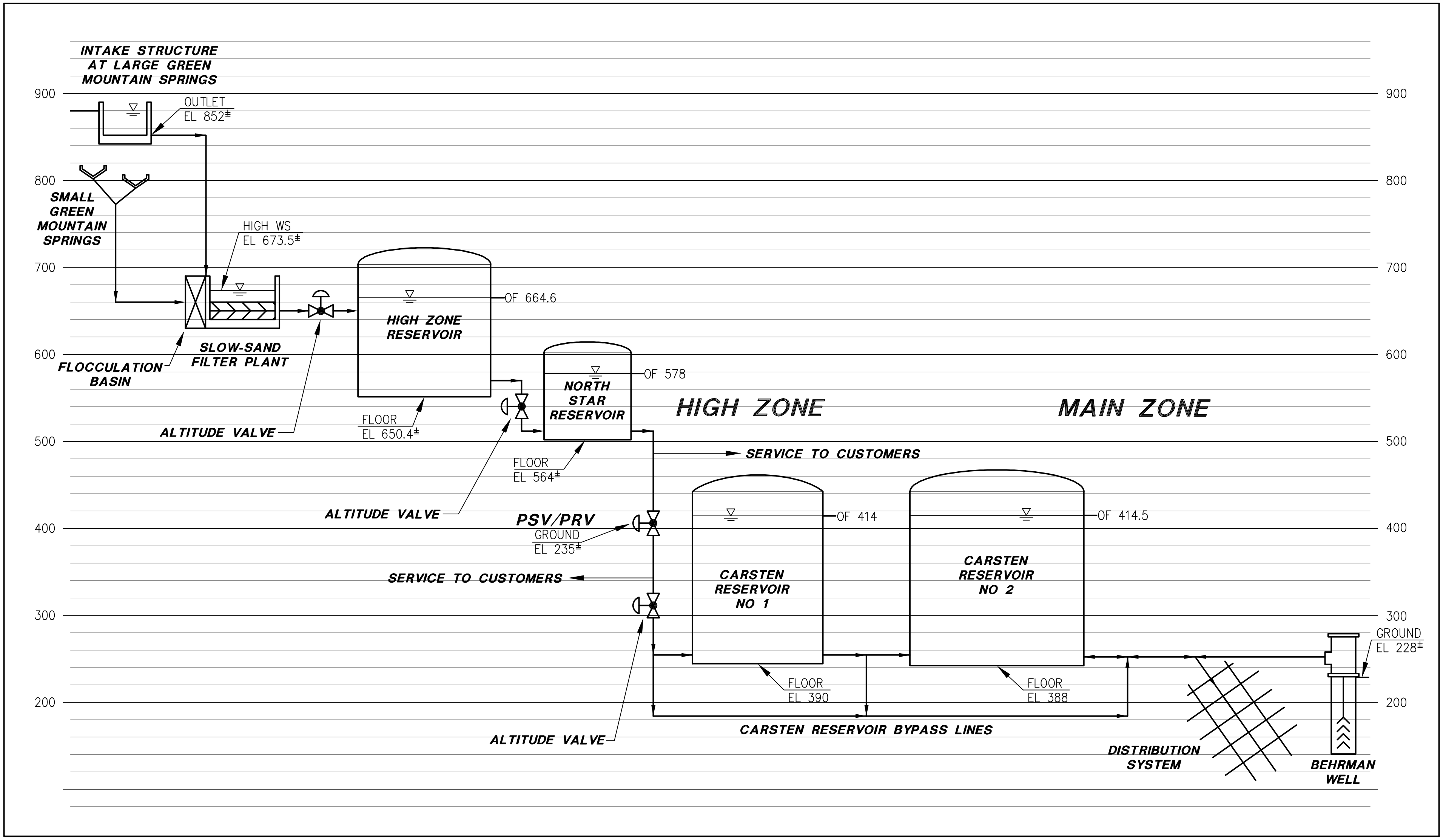
CITY OF BANKS
WATER SYSTEM MASTER PLAN

SURFACE WATER SOURCE AREA MAP

K/J 0791015.10

FIGURE 1-3



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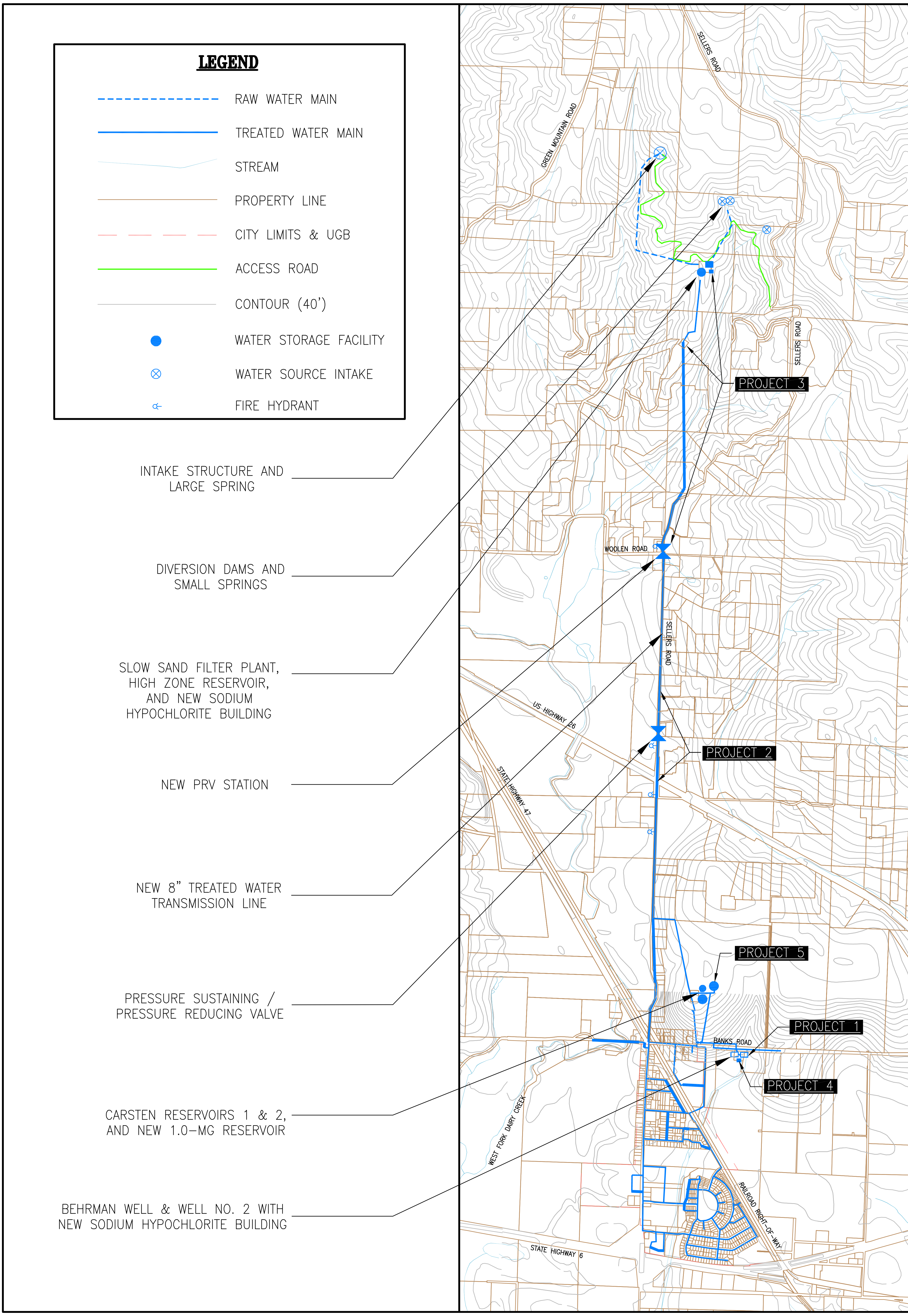
CITY OF BANKS
WATER SYSTEM MASTER PLAN

EXISTING SYSTEM SCHEMATIC HYDRAULIC PROFILE

K/J 0791015.10

FIGURE 1-4



NOTE: THICK WATER LINES INDICATE NEW OR UPGRADED FEATURES IN THE TRANSMISSION AND DISTRIBUTION SYSTEM

N

0 1,000 2,000

SCALE: 1" = 2,000'

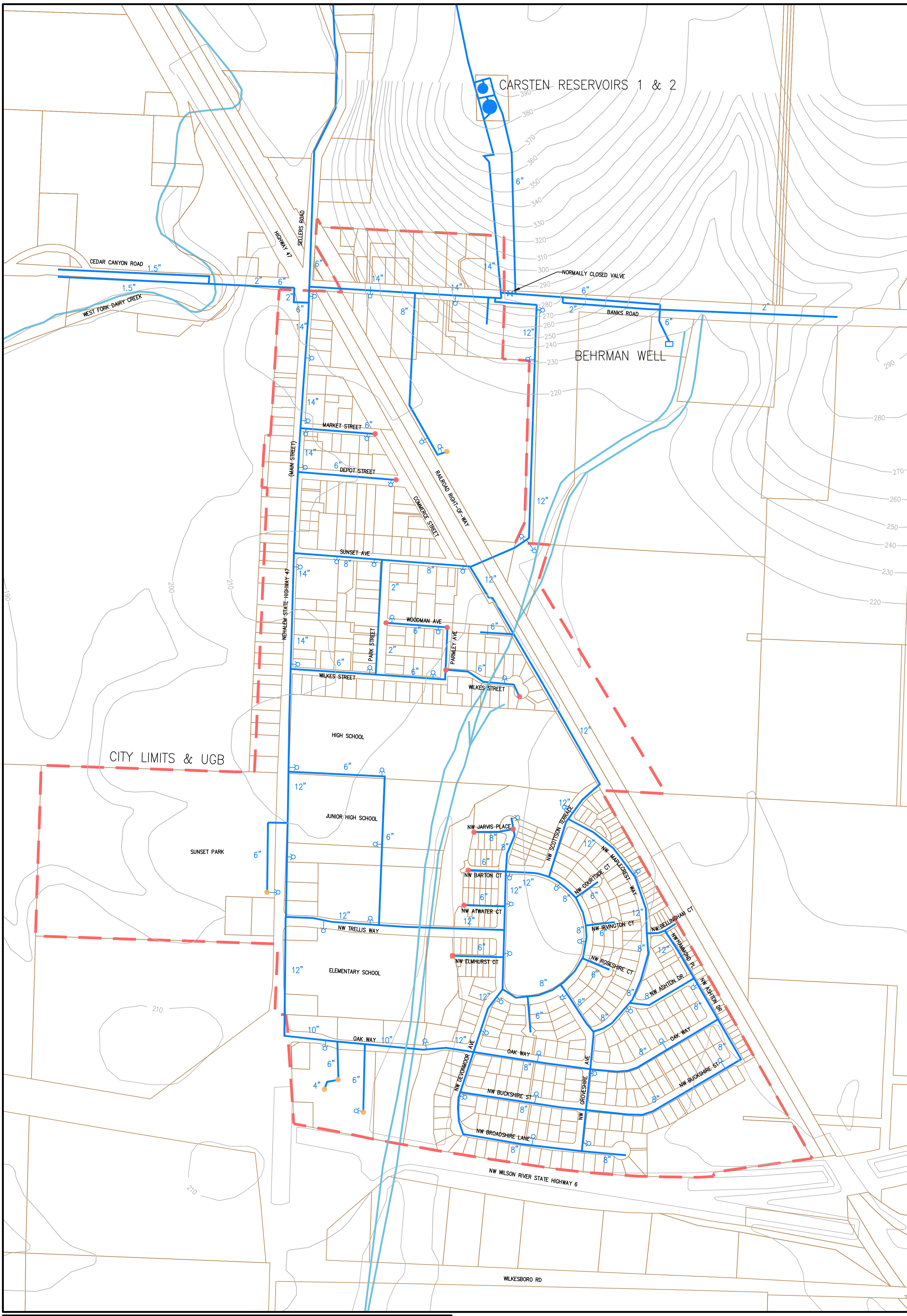
Kennedy/Jenks Consultants

CITY OF BANKS
WATER SYSTEM MASTER PLAN

FUTURE WATER SYSTEM MAP

K/J 0791015.10

FIGURE 4-1



LEGEND

8" DISTRIBUTION MAIN WITH PIPE DIAMETER	FIRE FLOW DEFICIENCY, COMMERCIAL ZONING
STREAM	FIRE FLOW DEFICIENCY, RESIDENTIAL ZONING
PROPERTY LINE	
CONTOUR (10')	
FIRE HYDRANT	

N

0 250 500

SCALE: 1" = 500'

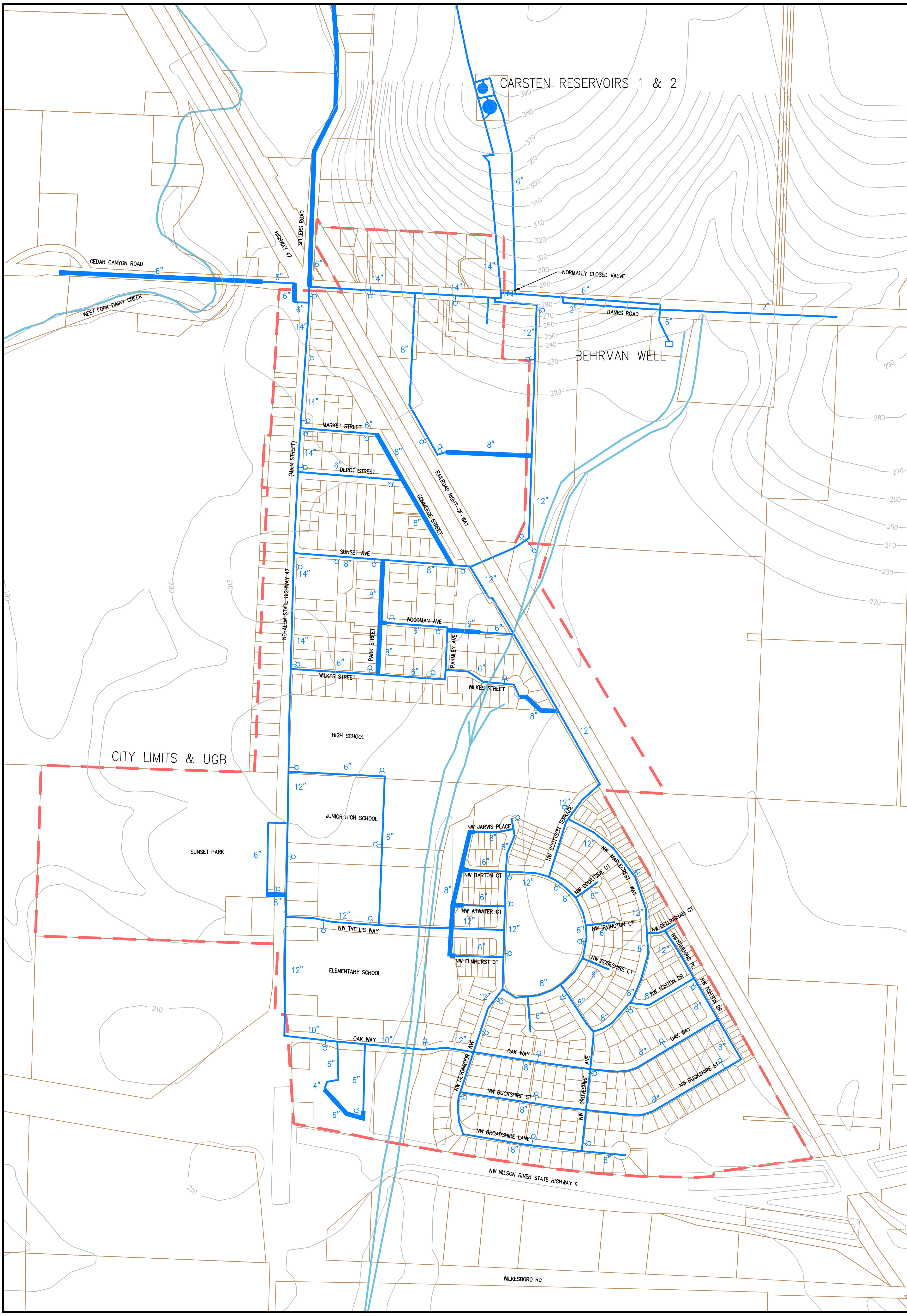
Kennedy/Jenks Consultants

CITY OF BANKS
WATER SYSTEM MASTER PLAN

EXISTING SYSTEM FIRE FLOW DEFICIENCIES

K/J 0791015.10

FIGURE 4-2



NOTE: THICK WATER LINES INDICATE NEW OR UPGRADED FEATURES IN THE TRANSMISSION AND DISTRIBUTION SYSTEM

LEGEND

- 8" DISTRIBUTION MAIN WITH PIPE DIAMETER
- STREAM
- PROPERTY LINE
- CONTOUR (10')
- FIRE HYDRANT

N

0 250 500

SCALE: 1" = 500'

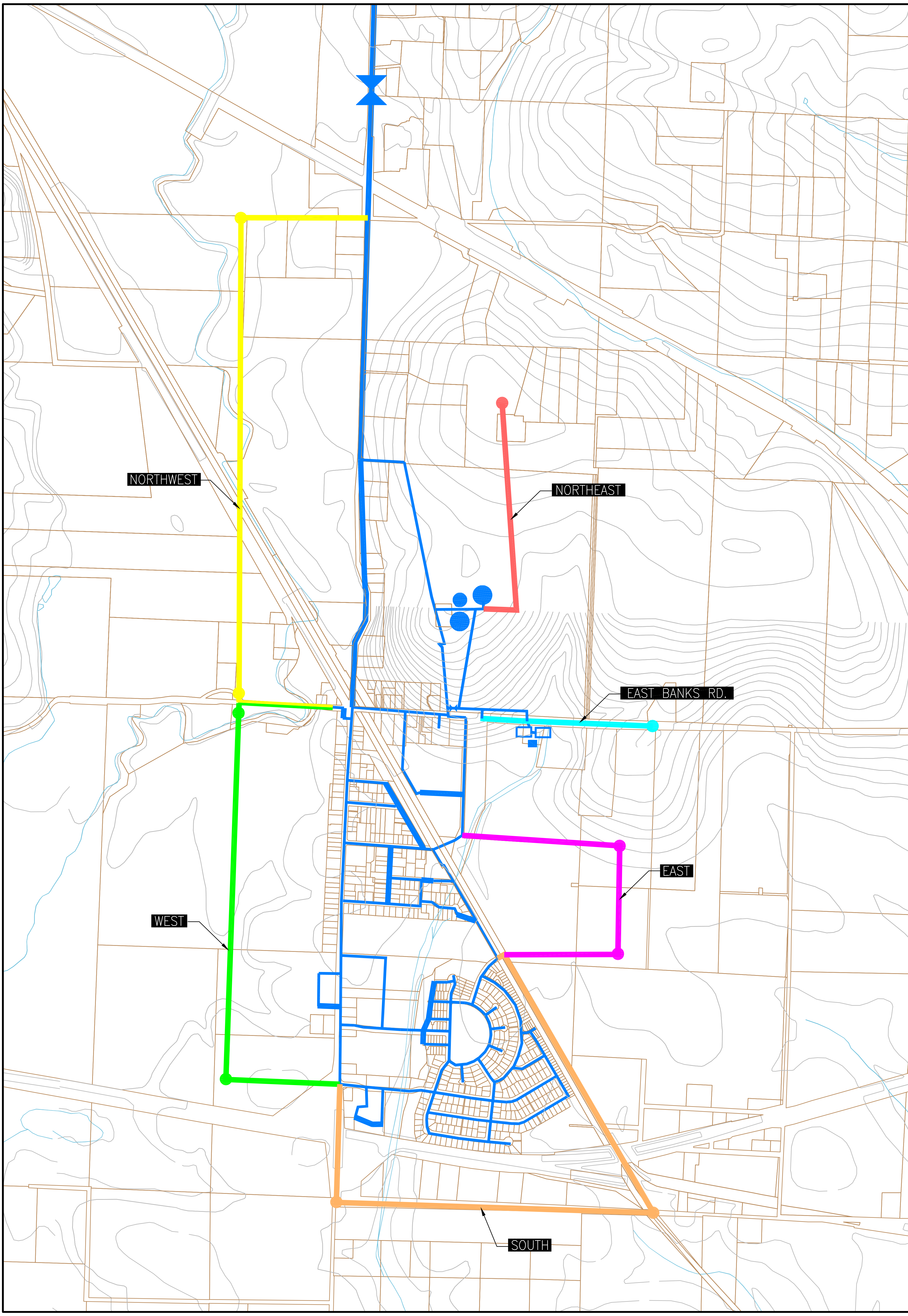
Kennedy/Jenks Consultants

CITY OF BANKS
WATER SYSTEM MASTER PLAN

FUTURE DISTRIBUTION SYSTEM

K/J 0791015.10

FIGURE 4-3



NOTE: DOTS IN EACH REPRESENTATIVE COLOR INDICATE WHERE DEMANDS WERE APPLIED FOR EACH BUILDOUT SCENARIO

LEGEND

- DISTRIBUTION MAIN
- STREAM
- PROPERTY LINE
- CONTOUR (10' & 40')

N

0 500 1,000

SCALE: 1" = 1,000'

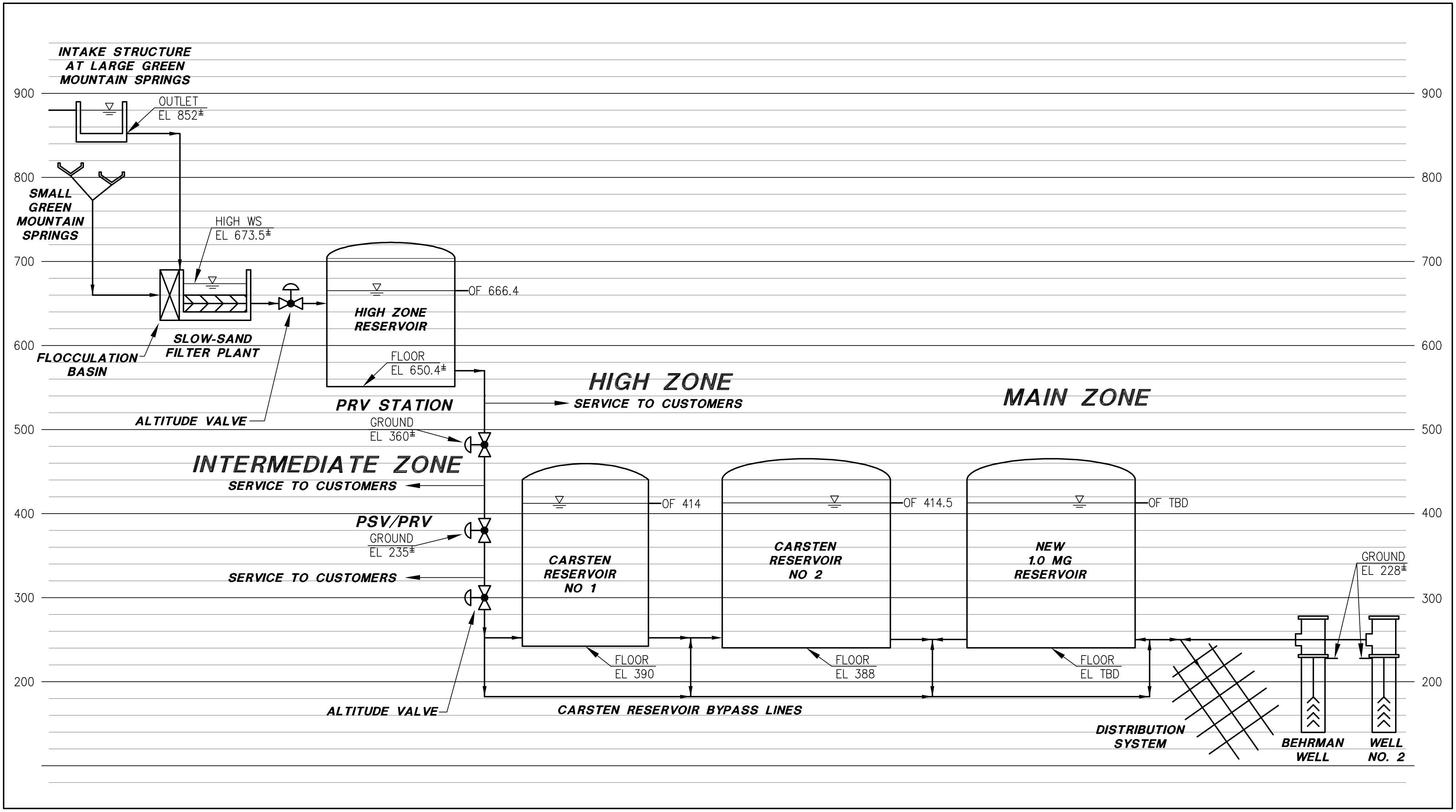
Kennedy/Jenks Consultants

CITY OF BANKS
WATER SYSTEM MASTER PLAN

FUTURE BUILDOUT SCENARIOS

K/J 0791015.10

FIGURE 4-4



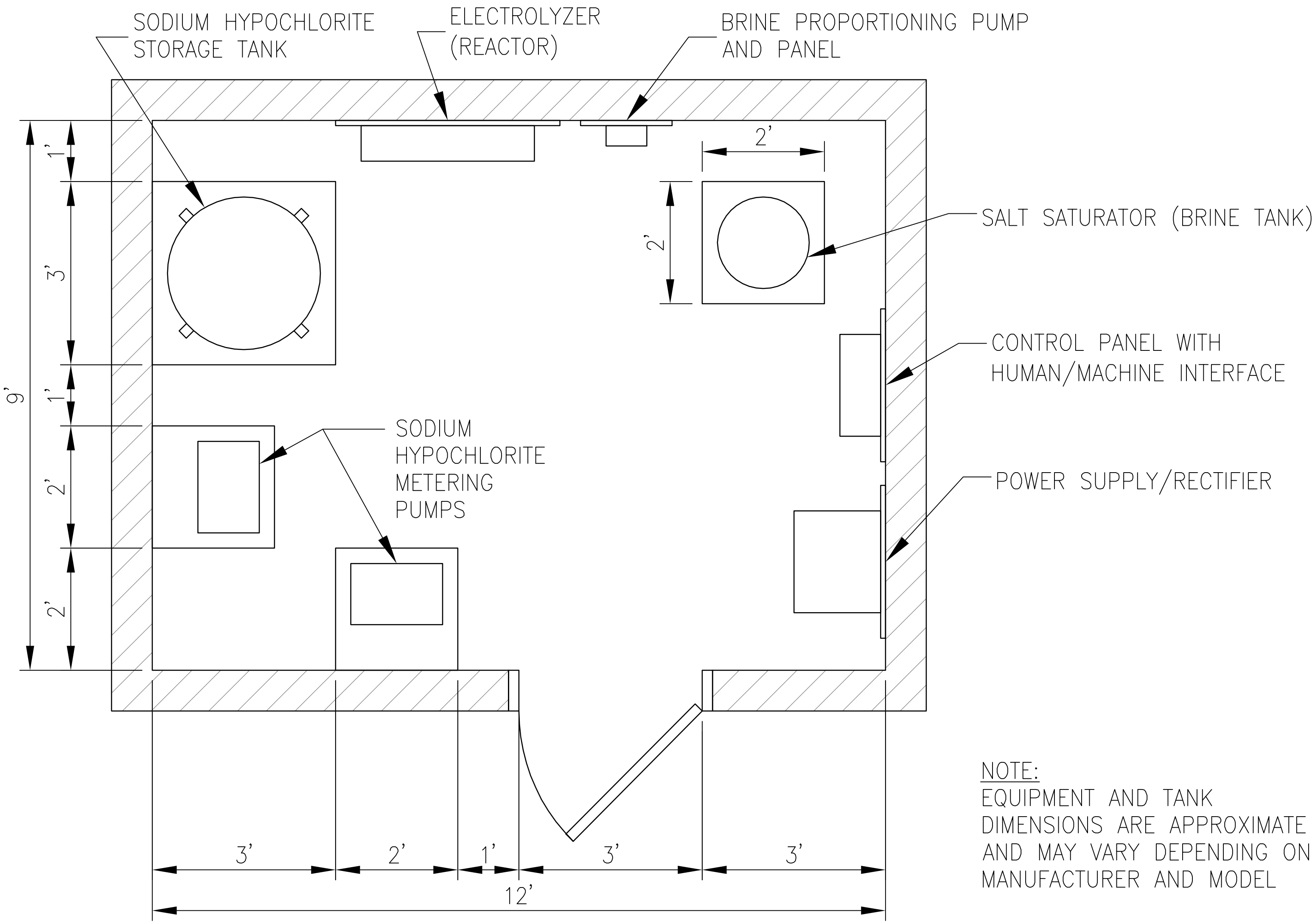
Kennedy/Jenks Consultants

CITY OF BANKS
WATER SYSTEM MASTER PLAN

FUTURE SYSTEM SCHEMATIC HYDRAULIC PROFILE

K/J 0791015.10

FIGURE 4-5



NOTE:
EQUIPMENT AND TANK DIMENSIONS ARE APPROXIMATE AND MAY VARY DEPENDING ON MANUFACTURER AND MODEL

Kennedy/Jenks Consultants

CITY OF BANKS
WATER SYSTEM MASTER PLAN

SODIUM HYPOCHLORITE GENERATOR BUILDING

K/J 0791015.10

FIGURE 4-6

Appendix A

Sanitary Survey

05-14-08 10:06 RCVD

Oregon
Theodore R. Kulongoski, Governor

Department of Human Services
Public Health Division
800 NE Oregon Street
Portland, OR 97232-2162
(503) 731-4030 - Emergency
(971) 673-0410
(971) 673-0457 - FAX
(971) 673-0372 - TTY-Nonvoice

May 12, 2008

Fred Evers
Banks Water Department – PWS #4100076
100 S. Main St.
Banks, OR 97106

Dear Fred:

Thank you for your time and assistance in conducting a **Sanitary Survey of the Banks Water Department on April 24th 2008**. The Drinking Water Program (DWP) aims to conduct a Sanitary Survey every three years to evaluate the entire water system in supplying safe drinking water to the public. I have enclosed a copy of the report for your records. Please let me know if any corrections need to be made.

The water system appears to be in good operating condition. The first page of the report lists deficiencies in the system that will have to be corrected as soon as possible. A new rule requires that all systems using a surface water source must submit a written plan within 45 days describing how and when the deficiencies will be corrected. **A corrective action plan must be submitted by June 30th 2008.** I recommend that you correct the deficiencies as soon as possible, and send written verification that the deficiencies listed were corrected and the dates of correction.

The deficiencies noted are as follows:

1. As a result of not calculating CT values correctly, the Banks Water Department is in violation of the Surface Water Treatment Rules and a Tier 2 public notice must be issued to all customers. The public notice must be re-issued every three months while the system remains in violation. A copy of the completed and distributed notice must be submitted to me to get credit for issuing the notice. Once the tracer study is completed and the actual contact time has been determined, this information can be used to determine if CT values are being met and then the public notice can be lifted.

2. A tracer study for the Northstar tank is required to determine the actual amount of contact time available prior to the first user. Attached is a fact sheet on conducting tracer studies. In addition, you may contact our circuit riders, HBH Consulting Engineers at (503) 625-8065 for free assistance in conducting the study as well as any other short-term operational projects you may have. Once complete, submit a copy of the study results to me.

3. The residual disinfectant concentration of the water must be measured and recorded at least <u>three</u> times a day at the entry point to the distribution system (i.e. the outlet of the Northstar tank). The day's samples cannot be taken at the same time, but at least one should be taken during peak flow. If at any time the residual disinfectant concentration falls below 0.2 mg/l, the system must take measurements every 4 hours until the residual disinfectant concentration is 0.2 mg/l.

4. A review of the Surface Water Quality Data Forms for this system shows that CT calculations are being done incorrectly. The actual CT value achieved must be calculated each day the treatment plant is in operation. The parameters necessary to determine the actual CT value must be monitored and recorded on the Surface Water Quality Data Form as follows:

   a. The temperature of the disinfected water must be measure at least once per day at the first user.
   b. The pH of the disinfected water must be measured at least once per day at the first user.
   c. The disinfectant contact time ("T") in minutes must be determined for each day during peak hourly flow, based on results of a tracer study (see deficiency #2 above).
   d. The residual disinfectant concentration ("C") in mg/l before or at the first customer must be measured. Report the highest of the three daily measurements (see deficiency #3 above).

5. A physical separation is required between untreated surface water and treated surface water. Therefore all bypasses around the Northstar tank must be physically removed. This includes the valve identified during the survey as well as the valve bypass.

6. Install a turbidimeter on the combined filter effluent (CFE) line prior to any storage and as close to the filter effluent as possible. Turbidity measurements must be performed on filtered water prior to any storage at least daily. Record the readings from this location on your monthly Surface Water Quality Data Form.

7. Calibrate all turbidimeters each calendar quarter according to the manufacturer's specifications.

8. The well lacks a current Radiologicals test. Four consecutive quarters of Gross Alpha, Radium 226/228, and Uranium must be collected at the entry point from the well beginning as soon as possible. If results are non-detect for the first two quarters, the last two quarters of testing may be waived.

9. A test needs to be done for Asbestos since there is some Asbestos-Cement (A-C) pipe in the system. This sample should be collected within the distribution system where A-C pipes are in place. Please do this test as soon as possible.

In addition to the above I have the following comments and recommendations:

1. A summary of your monitoring requirements can be found on page 12. Please maintain a copy of this page and refer to it for future scheduling.

2. Inorganics (excluding arsenic & nitrate) sampling schedules have been reduced to every nine years. You are welcome to sample more frequently.

3. The new well (L75346) will require plan review by our office prior to it being put into service. Please contact Marsha Fox at (971) 673-0408 as early as possible if you plan to use this well.

4. Contact your lab about measuring and recording the free chlorine residual on the lab slip at the time routine monthly coliform testing is done.

5. I recommend you do a pre & post coliform count test of your filter beds after each scraping to ensure that your ripening time is adequate. A slow sand filter is usually deemed ripened when total coliform counts of raw and treated are done and at least 95% removal has occurred in the filter.

6. You should collect raw water samples from the well and test them for coliform at least twice a year in order to confirm that the source is not contaminated with coliform. These samples should be marked "special" and do not need to be reported to the State.

7. If the operator does not use the written procedures that were produced when the water treatment plant was constructed, then he needs to create his own written procedure for operation of the water treatment plant for the purposes of preserving the information for future operators.

8. Since Fred Evers is performing the day to day operations of the water system and meets the qualifications, he should be designated as the DRC. Please fill out the enclosed "DRC Form" and return to the State Drinking Water Program, attention Dottie Reynolds.

If you have any questions or concerns, or would like this in an alternate format, please contact me at **(971) 673-0410.** Your cooperation is appreciated.

Sincerely,

Gregg Baird, REHS
Environmental Health Specialist
Drinking Water Program
www.oregon.gov/DHS/ph/dwp

encl: Tracer Study information
DRC Form

cc: Joseph Federico, Washington County Environmental Health

DHS Oregon Department of Human Services

Banks Water Department

Sanitary Survey
DHS Drinking Water Program

PWS ID: 41 00076
Survey Date: 04/24/08

Deficiency Summary

Surveyor: Kari Salis/Gregg Baird
Date Corrective Action Plan is Due: June 30th, 2008 **County:** Washington

Yes	No	Deficiencies	Date to be Corrected	Date Corrected
☐	☒	**Source Deficiencies:**		
		Well Construction:		
		Spring/Other Source:		
☒	☐	**Treatment Deficiencies:**		
		Surface Water Treatment Deficiencies:		
		• Turbidimeters not calibrated per manufacturer or quarterly		
		• Incorrect location for compliance turbidity monitoring		
		Disinfection Deficiencies:		
		• Minimum CT requirement not met all times		
		• Failure to calculate CT values correctly		
		• No means to adequately determine disinfection contact time under peak flow and minimum storage conditions (need a tracer study).		
		• Create physical separation between untreated and treated water.		
		• pH, Temperature, and chlorine residual not measured daily at first user.		
		• Chlorine not measured and recorded as required.		
☐	☒	**Finished Water Storage Deficiencies:**		
☐	☒	**Distribution Deficiencies:**		
☒	☐	**Monitoring Deficiencies:**		
		• Well lacks current Radiologicals test.		
		• Lacking a current Asbestos test.		
☐	☒	**Management & Operations Deficiencies:**		
☐	☒	**Operator Certification Deficiencies:**		
☒	☐	**Other Rule Violations:**		

Comments: See letter dated May 12th, 2008 for details and comments/recommendations.

DHS Oregon Department of Human Services

Banks Water Department

Sanitary Survey
DHS Drinking Water Program

PWS ID: 41 00076
Survey Date: 04/24/08

Inventory and Narrative

County: Washington

Type	Status	Size	Season
☒ Community (C)	Population:	1434	☒ All year ☐ Seasonal
☐ Non Transient Non-Community (NTNC)	Connections:	675	Begins: (mm/dd) /
	Service Chars	MU	Ends: (mm/dd) /
☐ Transient Non-community (NC)	Ownership:	4	**Coliform Sampling**
	License		Period: ☒ Monthly ☐ Quarterly
☐ State Regulated (NP)	☒ Not Lic ☐ HD ☐ Ag		Samples Required: 2
Operator Certification Required			**Responsible Agency**
WD 2 WT 1	FE ☐ Small GW ☐		☒ State ☐ County ☐ Dept of Agriculture

Mailing Address:

Contact Name: Fred Evers | Phone: (503) 324-5112 ext. 201
Title: Public Works Superintendent | Cell: (503) 957-5354
Street Address: 100 S. Main St. | Emergency #: ( )
City/State/Zip: Banks, OR 97106 | Email:

Legal/Owner Address:

Contact Name: City of Banks | Phone: (503) 324-5112
Title: | Cell: ( )
Street Address: 100 S. Main St. | Emergency #: ( )
City/State/Zip: Banks, OR 97106 | Email:

Supply Address:

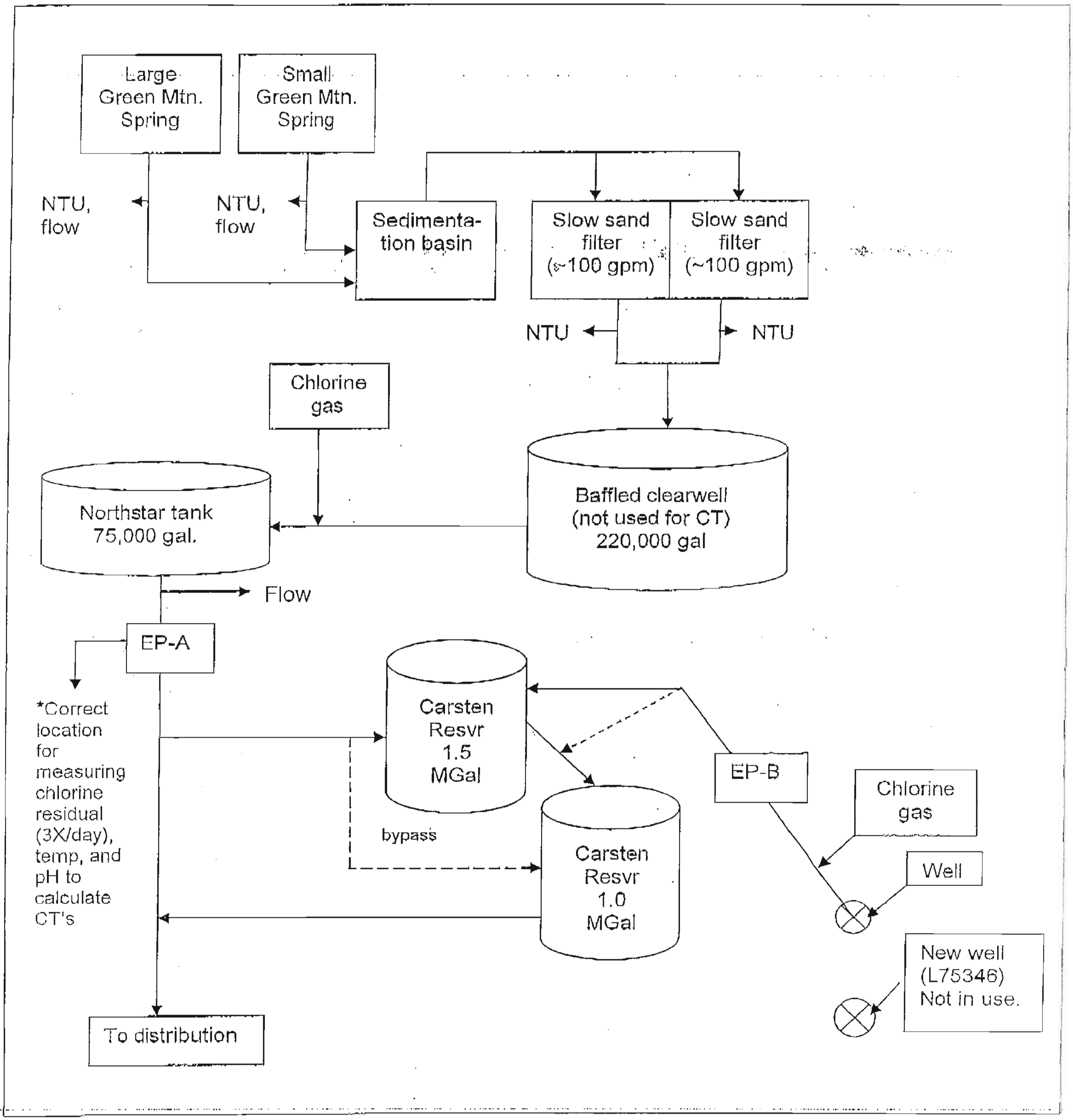
Contact Name: | Phone: ( )
Title: | Cell: ( )
Street Address: | Emergency #: ( )
City/State/Zip: | Email:

Emergency Systems Available:

Name: **PWS ID#:** 41

Narrative: This system serves the city of Banks located east of Hillsboro between HWY 26 and HWY 6. It consists of two entry points. EP-A is served by two spring sources that are classified as surface water. The spring water is treated by a slow sand filter, it then gravity flows into a 220,000 baffled tank next to the WTP, it then gravity flows down to the 75,000 gallon Northstar tank which is used for contact time (water is disinfected with chlorine gas prior to entering the Northstar tank). EP-B is served by a cased well that is treated with chlorine gas to provide residual maintenance. The well water is then pumped up the hill to the Carsten Road reservoirs (1.5 MG and 1.0 MG). The treated spring water is the primary drinking water source for most of the year (Fall-Winter-Spring). The well is used to manually fill the Carsten Road reservoirs as needed during the winter and is left on automatically during the summer when demand is highest.

Water System Schematic



DHS
Oregon Department of Human Services

Banks Water Department

Sanitary Survey
DHS Drinking Water Program

PWS ID: 41 00076
Survey Date: 04/24/06

Source Information

ID	Entry Points (Location where water enters distribution and is sampled) Name	Source Type: Ground	Surface	GWUDI	Pur. Ground	Pur. Surface	Availability: Permanent	Seasonal	Begins	Ends	Emergency	None	Treatment Codes
A	EP for Green Mtn Springs	☐	☒	☐	☐	☐	☒	☐			☐	☐	D403, P346, P660
B	EP for Well	☒	☐	☐	☐	☐	☒	☐			☐	☐	X401
		☐	☐	☐	☐	☐	☐	☐			☐	☐	
		☐	☐	☐	☐	☐	☐	☐			☐	☐	

ID		Individual Sources (Contributing to Entry Point) Name	*Land Use	Capacity (GPM)	Source Type: Ground	Surface	GWUDI	Pur. Ground	Pur. Surface	Availability: Permanent	Seasonal	Emergency	None	Treatment Codes
A	A	Large spring	K	165	☐	☒	☐	☐	☐	☒	☐	☐	☐	
A	B	Small spring	K	25	☐	☒	☐	☐	☐	☐	☒	☐	☐	
B	A	Well	G	250	☒	☐	☐	☐	☐	☒	☐	☐	☐	
					☐	☐	☐	☐	☐	☐	☐	☐	☐	
					☐	☐	☐	☐	☐	☐	☐	☐	☐	
					☐	☐	☐	☐	☐	☐	☐	☐	☐	
					☐	☐	☐	☐	☐	☐	☐	☐	☐	

*Land Use Codes: (A) **Pristine Forest** (B) **Irrigated Crops** (C) **Non-Irrigated Crops** (D) **Pasture** (E) **Light Industry** (F) **Heavy Industry** (G) **Urban-Sewered Area** (H) **Rural On-Site Sewage Disposal** (I) **Urban On-Site Sewage Disposal** (J) **Rangeland** (K) **Managed Forest** (L) **Commercial** (M) **Recreational Use**

List current operational patterns for all sources (e.g., Well 1 used continuously @ 100 gpm; Wells 2 & 3 used 6 hours/day; Well 1 used 30% of time & Well 2 used 70%; alternative use of Creek A & Creek B every 2 weeks; etc.). Be as specific as possible, and attach water use records if available.

- Springs are used at all times. During high demand, well kicks in. Small spring is only used when turbidity is <4 NTU (summer).

Yes	No	
☒	☐	Does the water system have water rights for all sources? ☐ Not required) ____
☒	☐	Has a Source Water Assessment been completed by DWP or DEQ? ____
☐	☐	Delineation (include date) or USGS Location Map (name & number) attached/on file? ____
☐	☐	Date of delineation or last update to delineation: ____ ☐ N/A
☐	☒	Have there been any modifications to the existing well(s) or spring(s) (e.g. deepened, change in screened interval, springbox reconstruction, etc.). Describe below:
☐	☒	Have there been any new high-use wells (e.g. irrigation, municipal, industrial, etc.) added within 1 mile of the existing source(s)? Provide direction and distance from system's well or spring and estimate use:

Comments:

DHS Oregon Department of Human Services

Banks Water Department PWS ID: 41 00076

Sanitary Survey Survey Date: 04/24/08

DHS Drinking Water Program

Treatment

Process Used*	Chemical Added**	Purpose	Location in System	Code***
Gaseous chlorination	Chlorine gas	Disinfection	WTP	D403
Filtration, Slow sand	NA	Particulate removal	WTP	P346
Sedimentation	NA	Particulate removal	WTP	P660
Gaseous chlorination	Chlorine gas	Disinfection	Well	X401

*See "Treatment Plant Inspection" page ofr details on filtration. **See "Disinfection" page for details on disinfection equipment. ***See Treatment Codes on back.

Yes	No	
☒	☐	Is equipment maintained properly?
☐	☒	Is redundant equipment available?

What lab equipment is available and used? (jar testing, turbidimeter, pH meter, etc.):

Raw turbidity, turbidimeters on each filter bed and sedimentation basin. Chlorine analyzer, pH meter.

Yes	No	
☒	☐	• Are chemicals NSF Standard 60 Approved?
☒	☐	Is operator aware of OSHA requirements for storage, handling, and spill containment?

Comments:

Yes	No	
☐	☒	Does System Practice Corrosion Control?
☐	☐	• Is it operated within parameters set by OHD?

Comments:

Records Kept:

Yes	No		Yes	No	
☐	☒	Dosages	☒	☐	Flowrate
☐	☒	Raw pH	☒	☐	Treated pH
☐	☒	Raw Temperature	☒	☐	Treated Temerature
☒	☐	Raw Turbidity and/or particle counts	☒	☐	Treated Turbidity

Comments:

DHS Oregon Department of Human Services

Banks Water Department
Sanitary Survey
DHS Drinking Water Program

PWS ID: 41 00076
Survey Date: 04/24/08

Well Information

	Source ID#:	BA											
	Well Name:	Well											
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	Well Log on File:	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wellhead Construction	Depth of Well (ft.)	450											
	Depth of Grout Seal (ft.)	210											
	Year of Installation (yr.)	1977											
	Casing Diameter (in.)	8											
	• Sanitary Seal & Casing Watertight	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Screened Vent	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Wellhead Protected from Flooding	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	• Well Meets Setbacks from Hazards	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Water Level Device	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	• Wellhead Terminates Above Grade	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Concrete Slab Around Casing	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Casing Height Above Slab (in.)	24											
	Pitless Adapter	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Protective Housing	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Control Building	Flowmeter	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Pressure Gauge	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Pump to Waste Piping	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	• Raw Sample Tap	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	• Treated Sample Tap ☐N/A	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Heated/Lighted	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Floor Drain	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Pump Removal Provision	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Check Valve	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Air/Vacuum Relief	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Pump Equipment	Pump Type*	VT											
	Pump Setting	0											
	Discharge Pressure (psi)												
	Horsepower (hp)	40											
	Bearing Lubrication (FG oil/water)	FGO											
	Pumping Capacity (gpm)	250											
	Static Water Level (swl) (ft.)	34											
	SWL Date	8/24/77											

* Pump Types: (VT) Vertical Turbine (SU) Submersible (CE) Centrifugal (SJ) Shallow Jet (DJ) Deep Jet (OT) Other

Comments: A new well has been drilled near the current well. The new well is capped, does not have a pump, and is not connected to the system. The new well is has an L-tag of L75346. This well needs Plan Review by this office prior to being put into use. Note: well water is pumped directly into Carsten Rd reservoirs where it mixes with spring water prior to going into the distribution system.

DHS Oregon Department of Human Services

Banks Water Department
Sanitary Survey
DHS Drinking Water Program

PWS ID: 41 00076
Survey Date: 04/24/08

Disinfection

No #.	Disinfection Method*	Location	Disinfection Source Water	Residual Maintenance	Proportional to Flow	Dosage Recorded
1	Chlorine gas	pre entry into Northstar tank	☒	☒	☒	☐
2	Chlorine gas	Well	☐	☒	☒	☐

*Chlorine Gas, Sodium Hypochlorite, On-site Generated Sodium Hypochlorite, Calcium Hypochlorite, Chloramines, Ozone, UV, Mixed-Oxidants, Other

Yes / No

☒ ☐ • Is a DPD type test kit used?

☐ ☒ • Are residuals recorded as required?

Distribution: ☒ Daily # samples: 1 ☐ Other:

Entry Point (sw only): ☒ Daily # samples: 1 ☐ Continuous if > 3300 pop

☐ ☒ If chlorinating for residual maintenance only, are raw water coliform samples taken? How often?

- Currently measuring daily at Northstar and Carsten reservoirs. Need to start measuring at least 3 times a day at the entry point (i.e. Northstar reservoir effluent).

Yes / No ☒ **Chlorine gas:**

Yes	No		Yes	No	
☒	☐	Separate room for gas storage and feeder?	☒	☐	Gas cylinders properly secured?
☒	☐	Fan with on/off switch outside?	☒	☐	Door that opens out
☒	☐	Vent located next to the floor?	☒	☐	Self-contained breathing apparatus?
☐	☒	Door with a window?	☐	☒	Air scrubber system?

CT Evaluation

Disinfection requirement (check one): ☒ (sw) 1.0 log inactivation giardia ☐ (sw) 0.5 log inactivation giardia ☐ (gw) 30 minutes contact time ☐ (gw) 4.0 log inactivation viruses

Maximum demand flow:

Effective volume calculation: (at lowest water level)

Minimum contact time: (estimated)

Yes / No

☒ ☐ • Does contact chamber have effluent flow meter or adequate alternative?

If no, how is peak flow determined for CT calculations?

☐ ☒ • Has tracer study been conducted or adequate alternative?

Tracer Study Date: Demand flow:

Volume used: Results: minutes

Describe alternate method to determine contact time: Currently estimating. Need a tracer study on Northstar tank.

Range of chlorine residual at first user: 0.54 to 0.71 at City Hall

Yes / No

☐ ☒ • (SW only) Are PH, Temperature, and chlorine residual measured daily at first user?

☐ ☒ • (SW only) Are CT values being calculated correctly? Not using CT tables; estimating required CT

☐ ☒ • Are CT values met at all times? Unknown b/c not calculating correctly

Comments: Recommend collecting raw water coliform samples from well at least twice a year.

DHS
Oregon Department of Human Services

Alternative Technology Treatment Plant Inspection

☒ WTP inspection done with Sanitary Survey (Contact Code 1 and 1D)
☐ WTP inspection only (Contact Code 1D)

WTP Name: TP for Green Mountain Springs WTP ID: A

Date of Inspection / Evaluation: 4/24/08

Plant Operator: Fred Evers Inspected by: Kari Salis/Gregg Baird

Total Points given: 20

Points	Visit Frequency	Check One:
Low range (0-15)	Every 3 years	☐
Mid range (16-25)	Annually	☒
High range (26 or more)	Every 6 months	☐

Comments: WTP needs to be inspected annually.

Source:

Describe Intake: Springs

Describe pumping facilities: Gravity

Watershed control information (protection plan, security measures, etc): Property is city owned.

Factors affecting water quality (algal blooms, logging, etc.):

General:

Treatment:

☐ Cartridge or Bag Filter Make / Model: ☒ Slow Sand Filter

☐ Membrane Filter Make / Model: ☐ Diatomaceous Earth

☐ Corrosion Control: ☐ Other:

Yes / No

☒ ☐ • Plan review approved? Any outstanding issues:

Log removal credit given: Giardia: 2.0 Crypto: 2.0 Date: w/ construction

Treatment Plant:

Yes / No		Item	If No, select points
☒	☐	Is raw water turbidity data collected at least daily? ☒ On-line ☐ Bench-top	0
		Average raw water: 0.5 to 2.0 NTU Peak: 4.0 NTU	
		Need install turbidimeter on Combined Filter Effluent (CFE) line prior to storage.	
☒	☐	• Are turbidity compliance standards met? (<1 NTU 95% of time; all < 5 NTU)	0
☐	☒	• Is CFE monitoring location acceptable (prior to any storage)?	5
☐	☒	Can chart recorder document turbidity > 5.5 NTU?	
		Currently measuring turbidity in town (says it's similar). Could add sample tap prior to tank. No chart recorder.	
☐	☒	• Are turbidimeters calibrated according to factory specifications or at least quarterly? **Calibrating 2X a year**	5
☐	☐	Are calibration standards valid (not expired)? **NOTE: Standards unavailable for inspection**	
☒	☐	Is flow through turbidimeter within manufacturer's range?	

DHS Oregon Department of Human Services

Banks Water Department

Sanitary Survey
DHS Drinking Water Program

PWS ID: 41 00076
Survey Date: 04/24/08

Alternative Treatment Plant Continued: — If No, select points

Yes / No

- [ ] Yes [X] No • Are CT's calculated correctly? — 10
- [ ] Yes [X] No • Is contact time based on tracer study or adequate alternative?
- [ ] Yes [X] No • pH, temperature and chlorine residual measured at 1st user?
- [X] Yes [ ] No • Is there a flow meter on effluent side of clearwell?

Currently taking pH, temp, Cl2 residual in town; will switch to outlet of Northstar tank (entry point effluent). Not using CT tables to calculate required CT. Violation of SWTR requires a Tier 2 public notice within 30 days.

- [ ] Yes [X] No Is corrosion control practiced?
- [ ] Yes [ ] No • Is it operated within parameters set by DWS? — 0

Method of corrosion control used: NA

- [X] Yes [ ] No • Do all under-certified operators follow a written decision-making protocol as established by DRC? — 0

Just Fred

- [X] Yes [ ] No • Are standard plant operating procedures written and followed? O&M manual available for WTP - doesn't use. — 0

- [ ] Yes [X] No Are operators on site during all hours of plant operation?
- [ ] Yes [X] No [ ] N/A If no, is there an alarm for low chlorine residual? •(>3300 Population only) — 0

[ ] Low chlorine [ ] High turbidity [ ] Plant shutdown [ ] Auto-dial

[X] N/A **Bag / Cartridge Filtration:** Type of pre-filtration: ____

- [ ] [ ] • Pressure gauges before / after filter?
- [ ] [ ] Are filters changed based on pressure differential? At psid: ____ — 0

[ ] N/A **Slow Sand:** Scraping / Cleaning /Ripening protocol: Scrapes ~3 months. Ripening: fills, then returns filters to service next day (goes by turbidity, not pre/post coliform counts). See comments below.

[X] NA **Membrane:**

- [ ] [ ] • Particle counter or laser turbidimeter post-filtration? ____ — 0
- [ ] [ ] • Is integrity testing done at least weekly? Method: ____ — 0

Backwash initiated by: [ ] turbidity: ____ [ ] TMP: ____ [ ] time: ____

[X] N/A **DE:**

- [ ] [ ] Precoat process used? Describe: ____ — 0
- [ ] [ ] • Is body feed added with influent flow? — 0
- [ ] [ ] Is DE discarded at end of filter run?

Total Points 20

Comments: Recommend you do a pre/post coliform count test of your filter beds after each scraping to ensure that your ripening time is adequate. A slow sand filter is usually deemed ripened when total coliform counts of raw and treated are done and at least 95% removal has occurred in the filter.

DHS Oregon Department of Human Services

Banks Water Department

Sanitary Survey
DHS Drinking Water Program

PWS ID: 41 00076
Survey Date: 04/24/08

Storage and Pressure Tanks

Number	Name	Tank Type*	Tank Material	Year Built	Volume (gal.)
1	WTP tank	G	Bolted steel	2002	220,000
2	Northstar reservoir	G	Concrete	1980	75,000
3	Carsten Rd (big "B" on the side)	G	Welded steel	1984	1.5M
4	Carsten Rd (pale blue)	G	Welded steel	1999	1.0M

* (G) Ground (E) Elevated (P) Pressure

Total Volume: ~2.8M

	Reservoir Number:	1 Yes	1 No	2 Yes	2 No	3 Yes	3 No	4 Yes	4 No	Yes	No
Reservoir Features											
Hatch	● Locked	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Hatch	● Watertight	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Hatch	Shoebox type lid (curbing)	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Features	Drain to Daylight	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Features	Overflow	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Features	● Flap Valve (on drain and/or overflow)	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Features	● Screened Vent	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Features	Water Level Gauge	☒	☐	☐	☒	☒	☐	☒	☐	☐	☐
Features	Bypass Piping	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Features	Fence/Gate	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Features	Cathodic Plates Watertight ☒ N/A	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Features	Alarm for High/Low Levels	☐	☒	☐	☒	☐	☒	☐	☒	☐	☐
Maintenance	Exterior In Good Condition	☒	☐	☐	☒	☒	☐	☒	☐	☐	☐
Maintenance	Approved Interior Coating	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Maintenance	Annual Inspection	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Maintenance	Cleaning Schedule	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Maintenance	Continuously Disinfected ● (redwood only)	☐	☒	☒	☐	☒	☐	☒	☐	☐	☐
Plumbing Config.	Separate Inlet/Outlet	☒	☐	☒	☐	☒	☐	☒	☐	☐	☐
Plumbing Config.	Baffling	☒	☐	☐	☒	☐	☒	☐	☒	☐	☐
Plumbing Config.	Used for Contact Time	☐	☒	☒	☐	☐	☒	☐	☒	☐	☐

	Hydropneumatic Tank Number:	Yes	No	Yes	No
Hydropneumatic Tank	Used for Contact Time	☐	☐	☐	☐
Hydropneumatic Tank	Accessible for Maintenance	☐	☐	☐	☐
Hydropneumatic Tank	Separate Inlet/Outlet	☐	☐	☐	☐
Hydropneumatic Tank	Bypass Piping	☐	☐	☐	☐
Hydropneumatic Tank	Access Port	☐	☐	☐	☐
Hydropneumatic Tank	Drain	☐	☐	☐	☐
Hydropneumatic Tank	Pressure Relief Device with Gauge	☐	☐	☐	☐
Hydropneumatic Tank	Air Blow Off Valve	☐	☐	☐	☐
Hydropneumatic Tank	Air Bladder/Diaphram	☐	☐	☐	☐
Hydropneumatic Tank	Valve for Adding Air	☐	☐	☐	☐
Hydropneumatic Tank	Water Level Sight Glass	☐	☐	☐	☐

Comments

WTP tank is not being used as designed for chlorine contact time. Northstar tank is where CT's are met.

If Northstar tank is used for contact time, then the tank bypass (and bypass of clayval) must be physically removed!

DHS Oregon Department of Human Services

Banks Water Department
Sanitary Survey
DHS Drinking Water Program

PWS ID: 41 00076
Survey Date: 04/24/08

Distribution System Information

Service Area and Facility Map

Yes	No	
☒	☐	Does the system have a Service Area and Facility Map with the following features:

- ☐ Booster Pumps
- ☐ Pressure Reducting Valves
- ☐ Pressure Zones
- ☐ Sampling Points
- ☒ Sources-wells & withdrawal points
- ☒ Storage Facilities (reservoirs)
- ☒ Treatment Facilities
- ☒ Water Lines (including size and material)

Distribution Data

Yes	No	Item	Comments
☒	☐	● System pressure >20 psi?	75-95 psi
☒	☐	System metered? (What %?)	100%
☐	☒	Water system leakage <10%?	12% estimate. Recommend calculating using meters.
☒	☐	Waterline depth > 30"?	
☒	☒	Piping looped?	
☒	☐	Hydrants or adequate blowoffs on all dead ends?	
☒	☐	Routine flushing? (How often?)	Every other year
☒	☐	Adequate valving?	
☒	☐	Routine valve turning?	Every other year

Comments:

Cross Connection Program (Community Systems Only)

Yes	No	Item	Comments
☒	☐	● Ordinance or enabling authority?	
☒	☐	List of installed devices?	
☒	☐	● Are devices tested annually?	
☒	☐	● Certified inspector (if serving more than 300 connections)?	Fred Evers

Comments: Testing done in the fall.

Booster Pumps

Number	Name (location)	Deficiencies Noted or Comments	HP	GPM	Aux. Power Yes	Aux. Power No
					☐	☐
					☐	☐
					☐	☐
					☐	☐
					☐	☐
					☐	☐

Comments:

DHS Oregon Department of Human Services

Banks Water Department

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Water Quality Monitoring

Contaminant	N/A	Frequency	Next Tests Due
Coliform Bacteria	☐	2 per month	ongoing
Nitrate	☐	WTP=annual. Well=annual	2008
Arsenic	☐	WTP=every 3 yrs. Well=annual	WTP=2010. Well=2008
Inorganic Chemicals (sw)	☐	WTP=every 9 years	2011
Inorganic Chemicals (gw)	☐	Well=every 9 years	2012
SOC's	☐	WTP=every 3 yrs. Well=every 3 yrs.	WTP=2008. Well=2010
VOC's (sw)	☐	WTP=annual	2008
VOC's (gw)	☐	Well=every 3 years	2010
Radiologicals	☐	See Below	
Asbestos	☐	Every 9 years	ASAP
TTHM's and HAA5's	☐	2 per quarter	ongoing
Lead and Copper, # 10	☐	Every 3 years	Summer 2008
TOC	☒		
Turbidity	☐	Daily	ongoing
Source Water Coliform	☐	Well=at least twice/year	
Other: Chlorine residual	☐	3 times daily before first user	ongoing

Yes ☐ No ☒ • Is all required monitoring current?

Comments: Well lacks current Radiologicals tests. Must do 4 consecutive quarters of Gross Alpha, Combined Radium 226/228, and Uranium. Note: WTP needs Combined Radium 226/228 every 6 yrs, Gross Alpha and Uranium every 9 yrs starting in 2008.

Yes ☒ No ☐ Has the system experienced chemical (last 5 years) or bacteriological (last 2 years) detections?
If yes, what contaminant and when? TCR = 8/9/07 & 11/2/07 (both not MCL's).

☒ ☐ • Have all MCL violations been addressed? NA

☒ ☐ Does the system have any monitoring reductions granted? Explain: WTP and Well have inorganics reduction to every 9 years.

☒ ☐ • Does the system have a written coliform sampling plan?

Does the plan include:

Yes	No		Yes	No	
☒	☐	Brief narrative	☒	☐	Rotation schedule?
☒	☐	Distribution map?	☒	☐	Repeat locations?
☒	☐	Sample site locations?			

Where in the system are the monitoring sites for TTHM and HAA5: (☐ Not required) DBPMAX01=660 S. Main DBPMAX02=42370 Lookover

☒ ☐ Are TTHM and HAA5 samples taken at location of maximum residence time?

Comments: Need to do an Asbestos test as soon as possible since have some A-C pipe in the system.

DHS Oregon Department of Human Services

Banks Water Department

Sanitary Survey
DHS Drinking Water Program

PWS ID: 41 00076
Survey Date: 04/24/08

Management & Operations

Management Operations

☒ ☐ • Does system have an operation and maintenance manual?
☒ ☐ • Does system have an emergency response plan?

Operator Certification

Requirements for system: WT: 1 WD: 2 Small System: ☐

Name	Certification Number	WT Level	WD Level	FE	Small System
DRC:*Todd F. Evers	6149	3	2	☐	☐
Fred A. Evers	3645	1	2	☐	☐
				☐	☐
				☐	☐
				☐	☐

*DRC= direct responsible charge. Attach additional sheets if necessary to list all certified personnel.

Yes No
☒ ☐ Is DRC identified?
☒ ☐ • Is DRC certified at appropriate level?
☐ ☒ • Does system have written operating protocols for other operators? NOTE: Fred is only operator.

If DRC is a Contract Operator:

Yes No
☐ ☐ Does DWP have contract on file?

How does contract operator work with system: NA

Plan Review/Master Plan

Yes No
☒ ☐ • Have all major modifications (since 8/21/81) been approved by DWP?
☐ ☒ Does system have a current plan review exemption for water main extensions?
☒ ☐ • Does the system have a current (<20 yr. old) master plan? (☐ Not required if < 300 connections)
What year was the plan completed? 1998; update to 1995 plan
☐ ☒ Does the master plan include a water conservation plan?

Compliance Status

Yes No
☒ ☐ • Is water system in compliance (all orders resolved and not a significant non-complier)?
How many violations has the system had in the past two years. 2
☒ ☐ • Does the system issue Public Notice for Violations as required?

Other
☒ ☐ Has a capacity assessment been completed by DWP?

If yes, list deficiencies noted: 8/16/00: need third round LCR, ERP, X-Conn plans.

☒ ☐ • Are consumer confidence reports sent to users each year?

Comments: Fred needs to be switched to being the DRC. He is qualified and is doing all the daily operation of the WTP and system.

Tracer Study Procedures

Continuous Feed or Step-Dose Method

The purpose of a tracer study is to determine the actual amount of contact time provided in the system during peak flow conditions and minimum contact volume, from the point of disinfection to the first user. Estimates can be calculated, but the degree of short-circuiting is only approximately known unless a tracer study is conducted.

Step 1: The test must be conducted during the **peak demand flow** on the system. Important: this is the peak flow leaving the reservoir or contact chamber, which is not necessarily the same as what comes from the well or through the filtration plant. The study can be done at the known peak flow time (in the morning or early evening), or the effluent pumps can be set for peak flow, if possible. It is also important that the study be conducted **when the reservoir or contact chamber is at the lowest level,** to represent the worst-case scenario.

Step 2: Choose a chemical to use. It is easiest to use something on hand already. Common choices are chlorine or fluoride. Make sure the proper testing equipment is available (chlorine or fluoride test kits).

Step 3: Prepare the data collection sheets in advance. Include columns for time, concentration, a space for the background concentration, and applied concentration.

Step 4: The tracer study parameters and procedure proposal should be submitted to and approved by the Drinking Water Program prior to conducting the study.

Step 5: If using a chemical that already exists in the system at background levels (e.g., chlorine), record this background dosage and residual at the first user before beginning the study.

Step 6: Set the time for zero when the concentration of the tracer study chemical is applied at the normal point of injection for disinfection. This concentration must be consistent at all times throughout the study.

Step 7: Record the concentration of the tracer study chemical at the first user and the time. Tests should be done every minute or so, perhaps as frequently as possible. When the concentration increases by 10% of the additional concentration added, this is used as the contact time. For example, if the system normally is chlorinated at 0.5 ppm and during the tracer study it is increased to 2.5 ppm (a difference of 2.0 ppm), the increase you would be looking for is 10% of 2.0, or 0.2 ppm. So in this example, when the residual reaches 0.7 (0.5 + 0.2) ppm, that is the contact time provided. It is best to continue testing the concentration to make sure it was a good reading and the concentration indeed is increasing as time goes on. Sometimes the concentration may inexplicably go up and down before it consistently increases.

Step 8: Keep records of absolutely everything that was done, for future reference. A written report of procedures should accompany all data to justify the conclusion of the tracer study (the actual contact time).

Step 9: Submit the tracer study results to the County Health Department and DWP for review and approval.

For further information and details, contact DWP or refer to EPA's SWTR Workshop Manual or AWWA Research Foundation's Tracer Studies: Protocol and Case Studies.

Tracer Study Parameters & Results

Water System Name: ______________________ ID#: ____________

Date of Tracer Study: ______________________

Contact Volume:

Volume of Clearwell when Full: ____________ gal (a)

Water level height when full: ____________ ft (b)

Minimum water level height: ____________ ft (c)

Minimum Volume of Clearwell (a x c / b): ____________ gal (d)

Volume or height at time of tracer study*: ____________ (e)

* Note: Must be within 10% of minimum volume

Additional contact volume in pipe: ____________ gal (f)

Total volume used for tracer study (to 1st user): ____________ gal (g)

Flow Conditions:

Peak flow at contact chamber effluent: ____________ gpm (h)

How is peak flow determined? ___ flow meter at effluent

___ pump rates

___ other ____________

Flow at time of tracer study: Beginning: ________ gpm

End: ________ gpm

Average*: ________ gpm (i)

* Note: Flow (i) during tracer study must be at leastn 90% of peak flow, or 0.9 x h

Note: Tracer study must be repeated when peak flow increases by 10%

Repeat tracer study when peak flow is: 1.1 x (i) = ________ gpm (j)

Tracer Chemical:

Which chemical is to be used?

___ Chlorine compound ___ Fluoride compound

___ Other ____________

Initial concentration: ________ (k) Dosage conc.: ________ (L)

Target concentration at 1st user: k + [0.1 x (L-k)]= ________ (m)

Results:

Time for target concentration to be reached: ________ min (n) **Minimum Contact Time!!**

Baffling factor = (n x i) / g = ________ (o)

Note: Baffling factor may be used when volume is greater or flow is less than in study

Name: ______________________

Signature: ______________________ Date: ____________

Worksheet for Tracer Study

Addendum to "Tracer Study Parameters and Results" Page

Water System: ______________________________ Date: ______________

Time	Concentration (ppm)	Comments

Department of Human Services — Drinking Water Program

Water System Operator Designation
DRC Form

If you need this information in an alternate format, please call Operator Certification at (971) 673-0413

System:

PWS #:
Required Certifications:

Distribution Level
Treatment Level
Filtration Endorsement
N= None Required

Previous DRC: ______________________________

Indicate the reason for the change: ☐ Retired ☐ New job duties ☐ No longer employed ☐ Other

New DRC DISTRIBUTION	TREATMENT
Name:	Name:
Cert #: Level:	Cert #: Level:
Signature:	Signature:

Does this system contract for a certified operator? YES___ NO___
If YES submit a copy of the contract and complete the information below

Name of Business: ______________________________

Name of Operator: Cert. #

Address:

Phone: Signature

This contract is for: Distribution___ Treatment___ Both___

I am the owner or legal representative for the water system. I have reviewed the information on this form and verify that it is true, complete, and accurate to the best of my knowledge.

Signature: ______________________ Title: ______________

Printed Name: ______________________ Phone ___________ Date:_______

Send completed form (with copy of contract, if required) to:
Operator Certification • DHS-Drinking Water Program • PO Box 14450 • Portland, OR 97293-0450

Operator Designation Information on back of form

10/07

Direct Responsible Charge Information

Pursuant to OAR 333-061-0225 the water system owner or authorized agent delegates the responsibility to the certified operator(s) listed below of:

- Supervising the technical operations of the system, and
- Establishing and executing specific practices and policies for operating the system in accordance with policies and practices of the owner and the requirements of public water system rules, and
- Are engaged in the actual day-to-day operation and/or supervision of the system.

The principal operator must hold a current, valid Oregon certificate at a grade level equal to or greater than the system's classification level.

Water systems contracting with a certified operator must include name and address of company/individual the contract is with. A copy of the contract must be submitted with this form.

Requirement: All Community and Non-Transient Non-Community Public Water Systems are required designate and notify the Drinking Water Program (DWP) of the certified operators designated for each Treatment Plant and Distribution System. The Operator Designation Form is to be submitted by the Public Water System to notify the DWP of any designations or changes. Per Oregon Administrative Rules, this form shall be submitted within 30 days after any change so that the system is not in violation of operator certification regulations. Certified Operators should ensure that this form is submitted if they are no longer the operator for a system so that the DWP does not continue to hold them responsible for the system's operation.

Visit the DWP, Operator Certification Web site, for additional information at www.oregon.gov/dsh/ph/dwp

Water Treatment Facility
Disinfection Contact Time Tracer Study

City of Banks
Washington County, Oregon

Test Date: May 15, 2008

Provided by the Oregon Department of Human Services, Drinking Water Section as part of the Circuit Rider Technical Assistance Program

Prepared By:

HBH Consulting Engineers

20015 SW Pacific Hwy
Suite 101
Sherwood, Oregon 97140
503.625.8065
fax 503.625.1531

486 E Street
Suite 3
Coos Bay, Oregon 97420
541.266.0355
fax 541.266.7504

Date of Site Visit: May 15, 2008 PWS ID: 41-00076
HBH Staff: Robert Henry, PE

Description of Facilities

The City of Banks owns and operates a water treatment plant to treat surface water (springs) for municipal use and domestic consumption. The city treatment plant is a slow sand filter. Following filtration, water flows to a 75,000-gallon, concrete reservoir, where chlorine (gas) is added. The water flows though the unbaffled reservoir, then though approximately 1/2 mile of 6-inch pipe before reaching the first user.

Testing Procedure

Test Point
The sample point for this test was a sample tap adjacent to the first user's meter.

Test Flow Level
The accepted EPA method of determining contact time is to measure the travel time through the contact basin and transmission piping at peak flow. The maximum flow from the treatment plant is held to 120 gpm by a flow-control valve near the city (peak flows are taken care of through reservoir storage and supplementation from the city well).

Clearwell Configuration/Level
The "clearwell" is the 75,000-gallon reservoir. This reservoir is unbaffled. The normal minimum operational level for the reservoir yields a minimum volume of 66,700 gallons. This level is 2 feet from the top of the tank.

Chlorine Dosage
Prior to beginning the test, the target chlorine residual leaving the treatment plant was 0.83 mg/L. With chlorine demand exhausted, an increase of 1.2 mg/L of chlorine dosage was used to provide the tracer concentration.

The accepted EPA method of determining contact time is to use the time at which 10% of the added tracer concentration reaches the sampling point (T_{10}). During the test, a residual increase of 1.2 mg/L was added to an initial residual concentration of 0.83 mg/L. The 10% increase concentration (C_{10}) is therefore 0.95 mg/L as shown in the following calculation:

$$C_{10} = \text{initial mg/L} + 10\% \text{ (added residual)}$$
$$C_{10} = 0.83 \text{ mg/L} + 0.1 \text{ (1.2 mg/L)}$$
$$C_{10} = 0.95 \text{ mg/L}$$

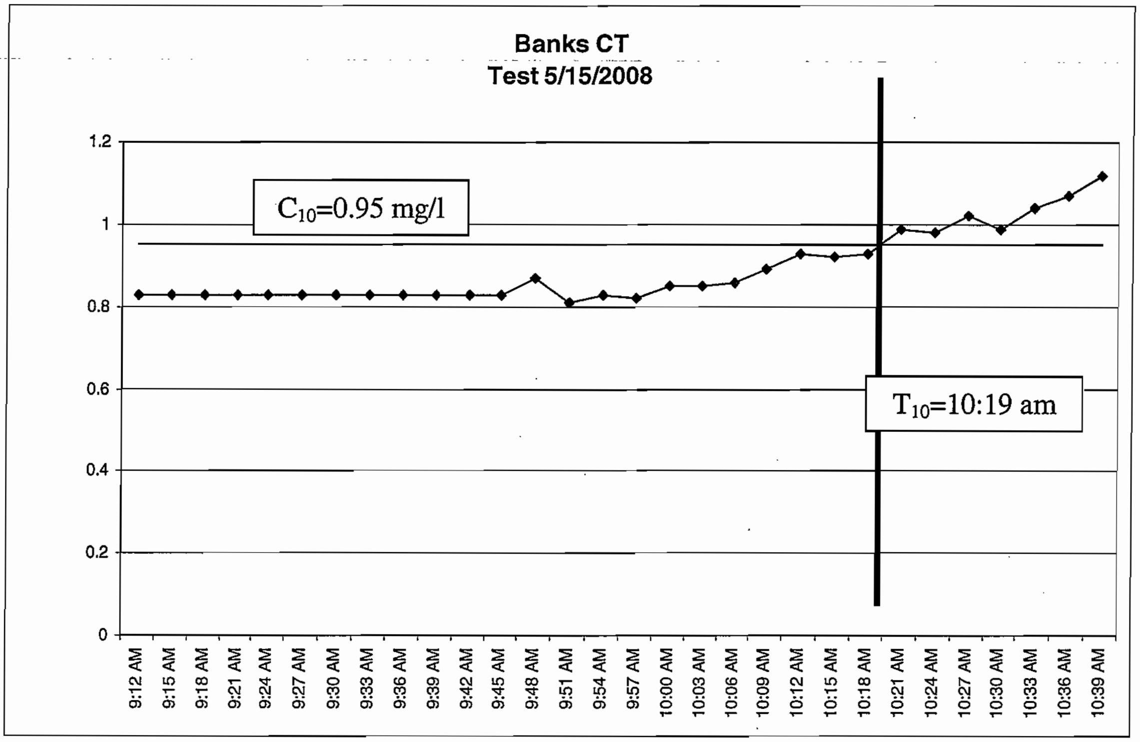
Measured Contact Time

The chlorine dosage was increased at 9:12 AM, starting the test. As can be seen in Figure 1, the time at which the C_{10} concentration was reached was 10:19 AM or **67 minutes** after the dosage was increased.

Appendix B

Disinfection Contact Time Tracer Study

Figure 1 – CT Tracer Test Results (11-28-07)



Calculated CT

The product of the free chlorine residual concentration (mg/L) and the contact time (min.) is termed "CT". CT tables have been developed to allow operators to determine the CT value required to ensure adequate disinfection. The required CT value depends on the water temperature, pH, chlorine residual, and the log-reduction required. Actual achieved CT must be greater than the required CT. The maximum CT required for the City of Banks would be **58** (assumes most conservative values of Temp = 5.0 degrees-C, pH < 7.5 and 1.0-log inactivation of giardia cysts).

The residual of 0.8 is typically used. During times matching the test conditions the contact time is **67 minutes**. The CT available in this case is **53.6** [0.8 mg/L x 67 min.].

Conclusions

Based on the current operational strategy, the City of Banks does not have sufficient contact time for the worst-case scenario (Temp = 5.0 degrees-C, pH < 7.5). However, the temperature is rarely lower than 8 degrees-C. When the temperature is 10 degrees-C, the required CT is 44. The City meets the required CT under these conditions. ***Based on the contact tracer study, it is recommended that when water temperatures are below 10 degrees-C, the City of Banks increase the residual chlorine concentration to 1.0 mg/l.***

Appendix C

Amendment #1 – Water System Flow Control

27 July 2011

Technical Memorandum

To: Jim Hough – City of Banks

From: Gordon Munro – Kennedy/Jenks Consultants
Erik Hoovestol – Kennedy/Jenks Consultants

Subject: City of Banks – Water System Flow Control Evaluation
K/J 0791015*12

1.0 Introduction

Kennedy/Jenks Consultants (Kennedy/Jenks) was authorized by the City of Banks (City) to investigate opportunities to increase the efficiency and reliability of the operation of the Banks Water System and prepare an updated Water System Capital Improvements Plan (CIP). The focus of the investigation is flow control through the system from the springs to the Carstens Reservoirs. This memo presents the findings of this effort along with recommendations. Efforts into this study included several site visits and many discussions with City staff as well as Frost Engineering, who maintains the City's current SCADA system.

The attached Figure 1 shows a schematic of the City's water system and the location of proposed features and existing features relevant to this study.

Flow through the facilities from the springs to the Carstens Reservoirs is by gravity. The design plans for the various elements show flow control elements that were either never installed or taken out of service. The flow control points in the system consist of the following:

- flow into the slow sand filter (SSF) treatment plant;
- flow out of the SSF and into the chlorine contact tank;
- flow out of the chlorine contact tank and into transmission pipe;
- flow through the pressure reducing valve (PRV) at the North Star Reservoir site and into the upper pressure zone;
- flow through a second PRV on Sellers Road and into the main pressure zone;
- flow into the Carstens Reservoirs.

The key issues are:

- controlling the flow into the slow sand filters to maximize water production and operator efficiency;
- controlling the flow from the SSF to the chlorine contact tank such that the treatment is not compromised, and maximizing the flow from the springs;
- controlling the flow out of the chlorine contact tank to allow for adequate disinfection and provide flow into the distribution system;
- keeping the 40 customers on the transmission line supplied with water during filter changes.
- setting the PRV's to provide appropriate pressure and maximize flow from the springs;
- controlling the flow into the Carstens Reservoirs to maximize the flow from the springs, but avoid overflowing the reservoirs.

2.0 Clearwell Outlet Flow Control

The State of Oregon requires that surface waters, such as that from the springs, have a minimum amount of disinfection time after chlorine is added before it can reach the first customer. This is referred to as chlorine contact time. The Clearwell built in 2002 next to the SSF was installed primarily for this purpose but has not been utilized for chlorine contact time. However, it will be used for chlorine contact after the current water system improvement project is completed.

The amount of time the water is retained for contact time is a function of the volume of water in the Clearwell and the flow rate of water through the Clearwell. The contact time required is a function of the chlorine concentration, the log inactivation required (which is based upon the treatment system employed) and the temperature. If the actual contact time is less than the required contact time, then the water will be insufficiently disinfected and "boil water notices" will need to be sent out.

Based upon our calculations the minimum level in the Clearwell for a flow maximum flow rate of 270 gpm would be 10.4 ft. Lower flow rates will require less volume of water in the Clearwell. This can be achieved by controlling the flow out of the Clearwell and/or controlling the water level in the Clearwell to maintain a minimum volume.

Although the original construction plans for the Clearwell showed a flow control valve on the outlet of the tank, for reasons unknown it was never installed. We are proposing to install a valve to limit the flow of water out of the tank and thus maintain an appropriate contact time for disinfection. The valve will be a modulating butterfly valve installed in the existing vault with the flow meter next to the Clearwell. The settings on the valve will be adjustable remotely so the operators do not have to enter the vault to change the settings. The flow rate will correspond to a minimum operating level of the Clearwell. A table showing flow rates and the corresponding Clearwell levels will be provided to the operators.

This valve should not be adjusted below 100 gpm to insure that the 40 customers connected to this line are adequately supplied during peak hourly demand times of the day such as early morning and evening.

During the summer the actual flow available from the springs may be less than 100 gpm. If it is less, the valve setting should be adjusted down to the available flow.

Estimated Cost, Clearwell Outlet Control Valve

Valve	$4,500
Installation	$500
Electrical	$500
Engineering	$2,500
SCADA and PLC Programming	$1,000
Contingency	$1,000
Total	**$10,000**

This valve should be installed as part of the water system improvements project along with the associated electrical and controls. Engineering includes adding the valve to approximately 4 sheets, preparing specifications, and adding the flow feature to the controls strategy. Pending timing with the upcoming project, this work could be done prior to bidding, during bidding by addendum, or by change order during construction.

If not included in the upcoming project, the costs would be higher due to separate bidding and contracting requirements.

2.1 Clearwell Inlet Valve

There are two events that need to be controlled to prevent the Clearwell from overflowing. First, when the demand is low enough that the Clearwell fills. Second, when the Carstens reservoirs are full which will in turn cause the water to backup into the Clearwell. The resulting discharge of chlorinated water to the local stream is environmentally undesirable.

A simple on/off actuated butterfly valve on the inlet line between the SSF and the Clearwell is proposed that will shut when the Clearwell is full. The valve could be installed in the metering vault already included in the current water system improvement project. If this valve is closed for a long enough time period, the SSF will be allowed to overflow. There is existing piping to accommodate the overflow of water from the SSF and return the water to the stream. The water from the SSF is not chlorinated and therefore is not an environmental risk if it is returned to the stream. The overflow water does not pass through the sand filter so filter maintenance costs are not affected.

It is recommended that this valve be installed as part of the water system improvement project. If it is decided not to proceed initially with the installation of this valve, it is recommended that provisions in the electrical and controls system should be made during construction in the upcoming Water System Improvements Project to allow for installation of the Clearwell Inlet valve after the testing period for the increased flow rate of the SSF. Provisions would involve installing conduit and preserving space in the SCADA display screens. These provisions should only total a few hundred dollars and could most easily be done by a change order during construction and changes made to the as-built drawings.

Estimated Cost, Clearwell Inlet Valve

Valve:	$4,200
Installation	$500
Electrical	$200
Engineering	$1,000
PLC Programming	$ 300
Contingency	$ 700
Total	**$6,900**

If not included in the upcoming project, the cost would be significantly more as there would need to be separate bid documents, bidding, and construction.

2.1.1 Transmission Line Flow Control

During filter cleaning episodes, one of the two sand filters is taken off line. During filter changes the level in the Clearwell may lower to unacceptably low levels if the remaining filter cannot keep up with the minimum flow setting of 100 gpm.

Under these circumstances the system needs to be able to provide 100 gpm to the upper pressure zone for potential peak demands, and limit the flow from the upper pressure zone into the Carsten reservoir to reduce the total demand supplied by the springs. . Providing a valve to control the amount of water going into Carstens Reservoirs would allow the operators the flexibility to reduce the flow rate leaving the Clearwell during filter changes and to insure water to the customers located on the transmission main.

The best location for this valve would be at inlet valve vault at the Carstens Reservoir site. The vault has existing electrical conduit to the control panel that is being used for the existing flow meter that could be utilized. The valve would be a modulating butterfly valve and could be controlled remotely via the SCADA system. The valve could be programmed such that it would not close all the way in order to prevent over pressurizing the segment of the transmission line between the Sellers Road Valve and Carstens Reservoirs.

Estimated Cost, Automated Inlet Valve

Valve	$4,500
Installation	$500
Electrical	$500
Engineering	$1,000
SCADA and PLC Programming	$1,000
Contingency	$1,000
Total	**$8,500**

As a lowest cost option, a manually operated butterfly valve installed by City crews could be installed for approximately $1,000 for materials (valve, coupling, and valve can). This would be a buried butterfly valve and operated from the surface using a typical valve wrench and will require the operators to adjust as needed during filter changes. Adjusting the valve to the desired flow rate could be time consuming at least initially and there is risk that the valve could be closed all the way and cause the segment of the transmission line from the Sellers Road Valve and the Carstens Reservoirs to over pressurize.

It is recommended that the automated valve be installed with the water improvement project.

2.1.2 Slow Sand Filter Inlet Control

Previously, the flow rate from the springs were adjusted up at the Large Green Mountain Springs and required the operators to drive up to the springs, adjust the valve and come back to the SSF and see if their manual adjustment was correct and repeat as necessary. As part of this study it was learned that the operators can adjust a valve inside the SSF pipe gallery and this has increased operator efficiency greatly.

The flow into the filters from the springs is now controlled by manually adjusting a gate valve from the Large Green Mountain Springs inside the filter room gallery. The operators rarely need to make more than one adjustment per day. The valve for the Small Springs line is not typically adjusted.

Automated butterfly valves were at one time installed on both the Large and Small Springs lines and were reportedly set to automatically shut down when the turbidity from the springs was too high. These valves are not currently operational as they lack power conductors and controls programming. They have simple on/off actuators that may or may not still be functional.

Currently, adjustments for controlling flow to the filters is done by adjusting the valve from the Large Springs inside the SSF. Automating the valve on the Large Green Mountain Springs line with a modulating actuator and connecting it to the SCADA and PLC programming so that adjustments could be made remotely would only slightly increase operator efficiency, and possibly provide for slightly more efficient operation of the SSF by keeping the water levels and resulting throughput at maximum levels. The valve would be adjusted by operator set points and controlled by the flow rate and the level of the water in each of the slow sand filters.

Due to the typical low flow rates from the Small Springs, no automated controls are recommended on the influent line from the small springs. Currently, adjustments for controlling inflow to the filters are done with adjusting only flow from the Large Springs.

It would be most cost effective to have this valve installed during the upcoming water system improvements project.

Estimated Cost, Slow Sand Filter Inlet Valve

Actuator:	$1,500
Installation	$ 500
Electrical	$ 500
Engineering	$ 500
SCADA and PLC Programming	$1,000
Contingency	$ 500
Total	**$4500**

If not included in the upcoming project, the costs would be higher due to separate bidding and contracting requirements.

Due to the limited benefits and cost of this valve, Kennedy/Jenks and City staff concur that it is not required as part of the water improvement project. The City may want to consider installation at a later date in order to provide control capability during times when access to the SSF site is impaired.

3.0 Water Production Efficiency

Water produced from the springs and SSF is approximately 35% less expensive than the water produced from the wells mainly due to the lower power costs than pumping from the wells; therefore, efforts should be made to maximize flow from the SSF and decrease the need for water pumped from the wells.

The City currently has water rights for a total of 270 gallons per minute (gpm) from the Large Springs and Small Springs. Currently only about 120 gpm or 44% of this is utilized on an annual basis. The Large and Small Springs reportedly have a minimum summer flow rate of about 90 gpm and 20 gpm respectfully with ample additional water reportedly available during the remainder of the year. However, the flow rate available during the rest of the year has not been verified or documented.

The amount of water that can be used from the springs is currently limited by the size (and associated chlorine contact time) of the existing 70,000 gallon Northstar Reservoir. The State of Oregon has limited the flow rate through the Northstar Reservoir to 120 gpm . After the point of chlorination is moved to the 220,000 gallon Clearwell next to the SSF, as is currently planned for in the current Water System Improvement Project, this limitation will be absent. The flow rate out of the Northstar Reservoir is currently partially controlled by manually adjusting the Sellers Road Valve.

The Clearwell and the volume in the piping from the Clearwell to the North Star site has the disinfection contact time capacity for 400 gpm. However, the actual flow rate is limited to 270 gpm by the water right.

The output of the system is limited by the existing valving at the SSF. The 1998 Water System Master Plan Update suggests that the filters were conservatively designed for a maximum flow rate of 100 gpm each and reports that by removing the inserts on the effluent control valves the maximum flow rate could be increased to 150 gpm each. Again, this would need to be limited to a total of 270 gpm based upon the current water right. This flow would likely be only achievable immediately after cleaning. Current maximum flow rates after cleaning are limited to 100 gpm maximum by the valving and as the filters become partially clogged the flow rates go down to about 60 gpm before cleaning.

The State of Oregon has no requirements on maximum flow rate through the filters and is only concerned that the required turbidity levels are reached. In the last Sanitary Survey, the State reported that the current flow rate of 0.065 gallons per minute per square foot (gpm/sf). falls well within commonly accepted range of .03 gpm/sf to 0.10 gpm/sf. Assuming an optimistic increase to a maximum of 135 gpm per filter, we would still fall within this range with a flow rate of 0.088 gpm/sf which is still within the commonly accepted range.

Due to many factors, the true capacity of the filters can only be determined by actual trial runs. We recommend removing the inserts in the existing valves and increasing the flow rate on a trial basis in incremental steps over a period of up to a year in different types of influent turbidity to evaluate the performance of the SSF at higher flow rates. If it is found that significantly higher flow rates can be achieved, then proceed with installing the following items which are discussed in more detail below:

1. The new multifunction altitude valve at Carstens Reservoir.

2. The low flow bypass at the Sellers Road Valve.

The total cost of the additional valving required to accommodate an increase in flow from the SSF is approximately $4,000 without engineering support. It is assumed that the work can be done by City staff. Additional engineering support may be needed to assist operators with maximizing the flow from the slow sand filters and analyzing filter cleaning down time frequency verses water production. The level of support is uncertain at this time; however, a place holder of $2,000 is included for planning purposes. Table 1 below presents the potential payback period for the cost of the valves at different lfow rates of increased SSF production and utilizing more of the less expensive water from the SSF instead of using the more expensive well water.

Table 1

Increase in Average Flow Rate per Filter	Total Increase in Flow Rate from the Slow Sand Filter	Annual Savings	Potential Pay Back Time $4,100 (years)*
10	20	$894	6.7
25	50	$2,235	2.6
50	100	$4,470	1.3

*Assumes power cost for pumping from the wells verses filter cleaning labor costs at the SSF. Labor cost per gallon at SSF is constant.

3.1 Carstens Reservoirs Valve

Currently there is no automatic valving to shut off the flow of water from the SSF into the Carstens Reservoir to prevent overflow. Overflowing of the reservoir presents two concerns. One is that the City is wasting treated water, and the other is that treated water with small amounts of chlorine will flow into the stream by the Behrman Wells and pose an environmental issue.

The altitude valve that was originally designed and installed to prevent overfilling has been removed. It was removed to prevent over pressurizing the segment of pipe between the existing PRV station and the Carstens Reservoirs and the 10-12 customers between the Sellers Road Valve and the Carstens Reservoirs. The valve was designed to close when the reservoir fills which could potentially over pressurize the segment of pipe between the Sellers Road PRV Station and the Carstens Reservoirs. Additionally, the valve did not allow for water to flow backwards from the reservoir to supply water to the customers between the Carstens Reservoirs and the Sellers Road PRV station should the Sellers Road valve close.

The Behrman Well pumping records and Carstens Reservoirs levels were reviewed and it was found that with current flow rates from the SSF, the Carstens Reservoirs do not overflow despite no control of the flow into the reservoirs from the SSF. The town currently uses slightly more water on the lowest use days than is currently provided from the SSF. Increasing the flow rate from the SSF will increase the likelihood of the Carstens Reservoirs overfilling during low water consumption periods.

We recommend installing a two way flow altitude valve with a pressure relief override if it is proved that the capacity of the slow sand filters can be significantly increased. The valve will function automatically with no need for electronic controls. This multifunction valve will prevent overfilling of the reservoirs, allow flow back from the reservoirs to customers located between the Sellers road valve and the Carstens's Reservoir, and prevent the line from over pressurizing. The existing valve (which is laying in the corner of the vault) could be refurbished and have the additional reverse flow and pressure relief features added.

Reinstallation of this valve would most effectively be done by City staff without the need for engineering design plans or contractor installation. The refurbishing, addition of features, and start up could be done on site by the factory technician. If the work is done differently, the cost will be higher.

Estimated Cost: $5,000 -new valve

Estimated Cost $3,000 -refurbishing and modifying existing valve.

3.2 Sellers Road Valve Low Flow Bypass

The Sellers road valve consists of a valve in a vault that has a pressure sustaining function for the water above the valve and a pressure reducing function to reduce pressure below the valve. As discussed above, when the flow into Carstens Reservoir is stopped, the only remaining flow would be to supply the 10 or 12 customer located on the transmission line. The valve manufacturer reports that the existing 3-inch diameter valve can be damaged and not function properly during low flow events. Installation of low flow bypass piping and valve inside the existing vault with a one inch pressure sustaining and reducing valve and piping is recommended. Installation of this valve would most effectively be done by City staff without the need for engineered design plans or contractor installation. A manufacture's technician would assist with the initial settings on the new by- pass valve. Adjustments in the settings of this valve and the new Northstar pressure reducing valve will need to be made to accommodate the additional flow rate.

Estimated Cost: $1,000

4.0 Summary and Recommendations

Kennedy/Jenks Consultants recommends that the following items be added to the current Water System Improvements Project:

1. Clearwell Outlet Control
2. Clearwell Inlet Control
3. Transmission Line Control into Carstens Reservoirs

The estimated cost for these improvements is $25,400 if they are done with the water improvement project. Since the project is currently out to bid, the City may want to consider waiting until bids are in and evaluate the project budget at that time.

It is not recommended to provide additional automated controls for the inflow to the slow sand filters.

After completion of the SSF Capacity study, assess the need for:

1. Carstens Reservoirs Multifunction Altitude Valve
2. Sellers Road Valve Modifications

The estimated cost for these improvements is $6,000 if the construction is done by City Staff as a maintenance item.

The water system can be operated as it has in the past with manual control in some cases and no control in other cases; however, operation of the system will not be as efficient or reliable. Further, there would be a greater potential for inadequate chlorine contact time.

5.0 Updated Water System CIP Plan

Table 2 presents a proposed updated Water System CIP Plan.

Of concern, but not included in this plan is providing a more reliable power service line to the Carstens Reservoir Site.

This is the same CIP plan as the adopted 2009 Water System Master Plan with the following changes:

1. The option 1B Well No. 2 Backup Supply, was selected and Option 1A-Well No. 2-Additional Water Source was deleted due to the hydrogeologic limitation of both wells not being able to operate at the same time; however, the original budget for item 1B of $540,000 was replaced with the budget of $670,000 from Item 1A.

2. Item 3.1-Clearwell Flow Control valves discussed above were added under Item 3-SSFP Site Upgrades.

3. Item 3.2-SSF Filter Capacity Study and Transmission Line Controls discussed above was added under Item 3-SSFP Site Upgrades.

4. Item 3.3-SSF Inflow Control was added under Item 3-SSFP Site Upgrades.

5. Item 10 - Initial Leak Detection Survey was completed; however, this item was retained in the CIP plan as leak detection surveys should be done on a recurring basis (approximately every five years).

Table 2: Water System Capital Improvement Plan

Project	Description	Total Project Cost	Schedule	SDC Eligible Cost
1	Well No. 2 – Backup Supply	$670,000	Currently In Design	$670,000
2	Transmission Pipeline Replacement	$2,750,000	Pending 11B Below	$530,000
3	SSF Site Upgrades, Creation of Intermediate Pressure Zone	$270,000	Currently in Design	$0
3.1	Clearwell Flow and Level Control	$25,400	2011	$0
3.2	SSF Filter Capacity Study and Additional Transmission Line Controls	$6,000	2012, Pending SSF testing	$0
3.3	SSF Inlet Control	$4,500	Optional	$0
4	Behrman Well Site Upgrades*	$220,000	Currently in Design	$0
5	1.0-MG Main Zone Reservoir	$2,200,000	By 2024	$2,200,000
6	Distribution System Looping and Upgrades	$620,000	2010-2024	$0
7	SCADA System Upgrades	$450,000	optional	$0

8	Automatic Meter Reading	$420,000	optional	$0
9	Security System Upgrades	$100,000	optional	$0
10	Leak Detection Survey	$10,000	2015	$0
11A	Quail Valley Golf Course Study	$40,000	2010	$40,000
	Design & Construction	$1,200,000	2011	$1,200,000
11B	Sellers Road Wellfield Study	$150,000	2011	$150,000
	Design & Construction	$2,400,000	2012	$2,400,000
11C	Southwest Well Field Study	$300,000	2013	$300,000
	Design & construction	$1,500,000	2014	$1,500,000
11D	Alternative Water Providers	$0	2010	$0
	CIP Total:	**$13,340,000***		**$8,860,000**

*Rounded to the nearest $10,000