



Kennedy Jenks

1500 NE Irving St., Suite 200
Portland, Oregon 97232
503-423-4000
FAX: 503-295-4901

**City of Banks
Water System Master
Plan Amendment**

9 March 2023



EXPIRES: 12/31/2024

Prepared for

City of Banks
13680 NW Main Street
Banks, Oregon 97106

KJ Project No. 2276009.00

Adopted by the Banks City Council on March 14, 2023

Table of Contents

List of Tables.....	iv
List of Figures.....	iv
List of Appendices.....	iv
Section 1: Introduction	1
1.1 Purpose and Authorization	1
1.2 Introduction	1
Section 2: Water System Description	3
2.1 Water Supply	3
2.1.1 Water Rights	3
2.1.2 Water Production	4
2.2 Water Treatment	5
2.2.1 Surface Water	5
2.2.2 Groundwater	6
2.3 Treated Water Storage.....	6
2.3.1 High Elevation Zone	8
2.3.2 Main Pressure Zone	8
2.4 Transmission and Distribution Pipelines.....	8
2.4.1 Transmission.....	9
2.4.1.1 Treated Water Transmission	9
2.4.1.2 Water Transmission Main.....	9
2.4.2 Distribution System	9
Section 3: Water Supply Requirements	10
3.1 Growth Projections.....	10
3.2 Projected Supply Requirements	10
3.2.1 Water Supply Redundancy.....	11
Section 4: Storage & Distribution Requirements	12
4.1 Transmission Capacity	12
4.2 Storage Requirements	12
4.2.1 Projected Storage Needs	12
4.2.2 Recommended Storage Upgrade.....	13
4.2.3 Reservoir #2 Rehabilitation Project	13
4.2.4 Reservoir Site Power/Control Building Security Improvements.....	13
4.2.4.1 Power Improvements	14
4.2.4.2 Well Transmission Line	14
4.2.4.3 Control Building.....	14

	4.2.4.4	Security Improvements.....	14
4.3		Distribution System Capacity.....	15
	4.3.1	Fire Flow Conditions	15
	4.3.2	Distribution Piping Projects Completed	15
	4.3.3	Distribution Replacement and Expansion Projects	16
	4.3.3.1	Cedar Canyon Road Dairy Creek Crossing	16
	4.3.3.2	Banks Road Waterline Replacement.....	17
	4.3.3.3	Distribution System Future Expansion.....	17
	4.3.4	Metering.....	18
	4.3.4.1	Expand AMR Metering	18
	4.3.4.2	AMI Metering.....	19
	4.3.4.3	Recommended Metering Approach	19

Section 5: Water Supply and Treatment Requirements20

5.1		Surface Water Diversion Improvements.....	20
	5.1.1	West Springs.....	20
	5.1.2	East Springs.....	21
	5.1.2.1	Upper Diversion Point	21
	5.1.2.2	Lower Diversion Point	21
5.2		Slow Sand Filter Plant Improvements.....	22
	5.2.1	Existing Conditions.....	22
	5.2.2	Pretreatment	23
	5.2.2.1	Alternative PT1 - Gravity-Settling	23
	5.2.2.2	Alternative PT2 - Mechanical Prefiltration Unit.....	23
	5.2.2.3	Alternative PT3 - Recommission Existing Flocculator Unit	24
	5.2.2.4	Recommended Pretreatment Alternative.....	24
	5.2.3	Filter Plant Piping Gallery Improvements.....	24
	5.2.4	Water Filtration Plant Improvements	25
	5.2.4.1	Alternative F1 - Retrofit Existing Sedimentation Basin to Slow Sand Filter.....	25
	5.2.4.2	Alternative F2 – Construct a New Slow Sand Filter.....	25
	5.2.4.3	Alternative F3 – Package Pressure Filtration.....	26
	5.2.4.4	Comparison of Filtration Alternatives.....	26
	5.2.5	Filtration Recommendation	27
	5.2.6	SSF Plant Additional Improvements	28
	5.2.7	Post-Filtration Improvements.....	28
	5.2.7.1	Reducing Hydraulic Restrictions.....	28
	5.2.7.2	Sodium Hypochlorite Generation.....	28
	5.2.7.3	Chemical Room Climate Controls.....	29
	5.2.8	Plant Security.....	29
5.3		Disinfection for New Supplies.....	29
5.4		Long Term Water Supply Alternatives	29
	5.4.1	Regional Water Providers	30
	5.4.1.1	Tualatin Valley Irrigation District	30
	5.4.1.2	Alternative WS1 - Joint Water Commission	30
	5.4.1.3	Alternative WS2 - City of Hillsboro.....	31

5.4.2	Alternative WS3 - Local Surface Water Supply	
	Alternative	31
5.4.2.1	Treatment Plant Description	32
5.4.2.2	Operation and Maintenance	32
5.4.3	Water Supply Alternatives Discussion	33
5.5	Long Term Water Supply and Storage Strategy	33
5.5.1	Phase 1 – Maximize City’s Existing Assets	34
5.5.2	Phase 2 – New Wells and ASR Testing	34
5.5.3	Phase 3 Implement Surface Water Treatment and ASR.....	34
Section 6:	Capital Improvements	36
Section 7:	Funding Sources	38
7.1	Federal Programs	38
7.1.1	Rural Utilities Service Water and Wastewater Loans and Grants	38
7.1.1.1	Eligibility Requirements	38
7.1.1.2	Terms.....	38
7.1.2	Community Development Block Grants.....	39
7.1.2.1	Eligibility Requirements	39
7.2	State Programs	39
7.2.1	Water/Wastewater Financing Program.....	39
7.2.1.1	Eligibility Requirements	39
7.2.1.2	Terms.....	40
7.2.2	Safe Drinking Water Revolving Loan Fund.....	40
7.2.2.1	Eligibility Requirements	40
7.2.2.2	Terms.....	40
<i>References</i>		42

List of Tables

- 2-1 Summary of Water Rights Held by City of Banks
- 2-2 Summary of Water Right Volumes Held by City of Banks
- 2-3 Historic Diversion from Springs Water Supply
- 2-4 Summary of Existing Water Storage Facilities and Pressure Zones
- 3-1 Projected Growth in Residential Population through 2042
- 3-2 Projected Water Demand for 2042
- 3-3 Maximum Reliable Water Supply Scenarios
- 4-1 Storage Requirements for Projected Growth Scenarios
- 5-1 Comparison of SSF Loading Rates for Filter Combinations
- 5-2 Summary of Firm Capacity Conditions for SSF Alternatives
- 5-3 Alternative WS1 - JWC Initial Connect Costs
- 5-4 Alternative WS2 - City of Hillsboro Initial Connection Costs
- 5-5 Design Phases for Water Treatment Plant
- 5-6 Water Treatment Plant Life Cycle Cost Summary
- 6-1 Capital Improvement Plan

List of Figures

- 2-1 Water System Map
- 2-2 Distribution System
- 4-1 Future Buildout Scenarios

List of Appendices

- A Water Use Flowchart

Section 1: Introduction

1.1 Purpose and Authorization

The purpose of this Water Master Plan Amendment (WMPA) plan is to provide the City of Banks (City) with an updated comprehensive water master plan for water supply, treatment, and distribution systems. The plan includes a description of the existing water system, the planning criteria, a water system analysis, and a capital improvement plan.

The City authorized Kennedy/Jenks Consultants (Kennedy Jenks) to prepare this amendment to document projects completed since the 2011 WMPA and provide project concepts to replace aging infrastructure, comply with updated regulations and standards, and projected growth.

1.2 Introduction

The City of Banks owns and operates Public Water System No. OR4100076 in Washington County Oregon. The City currently has no interties to other water systems and relies on surface water and groundwater supplies. From 2015 to 2020 the City enacted several water use curtailments during peak summer demands. The curtailments were required for two primary reasons:

- The City's aging transmission and distribution system was in poor condition and unaccounted/non-revenue water was estimated as high at 50%
- The City's supply and treatment processes could not supply enough water to meet peak day demands

Since 2019 there has been significant interest in residential development in recently annexed areas of Banks. The total number of new residential connections proposed would more than double the number of connections to the water system. This has raised the water supply issue to the front of discussions. The City has imposed conditions of approval for large developments in Banks requiring developers to provide the City sufficient water supply to serve the proposed development. As a result, bringing these developments to approval has been slow.

This WMPA will provide a road map for the City to pursue additional supply, treatment, and storage to meet projected demands and maintain the existing system in good condition. It will also provide the basis of planning for growth and will support the City in pursuit of funding capital improvements.

1.3 Water System Master Plan Amendment Exclusions

This Water System Master Plan Amendment amends the 2011 Water System Master Plan and does not include all sections required by Oregon Administrative Rule (OAR) 333-061-0060(5). The following sections from the 2011 Water System Master Plan apply to this amendment:

- Water Quality, Service Goals, and Treatment Requirements – Existing water sources have not changed and the City has had no issues maintaining water quality or the level of service. Water sources and treatment recommendations in this
- Seismic Risk Assessment – OAR 333-061-0060(5)(J) requires Water Master Plans to Conduct a seismic risk assessment and mitigation plan for water systems fully or partially located in areas identified as VII to X, inclusive, for moderate to very heavy damage potential using the Map of Earthquake and Tsunami Damage Potential for a Simulated Magnitude 9 Cascadia Earthquake. Banks sits in the VII zone, however, because this is a water master plan amendment to a 2011 Plan this requirement does not apply. Projects recommended will be designed to survive the design event when they reach the design stage.

A review of these items will be included in the comprehensive Water System Master Plan Update that the City will be required to prepare by 2029.

Section 2: Water System Description

The City's water system elements are described in this section. The major supply, transmission, treatment, storage, and distribution elements are shown on Figure 2-1.

2.1 Water Supply

The City of Banks owns three sources of water supply.

- The large West Green Mountain Springs (West Springs) can reliably supply 110 gallons per minute (gpm) during the dry season and between 150 gpm and 200 gpm during the rainy season.
- The small Green Mountain Springs (East Springs) has been reported to supply up to 140 gpm during the rainy season and decreases to 100 gpm during the dry season. The small springs are subject to high turbidity events during heavy rain or snow and cannot be used continuously in winter. Recent work by staff have enabled capture of raw water up to 200 gallons per minute from the East Springs during spring when stream flow is typically high. Additional monitoring will be required to determine if such flowrates can be sustained throughout the dry season.
- Behrman Well #1 can reliably supply 230 gpm when pumping alone. Well #1 has sensor/control issues that currently prevent it from pumping for more than 1 hour.
- Behrman Well #2 can reliably supply 275 gpm for up to 7 days. Extended pumping at this rate can lower the groundwater table below the City's allowable drawdown.

The apparent subsurface connection between Well #1 and Well #2, resulting in aquifer drawdown, dictates that only one well can operate at a time.

2.1.1 Water Rights






Table 2-1 provides a summary of the City's water rights.

Table 2-1: 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	Large Springs
S-65611	S-48173	83138	--	25-Aug-1983	Municipal	Small Springs
G-8476	G-7593	--	T-10055	29-Sep-1977	Municipal	Well #1
G-15887	G-16312	95849	--	5-Dec-2002	Municipal	Well #2

The authorized use and maximum used to date volumes are summarized in Table 2-2.

LEGEND

Water Lines	
Water Reservoirs	
Water Wells	
City Limits	
Parcels	

INTAKE STRUCTURE AND WEST SPRING

DIVERSION DAMS AND EAST SPRINGS

SLOW SAND FILTER PLANT AND CLEARWELL

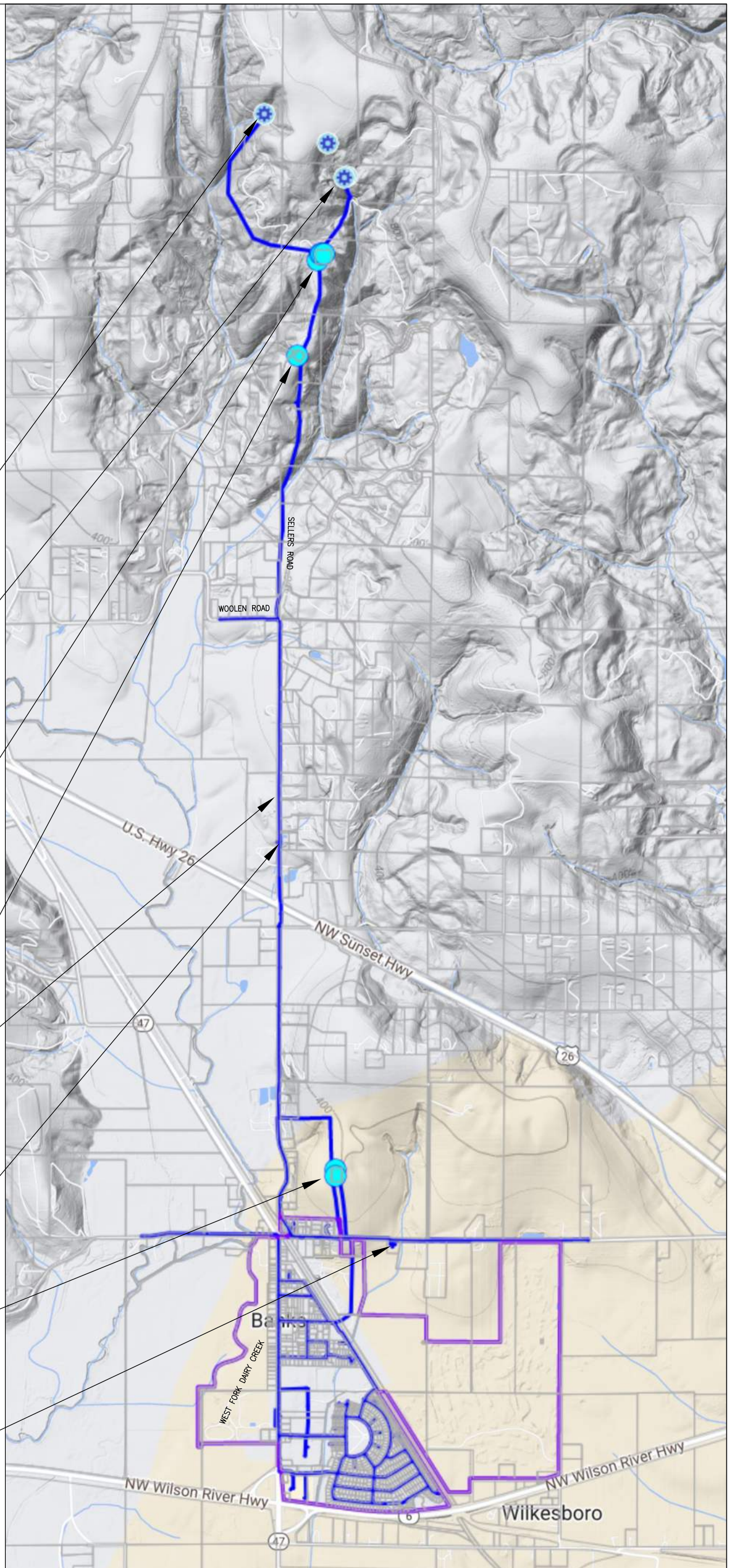
NORTH STAR RESERVOIR

8-INCH C-900 PVC TRANSMISSION LINE

PRESSURE SUSTAINING / PRESSURE REDUCING VALVE AND MONITORING METER

CARSTEN RESERVOIRS 1 & 2

BEHRMAN WELL



NOT TO SCALE

Kennedy/Jenks Consultants

CITY OF BANKS
WATER SYSTEM MASTER PLAN AMENDMENT
MARCH 2023

WATER SYSTEM MAP

K/J 2276009.00

FIGURE 2-1

Table 2-2: Summary of Water Right Volumes Held by the City of Banks

Application Number	Authorized Use cfs	Max Use to Date cfs	Authorized Date for Completion of Development
S-9207	0.42	0.42	Certificated
S-65611	0.18	0.18	Certificated
G-8476	0.67	0.61	Pending Extension
G-15887	1.00	1.00	Certificated

Note: These water rights specify a maximum rate, and do not have an associated maximum duty.
cfs = cubic feet per second

Banks owns water rights totaling 2.27 cubic feet per second (cfs) (1,020 gpm). A total of 0.6 cfs (269 gpm) is in the form of surface water which has two geographically distinct points of diversion. A total of 1.67 cfs (748 gpm) is in the form of groundwater which can be diverted from Wells #1 and #2.

The water rights for the two springs are specified at two different diversion points as follows:

- Small Springs is limited to 0.18 cfs (81 gpm)
- Large Springs is limited to 0.42 cfs (188 gpm)

While water is available from the small springs in excess of the permitted right during most of the year, it cannot be diverted under the current configuration. If the two diversion points could be combined, the total water that could be diverted from the springs combined would be 0.6 cfs (269 gpm).

A water use flowchart can be found in Appendix A detailing the City’s various water sources and water uses graphically. Sources (springs and wells), major infrastructure and measurement points (Banks Road, Carsten Reservoirs, etc.), and water use locations are represented by the horizontal blue bars.

2.1.2 Water Production

Production of water from the City’s supplies varies seasonally. The production from the surface water supply sourced from springs is high during winter and declines through the summer dry season. Table 2-3 provides a summary of historical diversion from the two springs combined from 2018 through 2022.

Table 2-3: Historic Diversion from Springs Water Supply

Month	Totalized Spring Diversions ^(a)	
	MG ^(b)	gpm
January	5.4	121
February	5.3	131
March	5.9	134
April	6.4	148
May	6.8	181
June	6.7	155
July	6.3	142
August	6.2	139
September	5.6	130
October	4.9	110
November	4.5	106
December	4.8	108
Minimum	4.8	108
Average	5.7	134
Maximum	6.8	181

(a) Combined monthly diversions from the West and East springs based on Oregon Water Resources Department (OWRD) Water Use Reporting 5-year average (2018-2022)

(b) MG = Million Gallons

For the years evaluated, the maximum production from the springs was 181 gpm near the end of the wet season when rainfall has recharged the springs. The decline in production is apparent from August to September at the end of the dry season and continues into December.

The small watershed that recharges the springs is limited in its capacity to provide water through the season and requires at least 3 months to recover. When coupled with challenging maintenance requirements for the small springs intakes the production of water can be significantly below the permitted water right.

Recent efforts to improve maintenance and small improvements to the impoundments have increased production from the small springs and the total production from the springs has been observed as high as 200 gpm during the rainy season. Some of this limitation is likely due to hydraulic restrictions in the pipeline which can be removed. Several years of data will be required to assess the reliable volume of water that can be secured from the springs.

2.2 Water Treatment

2.2.1 Surface Water

The City constructed a Slow-Sand Filter (SSF) Plant in 1997 to treat the raw water from the Green Mountain Springs supply. The treatment system consists of a single sedimentation basin followed by two identical SSFs followed by in-line disinfection. The design capacity of the filters basins is 150 gallons per minute (gpm) each, for a total of 300 gpm. In 2002, a package flocculating clarifier was constructed for the Small Green Mountain Spring to pre-treat raw water before conveying it to the slow-sand filter. The pre-treatment unit has a reported capacity of

80.8 gpm, which was based on the water right of the Small Springs. This unit has not been used since its installation.

The purpose of the pre-treatment system was to remove silt, which occurs in raw water from the small springs during heavy rain and snow events. Water quality from the large springs is not significantly affected by weather events, therefore, the pre-treatment unit was sized only to treat water from the small springs. During high silt events the small springs is removed from service until the turbidity decreased below the operator-determined threshold.

Water treated through the slow sand filter plant is disinfected using sodium hypochlorite solution generated in an onsite generation system installed in 2012. Treated water then passes through the clearwell tank, which has a series of curtains creating a serpentine flow pattern for increased disinfection contact time (CT).

2.2.2 Groundwater

Groundwater from Wells #1 and #2 are well suited for municipal drinking water use and only application of disinfectant for residual within the system. Sodium hypochlorite solution is used to add a chlorine residual to groundwater before it is sent to the reservoirs. A separate onsite generation system located at the Behrman Well site produces sodium hypochlorite for both wells.

2.3 Treated Water Storage

The City has four storage reservoirs for a total storage capacity of 1.9 million gallons (MG). The reservoirs, their locations, elevations, and service pressures are summarized in Table 2-4.

Table 2-4: Summary of Existing Water Storage Facilities and Pressure Zones

Name	Material of Construction	Capacity (MG)	Pressure Zone(s) Served	Overflow Elevation (ft)	Maximum Service Elevation (ft)	Minimum Service Elevation (ft)	Service Pressure (Static) Range (psi)
Clearwell	Bolted Steel Fused Glass	0.33	N/A	666.4	N/A	N/A	N/A
North Star Reservoir ⁽¹⁾	Reinforced Concrete	0.07	High	578	520	240	43 – 135
Carsten Reservoirs 1 & 2	Welded Steel	1.50	Main	414.5	320	200	41 – 93

Notes:

N/A = Not Applicable

(1) Northstar reservoir is currently bypassed and not in service.

2.3.1 High Elevation Zone

Under existing conditions, the High Elevation Zone historically relied on the 0.07 MG in the North Star Reservoir and 0.33 MG in the Clearwell. These two reservoirs provide adequate storage for peak management, however, there is an issue meeting fire flow requirements.

- If the Northstar Reservoir (70,000 gallons of storage) were to remain in service it could provide The volume of water in Northstar Reservoir would provide 46 minutes of fireflow compared to the established requirement of 120 minutes.
- If the Clearwell (330,000 gallons of storage) were to be used for fire flow, the maximum allowable withdrawal rate is 237 gpm. Beyond this rate there may be insufficient disinfection effectiveness to provide safe drinking water to customers from this source. In this case all customers of the water system would be required to operate under a boil-water notice until the Clearwell recovered.

The 2011 WMP recommended demolishing the North Star Reservoir due to its unknown reinforced concrete construction and possible risk of failure during a seismic event. Piping and control valves are in place to allow removing North Star from service, and the transmission line has been operated in this mode in recent history. If the City determines that the NorthStar Reservoir is no longer needed the system can operate without it, however, if the City determines providing fire flow from Banks Road to Northstar Reservoir, it should consider a larger seismically resilient reservoir at the Northstar Reservoir location.

2.3.2 Main Pressure Zone

Water for the majority of customers in Banks is stored in two reservoirs on Carsten Hill. Carsten Reservoirs #1 and #2 have capacities of 0.5 MG and 1.0 MG respectively. Reservoir #1 was constructed in 1983 and was rehabilitated in 2021 with a new coating inside and outside, as well as installation of a new cathodic protection system.

Reservoir #2 was constructed in 1999 and its coating is in fair condition with some chalking of the coating on the exterior surface. There is no apparent corrosion, and it is planned to be evaluated for a new coating.

Based on a preliminary analysis, the Main Pressure Zone has sufficient storage to meet existing needs, but as the City grows, additional storage will be required.

2.4 Transmission and Distribution Pipelines

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 (DI), poly-vinyl chloride (hl), and steel.

2.4.1 Transmission

2.4.1.1 Treated Water Transmission

The transmission line from the Clearwell to North Star Reservoir was constructed prior to 1995 and conveys treated water to the High Zone. One customer is connected to this line above North Star Reservoir. The transition from treated water transmission to the high elevation zone is made through either the North Star Reservoir or a Pressure Reducing Valve (PRV) at the same elevation as North Star.

2.4.1.2 Water Transmission Main

The transmission main from North Star Reservoir to the Carsten Reservoirs was constructed of 8-inch C900 PVC in 2021. There are 95 customers along the transmission line, which covers elevation range of 520 feet to 240 feet, and a pressure range of 40 psi to 135 psi at the main. One PRV maintains pressure along this segment of the line.

Some residences along the upper elevations of this transmission main are at higher elevations than the transmission line and must boost the pressure from their service to the residence to have sufficient pressure for water fixtures.

Water from the transmission main entering the Carsten Reservoirs is controlled by a modulating valve. When the reservoirs call for water, it is allowed to flow at a rate set by the operator. When the reservoirs are full the modulation valve restricts water into the reservoir to meet the demand and to maintain the reservoir full.

2.4.2 Distribution System

The City's water distribution system in the Main Pressure Zone is constructed primarily of DI and PVC pipe. Some small diameter galvanized steel pipe remains on Banks Road when the water system was extended outside the City Limits. Many of the replacement and looping projects listed in the 2011 WMPA have been completed, resolving most fire flow issues, and substantially reducing water loss. The City's water distribution system is shown on Figure 2-2.

The backbone elements of the water system are the 6-inch PVC treated water line, the 8-inch PVC transmission line, the 14-inch DI main from the Carsten Reservoirs to the south end of Main Street and Highway 6. A 12-inch DI main extends from Banks Road adjacent to the railroad to Arbor Village, providing looping and redundancy to commercial areas and residential neighborhoods to Highway 6.

Section 3: Water Supply Requirements

3.1 Growth Projections

The Banks Urban Growth Boundary (UGB) was expanded in 2011 and a significant portion of the UGB has been annexed into the City limits. Build-out of the annexed areas of Banks is expected to be completed by 2042. There are currently approximately 733 residential connections and 68 commercial connections to the City's system. The growth projections in this Report are presented in Equivalent Dwelling Units (EDUs) which are equivalent to residential connections (connections).

The historic growth rate of Banks has been 1.7%, however, water supply has limited development since 2015. With current demand for housing, we anticipate the growth rate will be significantly higher when water supply becomes available. In 2021 the Banks population was estimated at 2,100 residents, including customers both inside and outside the UGB. The City has an ordinance prohibiting extraterritorial connections, therefore, the number of connections outside City Limits (95 connections, 300 people) is expected to remain unchanged.

Population estimates were prepared assuming build-out of residential units to the existing UGB. At a density of 7 residences per acre, the population at build-out of the UGB is summarized in Table 3-1.

Table 3-1: Projected Growth in Residential Population through 2042

Development	Area (acres)	New Density (homes/acre)	New Residences	Residential Occupancy	Population
Existing Developed Area (2021)	705	--	--	--	2,100
New Development (2042)	283	7	1983	2.61	5,170
TOTAL PROJECTED POPULATION					7,270

Assumes 7 residences per acre, 2.61 persons per household

The projected population growth of 5,170 by 2042 is equivalent to a 12% growth rate. Based on conversations with developers, the projected rate of home construction is 150 per year, therefore, build-out would also occur around 2042.

Banks is currently in the process of identifying Urban Reserve Areas (URAs) and the next UGB expansion area. The UGB will not be expanded until a significant portion of the available land within the City limits has been developed.

3.2 Projected Supply Requirements

This section contains a discussion of the planning data used in developing population and water demand projections for the years 2022 to 2042. Based on 2021 per capita demands the projected demands to 2042 are summarized in Table 3-2.

Table 3-2: Projected Water Demand for 2042

Water Demand	Per Capita Demand (gal/day)	Demand (gal/day)	Demand (gal/min)	Season
Annual Average Demand	118	858,000	596	--
Average Winter Day Demand	102	742,000	515	Oct-Apr
Peak Month Demand	151	1,098,000	763	Jun-Aug
Peak Day Demand	265	1,927,000	1,338	--

The Projected Peak Day Demand in Table 3-2 exceeds the City’s permitted water rights by 318 gpm. In addition, the reliable water supply with current sources all operating at known capacity is less than the projected Average Day Demand (ADD). Two maximum-production water supply scenarios are summarized in Table 3-3.

Table 3-3: Maximum Reliable Water Supply Scenarios

Source	Scenario 1 Production (gpm)	Scenario 2 Production (gpm)
Large Springs	140	140
Small Springs	81 ⁽¹⁾	81 ⁽¹⁾
Well #1	230 ⁽²⁾	--
Well #2	--	290
Total	451	511

(1) Maximum currently permitted diversion from Small Springs

(2) Historic Production, Well #1 is currently out of service

The maximum available water supply in Scenario 2 is deficient to meet projected ADD by 75 gpm. This assumes all sources are functioning at the rates noted in Table 3-3. The small springs are especially susceptible to damage and reduced production due to major weather-related events, such as snowstorms, unusually heavy rain, and landslides. Similar events resulted in the failure of springs and water treatment plant in 1996, causing complete loss of springs water supply for two years. As a result, we recommend the City develop additional water supply from less vulnerable sources, such as groundwater wells, and develop redundancy in supply.

3.2.1 Water Supply Redundancy

Independent water systems such as Banks are susceptible to major service level loss if one of the water supplies fails. Failure of the water supplies could be due to weather, earthquake, drought, or aging infrastructure. For these reasons, the City should consider water supply redundancy in its planning for new supply to meet 2042 demands.

Section 4: Storage & Distribution Requirements

This section contains a discussion of the criteria used to evaluate water storage and distribution system to provide for existing and projected requirements.

4.1 Transmission Capacity

The Transmission Main from North Star Reservoir to Carsten Reservoirs is capable of delivering 250 gallons per minute while maintaining the pressure requirements of high and main zones. The capacity is equivalent to the maximum water production from the combined springs and water treatment plant. If an increase in flowrate is required because water production from the springs and treatment plant have increased significantly, the transmission line pressure sustaining arrangement may require reconfiguring.

4.2 Storage Requirements

Carsten Reservoirs #1 and #2 provide 1.5 MG of storage for maintaining pressure, equalizing daily peak demands, and providing storage for fire flow. The system serves approximately 733 connections in the main (lower) pressure zone.

4.2.1 Projected Storage Needs

The calculations for the required storage were determined by the Average Daily Demand (ADD) and Maximum Daily Demand (MDD) estimates and projecting the storage requirement for additional connections.

The Required storage was calculated from the following equations:

- *Required Storage (MG) = $\sum [(25\% * MDD) + (2 * ADD) + Commercial Fire Flow] * 1.1$*
- *Commercial Fire Flow = 3,000 gpm for 3 hours = 540,000 gallons*

The required 2022 storage was calculated as 1.31 MG for the existing connections.

Additional storage requirements are calculated based on the following equation:

[Existing Storage Requirement + New Storage Requirement] – (1.5 MG of existing storage)

The estimated storage requirement for 210, 750, 1,000, and 1,250 new residences are summarized in Table 4-1.

Table 4-1: Storage Requirements for Projected Growth Scenarios

Number of Residential Connections	New Residential Connections	Storage Requirement	Additional Storage Required
		<i>gallons</i>	<i>gallons</i>
733	--	1,310,000	(190,000) ^(a)
733	210	1,500,000	0
733	750	1,960,000	460,000
733	1,000	2,180,000	680,000
733	1,250	2,390,000	890,000

(a) Negative storage requirement indicates adequate storage

No additional fire flow was assumed for these connections, as they are served from the same reservoirs. The total storage requirement for existing connections and 210 proposed new residences is 1.5 MG and utilizes the remaining storage capacity in the existing reservoirs.

4.2.2 Recommended Storage Upgrade

To accommodate the projected build-out of 1,250 connections the additional storage required is 0.89 MG. The recommended size of the reservoir to accommodate this requirement is 1.0 MG and is a common size reservoir for municipal water storage.

Carsten Reservoir #1 and #2 are welded steel tanks on concrete footings. The clearwell is a bolted glass-fused-to-steel reservoir. The City has had experience with both types of reservoirs; therefore, we have considered these two types in our development of budgetary cost estimates. Additional reservoir site improvements are included in the reservoir upgrade as described in the following sections.

The estimated cost to construct a new 1.0 MG welded steel reservoir is \$4,900,000, including planning, engineering, permitting, and construction. This cost does not include property acquisition.

4.2.3 Reservoir #2 Rehabilitation Project

Existing 1.0 MG Reservoir #2 is in good condition and requires coating and a corrosion control system to preserve it for long-term use. The rehabilitation project includes pressure washing internal and external surfaces, removing minor corrosion areas, priming and coating the entire reservoir inside and outside. In addition, a passive cathodic protection system will be installed.

The estimated cost to rehabilitate Reservoir #2 is \$950,000, including planning, engineering, and construction.

4.2.4 Reservoir Site Power/Control Building Security Improvements

As part of the reservoir project upgrade the following are recommended to improve operations at the Carsten Reservoir site:

4.2.4.1 Power Improvements

The small electrical loads at the reservoir site are currently powered using a single 120-volt circuit from the Behrman Well site more than 1,000 feet away. The circuit is used to its capacity, and voltage drop across that length of wire is significant. For this reason, we recommend installing a new dedicated electrical service at the reservoir site to accommodate loads from planned improvements summarized in this section.

4.2.4.2 Well Transmission Line

To accommodate future activities related to Aquifer Storage and Recovery (ASR) and additional wells, new pipelines to the reservoir site should be installed for projected needs. Each line will include a meter to permit accurate inventory of water to and from sources and reservoirs.

4.2.4.3 Control Building

The existing steel shed is in poor condition and requires replacement. The reservoir site will include a new control building to house the following:

- Electrical service meter and power distribution to instruments on the site
- PLC and Interface for Operator use when on site
- Security System
- Future onsite sodium hypochlorite generation system and chemical pumping systems for supplemental addition of disinfection residual
- Future reservoir mixers

4.2.4.4 Security Improvements

The Carsten Reservoir site requires security improvements including the following:

- Motorized gate with card-lock access
- Security Cameras
- Intrusion Alert System

The security system will be connected to the Supervisory Command and Data Acquisition (SCADA) system at the reservoir site to permit Operators to remotely review and acknowledge alarms.

The estimated cost to for power, control building, and security updates to the Carsten Reservoir Site is \$810,000, including planning, engineering, and construction. This cost does not include property acquisition.

4.3 Distribution System Capacity

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

4.3.1 Fire Flow Conditions

The Distribution System was modeled with the original 2008 master plan and distribution system piping improvement projects were prepared to alleviate the deficiencies. Fire flow for rural areas is 1,000 gpm, 1,500 gpm for residential areas, and 3,000 gpm for commercial/industrial/schools.

Since the 2011 WMPA, the City has corrected 6 nodes within the distribution system that had fire flow deficiencies within the central residential/commercial area of Banks (including Wilkes Street, scheduled to be completed in 2023).

The remaining fire flow deficiencies in residential areas are found at dead-end lines along private streets NW Jarvis Place, NW Barton Court, NW Atwater Court, and NW Elmhurst Court. All of these areas have a second fire hydrant (meeting fire flow criteria) within 250 feet of the dead-end.

Remaining commercial/industrial fire flow deficiencies are found in the Oak Village Shopping Center, Sunset Park, and Hampton Lumber Mill. Making improvements to all of these conditions will require work on private property in easements.

- There are three fire hydrants on two separate lines at Oak Village Shopping Center. To secure full fire flow to this commercial area a new loop connection would be required to connect with a line in Arbor Village or connect to a line along Main Street/Highway 47.
- The fire hydrant in Sunset Park is connected to the 12-inch main in Main Street by a long 6-inch line. Reducing the length of the 6-inch connection will increase capacity, as would increasing the size of the line feeding the fire hydrant to 8-inches.
- The fire hydrant at Hampton Lumber Mill is on an 8-inch line, however, it is at a dead-end. To improve flow to this fire hydrant would require looping to the Commerce Street waterline or the existing 12-inch waterline to the east side of the mill property. The mill reports fire hydrants on the property are served by Tualatin Valley Irrigation District (TVID). Additional fire flow on the mill site can be provided by the TVID fire hydrants.

Future additions to the distribution system will be completed with current City public works design standards that will provide fire flow to all areas of the system.

4.3.2 Distribution Piping Projects Completed

The City has an adequate distribution system to serve the existing population, and it provides a backbone to expand distribution as the UGB expands. Since 2011, a number of improvements have been made to the City's pipeline system, summarized below.

- Transmission Main: The transmission main has been replaced for the entire 3.2-mile length traveling south from the North Star Reservoir to the Carsten Reservoirs. The existing line was replaced with an 8-inch C900 PVC pipeline extending to the Carsten Reservoirs and the 8-inch line in Sellers Road. The PRV/PSV was replaced, and two additional meters were installed to permit more accurate inventory of water use and loss.
- Cedar Canyon Road Improvements: The entire line along Cedar Canyon Road was replaced with 8-inch diameter C-900 PVC and 2-inch High Density Polyethylene (HDPE) pipe (for bridge crossings). This replaced a 1-1/2" galvanized steel line with numerous leaks.
- Woollen Road Improvements: The entire line along Woollen Road was replaced with new 8-inch diameter C-900 PVC pipe, replacing 2-inch diameter galvanized steel known to leak. A new fire hydrant was installed at the end of the line.
- Commerce Street Waterline Improvements: All Waterline on Commerce Street and Depot Street were replaced with new 6-inch and 8-inch C900 PVC, completing loops for improved fire flow and redundancy.
- Park Street Waterline Improvements: All waterlines on Park Street were replaced with 8-inch C900 PVC pipe, completing loops for improved fire flow and redundancy.

The Wilkes Street Waterline Improvements project is scheduled to begin construction in early 2023. The project is scheduled to include replacement of the entire Wilkes Street waterline with new 8-inch C900 PVC and completion of loops on Wilkes Street and Woodman Alley to the 12-inch main along the railroad. This will provide improved water quality and fire flow for this area of Banks.

4.3.3 Distribution Replacement and Expansion Projects

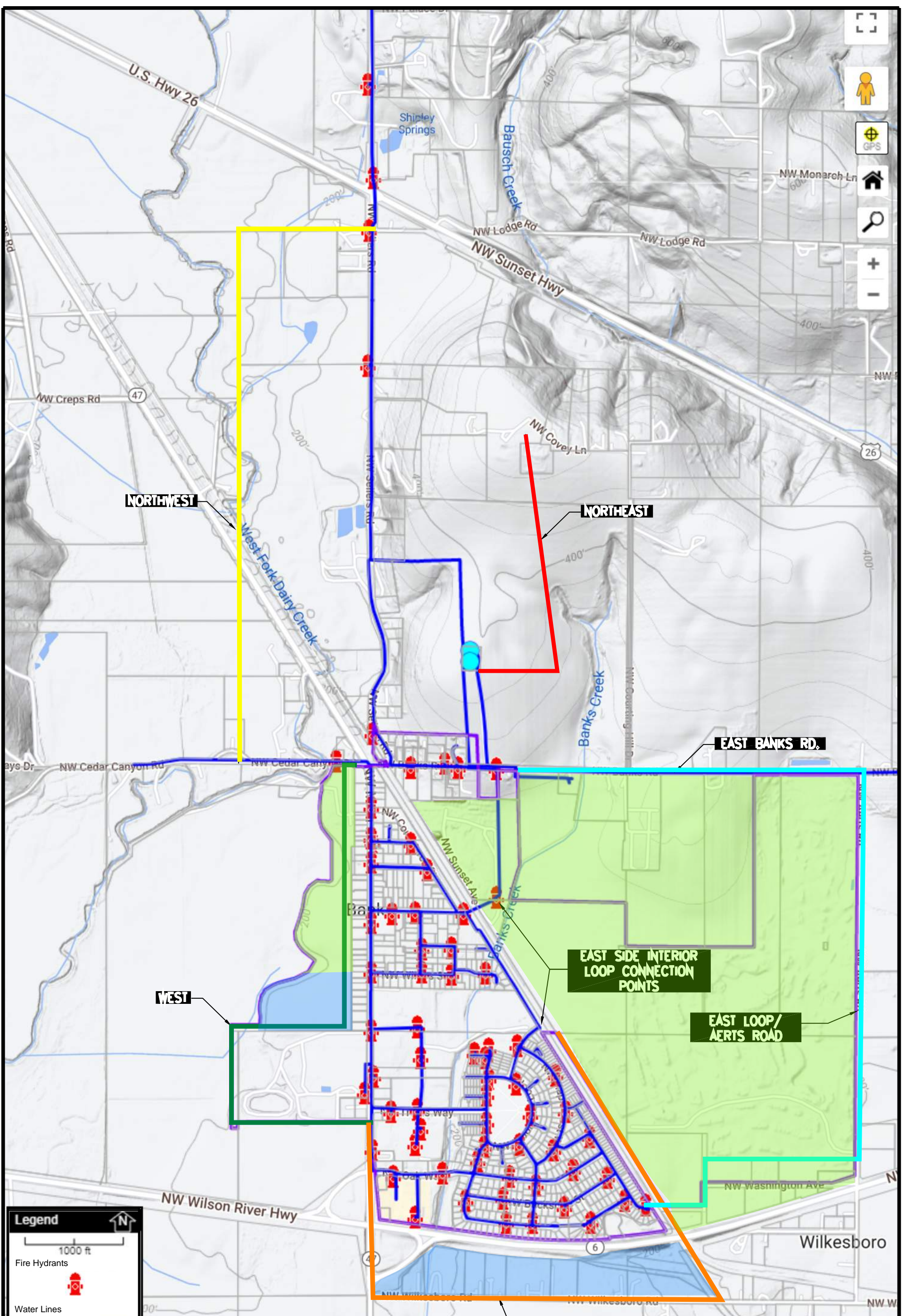
Two projects to enhance the existing distribution system remain, and several projects to expand the distribution system for anticipated growth are planned. These projects and conceptual expansion of the distribution system are shown on Figure 4-1.

4.3.3.1 Cedar Canyon Road Dairy Creek Crossing

The Cedar Canyon Road waterline was replaced in 2021 with 8-inch C900 PVC to the end of the existing service area. The line was a source of many leaks and replacement has eliminated those water losses. The West Fork Dairy Creek crossing and unnamed creek crossing to the west were made by mounting a 2-inch HDPE pipe on the bridges. As a result, no fire hydrants were installed west of the Dairy Creek Bridge.

Completion of the Cedar Canyon Road main is planned as an 8-inch C900 PVC within a 24-inch steel casing under the creek for approximately 300 feet. The planned trenchless under crossing of Dairy Creek was removed from the Transmission Line project due to its high cost and intended to be completed under a separate project.

The Dairy Creek crossing impacts the capacity of the future Northwest Loop, discussed in Section 4.3.3.4.2 of this report. The Northwest Loop is outside the UGB and in an area not planned for UGB expansion within the planning window of this report. As a result, this crossing could be deferred until design and construction of the Northwest Loop is being planned.



Legend

1000 ft

- Fire Hydrants
- Water Lines
- Water Reservoirs
- City Limits
- Parcels
- Residential Zone - Future
- Industrial Zone - Future

Kennedy/Jenks Consultants
 WATER SYSTEM MASTER PLAN AMENDMENT
 MARCH 2023

FUTURE BUILDOUT
 SCENARIOS

K/J 2276009.00

FIGURE 4-1

If the City wishes to extend fire flows west of Dairy Creek, or if the Northwest Loop main is required, this project can be completed for an estimated cost of \$500,000.

4.3.3.2 Banks Road Waterline Replacement

The Banks Road Waterline from the Behrman Well site to the east end of the waterline is a known source of leaks and has been considered for replacement since the 2011 WMP was prepared. A portion of this line is scheduled to be upgraded from 2-inch to 12-inch to be constructed when development requires it, however, the need to mitigate leaks could dictate this waterline is replaced before East Banks develops.

The recommended project to replace the Banks Road waterline includes Reach A: 3,000 feet of 12-inch C900 PVC waterline ending at Aerts Road and Reach B: 3,600 feet of 8-inch C900 PVC waterline, running east of Aerts Road. The waterline east of Aerts Road serves approximately 20 residential customers, and its replacement with 8-inch waterline would provide fire hydrants along Banks Road. The 12-inch portion of the waterline will be intended to accommodate growth; therefore, a portion of construction costs may be paid by System Development Charges (SDCs). Alternatively, a developer may construct the 12-inch waterline and receive SDC credits for the waterline value.

The estimated cost to construct Reach A is \$1,700,000, and a portion of this cost is SDC-eligible. The estimated cost to construct Reach B is \$1,100,000, none of which is SDC eligible.

4.3.3.3 Distribution System Future Expansion

The City's distribution system will require expansion to serve the areas of the City and UGB where growth is planned, as shown on Figure 4-1. The majority of the waterlines will be built as needed by development.

4.3.3.3.1 East Loop/Aerts Road Water Main

The development of the east side of Banks is anticipated to develop the majority of the existing Quail Valley Golf Course and surrounding farmland. To provide water service, fire flow, and redundancy, the proposed 12-inch waterline along Banks Road will connect to a new waterline on Aerts Road, a 12-inch ductile iron waterline approximately 4,000 feet long. The estimated cost to construct the entire East /Aerts Road Loop is \$2,800,000 and the entire line would be SDC-eligible.

4.3.3.3.2 Westside Loop

The Westside water main loop will be constructed to serve development on the west side of Banks to the existing western City Limits. The diameter of this line will be determined based on the proposed density and demands and is expected to be 8-inch to 12-inch diameter ductile iron pipe. The Westside Loop will have at least 3 connections to the Main Street water main at Cedar Canyon Road, Wilkes Street, and Oak Way. The estimated cost to construct the entire Westside Loop is \$2,600,000 and the entire line would be System Development Charge (SDC) eligible.

4.3.3.3.3 Northwest Loop

The Northwest Loop is primarily outside the City Limits and UGB. The loop shown on Figure 4-1 is conceptual and will likely change as the UGB is established in this area of the County. This line will form a loop between the Sellers Road Transmission Line and the Cedar Canyon Road Main. The estimated cost to construct the entire Northwest Loop is \$2,800,000 and the entire line would be SDC-eligible.

4.3.3.3.4 South Loop

The South Loop will extend the existing 12-inch main running parallel to the railroad lines south of Highway 6. The South Loop will be a 12-inch ductile iron main that runs east-west along Wilkesboro Road and north on Main Street to connect to the existing main. This loop will serve the industrial-zoned area within the UGB. The estimated cost to construct the entire South Loop is \$3,500,000 and the entire line would be SDC-eligible.

4.3.3.3.5 Northeast Extension

The Northeast Extension will serve areas outside the existing UGB north of the Carsten Reservoirs. The elevation of most of this area is higher than the Carsten Reservoirs, therefore, this extension will require a booster pump station to serve residences near the elevation of the reservoirs. The estimated cost to construct the entire Northeast Extension is \$1,100,000 and the entire line would be SDC-eligible.

4.3.4 Metering

The City of Banks customer meters are approximately half manually read, and half read through Automatic Meter Reading (AMR) technology. AMR allows meters to be read remotely from a slow-moving vehicle traveling throughout the service area. AMR technology provides periodic totalized information as frequently as the meters are read. Meter readings are collected monthly and require 2 to 3 days to read both manually and AMR. The information collected provides sufficient information to generate monthly billings. If a meter reading increases significantly from one month to the next indicating a leak, the increase must be recognized by the biller and reported to the customer.

The City wishes to completely automate meter reading. There are two alternatives to provide this ability with different levels of service:

- Complete installation of remaining AMR meters for 100% coverage
- Convert meters to Automated Metering Infrastructure (AMI)

These alternatives are described in the following sections.

4.3.4.1 Expand AMR Metering

Expanding AMR includes installation of approximately 400 new meters to replace existing meter installations. The level of service will remain the same as the existing service, however, all meters will be read remotely, expediting the meter reading process somewhat. The level of service will remain the same, however, meter readings will be more accurate.

The estimated cost to replace 383 meters is \$1,100,000, or \$2,900 per meter. This will leave the remaining AMR meters at an average age of 10 years, or half of their useful life remaining.

Assumptions included in the cost to replace meters at \$2,900 per meter include:

- Work is done under Prevailing Water Requirements.
- Costs include Engineering, Administrative, Contractor overhead and profit, and 30% contingency.

- A portion of the meters are within sidewalks, and will require demolition and replacement of sidewalk, relocation of meter, meter box, licensed plumber, and landscape restoration.
- Most meters will require some piping modification to bring the connection up to Public Works Design Standards.

4.3.4.2 AMI Metering

Automatic metering infrastructure consists of smart meters that communicate with a set of radio receiver installations located throughout the City. The meter readings are retained in online storage which can be synchronized with the City's billing system as needed.

Developing AMI in Banks will require replacement of the majority of customer meters with new meters. Some newer meters could be fitted with new AMI transmitters, which would reduce the cost per meter slightly. Based on the likely timing of the meter replacement we have assumed that all meters will require replacement. The service area for Banks will require two radio receivers. A small number of meters located at the north end of the service area may remain outside the service area and would require continued readings via AMR collection or manual readings.

AMI can provide increased convenience in monitoring as well as more frequent meter readings. The additional data Automatic reading frees City staff several days each month to complete other work. Some optional capabilities include audio monitoring for leaks and automatic recognition and flagging of unusually high water demand.

The estimated cost to install new AMI equipment is \$2,300,000 or \$3,200 per meter. Operation of AMI requires annual subscriptions for online monitoring services. The annual costs for these services total \$10,000 per year.

4.3.4.3 Recommended Metering Approach

The cost to implement AMI is significantly higher than to expand AMR. The benefits of AMI are significant to a larger water utility with significant water loss; however, Banks has replaced much of its water system infrastructure, and water loss is currently low. If the City maintains the water system AMI would not be an expense worth recommending. Therefore, we recommend expanding AMR to the half of the system not yet outfitted with this technology.

Section 5: Water Supply and Treatment Requirements

This section describes improvements required for the water treatment plant (including improvements at both springs) and wells.

5.1 Surface Water Diversion Improvements

This section provides evaluation and recommendation to improve capture of water from the City's existing surface water supply from the Green Mountain Springs, which consists of the West (Large) Springs (West Springs) and the East (Small) Springs (East Springs). Ongoing operational modifications have addressed several supply constraints or water quality concerns at the West and East springs. Permanent improvements will be planned to increase the total quantity of water to the City's permitted water right of 270 gpm and improve reliability of supply from the springs.

5.1.1 Surface Water Right Diversion Point Adjustment

If the point of diversion of water rights for the two springs can be combined then the City can take advantage of water available from the Small Springs and maximize the available surface water right. The limitations on diversion from the two springs are:

- Small Springs is limited to 0.18 cfs (81 gpm)
- Large Springs is limited to 0.42 cfs (188 gpm)

If the diversion points could be combined the total water that could be diverted is 0.6 cfs (269 gpm). Assuming the Large Springs produces 140 gpm, this would allow the city to divert 129 gpm from the Small Springs for municipal use, providing an additional 48 gpm when the water is available.

The recommended improvement would be to investigate combining the diversion points and completing the water right administrative application to make this change to the permitted rights. The work would be completed by a Certified Water Rights Examiner and the estimated cost to complete this work is \$20,000.

5.1.2 West Springs

The West Springs consistently produces high quality water year-round and does not experience high turbidity during wet heavy rainfall or snow. The location and condition of the West Springs transmission line is poorly understood at this time. Record drawings show a 6-inch ductile iron transmission line constructed in 2001. We recommended the City pothole some locations in these drawings (including the combination air relief valve manholes at STA 24+35.20 and STA 31+00.94) to verify the record drawings and locate potential leaks or constrictions.

5.1.3 East Springs

The East Springs consist of two diversion points where the creek bed forks and runs roughly northwest and northeast. The upper diversion point is toward the northeast and the lower diversion point is to the northwest.

5.1.3.1 Upper Diversion Point

The upper diversion point collects water from surfacing springs which is conveyed down the slope through a polyethylene trash can into a pipe. Below the trash can the pipe is broken, and the collected water then flows into the stream bed before reaching the first impoundment. Return of the water from the pipe to the stream bed causes additional turbidity in the raw water. The trash can arrangement is difficult to maintain and causes reliability issues.

We recommend constructing a concrete impoundment to replace the trash can. The pipe from the new upper impoundment should be replaced with new HDPE pipe down to where it joins the lower pipe (at the lower impoundment). The cost to replace the trash can diversion structure with a permanent concrete structure and run HDPE pipe to the lower raw water line is approximately \$90,000, including planning, permitting, design, and construction.

5.1.3.2 Lower Diversion Point

The lower diversion point impoundment is a concrete wall across the creek. The impoundment collects silt and stops producing water when the impoundment is full. City Staff have developed a flushing procedure that can maintain the impoundment function if maintained with sufficient frequency. A new pipe through the impoundment wall with valve will permit operators to easily flush silt and maintain raw water production.

The lower diversion point pipeline was recently replaced with 8-inch HDPE pipe. Staff have removed a number of restrictions from the raw water line leading from the East springs to the SSF Plant and have seen significant increases in raw water production. The remaining constriction is a 3-inch diameter spool piece that could be replaced with 8-inch pipe for more capacity in the line. We recommend replacing this spool piece with a larger diameter pipe. We also recommend conducting a pothole investigation to confirm location and diameter of the existing buried raw water line from the East springs and upsize this pipe to 8-inch HDPE where appropriate.

The cost to repair and make improvements to the lower diversion point is approximately \$80,000 including planning, permitting, design, and construction.

5.2 Groundwater Supply Improvements

5.2.1 Well #1 Function

Well #1 has reduced production for unknown reasons. The City's hydrogeologist has developed a list of likely issues:

- Fouled Water-bearing Formation – The basalt water-bearing formation in the vicinity of the well could be fouled by chemical precipitation or by biological fouling.

- Faulty Level Pressure Transducer – The down-hole level transducer could be faulty, mis-located, or measuring erroneous readings.

The recommended approach to diagnose and repair the well is to complete the following steps:

- Conduct a pump test to verify rapid shutdown of the pump.
- Collect water samples during the pump test to identify bacteria that could cause fouling of the well.
- Measure the water surface elevation manually (if possible) and compare to pressure transducer readings.
- Remove the pump and conduct a down-hole video survey of the well to identify structural or well construction defects that could affect the well's production.

The estimated cost to complete these tasks is \$60,000. There may be additional costs to repair the well after the recommended work has been completed. At this time it is not possible to estimate the cost for those repairs.

5.3 Slow Sand Filter Plant Improvements

The SSF Plant treats all surface water the City uses. The plant's capacity is 300 gpm, which is slightly greater than the City's permitted water right of 270 gpm. The filters require cleaning (surface scraping) two to four times per year, which requires one of the two filters to be out of service for several weeks, and limit the filter capacity to 150 gpm. Additional filter capacity would increase the reliability of the SSF Plant and allow continued production of available water up to the City's water right throughout the year. Based on recent temporary improvements it appears 270 gpm can be secured from both springs; therefore, additional treatment capacity should be provided.

5.3.1 Existing Conditions

The SSF Plant is in fair to good operating condition (depending on the component) and is currently being used to treat water from the East and West springs. The SSF Plant consists of a sedimentation basin that receive raw water from the East and West springs, followed by two 1,550 square foot (ft²) downflow granular media filters; an on-site sodium hypochlorite generation unit; a piping gallery and meter vault where chlorine is injected; and a 330,000-gallon clearwell tank before transmission to the City water system.

The current plant configuration was established in 2012 and granular filter media was replaced in 2017. A 20-gpm package flocculation unit was installed between 1997 and 2000 upstream from the sedimentation basin to pre-treat excess turbidity from the East springs but was never used.

The SSF Plant was designed to accept a loading rate of 0.065 gallons per minute per square foot (gpm/ft²) of filter area, for a total capacity of 200 gpm (or 100 gpm/filter). Operator's report the filter basins are currently able to treat a maximum of 150 gpm each, for a total of 300 gpm. A hydraulic restriction in the piping gallery is preventing more than 150 gpm from flowing from each filter. With two filters operating the plant has the capacity to treat the entire water right of 270 gpm, however, hydraulic restrictions built into the piping limit flowrate to 200 gpm.

5.3.2 Pretreatment

Siltation and high-turbidity water from the East springs (especially during heavy precipitation events) could limit the City's available supply from the springs. Pretreatment of this raw water could expand the usability of this water during winter. Three pretreatment alternatives are presented in this section.

5.3.2.1 Alternative PT1 - Gravity-Settling

Gravity settling will take place in a new tank installed before the filters. A low-cost option for this could be a cross-linked polyethylene cone-bottom style tank, as manufactured by Snyder. The tank will be fitting with bulkhead fittings for inlet and outlet connections and would be sized for a peak flow detention time of 10 to 30 minutes. Silt will be discharged through an automated valve at the bottom of the tank.

Discharged solids will be contained and dewatered in a curbed concrete pad. Liquids from the containment area will drain to an infiltration basin. Collected silt can be used for landscaping material or hauled for landfill disposal.

Gravity settling will be very slow and inefficient due to the colloidal nature of quality of silt, and when high silt concentrations occur the system will become ineffective. A chemical additive may improve settling; however, use of coagulants is not advisable with slow sand filter plants because any carryover of floc to the filters could quickly bind the filter slowing treated water production. For this reason, the settling alternative is recommended without chemical addition.

The estimated capital cost for pretreatment Alternative PT1 is \$80,000. If this alternative is selected, a pilot test should be conducted to verify settling characteristics and confirm detention time and tank sizing.

5.3.2.2 Alternative PT2 - Mechanical Prefiltration Unit

A self-cleaning filter can provide efficient silt removal that would permit treatment of higher turbidity raw water through the sand filters. TEKLEEN® manufactures a filter with screen size down to 10 microns, which would remove a significant portion of silt (2 to 50microns). A prefilter with a capacity of 200 gallons per minute would be mounted on a skid with a control panel and booster pump. The solids rejected from the filter would be drained in a concrete curbed drying bed. Water drained from the solids will drain to an infiltration basin.

The skid-mounted pre-filtration system requires power to operate the booster pump and controls and would report its operating status to the SCADA system. A skid-mounted pre-filter system with booster pump and self-cleaning mechanism could be installed inside an existing building. Capital costs for Alternative PT2 would be approximately \$220,000 and assumes adequate power is available to operate the booster pump.

An automated mechanical filter is a good application to remove silt from raw water, as it can operate at higher silt concentrations than simple gravity settling. Filter flushes are automated using a timer.

5.3.2.3 Alternative PT3 - Recommission Existing Flocculator Unit

The existing flocculator unit was installed to remove silt from raw water prior to filtration. The unit was never used and sits idle at the treatment plant. Chemical mixers and pumps have been removed from the flocculator building, so some improvements will be required to return this unit to service.

An assessment of the existing flocculator unit (including wet chemistry testing) would be conducted to determine the functionality of the existing equipment; required component replacement; and operational polymer dosages required to utilize this existing system. This option assumes that the original equipment manufacturer would be involved in testing and startup and would conduct a 3-day site visit. The cost to re-commission the existing system estimated to be \$240,000, including equipment evaluation, testing, replacement, and manufacturer startup.

Use of a coagulant in a process before a slow sand filter is not recommended because an upset resulting in flocs in the sand filter will bind the filter, requiring a filter cleaning which labor and time intensive. For this reason, Alternative PT3 is not recommended.

5.3.2.4 Recommended Pretreatment Alternative

The recommended pretreatment alternative is PT2, mechanical filtration. While adding a mechanical filter would increase Operation and Maintenance (O&M) costs, there may be a decrease in O&M labor effort associated with cleaning SSF media. The City should consider operating a pilot mechanical filter unit during the rainy season and decommissioning the existing flocculator unit so the building can be used for the mechanical filter unit.

5.3.3 Filter Plant Piping Gallery Improvements

The existing piping gallery was constructed in 1995 and has seen piece-wise modifications since that time. Most or all piping is in poor operational condition and many of the joints are separating due to failed PVC cement or insufficient restraint provided by the fittings. Plant staff report flow restrictions due to small pipe sizes, difficulty accessing areas of the piping gallery room, and water visibly leaking from pipe joints. Due to age and condition, existing piping should be replaced.

Raw water from the small springs enters the treatment plant and join at a common header. Due to differences in pressure, raw water from the large springs reduces the flowrate from the small springs. To mitigate this issue three options were considered:

- Installing pressure reducing valves on the high-pressure West springs line would equalize and allow the East springs. However, this would limit raw water flowrate to the plant when both sets of springs are in operation and may too severely limit the raw water flowrate.
- Raw water from both springs can be combined in a weir box or distribution box with a common feed point the filters. Water from both springs will be combined in an open box where their respective pressures will not work against each other. A hydraulic analysis will confirm this alternative is possible.

The preferred alternative for piping gallery improvements is to replace all piping and valves, and selected instrumentation with C-900 PVC pressure pipe. Some modifications, such as adding piping at the sedimentation basin to allow for additional operational flexibility, could also be added as part of the project. Additionally, it is recommended that a common weir box be constructed to combine the springs. This would allow both springs to flow into the filters at their respective pressures and maximize flowrate to the plant. Constructing filter gallery hydraulic improvements would cost approximately \$190,000.

5.3.4 Water Filtration Plant Improvements

At present, the total available supply of water from the springs could exceed the capacity of the plant. In spring of 2022, City Staff conducted maintenance work to the Small Springs line and determined the small springs could produce 140 gpm through most of the year, with occasional peaks up to 200 gpm. To treat additional raw water from the springs to the water right capacity of 270 gpm three options were evaluated:

- Alternative F1 - Retrofit the existing sedimentation basin to a slow sand filter
- Alternative F2 – Construct a new slow sand filter matching the two existing filter sizes
- Alternative F3 – Install a parallel pressure filter

5.3.4.1 Alternative F1 - Retrofit Existing Sedimentation Basin to Slow Sand Filter

Staff report little pre-treatment benefit from the existing rectangular sedimentation basin. Additionally, O&M effort to clean the basin is high because it must be removed from service to clean manually. Retrofitting the existing sedimentation basin to a slow sand filter would provide an additional filter area of approximately 440 ft². This additional filtration capacity of 40 gpm would increase total plant capacity to 230 gpm at average loading rates. At the maximum recommended loading rate Alternative F1 could product up to 80 gpm, extending the total treatment plant capacity to 270 gpm, nearly reaching water right capacity of the combined springs.

To implement Alternative F1 the sedimentation basin will require demolition of the existing sloped portion of the basin bottom. New piping will be installed and filter media will be placed. Some existing piping in the sedimentation basin can be used for the future filter, however, additional piping and valves will be required to make this basin a fully functional filter.

Advantages of this alternative are 1) operation of this unit would be similar to the two other SSF cells currently in operation, and 2) new piping and valves could be easily incorporated into the piping gallery. The cost for retrofitting the sedimentation basin as an additional SSF cell would be approximately \$350,000.

5.3.4.2 Alternative F2 – Construct a New Slow Sand Filter

Alternative F2 includes construction of a new slow sand filter sized to match the two existing filters. The filter will be constructed of reinforced concrete and will have matching piping and filter media installed. Additional piping and valves in the gallery will be required to accommodate

the new filter. This may be challenging, as the gallery is currently filled densely with piping. To implement Alternative F2 a new basin will be constructed adjacent to the west of existing filters.

Advantages of this alternative are 1) operation of this unit would be identical to the two other SSF cells currently in operation, and 2) more capacity could be achieved with a full-sized filter. The estimated cost to construct a new SSF is \$850,000.

5.3.4.3 Alternative F3 – Package Pressure Filtration

A package rapid sand filtration unit could be used to increase the plant’s capacity as an alternative to retrofitting the sedimentation basin. Pressure filtration could allow treatment of higher turbidity water because backwashing is more convenient in this automated filter. However, treatment is less efficient, with a greater quantity of backwash water generated from more frequent backwash cycles. Recommended pressure filter units would be the Pacer II® by Roberts Filter Group or Trident® by Westech incorporated. Both units are package contact clarifiers followed by granular media filtration (rapid sand filter) with backwash cycles. Other options with a smaller footprint would be vertical pressurized media filtration vessels. Unlike slow sand filtration, some polymer addition would be required. The estimated cost for an installed pressure filtration system treating 100 gpm is \$840,000.

5.3.4.4 Comparison of Filtration Alternatives

The existing SSF cells were designed with a hydraulic loading rate (HLR) of 0.065 gpm/ft² or 100 gpm/filter cell. Plant staff report that they have been operating at higher rates of up to 150 gpm/ filter cell, or 0.098 gpm/ft². OHA draft design guidance recommends SSF HLRs of 0.03 to 0.10 gpm/ft². Based on this guidance, the current loading rate of 0.098 gpm/ft² likely represents a maximum treatment capacity at the SSF.

5.3.4.4.1 Hydraulic Loading Rate Analysis

Table 5-1 provides a summary of hydraulic loading rates for Alternative F1 for the existing filters plus a converted sedimentation basin and Alternative F2 adding a new full-sized 440 ft² filter basin.

Table 5-1 Comparison of SSF Loading Rates for Filter Combinations

Flowrate (gpm)	Hydraulic Loading Rate, Total Capacity gpm/ft ²			
	One Filter	Two Filters	Alternative F1 2 Filters + Converted Sedimentation Basin	Alternative F2 Three Full- Sized Filters
100	0.065	0.033	0.028	0.022
150	0.098	0.049	0.043	0.033
200	0.130	0.065	0.057	0.043
225	0.146	0.073	0.064	0.049
250	0.163	0.081	0.071	0.054
300	0.195	0.098	0.085	0.065
340	0.221	0.111	0.097	0.074
450	0.293	0.146	0.128	0.098

Cells highlighted in green represent hydraulic loading rates at or below the existing design condition. Cells highlighted in orange represent hydraulic loading rates at or under the maximum capacity (peak flow conditions). Cells highlighted in red represent hydraulic loading rates above the maximum capacity. Based on this analysis, Alternative F1 would increase the total capacity of the SSFs from 300 to 340 gpm, well beyond the water right capacity of combined springs. Adding an additional SSF cell under Alternative F2 would increase the total capacity to 450 gpm.

5.3.4.4.2 Firm Capacity Analysis

The firm capacity of the water treatment plant is determined by the capacity with the largest filter out of service. This analysis views the firm capacity at peak loading conditions.

For Alternative F1 the total surface area provided by a retrofitted sedimentation basin would be approximately 440 ft² of area. Under a maximum hydraulic loading rate of 0.098 gpm/ft², this would provide roughly 40 additional gpm of treatment. Retrofitting the sedimentation basin would increase the firm capacity of the SSFs from 150 to 190 gpm (under a maximum HLR of 0.098 gpm/ft²). Adding an additional full-sized SSF cell would increase the firm capacity to 300 gpm. Table 5-2 summarizes firm capacity of the filter plant under existing conditions, Alternative F1 and Alternative F2.

Table 5-2: Summary of Firm Capacity Conditions for SSF Alternatives

Firm Capacity Hydraulic Loading Rate gpm/ft ²			
Flowrate (gpm)	Two Existing Filters	Alternative F1 2 Filters, Converted Sedimentation Basin	Alternative F2 Three Filters
100	0.065	0.050	0.033
150	0.098	0.076	0.049
190	0.124	0.096	0.062
225	0.146	0.114	0.073
250	0.163	0.126	0.081
275	0.179	0.139	0.089
300	0.195	0.151	0.098
450	0.293	0.227	0.146

5.3.5 Filtration Recommendation

By retrofitting the sedimentation basin, the City gains an additional 40 gpm of firm treatment capacity and 80 gpm of peak capacity of at a cost of approximately \$4,400 per gpm. By adding a package filtration plant, the City gains an additional 100 gpm treatment capacity at a cost of approximately \$8,500 per gpm. With an additional 40 gpm of treatment capacity, they City would

be able to treat essentially all of its total water right of 270 gpm and have a firm capacity of 190 gpm with the largest filter out of service.

Installing a pressure filter package skid would provide slightly more total treatment capacity but would not increase the plant firm capacity. Due to the lower cost, it is recommended that the City pursue retrofitting the sedimentation basin, unless the water rights are increased.

5.3.6 SSF Plant Additional Improvements

Other factors affecting treatment capacity are filter downtime due to maintenance. The SSFs are uncovered and susceptible to clogging via organic debris (leaves falling into the filters, etc.) and growth of algae. It is envisioned that less filter maintenance and more operational time could be achieved by covering the SSF cells to prevent the ingress of organics and reduce the contribution of sunlight to algal growth.

There are a number of vendors who specialize in filter basin and clarifier covers. However, coverings for the SSF may require custom construction to accommodate access and cell dimensions. Tight-fitting covers made from steel composite materials would have the highest capital costs and would provide the tightest fit. Capital costs for fabric awning-type coverings would be significantly less but would incur higher O&M costs (more frequent cleaning and replacement) and would allow some sunlight/organic debris into the tanks. Capital costs for a close-fitting, composite, weight-bearing tank cover would be approximately \$300,000. Much of the existing vegetation has been removed near the filters, so this option is not currently recommended unless significant leaf/needle deposition is observed in the future.

5.3.7 Post-Filtration Improvements

5.3.7.1 Reducing Hydraulic Restrictions

Record drawings for the SSF show both SSFs 1 and 2 have 10-inch outlet lines that decrease to 4-inch and then 3-inch before going through a magnetic flow meter (on each filter). Operations staff report that the 3-inch diameter outlet lines decrease filtration capacity to approximately 200 gpm, functionally reducing the total existing capacity of the SSF plant by 100 gpm. Reducing hydraulic restrictions would allow the SSF units to produce more water.

Reducing hydraulic restrictions consists of replacing small diameter piping, except lengths required per manufacturer's recommendations. The limitation of flowrate from the filters to their rated capacity is advised by the manufacturer, however, the flowrate could be adjusted manually by the operator or automatically by a modulating valve.

5.3.7.2 Sodium Hypochlorite Generation

The existing onsite sodium hypochlorite generation system was installed in 2012 and is still operational, but the technology has advanced considerably, and a new hypochlorite generation system would increase plant resiliency. For this reason, a new sodium hypochlorite generation system should be implemented when the existing system reaches its predicted service life of 20 years. The estimated cost to replace the sodium hypochlorite generating system improvements is \$250,000.

5.3.7.3 Chemical Room Climate Controls

Hot weather operation issues for the onsite sodium hypochlorite generation system can be resolved by adding a mechanical chiller or air-conditioning unit should be considered as an auxiliary update to the existing hypochlorite system. The existing system fails on days where the water temperature exceeds approximately 75 F, so a chiller would increase system resiliency on the hottest days of the year.

A 2-ton ductless split central air conditioning system would cool the hypochlorite room at an estimated cost of \$10,000. However, this system would be susceptible to corrosion and require frequent replacement due to chemical corrosion. A more robust solution would be a system that offers continuous ventilation with a duct-mounted cooling coil coupled to an outdoor AC unit. The estimated cost for this option is \$30,000.

5.3.8 Plant Security

Communications and security improvements are recommended for the water plant site. Improvements specific to the plant site are:

- Construct chain link fence limiting access to the springs and treatment plant with electronic card reader type locks on the access road
- Install cameras outside and inside the water plant. This improvement would also allow plant staff remote visual confirmation of process conditions inside the plant.
- Install intrusion alarms that report to the operators through the SCADA system

To support video operations, the existing radio system would need to be upgraded to increase its bandwidth and to add ethernet capability. The antenna tower would also need to be raised to increase the radio system's reliability. The cost for these improvements is approximately \$190,000.

5.4 Disinfection for New Supplies

When new wells are added to the water supply system additional disinfection capacity will be required. A new onsite sodium hypochlorite generation system will be required for the new well complex. Onsite hypochlorite generation is reliable and has been used by the City in two facilities since 2012. Generating sodium hypochlorite solution is simple and requires salt and electric power. Using this source of disinfectant, the City is not subject to market pricing for sodium hypochlorite solution or manufacturing issues that recently impacted the hypochlorite market. We recommend continued use of onsite sodium hypochlorite and additional disinfection capacity should be in the form of additional onsite generation systems. The costs to add onsite sodium hypochlorite generation is included in well construction and treatment plant project costs.

5.5 Long Term Water Supply Alternatives

The long-term water supply alternatives discussed in this section are based on the concepts developed over several years with the City leading the discussion and technical support by

CwM-H2O and Kennedy Jenks and documented in CwM-H2O's reports "*Green Mountain Spring Aquifer Storage Feasibility Study*" (2018) and "*Demand Update and Infrastructure Plan*" (2022). The long-term water supply concept consists of the following elements:

- Maximize the City's existing water rights and sources
- Drill shallow and deep wells for short term use and Aquifer Storage and Recovery (ASR) testing
- Conduct an ASR Pilot Study to confirm suitability of ASR
- Develop additional water supply (Regional Provider or Surface Water Intake and Water Treatment Plant) for injection into the ASR system
- Develop Full ASR Capability for long term storage of water for withdrawal in summer

The City has a 20-year planning goal to develop 1.0 cfs of additional water supply and a long-term goal to develop 2.0 cfs additional water supply. The elements of this plan are developed in this section.

5.5.1 Regional Water Providers

New water could be secured from a Regional Water Provider such as the Joint Water Commission, City of Hillsboro, City of Forest Grove, or Tualatin Valley Irrigation District.

5.5.1.1 Tualatin Valley Irrigation District

Tualatin Valley Irrigation District (TVID) provides non-potable water to the Quail Valley Golf Course as supplemental irrigation water. A pipeline from TVID runs along Aerts Road on the east side of the UGB. If TVID water were to be considered for use in the City's ASR system, it would require treatment to drinking water standards before injection.

TVID was created by US Congress under the Bureau of Reclamation as an irrigation project benefitting agricultural users. The water provided by TVID is furnished under an irrigation right. It is unknown whether this water could be transferred to the City as a municipal right. Determining the feasibility of using TVID for municipal use requires legal expertise and investigation beyond the scope of this water master plan. There are several supply alternatives with clear path to water rights for the City, therefore, this option is not currently under consideration.

5.5.1.2 Alternative WS1 - Joint Water Commission

The Joint Water Commission (JWC) provides drinking water to the Washington County region and has the capacity to provide the required volume of high-quality water to Banks. In this arrangement, Banks would become a wholesale water customer to JWC. Water could be used for aquifer storage and recovery or could be used year-round.

To deliver the water to Banks, the City would need to construct a pipeline from JWC's North Transmission Line in Forest Grove or Hillsboro, a distance of approximately 10 miles. In addition, JWC requires all existing and new connections in Banks pay a System Development Charge (SDC) of \$3,835 for all connections in Banks. New connections would be required to pay both JWC's SDC and the City's SDC of \$5,000. Table 5-3 summarizes the initial costs to become a wholesale customer to JWC with 800 existing connections.

Table 5-3: Alternative WS1 - JWC Initial Connection Costs

Cost	JWC-Related Costs
Construct 12-inch Pipeline to North Transmission Line	\$15,000,000
System Development Charge-Existing Connections (\$3,835/each)	\$3,000,000
Total Initial Connection Costs	\$18,000,000

The annual wholesale water cost would be approximately \$250,000 per year.

5.5.1.3 Alternative WS2 - City of Hillsboro

The City of Hillsboro owns and operates the Cherryville Water Treatment Plant with the capacity to meet the Banks' 20-year water needs. In this arrangement, Banks would become a wholesale water customer of Hillsboro. Transmission line construction for this alternative would be approximately 11 miles to reach the Cherryville transmission line and the capital cost was estimated to be \$18,000,000. The SDC charges for retail water customers is \$14,577, however, it is likely wholesale water customers would be subject to a lower charge similar to JWC's SDC. Table 5-4 summarizes initial costs to become a wholesale water customer to Hillsboro's Cherryville water system.

Table 5-4: Alternative WS2 - City of Hillsboro Initial Connection Costs

Cost	Hillsboro-Related Costs
Construct 12-inch Pipeline to NTL	\$18,000,000
System Development Charge-Existing Connections (\$3,835/each)	\$3,000,000
Total Initial Connection Costs	\$21,000,000

5.5.2 Alternative WS3 - Local Surface Water Supply Alternative

Diversion of water from a local surface source in winter could supply the ASR project with winter water to inject while water is plentiful. The City has an opportunity to secure a surface water right from the West Fork of Dairy Creek. This water will require filtration and disinfection before use and could be sent directly into the distribution system or injected through ASR injection wells to be withdrawn during summer. Table 5-5 summarizes how a water treatment plant would be phased to accommodate 20-year growth and long-term growth.

Table 5-5 Design Phases for Water Treatment Plant

Phase	Peak Demand (gpm)	Supply Window
1	450	2042
2	900	2050
3	1,800	2050+

The treatment plant description and life-cycle cost estimates in this section are for Phase 1 demands.

5.5.2.1 Treatment Plant Description

This section summarizes a conceptual treatment plant design for a Dairy Creek intake. The proposed Phase 1 water treatment plant site would be located on City-owned land adjacent to the West Fork Dairy Creek. The water treatment plant will divert raw water from Dairy Creek and pump treated water directly into the distribution system. The processes are:

- Raw Water Intake – The raw water intake will be a concrete intake structure with a bar screen. Two raw water Pumps are mounted in the intake to pump water to the treatment plant. A raw water pipeline conveys water to the treatment plant filter building
- Pretreatment - Polymer flocculation and settling removes silt
- Filtration – Water is filtered through a membrane filtration unit (pending pilot testing).
- Disinfection – Onsite-generated sodium hypochlorite is injected for disinfection.
- Finished Water Storage Tank provides adequate contact time for disinfection
- Distribution pump conveys finished water into the distribution system at system pressure
- Residuals from the clarifier tank and the membrane filtration system will collect in a set of filter bags, which will periodically be removed and hauled to a landfill for disposal

Finished water pumped from the water treatment plant into the distribution system is consumed by water customers. Water not consumed is conveyed to the Carsten Reservoirs for storage. A control intertie between the Carsten Reservoirs and the treatment plant will call for the treatment plant to start and shutdown based on the water level in the reservoirs. During winter, when water demand is low, excess water will be injected through ASR injection wells.

The estimated cost to construct the Phase 1 Water Intake and Treatment Plant is \$8,000,000.

5.5.2.2 Operation and Maintenance

The water treatment plant will be automated and will generally operate unattended; however, it will require daily monitoring and maintenance of mechanical equipment, treatment chemical refills, management of waste residuals, and collection of samples for laboratory analysis. Additionally, the Operator will adjust the treatment process for optimal performance. Operation and Maintenance costs are comprised of the following:

- Operator Labor
- Electric Power
- Chemicals
- Residuals Disposal

Costs were prepared assuming the treatment plant operates at 450 gallons per minute and operates with 75% “up” time. The estimated O&M Cost for the water treatment plant is \$200,000 per year.

5.5.2.2.1 Water Treatment Plant Life Cycle Cost

Life-cycle cost for Phase 1 include capital construction cost plus 20 years of O&M costs. The total life-cycle cost for the water treatment plant is summarized in Table 5-6.

Table 5-6: Water Treatment Plant Life Cycle Cost Summary

Item	Estimated Cost
Estimated Construction Cost	8,000,000
Estimated O&M Cost (20-year Present Value)	3,000,000
TOTAL	\$11,000,000

5.5.3 Water Supply Alternatives Discussion

The City has considered two water supply alternatives:

- WS1 - Regional water provider (Joint Water Commission)
- WS3 – West Fork Dairy Creek Supply and Treatment

Under Alternative WS1, JWC can provide the required volume of water to the City and the volume can increase as the City grows. The City will need to notify the JWC it intends to reserve additional water and may be required to pay to reserve additional capacity until it is needed.

The initial connection cost, including capital cost and SDCs to connect to JWC’s transmission line, is much higher than the local water treatment plant alternative. In addition, the City will be subject to periodic wholesale rate increases from JWC with little opportunity to provide input. The capital cost for construction of the pipeline is significant because it must be sized to accommodate all phases of anticipated growth beyond the 20-year planning window in this plan.

Under Alternative WS3 the local surface water intake and treatment plant can be constructed in phases to permit the size and scope of the treatment plant to match the City’s current need. The Phase 1 plant will meet the 20-year need and its capital cost is approximately half of the cost of Alternative WS1. With a local supply and treatment plant the City will maintain control over its water supply, annual costs O&M costs, and user rates and SDCs.

Based on the lower capital cost and ability for the City to maintain control over its water supply, we recommend the City implement WS3 - Local Surface Water Supply and Treatment alternative.

5.6 Long Term Water Supply and Storage Strategy

The City of Banks and CwM-H2O prepared an *Aquifer Storage and Recovery Feasibility Study* (2018) indicating probable feasibility of ASR. CwM-H2O also prepared a *Draft - Water Master Plan Demand Update and Infrastructure Plan* (2022) that proposed a long-term supply and storage strategy. The strategy is in two phases.

- Phase 1 – Maximize the City’s existing assets and water rights
- Phase 2 – New Wells & ASR Testing
- Phase 3 – Surface Water Treatment Plant

These phases are detailed with planning level costs in the following sections:

5.6.1 Phase 1 – Maximize City’s Existing Assets

Phase 1 makes improvements to Springs and SSF plant to use the City’s full surface water right. This phase involves implementing water capture improvements and conducting ASR Pilot Testing. The elements of this project are summarized in this section.

- Optimization and modification of the East Springs as described in Section 5.1 and the SSF Plant as described in Section 5.2.
 - Estimated to add capacity of at least 36,000 gpd (average 35 gpm) year-round
 - Estimated to add capacity of up to 100,000 gpd (70 gpm) capacity in winter/spring.

5.6.2 Phase 2 – New Wells and ASR Testing

- Construction of 2 new shallow water bearing zone (WBZ) wells (Well 3 and 4):
 - Two new wells target rate of 125 to 250 gpm each
 - Additional peak day capacity of 400,000 gpd (operating at 100%, 24-hr)
 - Additional peak season capacity of 200,000 gpd (operating at 50%, 12-hr)
 - Average capacity of 100,000 (operating at 25%, 6-hr)
- Modification of Well 2:
 - Seal off shallow water-bearing zone and isolate deep WBZ for production
 - This will reduce the capacity of Well 2 by approximately 30-40%
- Construction of 1 new Deep WBZ Well (Well 5):
 - New deep well will be added to the Well 2 water right and split production
 - Add 315,000 gpd during peak day (operating at 100% max, 24-hr)
 - Add 150,000 gpd during peak-season (operating at 50% max, 12-hr)
- Pilot ASR Study with New Deep Basalt Well:
 - Apply for ASR Limited License and ASR Pilot Test Plan
 - Use expanded SSF Plant capacity to support a pilot test of an ASR system using Well 5
 - Testing results would inform the City on potential expansion to full-scale ASR in support of Phase 2 development

5.6.3 Phase 3 Implement Surface Water Treatment and ASR

Phase 2 will develop the City’s new surface water supply and implement full scale ASR. The elements of this phase are described in this section.

- Obtaining Permit for West Dairy Creek Winter Water - apply to Oregon Water Resources Department (OWRD) for a permit for application S-88915 for up to 2.0 cfs (896 gpm)
- Construction of West Dairy Creek Diversion and water treatment plant:
 - Initial capacity of 1.0 cfs (448 gpm), which is half of the water right
 - Add 645,000 gpd of available supply from December to April
 - Can completely replace groundwater sources and support demands in winter and spring, with roughly 100,000 gpd remaining for ASR

- Construction of a third Deep WBZ Well (Well 6):
 - Add Well 6 to the Well 2 water right
 - Along with Wells 2 and 5, will act as injection wells for full-scale ASR program
 - Wells can be configured to also act as pumping well in the summer

- Development of an Aquifer Storage and Recovery (ASR) Program:
 - When Dairy Creek WTP is online, at least 300,000 gpd would be available for injection between December and April
 - The unused portion of the SSF Plant production water would also be available for injection, possibly extending the injection season to November to May
 - 300,000 gpd is equal to 312 gpm for 16-hours per day, or 208 gpm for 24 hours per day
 - 300,000 gpd is equivalent to approximately 45 Million Gallons per season of injection
 - At 70% recovery rate, this would provide an additional 180,000 gpd of groundwater supply from June-October, or 300,000 gpd for July-September
 - If full capacity of ASR system is not needed during peak, the excess storage volume would contribute to aquifer recharge, increasing the sustainability of the groundwater system

Section 6: Capital Improvements

This section contains the Capital Improvement Plan (CIP) Project list with costs and suggested schedule for the City's water system over the next 20 years as well as costs for distribution system extensions estimated to be required beyond 2050.

- Division 1 costs: 10%
- Contractor Markup for Subcontractors: 12%
- Contractor Overhead and Profit: 15%
- Owner Contingency at Preliminary Design Stage: 30%
- Escalation to Midpoint of Construction: 7%
- Engineering/Legal/Administrative Costs: 35%

Table 6-1 contains a summary of CIP Projects and their recommended timing. The actual year of construction for the CIP projects may change based on a change in need, available funding, regulatory requirements, or development-influenced factors.

Table 6-1: Water Capital Improvement Plan through 2042

CIP Item	Project	Budgetary Cost	SDC Eligible Cost	Critical to Growth?	Planned Year
Storage and Metering Improvements					
1	1.0 MG Welded Steel Reservoir	4,900,000	4,900,000	Yes	2027
2	Reservoir #2 Rehabilitation	950,000	-	No	2025
3	Reservoir Site Power/Control Building/Security Improvements	810,000	324,000	Yes	2026
4	AMR Metering Expansion	1,100,000	-	No	2023
Distribution System Improvements					
5	Cedar Canyon Road Dairy Creek Crossing	500,000	-	No	2026
6	Banks Road Waterline Replacement Reach A	1,700,000	425,000	Yes	2024
7	Banks Road Waterline Replacement Reach B	1,100,000	-	No	2025
8	East Loop/Aerts Road Water Main	2,800,000	2,800,000	Yes	2028
9	Westside Loop	2,600,000	2,600,000	Yes	2025
10	Northwest Loop (Cedar Canyon to Hwy 26)	2,800,000	2,800,000	Yes	2042
11	South Loop (Wilkesboro)	3,500,000	3,500,000	Yes	2035
12	Northeast Extension	1,100,000	1,100,000	Yes	2040
Phase 1 Water Supply Improvements					
13	East Springs Improvements	170,000	-	No	2024
14	Mechanical Prefiltration Unit	220,000	-	No	2024
15	Filter Plant Piping Gallery Improvements	190,000	-	No	2025
16	Retrofit Existing Sedimentation Basin to Slow Sand Filter	350,000	-	No	2025
17	Combine Diversion Points for Large and Small Springs	20,000	-	No	2024
18	Evaluate Well #1	60,000	-	No	2023
19	Sodium Hypochlorite Generation Upgrades	250,000	-	No	2026
12	Chemical Room Climate Controls	30,000	-	No	2026
	Plant Security	190,000	-	No	2026
Phase 2 Water Supply Improvements					
21	New Shallow Wells #3 & #4/Building/Controls/Conveyance Pipeline	3,750,000	3,750,000	Yes	2026
22	Modify Well #2	430,000	430,000	Yes	2027
23	New Deep Well #5/Building/Controls/Conveyance Pipeline	2,800,000	2,800,000	Yes	2028
24	ASR Pilot Testing	500,000	500,000	Yes	2031
Phase 3 Implement ASR					
25	Water Right Acquisition/Legal/Permitting	380,000	380,000	Yes	2031
26	Land Acquisition for Water Treatment Plant	350,000	350,000	Yes	2032
27	Water Treatment Plant/Diversion Structure/Conveyance Pipeline	6,260,000	6,260,000	Yes	2033
28	Land Acquisition for Well Building	130,000	130,000	Yes	2034
29	Construct New Well #6/Building/Controls/Conveyance Pipeline	5,100,000	5,100,000	Yes	2036
TOTALS		\$ 45,040,000	\$ 38,150,000		

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, we highly recommended to attend a “One-Stop” meeting hosted by Oregon Business. Representatives of all the funding agencies attend and provide funding available projects.

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.

Median household income, grant amounts, and interest rates fluctuate and should be verified prior to proceeding with an application.

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. Federal funds come through Oregon Business and are administered by Washington County.

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.

7.2 State Programs

7.2.1 Water/Wastewater Financing Program

The Oregon Water/Wastewater Financing Program 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.

7.2.1.1 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.

7.2.1.2 Terms

The following terms apply:

- The maximum loan term is 30 years; a 20-year term is typical.
- Maximum grant amount is \$750,000, including issuance costs and any debt service reserves (if required).
- Loans are typically repaid with utility revenue, general funds, or voter approved bond issues.

7.2.2 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).

7.2.2.1 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.

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.

7.2.2.2 Terms

The following terms apply:

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

7.3 Local Funding and Investment

The City may elect to partner with commercial developers to assist in bringing some capital improvements to design and construction. The City's application for grants and loans to fund water infrastructure construction typically requires at least 2 years. Financial resources of developers can assist the City in expediting construction of water infrastructure, which then could be reimbursed through water system development charge credits.

If the City wishes to pursue agreements with developers to construct water infrastructure, the agreements should include the requirements to uphold City Public Works Design Standards, municipal water supply industry standards, adequate time for City review and input at planning and design phases.

References

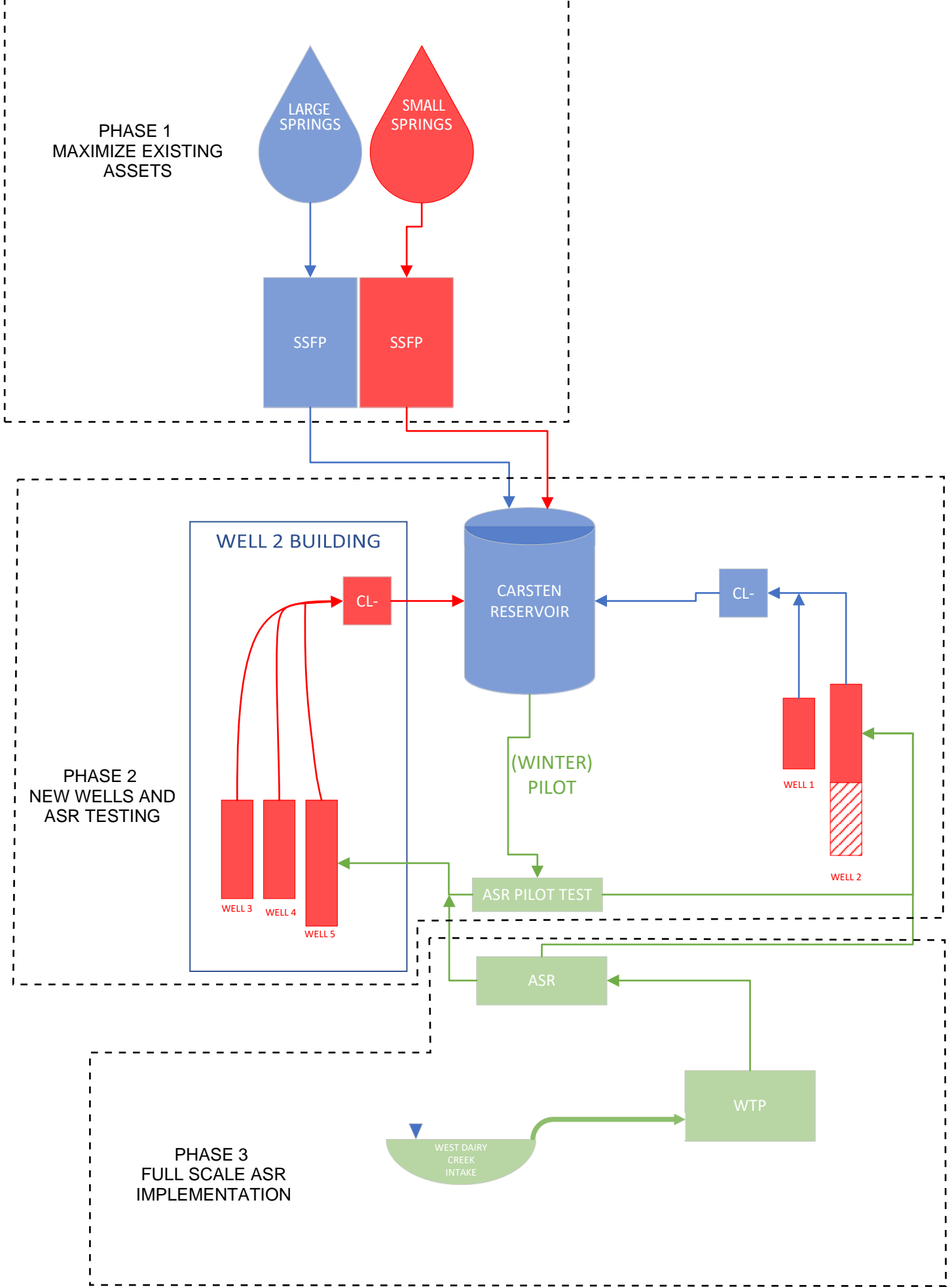
Water Master Plan Amendment, Kennedy/Jenks Consultants, 2011

Green Mountain Springs Aquifer Storage and Recovery Feasibility Study, CwM-H2O, 2018

Draft - Water Master Plan Demand Update and Infrastructure Plan, CwM-H2O, 2022

APPENDIX A

Water Supply Flow Chart



APPENDIX A - WATER SUPPLY FLOW CHART
 CITY OF BANKS WATER MASTER PLAN AMENDMENT
 MARCH 2023