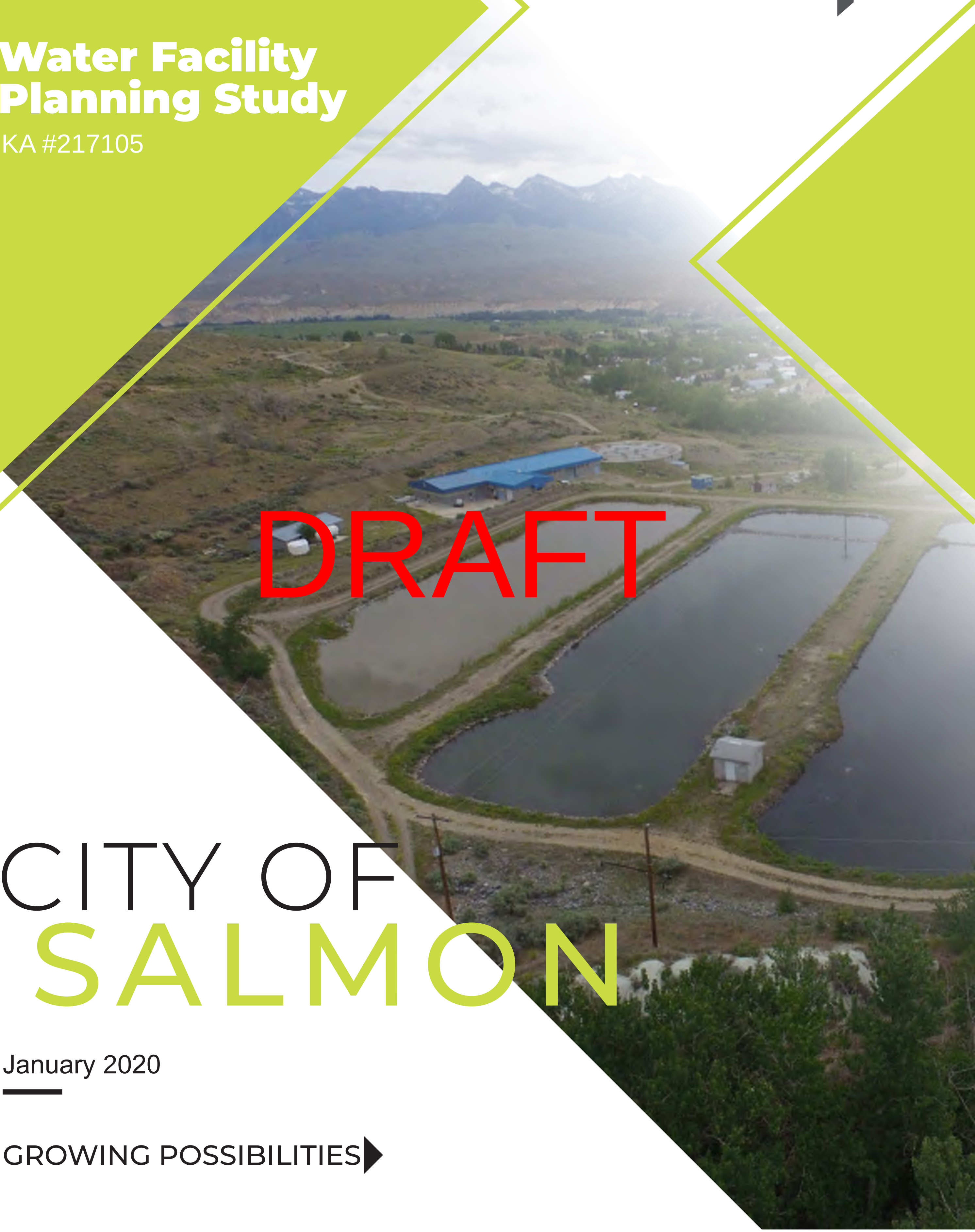
KELLER ASSOCIATES

Water Facility Planning Study

KA #217105



DRAFT

CITY OF SALMON

January 2020

GROWING POSSIBILITIES

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AUTHORIZATION

In October 2017, the City of Salmon, Idaho (potable water system (PWS) No. ID7300042) contracted with Keller Associates, Inc. to complete a Water Facility Planning Study (WFPS) in accordance with IDAPA 58.01.22 to evaluate the City's water supply and distribution system and develop a plan to meet future system demands. The study was funded by a 50/50 grant through the Idaho Department of Environmental Quality (Grant # DWG-190-2018-9).

EXECUTIVE SUMMARY

Introduction
The purpose of this Water Facilities Planning Study (WWFPS) is to assess the condition of the water distribution system, provide an evaluation of the water treatment plant and its ability to provide for the long-term needs of the City, and to provide a comprehensive water system planning document.

This study evaluates multiple alternatives and identifies improvements to overcome distribution and treatment system deficiencies and addresses any violations of State or Federal requirements. Implementation of these recommendations will help the City meet water needs for the next 20 years.

System Summary
The City of Salmon provides drinking water for City residents. The distribution system consists of large diameter water mains that convey water to smaller diameter distribution lines. The entirety of the drinking water first passes through the City's municipal drinking water treatment plant and storage reservoir and the entire system floats off of the tank. A majority of the distribution system is aging and only minor upgrades have been completed since that time.

Treatment of water is achieved using a membrane filtration treatment system with multiple stages of pre-filtration including sand beds and pre-flocculation followed by Amiad 300-micron pre-filters. Flows can be diverted from multiple mountain streams or the Salmon River to provide for the needs of the City. Treated water is dosed with liquid chlorine and enters the 1.5-million-gallon storage tank which feeds the rest of the distribution system.

Average day demands within the system are approximately 1.6 MGD and increase to 2.76 MGD during maximum demand days in the summer months. Peak hour demands are 3.87 MGD. For planning purposes, 20- and 40-year demand projections are considered herein.

System Deficiencies and Need for Action
Deficiencies and issues throughout the distribution system reported by the operators and observed through the course of this study are summarized below:

- The City of Salmon has had historical issues related to disinfection byproducts (DBPs).
- Storage volumes are currently below recommended values due to a lack of emergency power generation at the treatment plant.
- System pressures vary widely throughout the system and are low in the upper pressure zone and high in the middle pressure zone.
- A significant number of the City's fire hydrants are connected to 4-inch water mains. IDAPA 58.01.08.542.06 requires that fire hydrants be connected to water mains no smaller than 6 inches.
- Fire flow test results indicate that sections of the City are unable to meet fire flow requirements in some City hydrants (IDAPA 58.01.08.552.01).

- Current average water use in Salmon (514 gpcd) is over two times greater than average Idaho use (210 gpcd).

Deficiencies at the water treatment plant reported by the operators and observed through the course of this study are summarized below:

- Alum & sodium hypochlorite feed systems should be plumbed to provide flush or carrier water.
- Pump basins need to be placed on a regular cleaning cycle.
- Chemical feed piping is beginning to leak.
- The plants turbidimeters should be inspected and their calibration should be checked on an annual basis, at a minimum.
- The treatment plant has a particle counter but it is inoperable.
- Settling ponds have history of algal blooms.

Evaluation of the identified deficiencies resulted in several improvement alternatives which are intended to address current shortcomings, facilitate compliance with state and federal regulations, and assist the City in providing a high quality of service that the community has come to expect.

Alternatives Considered

Numerous water supply, storage, and treatment alternatives were developed for consideration by the City. These alternatives are explored in depth within Chapter 5. Alternatives considered included both no action alternatives and capital improvements including rehabilitations, upgrades, and replacement of existing infrastructure. Several different priorities that were identified by City water operators included the replacement of known problem water lines and the creation of an additional pressure zone to limit pressures within the system.

Preferred Alternative

To be completed after the City Council approves the preferred alternative

Financial Analysis

To be completed after the City Council approves the preferred alternative

Implementation Schedule

To be completed after the City Council approves the preferred alternative

CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION

In 2017, the City of Salmon, Idaho contracted with Keller Associates to prepare a Water System Facilities Planning Study. The purpose of the study is to provide a comprehensive evaluation of the existing water system, and to identify deficiencies that need to be addressed to meet current and future demands.

The City of Salmon, Idaho is a small community sheltered by the mountains of North-Central Idaho, approximately 35 miles south of the Idaho-Montana Border along Highway 93. Salmon is the county seat of Lemhi County and is notable in American History as being the birthplace of Sacajawea and home to the AgaiDika Shoshone that gave aid to Lewis and Clark on their journey to the Pacific Ocean (City of Salmon, Idaho, 2018). Later, the area was influenced by mining, logging, and ranching activities and has grown into a recreational destination offering a wide variety of outdoor activities. Background information regarding the City of Salmon can be found throughout the introductory sections of this report, and in Appendix A.

The City of Salmon had a 2010 census population of 3,112, and a 2016 estimated population of 3,059 (U.S. Census Bureau, 2018). A majority of the citizens of Salmon are employed in the services trade as reported by the Idaho Department of Commerce (Idaho Department of Commerce, 2018). The City currently provides drinking water, irrigation water, and sewer services to residents. Other utilities available to community residents and businesses from non-municipal entities include, among others, garbage collection, electrical power, and high-speed communications.

The City of Salmon water system provides potable water to approximately 1,620 water connections via approximately 37 miles of primarily cast iron, ductile iron, and PVC pipe. Water is fed to the distribution system through the main 1.5 MG storage tank located on the eastern extent of the City limits, directly below the surface water treatment plant. The City of Salmon can draw water for municipal uses from Chipps, Jesse, and Pollard Canyon Creeks along with the Salmon River.

Surface water diverted into the drinking water treatment plant is piped into one of three pre-sedimentation ponds originally constructed in 1974 as slow sand filters (Forsgren Associates, 1989). An additional sedimentation pond which can service flows from Chipps, Jesse, and Pollard Canyon Creeks is located on Jesse Creek approximately 1300 ft. upstream of the three main pre-sedimentation ponds. Flows from the three creek sources and the Salmon River can be blended within the three main pre-sedimentation ponds before treatment. Following pre-sedimentation, a coagulation/flocculation process using alum and additional sedimentation further clarifies the water. Water is then forced through membrane filters with a nominal pore size of 0.1 microns before chlorine is added. The main 1.5 MG storage tank acts as both storage and a chlorine contact chamber.

Current Average Day Demand is approximately 1.6 million gallons per day (MGD) which corresponds to a per capita demand of approximately 518 gpcd. Thus, the City of Salmon experiences demands over two times greater than the 210 gpcd Average Day Demand in Idaho (U.S. Geological Survey, 2017). Additional discussion will be provided in subsequent sections.

The City of Salmon owns and operates the water supply, storage, and distribution system; and is committed to providing all residents with high quality water. This study has been completed to aid The City of Salmon in maintaining their high quality of service by assessing the current condition of the Salmon water system, identifying current system deficiencies, and developing a framework to address the future needs of the system. System improvements were developed without any consideration of the ethnicity, religion, or socioeconomic status of the residents that the proposed improvements will benefit.

1.2 SCOPE

The scope of this study includes the following:

- Identify and evaluate standards, recommendations, and design criteria for:
    - Water supply
    - Storage
    - Pressure requirements
    - Fire protection
- Existing Facilities Condition and Evaluation
    - Compilation of data concerning the age and condition of the existing water system, including but not limited to pipelines, valves, the tank, springs, wells, and other facilities
    - Evaluation of the existing water system components
        - System pressures
        - Pressure zones
        - Facility and pipe capacities
        - Available fire protection
        - Water supply
        - Water storage
        - Transmission and delivery
    - Outline of prioritized recommended improvements
- Identify and describe environmental conditions within the planning area
- Model Existing Water Facilities
    - Compile and review in the computer model:
        - Study area boundaries
        - Inventory of existing facilities
        - Type and amount of water consumption and production
- Existing and projected land use and population
    - Develop alternative solutions to address potential system deficiencies
- Master Planning and Capital Improvement Plan
    - Develop population projections (20-yr and 40-yr)
    - Review current and future water supply and storage needs
    - Prepare Master Plan including:
        - Future facility needs
        - Replacement and pipeline extensions
    - Develop an estimated schedule for capital improvements and a summary of potential impacts on rates
    - Discuss funding sources and options
- Report Preparation
    - Submit to the City of Salmon for their review and approval
    - Submit to Idaho Department of Environmental Quality for review and approval
- Public Participation, Presentations, and Meetings

1.3 REPORT ORGANIZATION

This report is intended to provide a methodical description of the complete water system for The City of Salmon, including a synopsis of source water, storage, transmission, delivery, and treatment. This report is organized to address these items in regard to current and future conditions. A table of contents is provided as a comprehensive layout of the report, following which a list of tables and figures is included for reference. A summary of the chapters included in the report follows.

- Chapter 1 – Introduction
- Chapter 2 – Project Planning
- Chapter 3 – Existing Facilities Condition & Evaluation
- Chapter 4 – Need for Project
- Chapter 5 – Alternatives Considered
- Chapter 6 – Alternative Analysis
- Chapter 7 – Proposed Project (Recommended Alternative)

Project planning and environmental conditions are presented in Chapter 2; existing facility conditions and identified system deficiencies will be discussed in Chapter 3; future conditions and the need for the project are discussed in Chapter 3; alternatives to mitigate the deficiencies to meet current and future demands are evaluated in Chapter 5; selected alternatives, and an analysis of each alternative is presented in Chapter 6; the proposed project is described in Chapter 7 and provides the final conclusions and recommendations pertaining to the scope of study.

1.4 PROJECT PURPOSE & NEED

This report presents the findings and recommendations of the City of Salmon Water Facility Planning Study. This study was commissioned by the City in an effort to determine the current state of the water system, and plan for future needs. Keller Associates has worked with key city personnel to understand the challenges currently faced by the system, and to develop practical, cost-effective solutions. Keller Associates gratefully recognizes the support and assistance of municipal, administrative, and support staff who were essential to the completion of this study, as well as the contributions of all others involved.

1.5 ABBREVIATIONS

- ADD — Average Day Demand
- AWWA — American Water Works Association
- bgs — below ground surface
- cfs — cubic feet per second
- Idaho DEQ — Idaho Department of Environmental Quality
- EPA — United States Environmental Protection Agency
- FFD — fire flow demand
- ft. — foot
- fps — feet per second
- gal — gallons
- gpcd — gallons per capita per day
- gpm — gallons per minute
- Hp — horsepower
- IDWR — Idaho Department of Water Resources
- IOC — inorganic chemical

- kW kilowatt
- MCL maximum contaminant level
- MDD Maximum Day Demand
- mg/L milligrams per liter
- MG million gallons
- MGD million gallons per day
- PHD Peak Hour Demand
- POD point of diversion
- ppb parts per billion
- ppm parts per million
- psi pounds per square inch
- SDWA Safe Drinking Water Act
- SOC synthetic organic chemical
- VOC volatile organic chemicals
- WFPS Water Facilities Planning Study

1.6 DEFINITION OF TERMS

- Average Day Demand (ADD) – the volume of water supplied to the system in a year divided by 365 days

- Consumption – refers to the volume of water customer's use. Consumption is generally measured with a water meter installed at each consumer's connection to the water system. In cases where a water system is not equipped with water meters at individual connections, consumers are charged a flat rate for water usage.

- Demand – refers to the water needed to meet residential, commercial, industrial, and public water needs over a period of time, as well as the system losses that are associated with the demand. Demands on the water system vary by the time of day and season. Due to varying consumer needs, system condition, and other factors, individual communities have unique water demand patterns. Volumetric rates (gpm or cfs), volumes (gal or MG), and per capita demand (gpcd) are often used to quantify the demand placed on a system.

- Demand Factors – also referred to as peaking factors. Demand factors define the relationships between ADD, MDD, and PHD.

- Fire Flow Demand (FFD) – flow required to supply a sufficient quantity of water to fight a fire. The *International Fire Code* establishes fire flow requirements and is the accepted code in the State of Idaho.

- Firm Pumping Capacity – the total pumping capacity that a pump system can deliver with the largest pump out of service.

- Maximum Contaminant Level (MCL) – refers to the greatest concentration of a contaminant allowed in drinking water often reported in ppm, ppb, mg/L, or µg/L.

- Maximum Day Demand (MDD) – the maximum volumetric rate or volume of water supplied to the system in one day during a year.

- Peak Hour Demand (PHD) – the maximum volumetric rate or volume of water supplied to the system in one hour during a year.

- Safe Drinking Water Act (SDWA) – United States regulation passed by Congress in 1974 to protect public health by regulating public drinking water. The Act was amended in 1986 and 1996 and is enforced by the EPA.

- Total Pumping Capacity – the total pumping capacity of all pumps within a pumping system.

- Firm Pumping Capacity – the total pumping capacity of the water system with the largest pump out of service

CHAPTER 2 PROJECT PLANNING

This portion of the report presents a general overview of existing conditions within the study area. An Environmental Information Document (EID) will be prepared in conjunction with this study if required for any improvements pursued by the City of Salmon. An EID, if prepared, will provide additional detail regarding environmental conditions within the planning area, potential environmental impacts which may result from the implementation of the proposed improvements, and means to mitigate these environmental impacts.

2.1 PROPOSED PROJECT PLANNING AREA IDENTIFICATION

The City of Salmon is the county seat of Central Idaho's Lemhi County, and lies along the banks of the Salmon River on Highway 93 approximately 35 miles south of the Idaho-Montana border. Based on the Boise Meridian, the City is located at the intersections of Township 21 North, Ranges 21 and 22 East and Township 22 North, Ranges 21 and 22 East. Figure 2-1 shows the location of Salmon with regard to the State of Idaho.

Figure 2-1 Vicinity Map

This Water Facilities Planning Study is based on a specific proposed project planning area which incorporates the region and population which the water system could reasonably be expected to serve for the 20-yr planning period from 2019 to 2039. Figure 2-3 identifies this planning area and is provided at the end of this chapter.

2.2 ENVIRONMENTAL RESOURCES PRESENT

2.2.1 Physiography, Topography, Geology, and Soils

The City of Salmon is located in north-central Idaho near the Idaho-Montana border. The City elevation ranges from 3,944 ft. to 4,413 ft. above sea level. The region immediately surrounding Salmon is dominated by narrow valleys and benches that rise at steep slopes above the Salmon River Plain in all directions.

The soils found within the planning area consist primarily of gravelly loams. Millhi and Breitenbach are the predominant soil classes within the City of Salmon, but significant quantities of Wimpey-Zeph-Ajax Complex are found southwest of the City and Snowslide-Badland-Perreau Complex to the northwest of the City. A soils map is available in Figure 2-4 and Appendix A contains additional mapping and soil descriptions as designated by the Natural Resources Conservation Service (NRCS) (U.S. Deptartment of Agriculture, 2018).

Due to the importance of agriculture in the region, soil is an important natural resource. Breitenbach soils, as found in and around Salmon, are considered to be prime farmland if irrigated as is the Wimpey-Zeph-Ajax Complex southwest of the City; however, much of the remaining soils are not considered to be prime farmland (U.S. Deptartment of Agriculture, 2018). A soil report containing detailed information on soils in and around the City of Salmon is available in Appendix A.

2.2.2 Surface & Ground Water Hydrology

According to the Idaho Department of Water Resources (IDWR) there are approximately 391 wells located within the proposed planning area (Idaho Department of Water Resources, 2018). Static water depth in these wells ranges from 0 ft. bgs to 225 ft. bgs; the average static water level is 24 ft. bgs (Idaho Department of Water Resources, 2018). The City of Salmon has refrained from pursuing groundwater rights and instead has focused on obtaining rights to surface water sources because of historical uncertainty that groundwater sources with sufficient capacity for municipal uses could be found (Forsgren Associates, 1989).

Surface water is found in and near the planning area in the Salmon River and various spring fed tributaries to the Salmon River such as Jesse, Chipps, and Pollard Canyon Creeks from which the City of Salmon diverts drinking water. The Salmon River originates in the mountains of Central Idaho and eventually flows into the Snake River immediately north of Hells Canyon. The Salmon River is one of the longest undammed rivers in the contiguous 48 States and provides for one of the longest migrations of Pacific Sockeye Salmon in North America (Idaho Public Television, 2018). The water rights held by the City of Salmon to the Salmon River are used to supplement higher quality flows from Jesse, Chipps, and Pollard Canyon Creeks.

2.2.3 Fauna, Flora, and Natural Communities

The Salmon River, and the region surrounding The City of Salmon, support a wide variety of plant and animal life, several of which are listed species by the US Fish and Wildlife Service. Species listed as threatened or endangered include the Canada Lynx, North American Wolverine, Yellow-billed Cuckoo and Bull Trout (U.S. Fish and Wildlife Service, 2018). Additionally, there is critical habitat for the Bull Trout within the project planning area.

2.2.4 Zoning, Land Use, and Development

Zoning in the City of Salmon is based upon five classifications: Agricultural, Core Commercial, Commercial, Industrial, Light-Density Residential, and Medium-Density Residential (City of Salmon, 2018). Figure 2-5 illustrates zoned areas in and around Salmon. A majority of the City is zoned as residential with areas of commercial use along Highways 93 and 28. The eastern portions of the City are zoned for agricultural uses.

Growth could be experienced to the north, south, and east of the existing City Limits due to new developments or annexation of existing residences. Limited growth is anticipated to the West of the existing City limits due to excessively steep terrain. However; the City anticipates growth primarily to occur along the southern portion of the City in the vicinity of the cemetery and between South St. Charles St. and Cottonwood Rd. Potential areas of growth are shown in Figure 2-6.

2.2.5 Cultural Resources (Historical & Archaeological)

Several entries exist on the National Register of Historic Places for structures within the City of Salmon and are provided in Table 2-1.

Table 2-1 Salmon Cultural Resources[1]

Title	Address	Date of Register
Myers A. Socrates Residence	300 Hall St. Salmon, Idaho	12/2/1977
Odd Fellows Hall	510-516 Main St. Salmon, Idaho	2/7/1978, 8/25/1978
Shoup Building	415 Main St. Salmon, Idaho	3/31/1978
Episcopal Church of the Redeemer	204 Courthouse Dr. Salmon, Idaho	1/12/1979
Salmon City Hall & Library	200 Main St. Salmon, Idaho	11/17/1982
Lemhi County Courthouse	206 Courthouse Dr. Salmon, Idaho	11/12/1998

It should be noted that in addition to the entries identified in Table 2-1, the Lewis and Clark Trail, Lemhi Pass, Fort Lemhi, Birch Creek Charcoal Kilns, Lars Geerston House, Lemhi Boarding School Girls Dormitory, and Shoup Rock Shelters are all registered historical resources found near the City of Salmon. None of the registered historical structures found within the City, nor any of the nearby historical resouces, will be significantly impacted as part of this study and the subsequent recommendations.

[1] (National Park Service, 2017)

2.2.6 Utility Use

The current Average Day Demand experienced by the City of Salmon is approximately 1.6 MGD which corresponds to a per capita demand of approximately 518 gpcd, roughly two and a half times larger than the 210 gpcd Average Day Demand in Idaho (U.S. Geological Survey, 2017). This higher demand may result from higher amounts of outdoor water use but could also be evidence of significant leaks within the distribution system which at times has been a serious issue for the City of Salmon (J. Val Toronoto & Associates, 1988). Demands are discussed more extensively in Chapter 3.

2.2.7 Floodplains/Wetlands

A majority of Salmon lies outside of the 100-year flood plain. However, low-lying areas along an area canal, Jesse Creek, and the Salmon and Lemhi Rivers are identified as lying within the designated 100-year flood area. This flood area is delineated in Figure 2-7. The flood areas identified would impact areas currently zoned by the City for residential and commercial uses. The City of Salmon is a member of the National Flood Plain Insurance Program. A copy of the Flood Insurance Rate Map (FIRM) for Salmon can be found in Appendix A (Federal Emergency Management Agency, 2018).

Areas classified as wetlands in or near the Salmon planning area are shown in Figure 2-8.

2.2.8 Wild & Scenic Rivers

There are no wild and scenic rivers within the planning area; however, it should be noted that a portion of the Salmon River downstream of the City and subsequent planning area from North Fork to Long Tom Bar is listed on the Wild and Scenic Rivers List (National Wild and Scenic Rivers System, 2018).

2.2.9 Public Health & Water Quality Considerations

It has been reported that the City of Salmon has experienced elevated levels of disinfection byproducts and exceeded the drinking water limits for disinfection by products (total haloacetic acid or total trihalomethanes) in 2012, 2013, and 2016 (Idaho Department of Environmental Quality, 2018). However, other than this single instance, there are no public health nor water quality concerns that have been identified as of the writing of this report.

2.2.10 Important Farmlands Protection

Prime farmland is defined by the U.S. Department of Agriculture as:

> *"Land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban, built-up land, or water areas."*[2]

Prime farmland will not be significantly impacted in the planning study area because the study and any subsequent recommendations will focus on previously developed areas or areas that are under current development. More information on prime farmland, including a USDA Soil Report and map showing prime farmland, can be found in Appendix A.

2.2.11 Proximity to a Sole Source Aquifer

A sole source aquifer, is defined by the Idaho Department of Environmental Quality as:

[2] (Soil Science Division Staff, 2017)

"…an aquifer that has been designated by EPA as the sole or principal source of drinking water for an area. As such, a designated sole source aquifer receives special protection. EPA designates an aquifer as a sole source based upon a petition from an individual, company, association, or government entity. Three of Idaho's aquifers—the Eastern Snake River Plain Aquifer, the Spokane Valley-Rathdrum Prairie Aquifer, and the Lewiston Basin Aquifer—are classified as sole source aquifers."[3]

The City of Salmon and the subsequent project planning area do not impact an identified sole source aquifer.

2.2.12 Climate

Climatic data for the City of Salmon is found in Table 2-2. Precipitation averages 9.79 inches per year of which almost 3 inches typically falls in May and June. Annual snowfall averages approximately 25 inches, and the average freeze free season is 120 days at 32°F (Western Regional Climate Center, 2018).

Table 2-2 Climate Data for Salmon, Idaho[4]

Month	Mean Temp (°F)	Precipitation (Inches)	Snowfall (Inches)	Evaporation[5] (Inches)
January	21.1	0.66	7.7	0.00
February	27.5	0.42	3.6	0.00
March	38.5	0.55	1.7	0.00
April	46.4	0.78	0.9	0.00
May	54.5	1.36	0.1	6.81
June	62.2	1.42	0.0	8.39
July	69.6	0.95	0.0	10.23
August	67.5	0.78	0.0	8.73
September	58.0	0.76	0.0	6.39
October	45.8	0.65	0.1	0.00
November	32.6	0.72	3.3	0.00
December	21.9	0.74	7.7	0.00
Annual	**45.5**	**9.79**	**25.1**	**40.55**

2.2.13 Air Quality & Noise

Salmon is located within the Salmon Area of Concern for PM 2.5 and since monitoring began in 2009, the area has frequently exceeded Nation Ambient Air Quality Standards (NAAQS) for PM 2.5 due to wildfires in the summer and wood-stove use in winters (Idaho Department of

[3] (Idaho Dept. of Environmental Quality, 2013a)
[4] (Western Regional Climate Center, 2018)
[5] Pan evaporation measurements are not taken during the winter months, therefore "0.00" indicates that no measurement was taken.

Environmental Quality, 2018). Figure 2-9 delineates nearby non-attainment and Class I protected areas.

The noise levels in the planning area are consistent with other rural communities. There is little industry in the City, and issues related to noise are not generally experienced. The City's wastewater treatment facility is located to the north of the city and has the potential to produce odors; however, no issues have been recorded at the time of this writing.

2.2.14 Energy Production & Consumption

The City of Salmon is served by Idaho Power. Minimizing electrical consumption is an important consideration when planning system upgrades or expansion. In cases where it is necessary to utilize electrical power (i.e. pumping) it is important to consider efficient components as well as proper design so that all components are operating as efficiently as possible. Such consideration will be given where applicable.

2.3 SOCIOECONOMIC PROFILE/POPULATION STATISITICS

The population of Salmon and Lemhi County, from the 2010 Census, was 3,112 and 7,936, respectively (U.S. Census Bureau, 2018). The most recent population estimate for Salmon, conducted in 2017, listed an estimated population of 3106. The median household income for the City, as reported by the 2012-2016 American Community Survey 5-Year Estimate, was $24,216 (U.S. Census Bureau, 2018).

Approximately 45% of the labor force is employed in the 'services' industry, meaning that a majority of the residents of Salmon were employed in positions that provide services for individuals, businesses, and government establishments such as hotels, repair services, educational institutions, and other miscellaneous activities (Idaho Department of Commerce, 2018). The retail trade and public administration were the next largest employment pools, accounting for 25% and 10% of the population respectively (Idaho Department of Commerce, 2018).

The City of Salmon, experienced slightly negative growth (-0.03%) from 2000 to 2010 while Lemhi County as a whole grew slightly at an estimated 0.17%. Based on the most recent available population estimates, the population is assumed to have increased slightly from 2010 through 2018 (U.S. Census Bureau, 2018). When comparing growth patterns to other rural central Idaho communities, similarities are observed between the growth rates of Salmon and Mackay, ID; however, the nearby community of Challis grew significantly over the same time frame. Table 2-3 summarizes growth rates for these communities since the 2010 Census based on Census Bureau Estimates. In order to provide a conservative estimate for planning purposes, a growth rate of 0.5% will be used to estimate a 40-year projected population for Salmon, the results of which are shown in Table 2-4 and Figure 2-2.

Table 2-3 Regional Population Growth Rates (Estimated)

Community	2010 - 2018
Salmon	0.12%
Challis	1.00%
Mackay	-0.66%

Table 2-4 Historical & Projected Population of Salmon

Year	Population
1970	2,910
1980	3,308
1990	2,941
2000	3,122
2010	3,112
2017	3,108
2018	3,141
2029	3,278
2039	3,447
2059	3,809

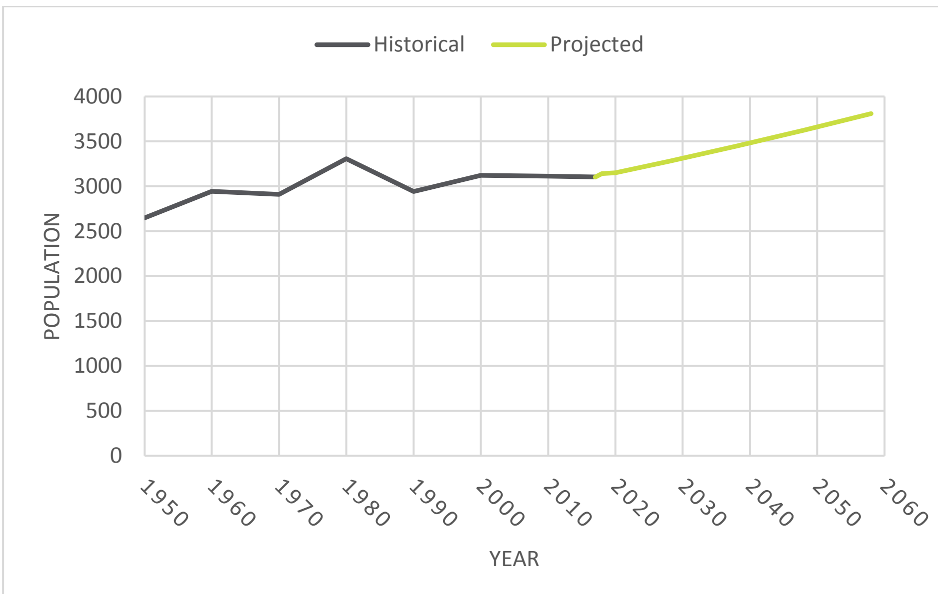

Figure 2-2 Historical & Projected Population of Salmon

It is anticipated that the Salmon water system will be serving approximately 3,700 individuals by 2029 and 4,300 by 2059.

2.4 COMMUNITY ENGAGEMENT

Community engagement in the project planning process is critical to its success. The purpose of a water utility is to serve the needs of the community. As such, involvement of the community in the planning process can help develop public understanding of the need for the project, funding requirements, and revenue strategies.

Information will be made available to the public through council meeting updates, open houses, and public comment periods as determined by the City Council. City Council meetings are open to the public and held at the City Hall on the second and fourth Monday of each month. The public are encouraged to attend and participate in these meetings. Additionally, following Idaho DEQ's technical approval of the WFPS, a public meeting will be held and notification of this meeting will be published in the local newspaper. The notification will provide basic information, such as date, time, location, and an explanation of where the public can access the WFPS and provide comments.

This public meeting will facilitate a discussion of the proposed and rejected project alternatives, projected customer costs, related environmental impacts, and mitigation measures specific to each alternative. The meeting will be documented in the City Council agenda and meeting minutes.

A 14-day public comment period follows the public hearing meeting. A copy of the WFPS will be made available for review at the City Hall. Public comments will be accepted during the public comment period, following which the comments will be reviewed and considered as the City moves forward with selection of an alternative. A bond election or judicial confirmation will follow the public participation period to secure funding of the selected alternative.

2.5 MAPS, SITE PLANS, SCHEMATICS, TABLES, & LETTERS FROM CONSULTED AGENCIES

General maps of environmental conditions are presented in this chapter; however, any detailed information and agency consultation will be included in the Environmental Information Document (EID) if the City decides to move forward.

PROJECT NO. 217105

FILENAME SalmonWFPS.mxd

KELLER ASSOCIATES
305 N. 3rd Avenue
Pocatello, ID 83201
208.238.2146

City of Salmon

Water Facilities Planning Study

Project Planning Area

FIGURE NO. **2-3**

Print Date: 4/23/2018
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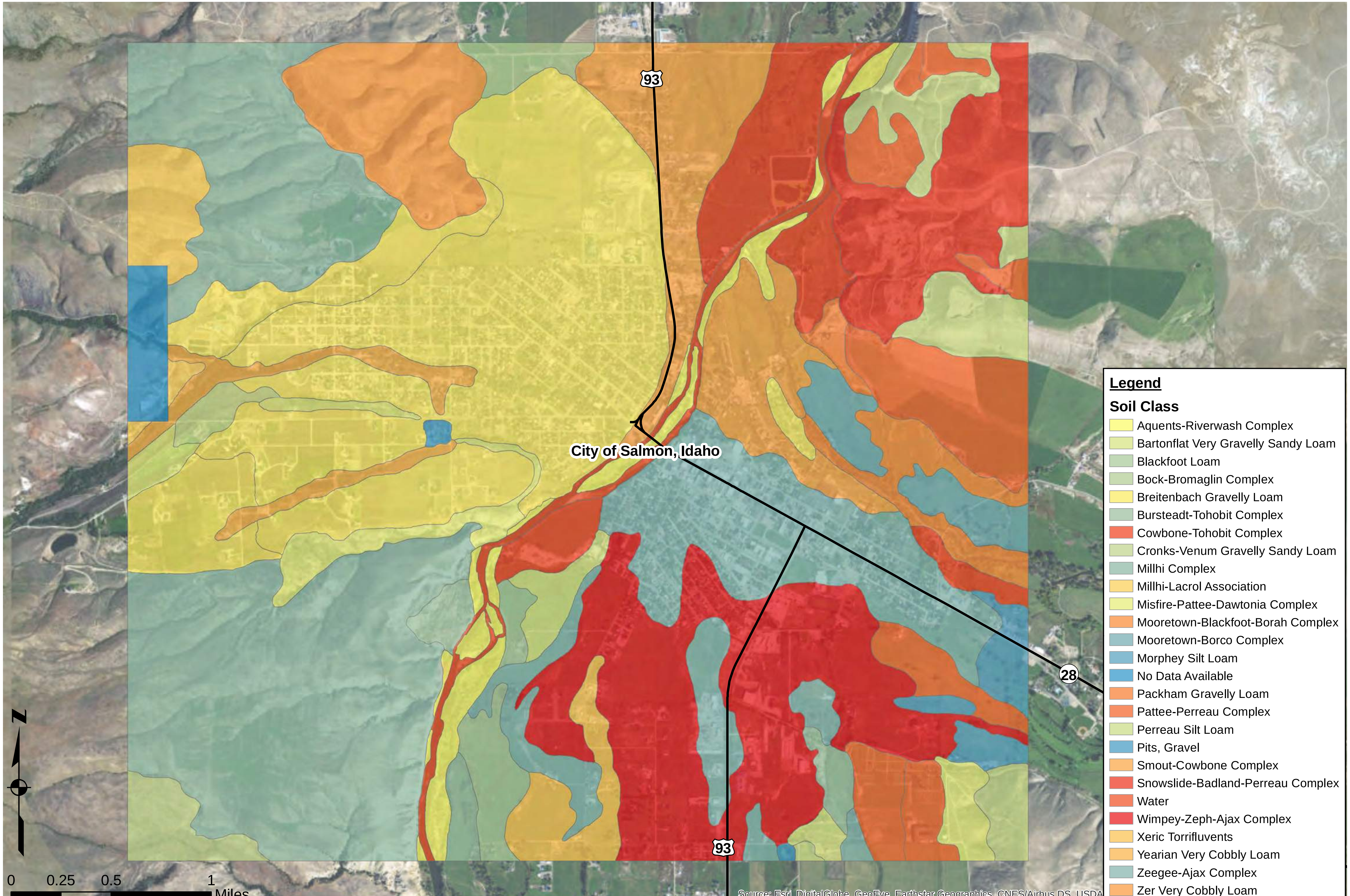

PROJECT NO. 217105
FILENAME SalmonWFPS.mxd

KELLER ASSOCIATES
305 N. 3rd Avenue
Pocatello, ID 83201
208.238.2146

City of Salmon

Water Facilities Planning Study

Soil Map

FIGURE NO. 2-4

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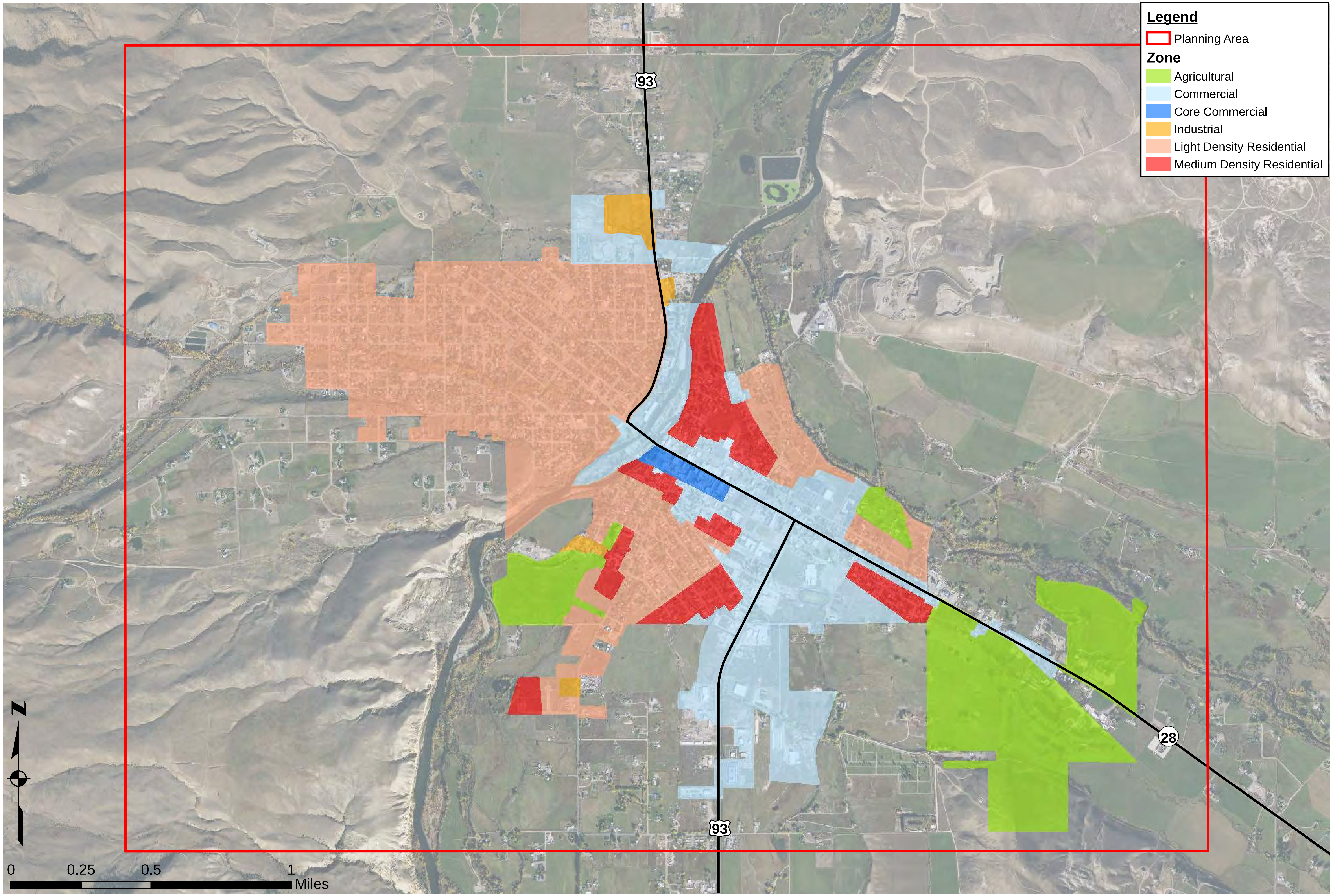

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305 N. 3rd Avenue
Pocatello, ID 83201
208.238.2146

City of Salmon

Water Facilities Planning Study

Zoning Map

FIGURE NO. 2-5

Print Date: 8/7/2019

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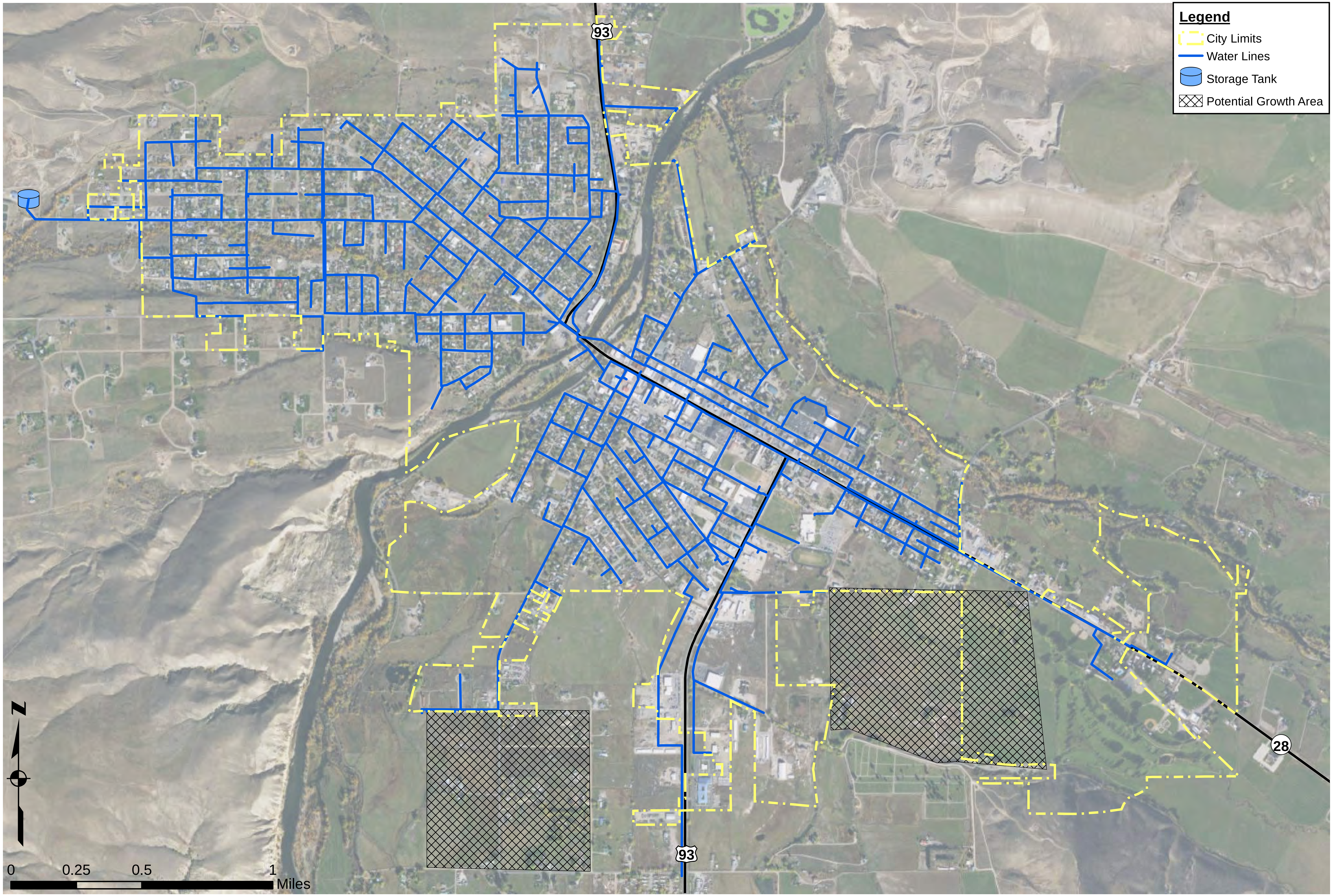

PROJECT NO. 217105

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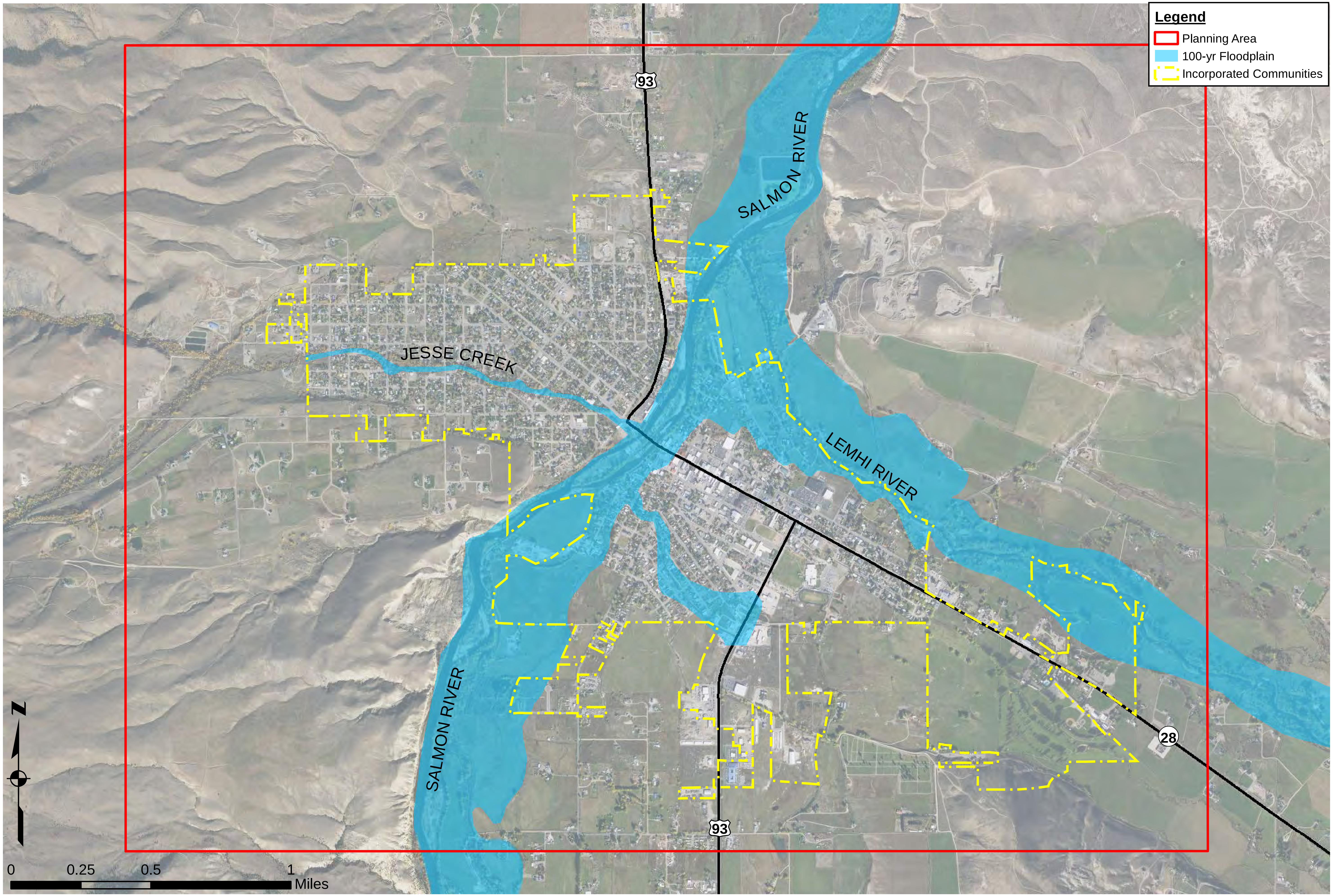
Water Facilities Planning Study

Potential Growth Areas

FIGURE NO. 2-6



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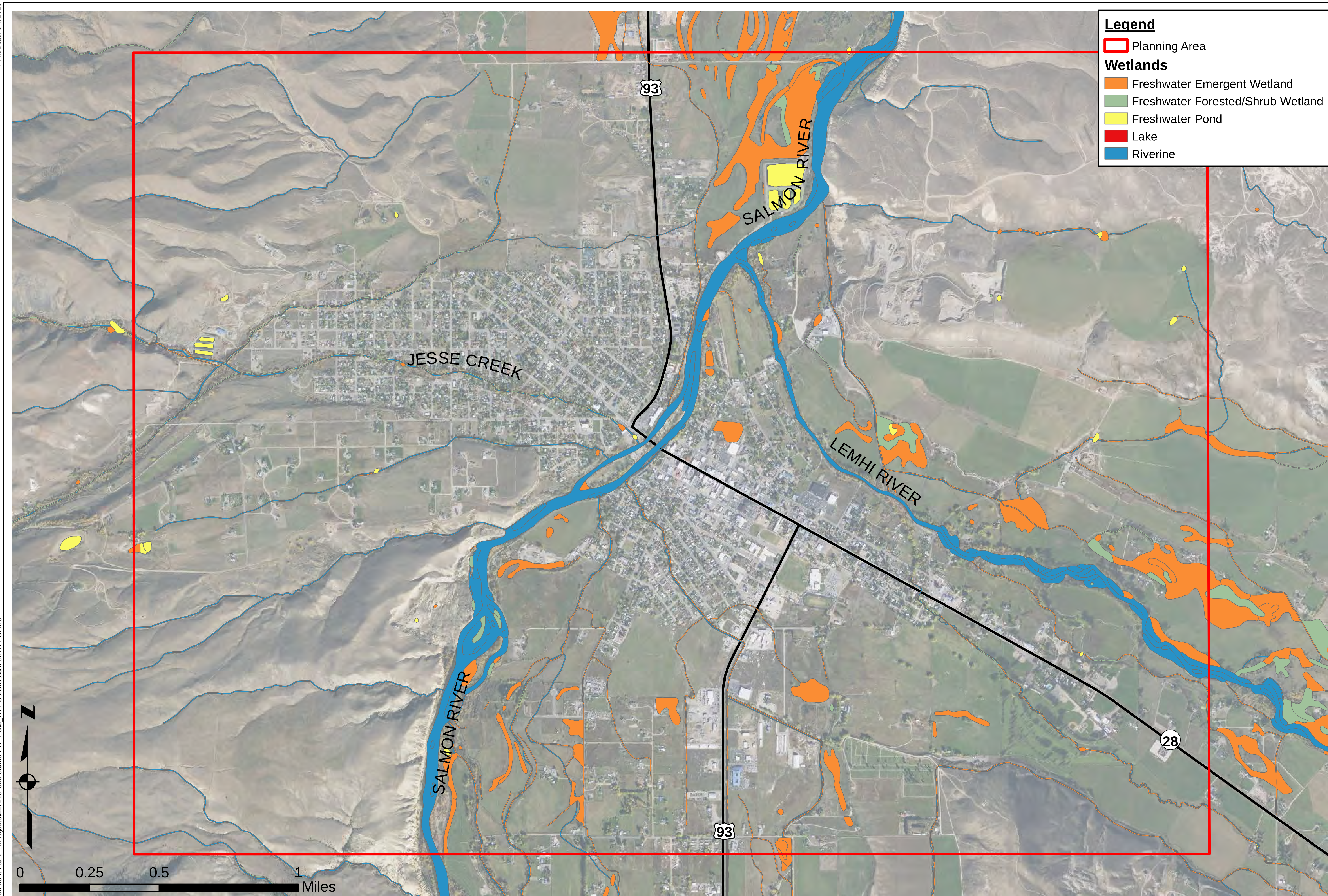
Water Facilities Planning Study

100-yr Floodplain Map

FIGURE NO. 2-7



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City of Salmon

Water Facilities Planning Study

Wetlands Map

FIGURE NO. **2-8**

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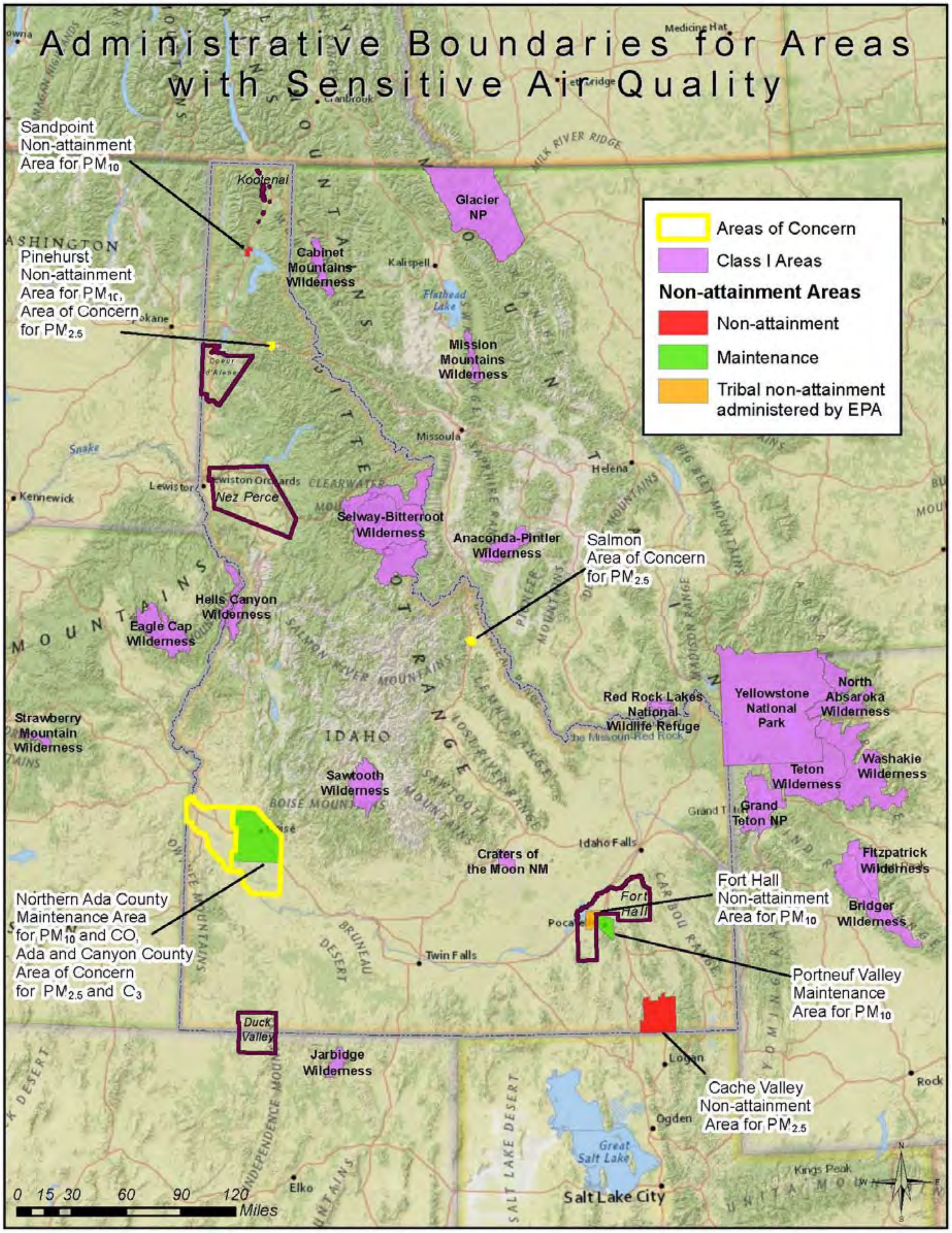

Figure 2-9 Administrative Boundaries for Areas with Sensitive Air Quality[6]

[6] (Idaho Department of Environmental Quality, 2018)

CHAPTER 3 EXISTING FACILITIES CONDITION & EVALUATION

This chapter summarizes the current condition of The City of Salmon's drinking water system. Regulatory requirements are presented in the sections to which they pertain. Idaho DEQ sets rules to:

> *"…control and regulate the design, construction, operation, maintenance, and quality control of public drinking water systems to provide a degree of assurance that such systems are protected from contamination and maintained free from contaminants which may injure the health of the consumer."*[7]

3.1 SYSTEM HISTORY

Residents of Salmon receive domestic potable water from a community-wide water system. The original distribution system has grown to comprise approximately 37 miles of pipe (J. Val Toronoto & Associates, 1988). Four-inch ductile- and cast-iron pipe continue to make up a significant portion of the distribution system and there is evidence that two-inch galvanized pipe continues to service some portions of the City. Significant improvements were made in the 1980's and 1990's and the system is now serviced by water mains as large as 20 inches. Six-inch ductile iron and PVC pipe also now service a significant portion of City neighborhoods. Improvements have continued to be made as needed and portions of the distribution system were installed within the last few years; however, some areas are approaching 40-50 years in age and existing water department records show lines in use that were originally installed as far back as 1940 (City of Salmon, 2018).

The original slow sand filter treatment plant was constructed in the 1970s and was oversized to provide additional capacity due to large losses that were experienced with the deteriorating distribution system at that time (J. Val Toronoto & Associates, 1988). The treatment plant consisted of three large sand filters with an additional sedimentation pond upstream of the treatment plant. At that time the distribution system 'floated' on the City's 90,000-gallon storage structure which was filled directly by flows from the water treatment plant. Historically, spring-fed creek sources have provided high-quality drinking water to the City. An additional diversion and pumping structure have been added on the Salmon River to provide additional flows during high-demand periods or in the event an alternative water source is required; however, the creek sources are still utilized as the primary water source for the City.

A 1.5 MG storage tank was added in 1978 to increase storage capacity and remains in use today as the 90,000-gallon storage tank was decommissioned and removed in the 1990s.

The original treatment structures still exist and are operated by the City today as pre-sedimentation basins which increase the overall efficiency of the current membrane filtration process. The existing treatment plant has a total treatment capacity of 4.0 MGD and additional room to increase capacity to 5.2 MGD with minimal capital cost (Idaho Department of Environmental Quality, 2007).

Currently, there are approximately 1,620 residential, commercial, and business connections. Connections are metered and users are assessed a fee consistent with the consumption measured.

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[7] (Idaho Dept. of Environmental Quality, 2014)

The existing system, as of July 2019, is represented in Figure 3-4 at the end of this chapter.

3.2 WATER RESOURCES ANALYSIS

Water systems tend to experience both daily and seasonal extremes in water demand due to daily usage patterns and outdoor water use in the summer months. The greatest water consumption in Salmon occurs during the summer months and it is assumed to occur in the morning and evening hours as is typical in Idaho. The lowest consumption period for Salmon occurs during the winter at night. Due to the variability in water demand, demand scenarios must be established to estimate water system requirements. Peak Hour Demand (PHD) is used to represent the largest single demand on a given water system in a single hour during a year. Similarly, Maximum Day Demand (MDD) and Average Day Demand (ADD) represent the maximum daily use and average daily use respectively; and must also be considered in water system design. Each demand was determined using daily and peak hourly demand data collected by the City of Salmon. Data from 2015-2017 was considered as part of this report.

3.2.1 Water Production

Production data recorded at the water treatment plant can be used to approximate total system requirements that take into account water loss in the distribution system as well as water that is actually consumed by City residents. Therefore, this data may over-estimate actual usage but accurately represents system demands. Flow meters located at various stages of the treatment process measure what is produced on daily and hourly time scales. Water production data from 2015 through 2017 was used and is presented in Figure 3-1 and Figure 3-2.

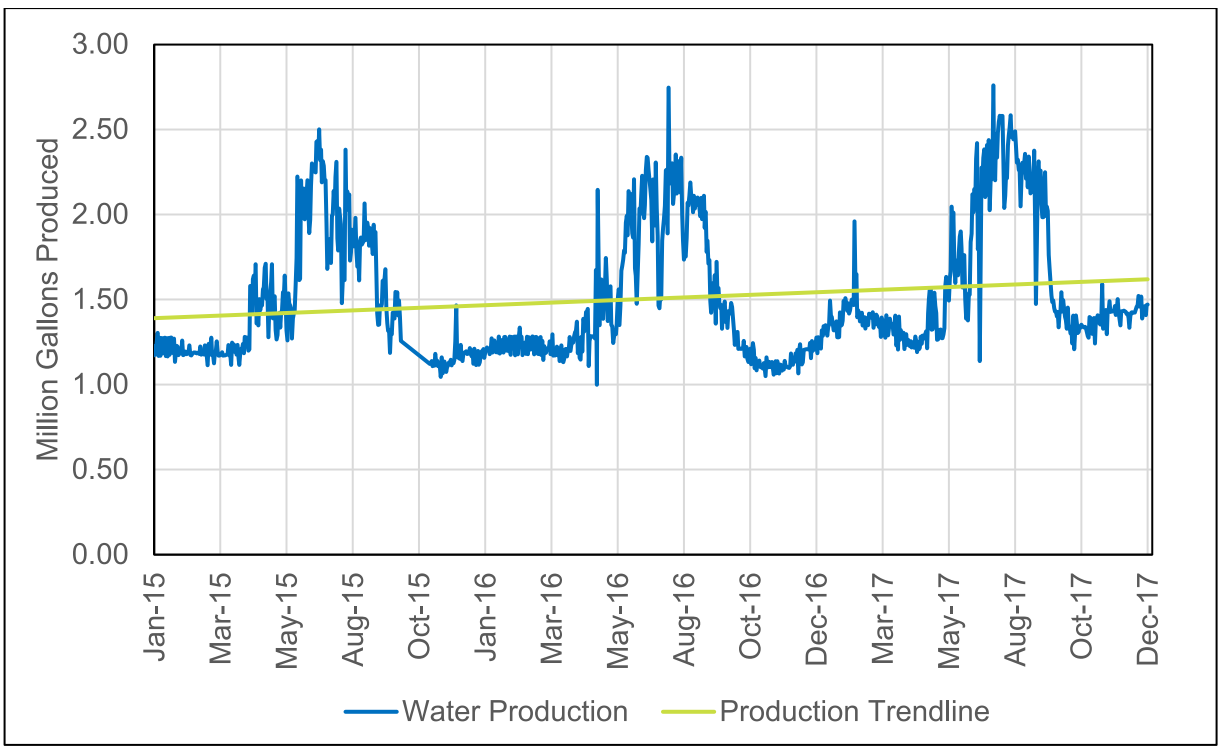


Figure 3-1 Salmon Water Usage (2015 – 2017)

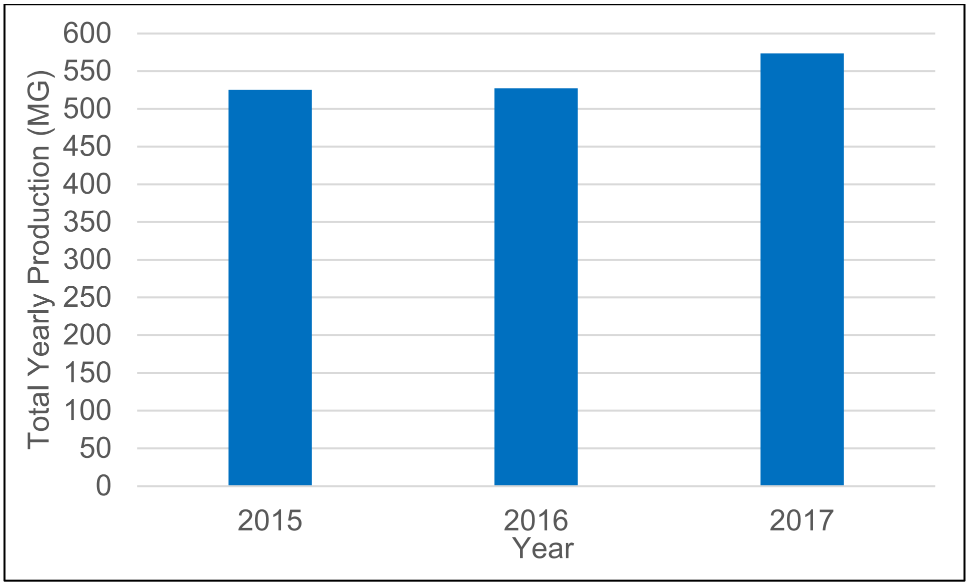


Figure 3-2 Salmon Annual Water Usage (2015 – 2017)

An increasing trend in water usage has been measured over the three years considered as part of this report. The highest production values were recorded in 2017 and could be a result of several finite factors, or a combination thereof, including local weather patterns which may have increased the need for irrigation water during the summer months, additional losses due to an aging distribution system, and small increases in population. In an attempt to conservatively estimate the needs faced by the City of Salmon, 2017 data will be used throughout this study.

3.2.2 Water Demand

Water demand can be divided into winter demand and summer demand. As is shown in Figure 3-1, demands in Salmon vary significantly over the course of a calendar year. Winter demand is considered a function of indoor use only, while summer demand is considered to be winter demand plus the additional demand created by outside water use and irrigation. Assuming the months of November-February represent winter demands, the average winter day demand over the three-year period described above is 413 gpcd, or approximately 1.28 MGD.

Average Day Demand over the three years considered ranged from a low of 1.46 MGD (469 gpcd) to a high of 1.60 MGD (514 gpcd). In an attempt to approximate the highest demands that Salmon is likely to experience, the highest value, measured by the City in 2017, will be used. A summary of demands measured based on the data provided by the City of Salmon is provided in Table 3-1.

Table 3-1 City of Salmon Water Demands

Demand Scenario	Units		
	(MGD)	(GPM)	(GPCD)
Average Day	1.60	1,110	514
Max Day	2.76	1,916	887
Peak Hour	3.87	2,687	1,244

To provide context for these reported demands, the Average Day Demand in the United States and the State of Idaho are 89 gpcd and 210 gpcd, respectively (Maupin et al. 2014, US Geological Survey 2017). Thus, the ADD of Salmon is roughly two and a half times as high as that of the State of Idaho and almost six times as high as the corresponding value for the United States. It should also be noted that even the Average Winter Day Demand of 413 gpcd is almost twice as high as the ADD of the State of Idaho as a whole.

Despite relatively recent improvements to the water system and a metered rate structure, water demand in Salmon continues to significantly exceed average measured values for both the United States and the State of Idaho. This overuse may indicate that serious leaks exist within the transmission and distribution system despite the recent upgrades. Furthermore, it can be deduced that by continually providing disproportionately large quantities of water, the City of Salmon is continuing to pay a higher cost to produce water than would be expected when comparing to other communities of similar size.

3.2.3 Water Rights

The City of Salmon holds numerous water rights which can be used for municipal purposes, the majority of which have been decreed while one permit remains listed as a license and another, that was protested in 2006, is identified as an application. An application does not allow a user to withdraw water from a point of diversion but is used to obtain a water right permit. A water right permit authorizes a user to develop and withdraw water from the defined point of diversion, while a decreed water right is a right that has been adjudicated by a court. In the event a protest is filed on a water right application, the opposing parties must enter into a mediation period until an agreement can be reached and the conflict has been resolved at which point the application can be upgraded to a license.

Water rights held by the City of Salmon are summarized in Table 3-2 and reference information for each individual right is available in Appendix C. All water rights held by Salmon for municipal uses are surface water rights that are limited by flow rate, with the exception of water rights 75 -4, -7, -17A, -17B, -19B, -19C, -26A, -114, and -10075 which may be used between April 1st and October 31st and are limited to a combined volume of 1740.5 acre-feet (Idaho Department of Water Resources, 2018). Of the total 1740.5 acre-feet which are allowed to be diverted, only 970.5 acre-feet may be diverted from Pollard Canyon and Chipps Creek (Idaho Department of Water Resources, 2018). Additionally, diversions from Jesse Creek must meet their established limits before any diversions can occur from Pollard Canyon and Chipps Creek.

Two other water rights, 75-2167 and 75-7563, overlap the period of use identified for the aforementioned rights. Right 75-2167 may be used from January 1st to December 31st and 75-7563 allows for the diversion of 1.01 cfs from April 1st to October 31st, and 5 cfs from November 1st to March 31st; however, the City can only use the overlapping rights in the event that the City's rights have reached the total volume limit or there is surplus water available for diversion (Idaho Department of Water Resources, 2018). Two other rights, 75-14700 and -14701 allow for additional diversions from Jesse, Pollard Canyon, and Chipps Creek from November 1st to March 31st. In addition to the water rights listed for Jesse, Pollard Canyon, and Chipps Creeks, the City of Salmon has obtained water rights to divert flows from the Salmon River under Rights 75-4084, -7156, -7108. The Salmon River Rights can be used year-round and are limited to a total diversion rate of 8.15 CFS with no total volume limit. Salmon River water is used only as a supplementary source due to preferential water quality and lower diversion costs associated with the rights held on the creek sources.

An application for an additional right to Jesse Creek was filed in December of 2005 and protested in 2006. The application was ultimately abandoned.

Table 3-2 Municipal Use Water Rights[8]

Water Right	Type	Priority	Location	Availability	Rate (CFS)	Rate (gpm)
75-2167	Decreed	4/21/1905	CHIPPS, JESSE, POLLARD CREEK	1/1 – 12/31	2	898
75-4084	Decreed	7/1/1938	SALMON RIVER	1/1 – 12/31	4.35	1,952
75-7156	Decreed	10/5/1979	SALMON RIVER	1/1 – 12/31	2.25	1,010
75-7108	Decreed	5/1/1978	SALMON RIVER	1/1 – 12/31	1.55	696
75-14700	Decreed	8/18/1961	CHIPPS, JESSE, POLLARD CREEK	11/1 – 3/31	0.24	108
75-14701	Decreed	4/12/1940	CHIPPS, JESSE, POLLARD CREEK	11/1 – 3/31	2.3	1,032
75-7563	License	12/3/1990	JESSE CREEK	11/1 – 3/31	5	2,244
75-4	Decreed	4/1/1894	CHIPPS, JESSE, POLLARD CREEK	4/1 – 10/31	1.2	539
75-17B	Decreed	6/1/1867	CHIPPS, JESSE, POLLARD CREEK	4/1 – 10/31	0.24	108
75-19C	Decreed	6/1/1868	CHIPPS, JESSE, POLLARD CREEK	4/1 – 10/31	1.5	673
75-26A	Decreed	5/1/1884	CHIPPS, JESSE, POLLARD CREEK	4/1 – 10/31	0.3	224
75-7	Decreed	4/1/1894	JESSE CREEK	4/1 – 10/31	1.26	565
75-17A	Decreed	6/1/1867	JESSE CREEK	4/1 – 10/31	0.493	221
75-19B	Decreed	6/1/1868	JESSE CREEK	4/1 – 10/31	0.493	221
75-114	Decreed	4/1/1894	JESSE CREEK	4/1 – 10/31	4	1,795
75-7563	License	12/3/1990	JESSE CREEK	4/1 – 10/31	1.01	453
75-10075	Decreed	6/1/1867	CHIPPS, JESSE, POLLARD CREEK	4/1 – 12/31	2.3	1,032

3.3 WATER QUALITY AND CAPACITY

3.3.1 Water Quality Criteria

Water quality standards for the City of Salmon are based on the U.S. Environmental Protection Agency's (EPA) Safe Drinking Water Act (SDWA) which includes primary standards (legally enforceable) and secondary standards (not legally enforceable). Primary standards are designed to protect public health while secondary standards regulate aesthetic qualities that pose no public

[8] (Idaho Department of Water Resources, 2018)

health issue such as taste, color, and odor. Primary standards exist for microorganisms, disinfectants, disinfection byproducts, inorganic chemicals, organic chemicals, and radionuclides (U.S. Environmental Protection Agency, 2017). Drinking water quality test results are included in Appendix D.

As required by the SDWA, the EPA has developed rules to further address water quality. The following drinking water rules are considered priority rulemakings by the EPA. A brief overview of rules which are applicable to this study is provided below; however, it should be noted that these summaries contain only an outline of the associated rule and should in no way be considered authoritative. For additional information, please consult the EPA's Current Drinking Water Regulations page (U.S. Environmental Protection Agency, 2018).

Ground Water Rule
The purpose of the Ground Water Rule is to reduce the risk of illness caused by microbial contamination in public ground water systems. Viral and bacterial pathogens are found in fecal matter which can be introduced to ground water sources from leaking septic systems, leaking sewer systems, and potentially through open flow paths in the ground. This rule addresses risk through a risk-targeting approach using four components. These components are:

- Periodic sanitary surveys
- Source water monitoring
- Corrective actions
- Compliance monitoring

Total Coliform Rule
This rule was established in 1989 to protect public health by reducing fecal pathogens to minimal levels through control of total coliform bacteria, including fecal coliform and E. coli (U.S. Environmental Protection Agency, 2017). Sources of these organisms include sewage and animal wastes. Sampling requirements are based on the population served by the utility.

Nitrate Rule
The Phase II Rule, the regulation for nitrate, became effective in 1992. The MCL for nitrate is 10 mg/L or 10 ppm. Nitrate itself is reasonably non-toxic and primarily used as fertilizer for agriculture. However, when nitrates are ingested, the resultant biochemical reactions reduce the bloods ability to oxygenate and decrease the transportation of oxygen throughout the body. This condition is known as methemoglobinemia. The ingestion of nitrates is especially harmful to infants. (Argonne National Laboratory, 2005) Infants below six (6) months of age who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome. (U.S. Environmental Protection Agency, n.d.).

Arsenic Rule
Long-term exposure to arsenic in drinking water has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver, and prostate. Other effects of ingesting arsenic include cardiovascular, pulmonary, immunological, neurological, and endocrine effects (U.S. Environmental Protection Agency, 2017). The Arsenic Rule was published in January 2001 and changed the MCL from 50 ppb to 10 ppb (~0.01 mg/L).

Disinfectants and Disinfection Byproducts Rule
Disinfectants are used to inactivate many potentially harmful microorganisms, but they may also react with natural organic and inorganic material in drinking water, forming disinfection byproducts

(DBP's). Some DBP's, such as the trihalomethane chloroform, have been shown to be carcinogenic and cause reproductive and developmental effects in laboratory animals. The Stage 1 Disinfectants and Disinfection Byproduct Rule was promulgated in December 1998 and establishes maximum residual disinfectant levels (MRDL) and MCL's for disinfection byproducts. Additionally, this rule addresses removal of total organic carbon (TOC) to minimize the production of DBP's. The Stage 2 Disinfectant and Disinfection Byproducts Rule was promulgated in December 2005 and focuses on decreasing DBP concentration peaks in the transmission and distribution system.

Radionuclide Rule

The Radionuclide Rule was promulgated in December 2000 to address exposure to radionuclides found in drinking water. This rule retains existing MCL's for combined radium-226 and radium-228, gross alpha particle radioactivity, and beta particle and photon activity; and establishes an MCL for uranium. (U.S. Environmental Protection Agency, 2017). The purpose of this rule is to reduce exposure to radionuclides in drinking water due to the increased risk of cancer from exposure.

Nuisance Contaminants

Some of the nuisance contaminants found in municipal water systems are hydrogen sulfide, ammonia, iron, and manganese. Where applicable, these contaminants have been compared to the National Secondary Drinking Water Regulations as set by the EPA. These are non-enforceable guidelines regulating aesthetic water quality parameters. The EPA does not have suggested guidelines for hydrogen sulfide and ammonia.

The presence of hydrogen sulfide adversely affects the smell and taste of the water. Hydrogen sulfide causes the "rotten egg" taste and odor problems commonly encountered in many wells in the area. At concentrations of 1 mg/L, hydrogen sulfide may tarnish some metals, and leave black stains on laundry and porcelain fixtures.

Ammonia is found naturally in groundwater supplies or as a result of agricultural and industrial processes. According to the studies performed by the World Health Organization, natural levels of ammonia are usually below 0.2 mg/L in groundwater. Typically, ammonia has no other impact than to the taste and smell of drinking water. Toxic effects from ammonia do not become an issue until concentrations of 200 mg/kg of body weight are reached.

Iron naturally occurs in drinking water and is typically found in concentrations ranging from 0.5 mg/L to 50 mg/L depending on the geologic characteristics of the area. Excessive iron in drinking water can cause discoloration and taste problems.

Manganese is a metal found naturally in ground and surface water supplies at concentrations ranging from 1 µg/L to 10 mg/L. Its presence in drinking water is not considered a health risk, but it can lead to discoloration and precipitate deposition on water fixtures. Iron and Manganese are responsible for the "hard" taste in many waters and can be treated by adding a polyphosphate when iron and manganese levels are low to moderate.

A chlorine residual of 0.2 mg/L in a water distribution system can be used to eliminate the growth of bacteria and other contaminants throughout the distribution system. Chlorination is also used to oxidize constituents such as hydrogen sulfide which causes "rotten egg" taste and odor problems as well as iron and manganese.

3.3.2 Water Quality Monitoring Program

The City of Salmon is required to monitor the distribution system for Total Coliform Bacteria, Asbestos, Disinfection Byproducts, Lead, and Copper; and the raw water intake for Total Organic Carbon and Alkalinity. Additional monitoring is required at the plant manifold for fluoride, Phase II and V inorganic chemicals, nitrite, nitrate, volatile organic chemicals, sodium, arsenic, radium, uranium, and gross alpha particles. The City must report any violation to Idaho DEQ and has experienced violations of drinking water standards in 2012, 2013, and 2016 due to a spike in DBP's. Since that time, quarterly sampling has indicated levels of DBP's that remain below the MCL.

3.3.3 Source Water Quality and Capacity

The capacity of a water supply is a function of the water source and water rights held by the water supplier. Withdrawal from the source is governed by either the quantity of available water, or the limits placed upon the user by the associated water right. Under Idaho water law, a water right must be put to beneficial use or a portion up to 100% of the right can be lost (Idaho Department of Water Resources, 2017).

The City of Salmon domestic water supply is sourced from four surface water sources, three of which are herein termed 'creek sources' and the last of which is the Salmon River. All diversions from the water sources are located in or near to the City limits and the City provides treatment and disinfection for their water. With few exceptions, the sources provide good quality water, and land uses around the water sources consist of mainly recreational, residential, commercial, and agricultural.

Creek Sources

Jesse, Chipps, and Pollard Canyon Creeks are largely snow-melt and spring fed creeks which originate on the eastern slopes of the Salmon River Mountains west of Salmon. The base of the watershed is approximately 4420 feet above sea level while the highest portions climb above 9100 feet. Soils in the watershed are reported to vary between silt loams and clays, the latter of which caused some issues when slow sand filters were Salmon's sole treatment process (Forsgren Associates, 1989).

Water quality from the creek sources is generally good; however, quality can deteriorate during heavy storm events and spring runoff when additional sediment and particulate matter can cloud the water. The diversion structure is equipped with screens to remove larger objects such as branches and leaves that may be present during certain times of the year. Low levels of wood preservatives and herbicides have been detected within the treatment process in the past (J. Val Toronoto & Associates, 1988). Grazing in the areas contributing stream flow to the creek sources has not been a historic concern for the City and formal agreements exist between the City of Salmon and the US Forest Service to encourage protection of water quality (J. Val Toronoto & Associates, 1988). The current memorandum of understanding between the City and the US Forest Service is being updated as of the time of this writing.

Salmon River

The City holds water rights to the Salmon River, allowing year-round diversions to occur through the City's siphon system at Island Park. A 12-inch transmission line connects the Island Park Siphon to the treatment plant roughly 500 vertical feet above (Idaho Department of Environmental Quality, 2007). The pump station on Island Park consists of one 125 HP, 900 GPM vertical turbine pump, and one 200 HP, 1300 GPM vertical turbine pump. The pumps have a combined capacity of 1950 GPM.

The City considers the Salmon River water rights to be supplementary due to the higher cost of use resulting from pumping, and the lower quality of Salmon River water compared to the City's creek sources. Water quality in the Salmon River can be heavily impacted by significant storm and runoff events; however, additional influences from upstream communities and land use adjacent to the river can further degrade water quality.

3.4 WATER TREATMENT PLANT

3.4.1 Water Treatment Criteria

Idaho Public Drinking Water Systems are governed by Section 58 of the Idaho Administrative Rules (IDAPA). IDAPA Section 58.01.08 provide required design standards for systems fed by surface water sources. A summary of pertinent elements of this administrative section is provided below:

- Intake structures must be capable of the following:
    - Holding velocity of flow into intake to a minimum on 0.5 fps if frazil ice may be a problem. Frazil ice is an ice formation that occurs rapidly due to a disturbance in a super cooled (temperature below freezing) liquid.
    - Provisions made for cleaning the intake system (including pipelines, screens, and intakes) as needed.
    - Provisions made to control the influx of large quantities of fish or debris from entering the intake.
- Filtration facilities shall be designed, constructed, and operated to achieve at least two log removal of Giardia lamblia cysts, two log removal of Cryptosporidium oocysts, and one log removal of viruses, or they must meet the exception requirements under IDAPA 58.01.08.518.09.B.
- Disinfection facilities must be designed, constructed, and operated to achieve two log inactivation of viruses for conventional or slow sand filtration technology.
- Each filter unit must be capable of filtering to waste unless it is shown through continuous turbidity monitoring or other means that water quality is not adversely affected following filter backwashing, cleaning, or media replacement.
- Equipment must be provided to continuously monitor the disinfectant residual prior to entry into the distribution system.
- A minimum of two flocculation and sedimentation units shall be provided for redundancy. Salmon's water treatment facility (WTF) is a direct filtration facility, therefore the requirements for sedimentation or settling post-flocculation do not apply.
    - Sludge removal design shall provide sludge pipes not less than three inches in diameter and arranged to facilitate cleaning. Sludge shall be disposed of as required in 58.01.08.540.
- Low pressure membrane filtration systems shall have at least two units unless it can be demonstrated that a secondary source or treatment component can supply the required minimum plant design capacity.

3.4.2 Existing Water Treatment Facility Condition

The WTF receives raw water directly from either the creeks or Salmon River sources or can receive a blended raw water from the pre-sedimentation ponds. Following initial screening at the water source diversions, and pre-sedimentation, the water enters the coagulation-flocculation stage of the process. A single mechanical in-line rapid mixer is used to incorporate coagulant (alum) and polymer into the raw water. Coagulant is only added when color and Total Organic Carbon (TOC) increase due to seasonal changes of the source-water, typically during spring runoff. As is common for mountain fed rivers and streams, as the snow pack melts, the water leaches organic acids (TOC) out of the decaying leaves, pine needles, and other forest debris. This TOC is a disinfection by product (DBP) precursor that is reduced or removed by a form of the coagulation process known as enhanced coagulation. Once the contaminants in the water have coagulated, they are aggregated through a process known as flocculation.

Flocculation within Salmon's WTF is accomplished in the flocculation basin. This basin is equipped with a vertical paddle type flocculator which mixes the water to promote the formation of pin floc. Pin floc is preferred in membrane filtration plants due to its more rugged structure, as opposed to sweep floc that may be used in a conventional treatment plant. The flocculation basin utilizes a mud valve to drain the basin and to waste solids through a sump pump. An overflow pipe conveys water to an exterior ditch in the event of a membrane feed pump failure or other emergency.

The flocculated water is allowed to settle for approximately 11 minutes, at design capacity, before the water is pumped through one of four Amiad 300-micron pre-filters (see Figure 3-3) using one of three 100 HP Goulds pumps. Normally, two pumps operate at a time while the third provides redundant pumping capacity. Finally, the pressurized water passes through the Pall Microza membrane filters, the filters have a nominal pore size of 0.1 microns. The water is then disinfected with gaseous chlorine and stored in a storage tank to achieve CT requirements.

Figure 3-3 Pre-filtration Prior to Membrane Filters

The Salmon plant staff clean the microfilters every 23,000 gallons using an air scrub that agitates the fibers dislodging accumulated solids. This backwash can also be triggered by a pressure decay across the membrane modules which indicates membrane fouling due to solids build-up. A feed flush or reverse flush (backwash) follows the air scrub to carry any remaining solids or air bubbles to the drain. A daily integrity test is conducted to check for broken fibers or leaking seals. The membranes are also washed with sodium-hypochlorite solution every 5 million gallons to remove recalcitrant solids build-up as well as any organic materials which may have accumulated during the interval. Occasionally, more rigorous cleaning (known as clean in place or CIP) is undertaken using concentrated sodium hypochlorite, caustic soda, and citric acid solutions to provide additional solids and organic removal.

The membrane backwashes and CIP cleaning waste are pumped to the backwash waste pond at the plant site.

A terminal junction box for a portable standby generator was provided as part of the design of the existing treatment plant. The junction box was designed with 600-Amp terminals; however, the City does not currently have any emergency power generation capacity. In the event of an extended power failure at the treatment plant, the City would be reliant upon storage capacity to feed the system.

Fire suppression is provided at the existing treatment plant using a dedicated engine driven fire pump that is rated to supply 1500 gpm at 100-psi of raw water from the pre-sedimentation ponds to a site hydrant. The pump is housed in a separate building to the south of the existing treatment plant.

3.4.3 Chemical Feed

The WTF uses and stores chemicals for three different purposes, water treatment, membrane cleaning, and disinfection. For water treatment, the WTF uses alum, sodium hydroxide, and sodium hypochlorite. Membrane cleaning uses citric acid, sodium bisulfite, and sodium hypochlorite, and disinfection uses sodium hypochlorite.

Aluminum sulfate, Alum [$Al_2(SO_4)_3$], is used for coagulation and enhanced coagulation. It is fed as a bulk liquid and is delivered to the WTF by tanker truck. Alum is stored in the chemical feed room in a polyethylene storage tank. It is fed to the treatment process as a neat liquid, meaning unblended with water, through a chemical feed pump panel. Alum is an acid and tends to lower the pH of the water as it is added. Alum is fed at the rapid mixer.

Sodium hydroxide, caustic soda (NaOH), is a base that is used to raise the pH of water. It can be used for pretreatment to improve the effectiveness of the coagulation process as part of enhanced coagulation, as well as, after the treatment process to adjust the pH of the water to restabilize it before it is pumped into the distribution system. The WTF uses sodium hydroxide for both pretreatment pH adjustment and post filtration stabilization. Sodium hydroxide is delivered to the WTF by bulk tanker truck. It is stored in a polyethylene bulk storage tank in the chemical room within the treatment plant. Sodium hydroxide is fed at the rapid mixer and in the finished water line after the membrane filters. Sodium hydroxide can also be fed to the clean in place (CIP) process for membrane cleaning.

Sodium hypochlorite, liquid chlorine (NaOCl), is used for disinfection, as a pretreatment oxidant to promote enhanced coagulation, as a CIP chemical, and as a disinfectant. The WTF is designed to inject sodium hypochlorite into the raw water at the rapid mixer and into the filtered water after the membrane filters. Sodium hypochlorite can also be fed to the (CIP) process for membrane cleaning. The WTF primarily uses sodium hypochlorite as a disinfectant injected before the contact chamber at the plant.

Citric acid is used to clean the membranes as part of the CIP process. It is delivered to the plant in carboys on an as needed basis. The acid is fed to the CIP tank for mixing by the Pall CIP control panel. Once blended it is fed into the membrane module to help remove hard water scaling and other foulant build up on the membrane fibers.

Sodium bisulfite, like the citric acid, is used in the CIP process. It is delivered to the WTF as needed in carboys or drums. The sodium bisulfite is fed to the CIP tank by the Pall CIP control panel. It is typically used to neutralize chlorine compounds but can also be used as a preservative for membrane modules.

3.5 DISTRIBUTION SYSTEM

3.5.1 Distribution System Criteria

System Pressures

Idaho DEQ has set specific minimum water pressure requirements. Water pressures at any point in the distribution system must not be below a minimum pressure of 40 psi during Peak Hour Demand conditions, excluding fire flow[9]. Water pressure at any point in the distribution system must be maintained above 20 psi during MDD and fire flow[10]. If pressure in the system drops below 20 psi the system is at risk of contamination and in violation of State of Idaho regulations.

Normal operating pressures should typically range between 60 and 90 psi. Pressures above 100 psi should be controlled with pressure reducing valve stations installed in the distribution main[11]. Higher pressures typically increase the amount of water lost due to leakage and the potential for water main breaks. In systems that rely on pumping to provide pressure, excessively high pressures can be indicative of higher than needed energy consumption.

In a letter dated October 30, 2013, the City of Salmon received notice from Idaho DEQ that they would not be required to comply with the 40-psi minimum pressure requirement during peak hour flows until the City's system had been substantially modified. Within the same correspondence, Idaho DEQ stated that the City's system would be substantially modified when there was a combined increase of 25% or more above 1985 levels in either 1) population served, 2) number of connections, 3) total length of transmission lines and distribution pipe, or 4) peak and average demands (IDAPA 58.01.08.003.132). See Table 3-3. Based on information provided to Idaho DEQ at that time, the City had increased in total length of waterlines by 15%. Based on this information, Idaho DEQ stated that the City may comply with the former 35-psi minimum pressure standard. This correspondence is provided in Appendix D.

Table 3-3 1985 Condition vs 2019 Condition (Estimated)

Item	1985 Condition	25% Increase	2019 Condition	Actual Increase
Population	3,125	3,906	3,141	1%
Connections	1,611	2,014	1,620	1%
Length of Lines	166,340	207,925	195,694	15%
Average Demand	1,117	1,397	1,123	1%
Peak Demand	2,706	3,382	2,720	1%

Pipe Sizing

Pipeline design is based upon meeting PHD and MDD plus fire protection while maintaining required system pressures. The following design criteria should be addressed:

[9] IDAPA 58.01.08 – Idaho Rules for Public Drinking Water Systems, § 552.01.b.v

[10] IDAPA 58.01.08 – Idaho Rules for Public Drinking Water Systems, § 552.01.b.i

[11] IDAPA 58.01.08 – Idaho Rules for Public Drinking Water Systems, § 552.01.b.vi

- Water lines where fire hydrants are provided must be six (6) inches in diameter or larger. If fire flow is not provided, water mains should not be smaller than three (3) inches in diameter[12].

- Dead end mains should be minimized by looping the system when practical. Dead end lines should be equipped with a means of flushing at a velocity of at least 2.5 fps[13].

- Valves should be located to minimize the amount of the system exposed to contamination due to loss of pressure during repairs.

- Fire hydrants should be placed 250 to 500 ft. apart, depending upon the area served.

- System pipe sizing should reduce the velocity head to reduce friction losses. Typical pipeline velocities should be between 2.5 ft./sec and 5 ft./sec and should not exceed 10 ft./sec under any circumstance.

- Pipelines may be oversized to allow for future growth.

Cross Connection Control

A cross connection control program should take reasonable and prudent measures to prevent unsafe or contaminating materials from being discharged or drawn into the drinking water system[14]. This can occur from pipes, pumps, hydrants, water loading stations, or tanks. The cross-connection control program should include provisions for evaluating the existing system and connections, addressing connections without backflow prevention, controlling new connections, testing of backflow preventers by a licensed backflow tester, and ensuring enforcement of the program is met. The U.S. EPA has published several resources to assist small utility systems in protecting their distribution systems (U.S. Environmental Protection Agency, 2017).

The City's existing cross-connection control ordinance requires no services be installed or continued within the City limits unless the water supply is protected by a backflow prevention device and expressly prohibits the installation or maintenance of a cross-connection (City of Salmon, Idaho, 2019).

3.5.2 Existing System Conditions

Salmon City water mains ranging in size from 20" to 10" deliver flows to smaller distribution lines. A majority of the distribution system has been upgraded to 6" ductile iron pipe; however, 4" ductile- and cast-iron pipe continue to make up a significant portion of the system and service several fire hydrants as shown in Figure 3-4. Smaller 2" lines also continue to service certain areas and some dead-end lines are found throughout the City. Table 3-4 provides a breakdown of waterline diameter as a percentage of the total length of pipe within the City.

To check fire protection coverage of the City through existing fire hydrants, a 300 ft radius was drawn around each hydrant as shown Figure 3-5. This indicates areas where there are gaps or areas lacking in coverage which should be considered as locations to add hydrants. Areas to be considered include: Shoup St near Eli St, along Lombard St, and all along Roosevelt its cross

[12] IDAPA 58.01.08 – Idaho Rules for Public Drinking Water Systems, § 542.06
[13] IDAPA 58.01.08 – Idaho Rules for Public Drinking Water Systems, § 542.09
[14] IDAPA 58.01.08 – Idaho Rules for Public Drinking Water Systems, § 543

streets. On Figure 3-5 the existing hydrants are shown in red, but hydrants that are served off 4" lines are shown in yellow. The 4" lines serving hydrants should be considered to be replaced to bring the system into compliance with IDAPA.

Table 3-4 Summary of the City of Salmon Water Distribution System

Pipe Diameter (in)	Approximate Length (ft)	Approximate Length (miles)	Percent of Total
>4	21,275	4.03	10.9%
4	34,258	6.49	17.5%
6	84,026	15.91	42.9%
8	6,408	1.21	3.3%
10	32,046	6.07	16.4%
12	12,747	2.41	6.5%
14	790	0.15	0.4%
20	4,087	0.77	2.1%
unknown	1,328	0.25	0.7%
Total	195,694	37.06	100.0%

The entire system is fed out of a single 1.5 MG storage tank located immediately below the water treatment plant at an elevation of approximately 4375 feet above sea level. The storage tank measures 110' wide, 21' deep, and is fed directly by the water treatment plant; acting as both storage and chlorine contactor. Two pressure relief valves (PRVs) effectively create three pressure zones within Salmon. The upper PRV is located at Roosevelt Ave and 9th St (approximately 4155 feet above sea level). The lower PRV is located the western end of the Main Street bridge (approximately 3950 feet above sea level). Pressures within the upper zone are determined by the water elevation within the tank, and the elevation difference between the tank and the area in question. It has been reported that, within the upper pressure zone above the 9th St PRV, water pressures can be variable, requiring tender trucks to respond to all calls received by the Salmon Fire Department (Werner, 2018). Pressures in the middle and lower zones created by the two PRVs are determined based upon the PRV setting. See Figure 3-6 for a map of the existing pressure zones and their respective pressure ranges. As can be seen on the figure, pressures at the lower end of the middle zone are excessively high reaching as high as 170 psi. This is well above the DEQ recommended limit of 100 psi.

A 2017 inspection of the concrete storage tank concluded that the structure remained in serviceable condition. Some rusting was observed on access hatches and tank vents, and some cracking was observed in the tank lid; however, nothing warranted immediate attention (LiquiVision Technology, 2017). Inside the tank, the access ladder was replaced due to excessive corrosion, and approximately 6" of sediment was removed from the western side of the tank (LiquiVision Technology, 2017). Routine maintenance was ultimately recommended at an increased interval of 2-3 years rather than the historical 5-year maintenance period.

Water meters are found on every connection throughout the City and citizens are billed according to their usage. It has been reported that the existing water meters were originally installed in the early 1990's and are therefore approaching 30 years in age and require replacement. As meters age the accuracy with which they measure flow decreases. Meter components can also begin wearing out and failing due to advanced age. The City has expressed interest in implementing a replacement program which will schedule meter replacement and maintenance on a more uniform schedule.

3.5.3 Fire Protection Requirements

Providing adequate fire protection in residential, commercial and industrial zones often governs distribution pipeline sizes, pipe looping requirements, and reservoir storage needs. The *Idaho Rules for Public Drinking Water* requires that the water system maintain residual pressures of 20 psi during a maximum day demand and fire event to minimize the risk of contamination to the water system[15]. Pumping systems supporting fire flow capacity must be designed so that the maximum day demand and fire flow demand may be provided simultaneously with any pump out of service.

Fire suppression storage reduces the requirement for redundant pumping capacity[16] and can be based on required fire flow. Required fire flow can be estimated using the *2012 International Fire Code* which identifies a fire protection requirement for each of five building types based on square footage. Table 3-5 estimates fire protection requirements based upon the *2012 International Fire Code* for *'Type VB, IIB, & IIIB'* structures. *'Type V'* buildings are generally considered to be wood-framed structures and typically have the highest fire protection requirements due to the materials used in their construction while *'Type IIB & IIIB'* may be constructed of non-combustible masonry but have elements susceptible to failure from extensive fire damage. These building types are used to estimate fire flow storage herein because they present the most rigorous requirements a City typically needs to plan for.

Table 3-5 Typical Fire Protection Requirements

Building Type	Building Size (ft^2)	Flow (gpm)	Duration (hr)	Storage (gal)
Type VB – Wood Framed Style	<3,600	1,500	2	180,000
Type VB – Wood Framed Style	3,601 – 4,800	1,750	2	210,000
Type VB – Wood Framed Style	4,801 – 6,200	2,000	2	240,000
Type IIB & IIIB – Masonry Style	5,901 – 7,900	1,750	2	210,000
Type IIB & IIIB – Masonry Style	7,901 – 9,800	2,000	2	240,000
Type IIB & IIIB – Masonry Style	9,801 – 12,600	2,250	2	270,000
Type IIB & IIIB – Masonry Style	12,601 – 15,400	2,500	2	300,000
Type IIB & IIIB – Masonry Style	15,401 – 18,400	2,750	2	330,000
Type IIB & IIIB – Masonry Style	18,401 – 21,800	3,000	3	540,000
Type IIB & IIIB – Masonry Style	21,801 – 25,900	3,250	3	585,000
Type IIB & IIIB – Masonry Style	25,901 – 29,300	3,500	3	630,000
Type IIB & IIIB – Masonry Style	29,301 – 33,500	3,500	3	840,000
Type IIB & IIIB – Masonry Style	33,501 – 37,900	4,000	4	960,000
Type IIB & IIIB – Masonry Style	37,901 – 42,700	4,250	4	1,020,000
Type IIB & IIIB – Masonry Style	42,701 – 47,700	4,500	4	1,080,000

[15] IDAPA 58.01.08 – Idaho Rules for Public Drinking Water Systems, § 552.01.b.i

[16] IDAPA 58.01.08 – Idaho Rules for Public Drinking Water Systems, § 501.18

Exact requirements can be referenced in the *2012 International Fire Code* which should be consulted for further details. It should also be noted that Reduction in fire flow requirements of up to 50% for one- and two-family residential buildings and 75% for buildings other than one- and two-family residential buildings is allowed when the building is equipped with an approved automatic sprinkler system.

The minimum fire flow assumed herein for residential areas was 1,500 gpm in accordance with the 2012 IFC and after discussion with the City Fire Marshall. Recommended fire flows for larger and/or commercial buildings were provided by the Idaho Surveying and Rating Bureau (ISRB). Buildings with required flows greater than 1,500 gpm were evaluated individually to assure adequate flows were available. The fire flow duration used by the ISRB is from the Fire Suppression Rating Schedule as published by ISO. For fire flows up to 2,500 gpm, 2 hours are required. Fire flows from 2,501 to 3,500 require 3 hours and fire flows greater than 3,500 gpm require 4 hours. Table 3-6 lists these addresses and their respective fire flow requirements.

Existing hydrant coverage is estimated and shown in Figure 3-5.

Table 3-6: ISRB Fire Flow Requirements & Field Measurements, 2016

Hydrant Location	Required Flow (gpm)	Flow (gpm)	Flow @ 20 psi (gpm)	Static Pressure (psi)	Residual Pressure (psi)
Main & Warpath – 1	3,500	1,030	2,200	60	50
Main & Warpath – 2	2,500	1,030	2,200	60	50
St. Charles & Gwartney	1,500	1,210	4,200	70	65
Lombard & Courthouse – 1	4,500	1,540	3,700	95	80
Lombard & Couthouse – 2	3,000	1,540	3,700	95	80
Hwy 93 & Forest Service	2,500	860	2,600	60	55
Shoup by Saveway Store	2,500	1,110	2,000	65	50
Lena & Daisy	3,000	1,190	4,100	70	65
Main & Center	2,500	1,190	4,100	70	65

3.5.4 Distribution System Hydraulic Analysis

Haestad Methods' WaterCAD v8i was used to create the hydraulic model for the Salmon water distribution, storage and delivery system. The software applies the Hazen-Williams formula in an iterative manner for complex networks to determine system pressures based on various flow scenarios. The software also has the ability to determine fire flow demand (FFD) available to each node by methodically analyzing each node (pipe junction) at different flow rates, and checking every node to determine the maximum amount of water available without drawing pressure levels below the minimum allowable at any node in the system.

Requirements for pressure calculations for PHD and fire flow demand scenarios shall be based on the lowest level after operational, equalization and fire suppression storage have been exhausted[17].

3.5.5 Model Development

Information regarding pipe diameters, network connectivity, and material types were determined through available mapping, previous reports, and consultations with staff familiar with the water system. Elevation data for the model is based on Google Earth DEM capabilities (Google, 2019). Demands (flows) were distributed to the nearest nodes based on individual connections within Salmon.

3.5.6 Model Calibration

Model calibration refers to the process of adjusting model parameters, so that model outputs match observed field conditions. For this study, fire hydrant flow tests served as the basis for model calibration. A series of FFD tests were conducted in July of 2018 by Keller Associates and Salmon Water System maintenance staff. Static and residual pressures (i.e. pressures before and during the FFD tests), and flows were recorded for each of the tests. The data sheets from the testing and a map showing locations of the fire flow testing are included in Appendix D.

A comparison of model versus field pressures was conducted to determine the accuracy of the model in replicating water system conditions. Table 3-7 summarizes fire flow testing results and shows a comparison between the field observed values and the calibrated modeled values. The “error” column represents the pressure difference between the field measurement and the model result. A positive difference means the model under predicts the pressure drop, and a negative difference means the model over predicts the pressure drop.

Table 3-7: Fire Hydrant Calibration Results

			Pressure Hyd. A		Pressure Hyd. B		Residual Error (psi)	
			Static	Resid.	Static	Resid.	Hyd. A	Hyd. B
Test 1	Flow (gpm)	Field (psi)	64	64	24	24	*4*	*-1*
	964	Model (psi)	69	68	24	23		
Test 2	Flow (gpm)	Field (psi)	73	68	46	44	*-4*	*-2*
	1,021	Model (psi)	71	64	46	42		
Test 3	Flow (gpm)	Field (psi)	96	80	114	106	*7*	*8*
	1,322	Model (psi)	91	87	117	114		
Test 4	Flow (gpm)	Field (psi)	120	108	140	118	*-30*	*5*
	1,520	Model (psi)	123	78	145	123		
Test 5	Flow (gpm)	Field (psi)	75	73	77	72	*-5*	*-5*
	888	Model (psi)	80	68	79	67		
Test 6	Flow (gpm)	Field (psi)	68	68	72	62	*-2*	*5*
	531	Model (psi)	70	66	73	67		

[17] IDAPA 58.01.08 – Idaho Rules for Public Drinking Water Systems, § 552.01.b.viii

The calibration resulted in a model that reflects the actual static conditions of the water system. Some error was introduced when calibrating residuals in the middle pressure zone which resulted from such high pressures. The error was less than or equal to 5 psi during static calibration and was off by 8 psi in the middle pressure zone during residual calibration. This illustrates that the water model is well calibrated and will serve as a tool for evaluation and planning in Salmon. There appeared to be an error during Test 4 with Hydrant A, as nothing in the model matched the field conditions. It is likely a valve was closed on the system or hydrant or an erroneous reading on the pressure gauge.

Development of a well calibrated model not only serves as a planning tool for future development, but can also be very useful for regular management of the existing system. It is recommended that the City update the model to reflect changes in physical attributes and usage patterns of the water system. This would help the City quickly identify possible causes for problems they are seeing in the system.

With the calibrated model, the current distribution system has been evaluated for compliance with pressure and flow standards. The following sections summarize the results. The system was analyzed using a steady state evaluation.

3.5.7 Maximum Day Demand plus Fire Flow Demand (MDD + FFD)

The model was populated using a base fire flow demand of 1,500 gpm and increased fire flows where identified by the ISRB presented in Table 3-6. Under maximum day demands of 1,916 gpm and the FFD requirements stated, the system was tested with the criterion of pressures not dropping below 25 psi. A maximum velocity constraint was not used. The tank was assumed to be approximately half-full initially based on observed pressures in the upper pressure zone.

The water model evaluates each of the nodes individually under the previously stated criteria, while considering pressure at other nodes in the system. The analysis is steady state and assumes adequate fire storage is provided to support the design durations. Ultimately, the model predicted that significant portions of the distribution system cannot meet the MDD + FFD scenario especially in the upper pressure zone, where limited looping is provided, and at some hydrants connected to 4-inch lines. See Figure 3-7. Results are presented in Appendix D. Suggested improvements will be discussed in a subsequent section of this report.

3.5.8 Peak Hour Demand

The system was modeled under current peak hour demands (PHD) of 2,687 gpm to check for pressures in the system dropping below 35 psi. The tank was assumed to be half full. Model results indicate that within the upper pressure zone the highest nodes are right near the 35 psi limit. When the City is required to comply with a 40 psi minimum system pressure, it is anticipated that a significant portion of the upper pressure zone may out of compliance. Model results are included in Appendix D.

3.5.9 Pressures During Low Demands

Because potable water demands are variable throughout the calendar year, a low demand scenario was evaluated to determine whether or not any of the distribution system pressures are over 80 psi. The average day demand (ADD) of 1,110 gpm was used and the tank level was assumed to be full. The model predicted that at low demand periods the system is subject to excessive system pressures, particularly in the middle pressure zone where pressures in the lowest elevation lines within the zone can reach nearly 170 PSI. Modeled pressure ranges for each zone are identified on Figure 3-6. Model results are included in Appendix D.

3.6 STORAGE EVALUATION

3.6.1 Storage Criteria

Water storage requirements are composed of several components that include: operational storage, peaking storage, fire storage, emergency storage, dead storage, and tank freeboard.

- Operational: Storage that supplies water when, under normal conditions, sources are off. Volume required to prevent excessive pump cycling and stagnation.
- Peaking: Peaking or equalization storage refers to the storage required to meet peak demands and fluctuations in demand throughout the day. Where hourly SCADA data is available, peak demands greater than firm capacity is used. When hourly SCADA data is not available the Peak Hour demand minus the firm pumping capacity is often used to calculate this value.
- Fire: The water needed to support fire flow in systems that provide it. The required fire flow can be the largest fire requirement in the system or what is approved by the local fire authority.
- Emergency: Idaho DEQ requires a minimum of 8 hours of average day demand. This can be offset with standby power.
- Dead: Storage in the bottom of the tank that can’t be used due to slopes or silt traps.
- Freeboard: Space above overflow pipe and below the tank roof.

Both elevated and ground level tanks can be used to provide equalization storage to maintain flows and pressures as required. An elevated storage tank develops the required pressure with the storage location elevation relative to the water system. A ground level tank utilizes booster pumps to supply flow and pressure to a system.

3.6.2 Storage Analysis

Table 3-8 shows the minimum recommended storage volume for the system based on the previously mentioned storage criteria. Comments regarding the values used are included for clarification.

Table 3-8 Existing Recommended Storage Volumes

Storage Component		Minimum Recommended (gallons)	Comments
Operational Storage		150,000	Use 10% to keep water in tank from stagnation
Total Storage (MG)	1.5		
% of Total	10%		
Peaking/Equalization Storage		0	Plant redundant pumping capacity exceeds PHD
PHD - Firm Cap. (gpm)	0		
Duration (hrs.)	1.0		
Fire Storage		1,080,000	Stage Coach Inn Demand from ISRB
Fire Demand (gpm)	4,500		
Duration (hrs.)	4		
Emergency Standby Storage		532,800	No backup power at water treatment plant
ADD (gpm)	1,110		
Duration (hrs.)	8		
Offset Storage Needs with Source Capacity		0	Fire flow can be offset with direct source capacity.
Source Capacity (gpm)	0		
Duration (hrs.)	0		
	Total	**1,762,800**	**17.5% Under Capacity**

This analysis suggests that there is not sufficient storage for the system. This is directly related to the fact that the WTP does not have any source of backup power. If a generator were installed, then the system can operate at its normal capacity and there is no issue with storage.

3.7 SYSTEM OPERATION

Water diverted from Chipps and Pollard Canyon Creeks into Jesse Creek for use at the water treatment plant must be established and maintained manually; however, the final diversion from Jesse Creek into the treatment plant can be controlled both manually and automatically. Supplemental flows are available from the Salmon River and can be pumped to the pre-sedimentation basins to be mixed with creek sources if required.

The entire water system is divided into three pressure zones which float off of the storage tank. Pressures in the upper pressure zone are controlled using tank elevation. A PRV located at 9th St and Roosevelt Ave creates a middle pressure zone limited by a lower PRV located on the western end of the Main Street Bridge. The most significant elevation changes occur in the upper and middle pressure zones and pressures reach nearly 170 psi within the system on the upstream side of the lower PRV. Due to the extremely high pressures, some residents have elected to install individual PRVs on their water connections to reduce the likelihood of damage to their plumbing. These private PRVs are maintained by the citizens who install them.

The City of Salmon is organized under an elected mayor and six council members. The City currently employs James Miller as the Responsible in Charge (License #DWD2-18424) and Harry Shanafelt as the Substitute Responsible in Charge (License #DWT2-11913).

The City requires backflow preventers on all connections that carry the risk of contaminating the water system and maintains backflow preventers at the water treatment plant; however, Idaho DEQ reported on the 2016 sanitary survey that these were overdue for testing.

3.8 FINANCIAL STATUS OF EXISTING FACILITIES

The City of Salmon water rate structure is based on residence or meter size. Single-family residential connections and ¾-inch meters are charged a base rate of $37.00 per month, while a duplex and triplex are charged a base rate of $48.50 and $69.50 respectively per month. Larger meters are charged a base rate of $69.00 for 1-inch meters, $175.00 for 1 ½-inch meters, $255.00 for 2-inch meters, and $515.00 for 4-inch meters. An additional fee of $0.78 per 1,000 gallons used is assessed on top of base fees. A $2,000 connection fee is assessed on new connections as well as a $950 water meter installation fee.

The City has a separate fund dedicated to the water system. The annual budgeted revenue for FY 2018 was $1,009,200 and anticipated expenses for salaries, benefits, maintenance, and reimbursements were $1,006,200. See Appendix E.

The City currently has two 30-year water loans. A bond was passed in 1990 for water system improvements and the City has been paying approximately $60,000 annually on the loan which is scheduled to amortize in 2020. The second loan allowed the City to make improvements to the treatment system and has been in place since 2006. This second loan requires an annual payment of $215,000 and will be amortized in 17 years.

3.9 WATER/ENERGY AUDITS

The City of Salmon has not had energy audits to evaluate the most efficient way to operate City drinking water infrastructure.

A simple water audit was conducted as part of this study comparing the water production value to the water consumption information collected by the City from each water meter using data collected throughout the 2017 calendar year. During 2017 there was approximately 573 million gallons of water produced, while only 137 million gallons of water were billed for according to billing records. This results in 59% of the water being unaccounted for. The resulting discrepancy of almost 440 million gallons of water is likely attributed to several factors.

Unmetered use by the City is one place where water goes unaccounted which includes when flushing fire hydrants, filling stations for construction purposes, and for City irrigation purposes. However, as this unmetered use is isolated to only a few hydrants, planter boxes and trees along Main Street, and green spaces, a majority of the 440 million gallons of water is likely due to leaks within the system. Water use at the cemetery and city parks are reported to be from wells, not from the City's water system.

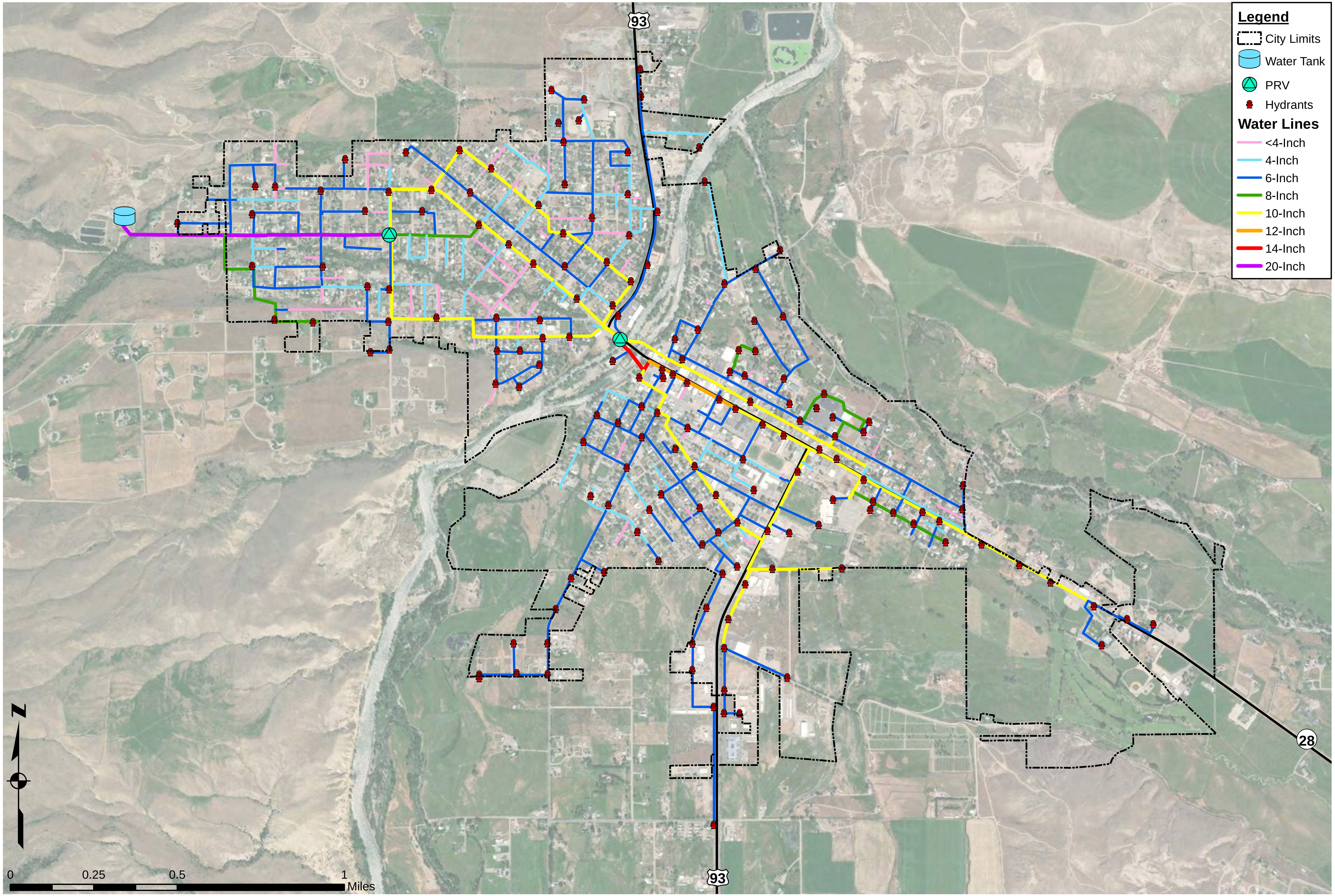
With the advanced age of the existing meters (20-25 years), the accuracy of the amount of water billed can be expected to decrease. It is not uncommon for meters to lose 10% over their lifespan. As the City works towards replacing their meters, it should be expected to see an immediate increase in the amount of water billed. As meters are being replaced, it would be good to evaluate all of the City's connections and consider adding a meter to be read but not billed to better account for water used from the WTP.

The likelihood of significant leaks is relatively high, particularly within the middle pressure zone where pressures exceed 100 PSI at a majority of the connections. The leaks have the potential to increase costs associated with the operation and maintenance of the treatment plant significantly over what would be otherwise anticipated. Assuming a linear relationship, if half of the water produced at the treatment plant cannot be accounted for through unmetered use and is therefore lost through system leaks, then by eliminating those losses the City may be able to reduce operational expenses at the plant significantly.

Another way to look at water system losses is by comparing winter water consumption to measured flows at the wastewater treatment plant. For loss estimates to be accurate winter flows must be used because it is assumed that most water used during the winter will enter the wastewater collection system and subsequently the wastewater treatment plant. Approximately 90% of water use during non-irrigation times becomes wastewater (Tchobanoglous, Burton, & David, 2004). Utilizing this approach, distinction between water (leaking) and wastewater (exfiltration) system losses is not possible, but it provides insight into the extent of the total losses. Flows into the WWTP are as low as 0.70 mgd in January while the WTP is producing around 1.30 mgd during the winter months. This approach suggests that about 46% of the water is unaccounted (or lost).

3.10 EQUIVALENT DWELLING UNITS (EDU'S)

There are approximately 1,620 connections to the water system. There are no large industries requiring conversion of demand to EDU's. Customers are billed based on the meter size.



PROJECT NO. 217105

FILENAME System.mxd

KELLER ASSOCIATES
305 N. 3rd Avenue
Pocatello, ID 83201
208.238.2146

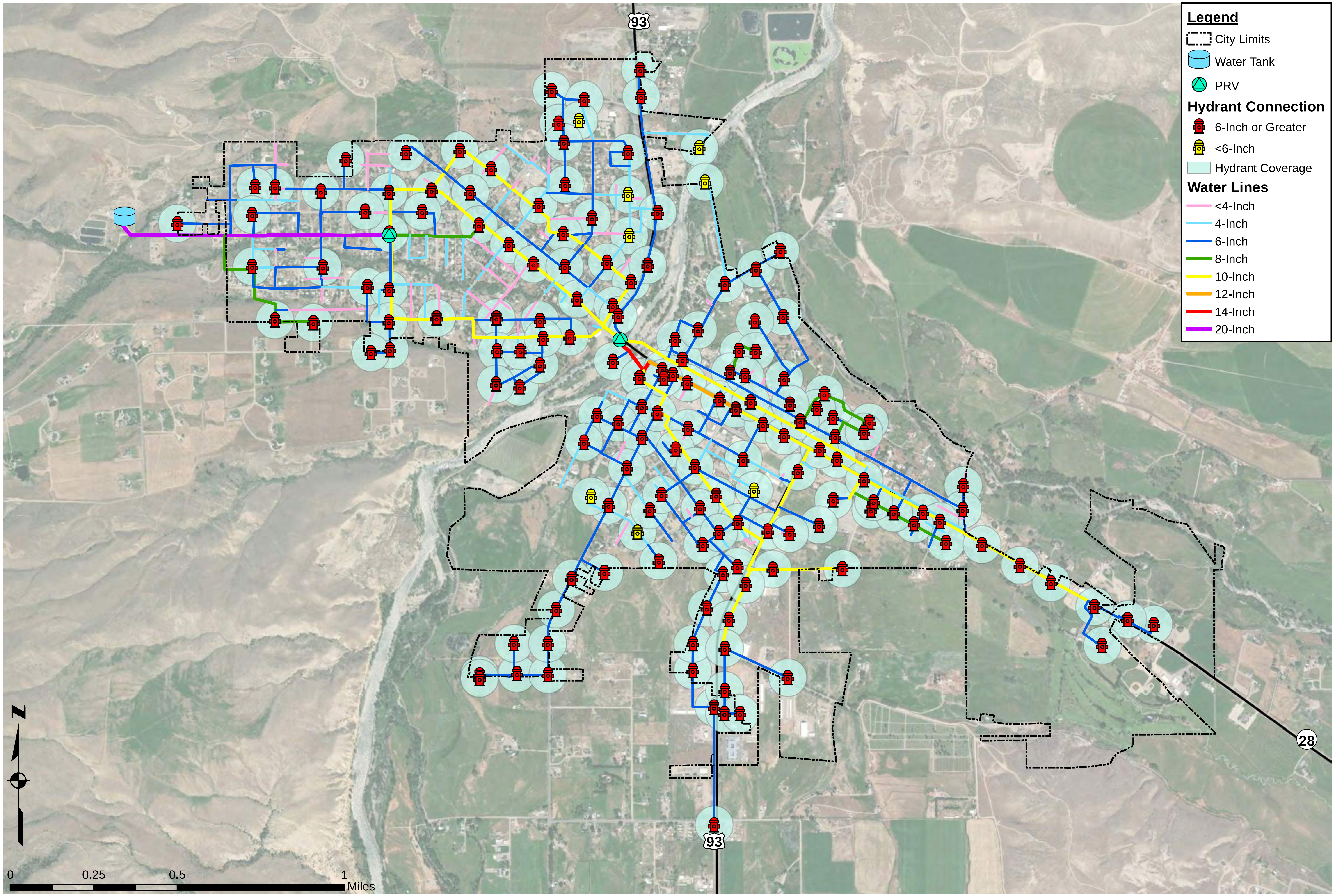
City of Salmon

Water Facilities Planning Study

Existing Water Distribution System

FIGURE NO. 3-4

Print Date: 8/7/2019
Document Path: Y:\Projects\217105-000 Salmon WFPS\b_WFPS\zGIS\Figure 3-4 Existing Distribution System.mxd



Print Date: 8/7/2019

Document Path: Y:\Projects\217105-000 Salmon WFPS\b_WFPS\zGIS\Figure 3-5 Existing Hydrant Coverage.mxd

PROJECT NO. 217105

FILENAME Coverage.mxd

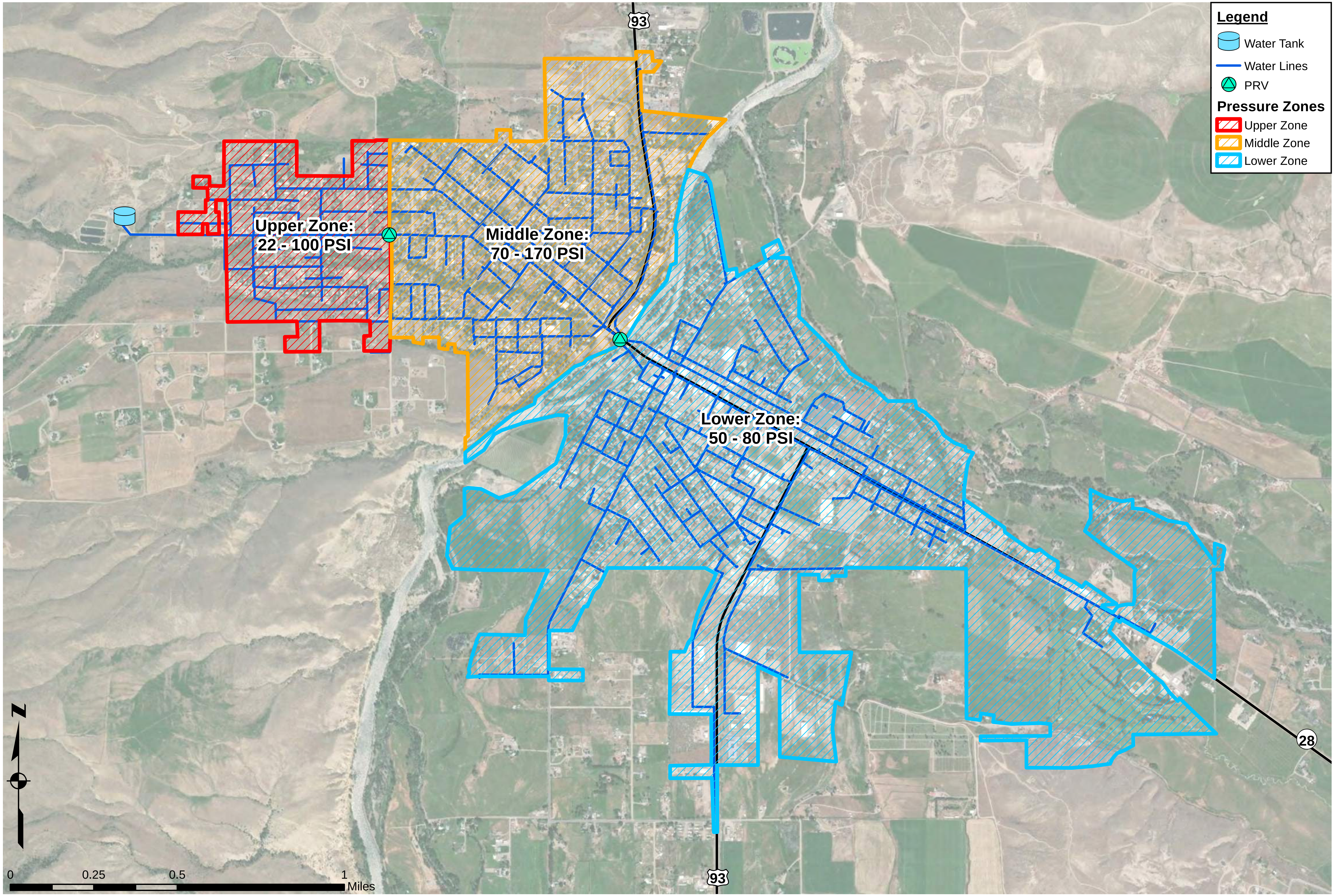
KELLER ASSOCIATES
305 N. 3rd Avenue
Pocatello, ID 83201
208.238.2146

City of Salmon

Water Facilities Planning Study

Existing Hydrant Coverage

FIGURE NO. 3-5



PROJECT NO. 217105

FILENAME System.mxd

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City of Salmon

Water Facilities Planning Study

Existing Pressure Zone Map

FIGURE NO. 3-6

Print Date: 8/7/2019

Document Path: Y:\Projects\217105-000 Salmon WFPS\b_WFPS\z GIS\Figure 3-6 Existing Pressure Zones.mxd

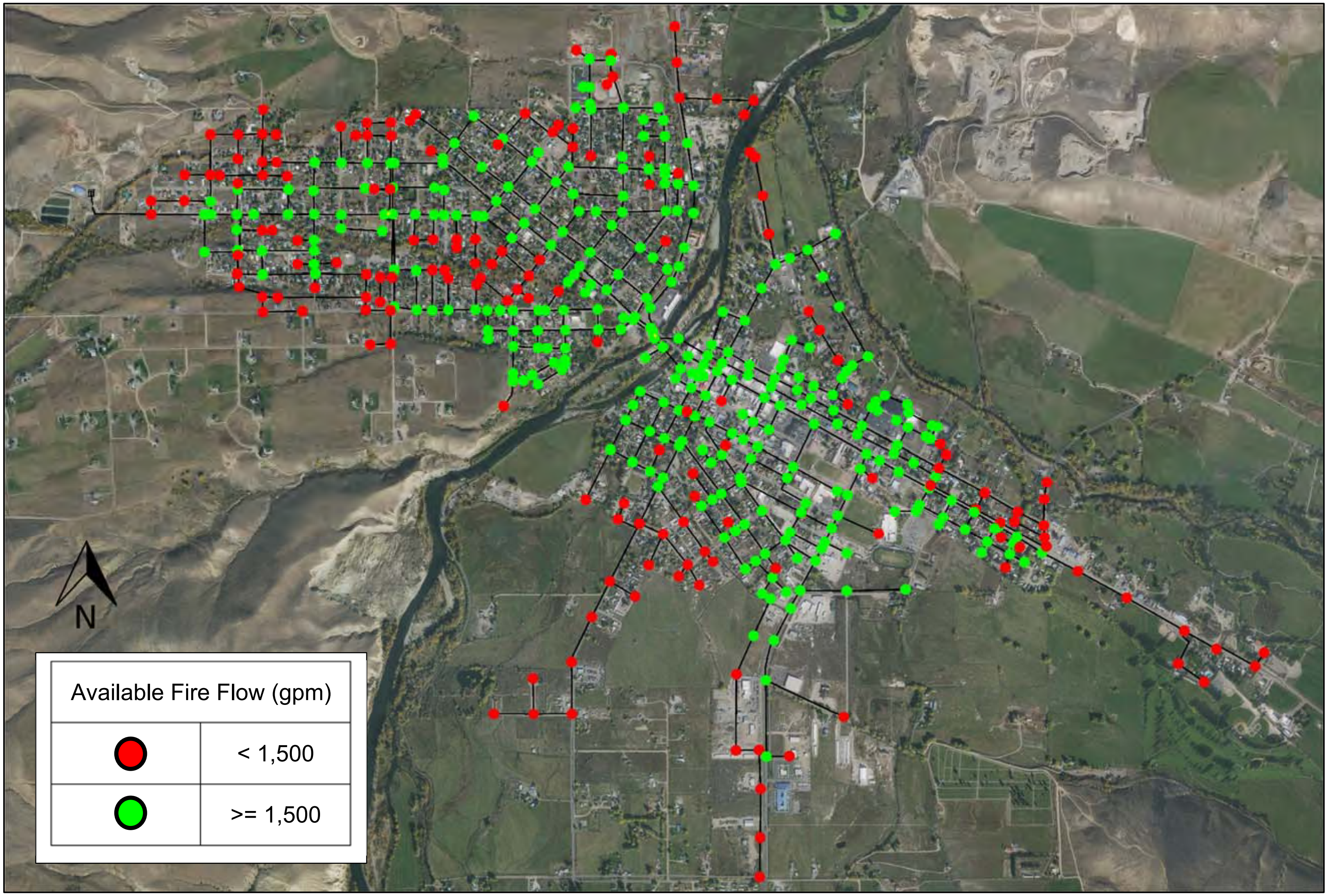


Figure 3-7 2018 MDD + FF Results

CHAPTER 4 NEED FOR PROJECT

4.1 PUBLIC HEALTH

It has been reported that the City of Salmon has experienced elevated levels of disinfection byproducts and exceeded the drinking water limits for either total trihalomethanes (TTHMs) or haloacetic acid (HAA) in 2012, 2013, and 2016 (Idaho Department of Environmental Quality, 2018). These have occurred at the farthest point in the distribution system at the Sacajawea Center.

Disinfection byproducts typically develop in portions of a drinking water system with long residence times such as poorly mixed storage tanks, dead-end waterlines, or areas located furthest from a centralized treatment plant. Long residence times allow for the completion of relatively slow reactions between disinfectants and naturally occurring organic materials from either the source water or what is entrained as water flows over biofilms that coat storage tanks and distribution lines. Two classes of disinfection byproducts are generally considered and include haloacetic acids (HAAs) and trihalomethanes (THMs). Both classes of disinfection byproducts are cause for concern as both present a risk to human health. The Center for Disease Control has classified two trihalomethanes, chloroform and bromodichlormethane (BDCM), as possible human carcinogens while the remaining THMs and HAAs are considered to be indicators for other harmful byproducts (Center for Disease Control, 2018).

No other public health nor water quality concerns have been identified as of the writing of this report.

4.2 COMPLIANCE WITH STATE AND FEDERAL REGULATIONS

Several issues have been identified in regards to the current condition and operation of the Salmon water system. Many of these issues are violations of the Safe Drinking Water Act or violate current IDAPA regulations. Where current issues violate SDWA or IDAPA standards, the specific rule violated is listed. These issues, and remedial action taken or advised to be taken, are summarized below:

- The City of Salmon has had historical issues related to disinfection byproducts (DBPs). Elevated levels of DBPs have been detected in areas furthest from the treatment plant and storage tank. Alternatives to improve water quality will be considered in subsequent sections of this study.

- Storage volumes are currently below recommended values due to a lack of emergency power generation at the treatment plant. Without emergency power capacity to provide treated water during an extended power failure, the City must exclusively rely on flows within the storage tank to provide for the needs of the community until power is restored.

- System pressures vary widely throughout the system and are too low in the upper pressure zone and too high in the middle pressure zone. System pressures should not be lower than 40-psi (35-psi until substantially modified) nor higher than 100-psi unless there is an operational justification for exceeding 100-psi per IDAPA 58.01.08.552.

- A significant number of the City’s fire hydrants are connected to 4-inch water mains. IDAPA 58.01.08.542.06 requires that fire hydrants be connected to water mains no smaller than 6 inches.

- Fire flow test results indicate that sections of the City are unable to meet fire flow requirements in some City hydrants (IDAPA 58.01.08.552.01).
- Current average water use in Salmon (514 gpcd) is over two times greater than average Idaho use (210 gpcd). This could be due to significant leaks in the City's system.

4.2.1 System Pressures

The City of Salmon experiences extremes in both high and low system pressures at different portions of their water system. The entire water distribution system floats off of the City's only storage tank located immediately below the water treatment plant. Low system pressures are observed at the highest end of the upper pressure zone due to a moderate elevation difference between the storage tank and the highest elevation connections. Some point-of-use booster pumps have been installed and are maintained by private citizens to address this.

In a letter dated October 30, 2013, Greg Eager with Idaho DEQ indicated that the City of Salmon would be able to comply with a minimum system pressure of 35 psi until the system was 'substantially modified.' This modification was defined as a greater than 25% increase in population, connections, total length of water lines, or demands over 1985 conditions. In 2013, Idaho DEQ estimated that the City of Salmon had increased the total length of water lines by 15% over 1985 conditions. After meeting the substantially modified criteria, the City will be required to meet minimum pressures of 40 psi which appears to be unlikely at the highest elevation connections based on current system pressures.

Pressures up to 100 psi are experienced in the upper zone, and pressures as high as 170 psi are observed in the middle pressure zone. Such high pressures can cause significant deterioration of water distribution lines and be potentially dangerous. Significant leaks can also develop when distribution lines are subject to such high pressures. Water system pressures should typically be maintained below 100 psi unless there is an operational need for higher pressures (IDAPA 58.01.08.552.b.vi).

4.2.2 Fire Flow Conditions

Salmon has approximately 165 fire hydrants connected to the municipal water system, some of which remain connected to 4-inch lines. According to the Idaho Rules for Public Drinking Water Systems (542.06) fire hydrants must be connected to water mains no smaller than six inches in diameter and system pressures must not fall below 20 psi during fire flow conditions. The minimum fire flow that must be available per request by City Officials, is 1,500 gpm.

Testing and modeling results reveal that certain locations within the City's water system cannot meet the minimum requirements for fire flow. Previous fire flow testing was performed by the Idaho Surveying and Rating Bureau, Inc. in 2013. In addition, fire flow testing was conducted by Keller Associates in July 2018 was used to calibrate a hydraulic model to be used in evaluating the system. Hydrants with the lowest fire flows and pressures were located in the upper pressure zone or along dead-end lines.

4.3 AGING INFRASTRUCTURE

It has been noted previously that the City of Salmon experiences much higher per capita flows than would be expected based on the Idaho average. This could be evidence of significant leaks that persist or which continue to occur within the system due to advancing age in conjunction with the high pressure. Several distribution lines are believed to have been installed as far back as the 1940's.

Several violations to IDAPA requirements have also been identified within the City of Salmon. While significant portions of the distribution system have been upgraded to 6-inch lines, some fire hydrants remain connected to 4-inch water lines and gaps exist within hydrant coverages. Additionally, water mains smaller than 4" are found within the system and numerous dead-end connections could be exacerbating the City's disinfection byproduct violations; particularly at the Sacajawea Center.

4.3.1 Water Treatment Plant

The existing surface water treatment plant has served the community well. However, it has been noted that maintenance is required on aging components. The plant does not currently have an emergency power source nor can one be easily connected in the event of a power failure, additionally the following housekeeping items need addressed:

- Alum & sodium hypochlorite feed systems should be plumbed to provide flush or carrier water. This will allow the operations staff to routinely flush the lines helping to mitigate the build-up of crystalized chemical.
- Chemical room heating needs to be upgraded. The plant is handling and feeding two chemicals that can form crystals within the tanks, feed piping, and equipment at temperatures below 50 degrees F. The two chemicals that will tend to form crystals are alum and sodium hypochlorite.
- Pump basins need to be placed on a regular cleaning cycle. In reviewing the process flow diagram for the plant, following the coagulation and flocculation processes the pump gallery provides a low velocity area that could allow flocculated particles to settle. This settling would occur in low velocity areas of the basin like the corners. Draining the basin and washing/cleaning it once or twice per year will remove any settled sludge. This removes the risk of filter blinding due to this mate34rial being scoured out of the basin.
- Chemical feed piping is beginning to leak. The feed piping is glued joint PVC. This is a typical material to use for feeding the chemicals that the WTF is feeding. Over time however, the chemicals will degrade the chemical structure of polyvinyl chloride pipe. This process can affect PVC glue more rapidly than the pipe and fittings. The Alum and sodium hypochlorite piping and fittings that are leaking should be replaced.
- The plants turbidimeters should be inspected and their calibration should be checked on an annual basis, at a minimum. Appropriate methods should be followed to verify the calibration following the manufacturers recommendations.
- The treatment plant has a particle counter but it is inoperable. Particle counters can be used to verify the effectiveness of the treatment process. In the case of Salmon, it can be used as a first indication of potential membrane integrity problems. It can also be used to verify the effectiveness of coagulation by monitoring floc formation after the membranes.
- Settling ponds have history of algal blooms. The decant water form these ponds, when reintroduced to the raw water supply for the plant, bring organic acid loading from the algae. This leads to the formation of disinfection by product precursors, regulated drinking water chemical contaminants.

4.3.2 Estimated System Losses

Based on the available data, 46-60% of the water produced by the treatment plant is unaccounted for. This is due to a combination of factors including high pressures and leaking pipes, unbilled water use, and inaccuracy of old water meters.

4.4 FUTURE WATER DEMAND

Population projections presented in Section 2.3 have been used to estimate future demand scenarios. If water use in Salmon remains consistent with current use (ADD = 514 gpcd) then average day demands would increase from 1.6 MGD to 1.8 MGD by 2039 when the population reaches 3,447. This increased water demand is equivalent to needing an additional 64.5 MG per year. Max day demand is projected to increase from 2.8 MGD to 3.1 MGD over the same time period. Additionally, it is estimated that average and max day demands will increase to 2 MGD and 3.4 MGD in 2059 when the population reaches approximately 3,809. In comparison, if water use could be reduced to the Idaho average, the ADD for the City of Salmon would actually decrease from 1.6 MGD to 0.725 MGD in 2039 assuming an ADD of 210 gpcd (U.S. Geological Survey, 2017).

Analysis of winter water demand is also valuable due to the low impact outdoor water use has on winter water usage. Current wintertime ADD is approximately 1.3 MGD (413 gpcd). Assuming future winter water demand will grow at the same rate as the other demands considered as part of this report, it is projected that winter demand, would increase from current levels to approximately 1.4 MGD in 2039, and 1.6 MGD in 2059.

Table 4-1 summarizes projected water demands. It should be noted that if water usage is decreased to quantities consistent with the Idaho average that the projected water demands in 2039 would be significantly less than current water demands.

Table 4-1 Current and Projected Water Demands for Salmon, ID

	2017 Demand	2039 Demand (Projected)	Reduction to ID Avg. 2039 (Projected)	2059 Demand (Projected)
ADD	1.6 MGD	1.8 MGD	0.7 MGD	2.0 MGD
MDD	2.8 MGD	3.1 MGD	1.3 MGD	3.4 MGD
PHD	3.9 MGD	4.3 MGD	1.8 MGD	4.8 MGD
Annually	583.2 MG	647.9 MG	264.2 MG	716 MG

The current total maximum feed capacity for the water treatment plant is 5.02 MGD with a maximum design rate for the water treatment plant of 4.0 MGD. This can be expanded to 5.2 MGD without significant capital expense. Idaho DEQ requires that water treatment systems have sufficient redundancy so as to provide minimum quality, quantity, and pressure requirements are met during any period of time when any component must be out of service. Based on the projected demands, it appears that the existing treatment system will be able to meet the anticipated future peak hour and max day demands. It is also often recommended that a City be able to meet MDD with any source out of service. Because of the redundant pumping capacity in the treatment plant and the water rights held by the City of Salmon from multiple sources, it appears that the City is able to meet this recommendation (Future MDD = 2130 gpm vs. Plant Redundant Capacity = 4550 gpm).

Table 4-2 shows the minimum recommended storage volume for the system based on the previously mentioned storage criteria. Comments regarding the future values used are included for clarification.

Table 4-2 20-Year Recommended Storage Volumes

Storage Component		Minimum Recommended (gallons)	Comments
Operational Storage		150,000	Use 10% to keep water in tank from stagnation
Total Storage (MG)	1.5		
% of Total	10%		
Peaking/Equalization Storage		0	Plant redundant pumping capacity exceeds PHD
PHD - Firm Cap. (gpm)	0		
Duration (hrs.)	1.0		
Fire Storage		1,080,000	Stage Coach Inn Demand from ISRB
Fire Demand (gpm)	4,500		
Duration (hrs.)	4		
Emergency Standby Storage		666,720	No backup power at water treatment plant
ADD (gpm)	1389		
Duration (hrs.)	8		
Offset Storage Needs with Source Capacity		0	Fire flow can be offset with source capacity.
Source Capacity (gpm)	0		
Duration (hrs.)	3		
Total		**1,896,720**	**26.5% Under Capacity**

While the City of Salmon has sufficient treatment capacity to provide for future needs, current and future storage capacity is insufficient based on the above criteria. A significant component of the recommended storage volumes is emergency standby storage which is storage that would be used in the event of an extended power outage. In order to overcome this deficiency, the City could consider installing emergency power generation at the treatment plant or increase the total volume of storage. Both alternatives will be considered in depth in subsequent sections of this study.

Additionally, it can be inferred that the City of Salmon continues to incur higher than typical costs to produce water for municipal use than would otherwise be anticipated because the City consumes water at a much higher rate than is typical of Idaho. Some of this could be due to leaks resulting from such high system pressures, but could also be due to public use. The City could consider employing a leak detection service and instituting a conservation program to decrease current water demands to a rate that is similar to the Idaho average of 210 gpcd. A water conservation program could include conducting a public outreach program focused on educating the public about efficient landscape irrigation and water conservation practices or installing water wise household devices. It is reported that installing water saving devices, such as, low flow shower heads and toilets can reduce household demand by up to 16% (Cornwell & Davis, 1998).

CHAPTER 5 ALTERNATIVES CONSIDERED

The Salmon water distribution system is in need of several upgrades to improve the operation of the system, protect water quality, achieve compliance with State and Federal regulations, and provide for long-term needs. In an attempt to provide the community with a plan for addressing these needs, a thorough discussion of system improvements with regards to; estimated funding requirements, potential grant monies, and improvement timelines is provided in the subsequent sections. Improvements will address water use, system losses and inefficiencies, compliance with State and Federal standards, efficient system operation, and recommendations to improve the overall health and safety of the water system.

5.1 GENERAL DISCUSSION

The results of an Idaho DEQ sanitary survey conducted in August 2016 designated no items as ‘significant deficiencies’ by Idaho DEQ reviewers. However, several items designated as ‘deficiencies’ were observed and are summarized below. A copy of the sanitary survey can be found in Appendix G.

1. Storage tank access ladder is rusting and the system should be aware that the structural integrity of the ladder will continue to degrade
2. The backflow preventers located within the treatment plant are overdue for testing.

Both findings by Idaho DEQ had been addressed by the City prior to the writing of this study and hence are not considered further. Previously identified system deficiencies have been incorporated into the improvement alternatives presented in this chapter. The alternatives found within this study have been developed to help bring the water system into compliance with current regulatory requirements, to provide necessary maintenance to avoid future non-compliance issues, and to improve the operability of the water system.

Estimated capital costs for each alternative have also been included. These costs are considered concept level cost estimates and used for planning purposes only. Cost estimates include expenses associated with engineering services, contractor overhead and profit, legal fees, funding fees, and a concept level factor to compensate for changes in the cost of construction. The cost estimates herein are based on a perception of current conditions at the project location. The estimates reflect opinions of probable costs at this time and are subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

In order to determine the best alternative for the City of Salmon, it is important to develop comparison criteria to be used in evaluating alternatives. The criteria used included cost, regulatory compliance, reliability, and public health and safety. Each alternative selected for consideration was ranked based upon these criteria using a numerical ranking system (1 thru 5), with 5 representing the best rating. All criteria were evenly weighted and results are tabulated in Chapter 6. Additional detail regarding final selection is provided therein.

5.2 NO ACTION ALTERNATIVE

The City may choose to continue operating the water system 'as is,' without addressing any of the deficiencies discussed in previous sections. Under this option the City will continue to face the present deficiencies until action is taken. The distribution system will continue to deteriorate, increasing the probability of significant system failures such as breaks, water outages, degraded water quality, and ultimately more costly repairs and maintenance to the system. Such actions involve prohibiting further connections until the deficiencies are corrected. Because of these issues, it is not prudent for the City to accept this alternative for all scenarios.

Environmental Impacts:
This alternative would not have any direct environmental impacts.

5.3 REGIONALIZATION ALTERNATIVE

Regionalization of the Salmon water system was not considered as a viable option for the City due to its isolation from other communities. Challis is one of the closest communities to Salmon with a public water system and lies approximately 60 miles to the south, making regionalization a cost prohibitive option, and will not be considered further.

Environmental Impacts:
Construction of this alternative would impact a significant amount of property to connect Salmon to an adjacent water system. It would not be a cost-effective approach.

5.4 WATER SUPPLY ALTERNATIVES

A water distribution system must be designed to meet the PHD or the MDD with fire flow requirements, whichever is greater. The entire water volume can either be delivered directly to the system from the source, or it can be delivered from a combination of source supply and storage. In cases where a system is being supplied by a source and storage, PHD can be supplied from storage, and source capacity can be reduced to MDD. This supply scenario reduces the demand capacity of the source due to the availability of water in storage. The City of Salmon currently feeds their storage tank directly and allows the water system to 'float' off the tank.

Based upon the analysis shown in Chapter 3, no additional water sources or water rights are currently needed. However, the City should evaluate obtaining additional sources and water rights to provide for potential future needs as land is annexed into the City. Obtaining additional water rights or access to new sources has become an increasingly difficult process in the western United States over the past several decades. Because of this, municipalities would be prudent to monitor water right transfers in their general vicinity for the possibility of obtaining additional water rights as they become available.

5.4.1 Water Supply Alternative 1 – No Action Alternative

The City of Salmon has sufficient supply to meet current and future demands and could elect to make no improvements regarding the City's water supply. However, DBPs are a recurring issue that has been experienced in the past. Additionally, it is possible that significant leaks exist within the system and cause the City of Salmon to use much more water than would be anticipated for a community its size.

While obtaining additional water sources is currently considered a low priority, it would be prudent for the City of Salmon to monitor water right transactions in the vicinity of the City and pursue any that may be able to supplement municipal water rights due to the extensive process required to obtain additional water rights. Thus, this alternative is not considered to be in the City's best interest.

Environmental Impacts:
This alternative would not have any direct environmental impacts.

5.4.2 Hydrant Flushing/DBP Reduction Alternative

The City of Salmon has had historical issues related to the formation of disinfection by products (DBPs) in the distribution system. DBP formation is a result of relatively slow chemical reactions between water disinfectants and naturally occurring organic matter within that water. DBPs represent a significant risk to human health, and their formation can be discouraged in several ways.

Among the simplest, cost effective, and easy to implement alternatives available for dealing with DBPs is eliminating dead-end lines when installing water mains, or providing a flushing hydrant and following a hydrant flushing program. Dead-end lines can experience low water turn-over allowing ample time for the slow chemical reactions associated with DBP formation to complete and impact those services tied to the dead-end line. Eliminating dead-end lines when installing water mains involves looping lines so that fresh water can constantly move through the loop in both directions. However, in some cases looping is not a viable alternative and a flushing hydrant would better suit the needs of the community. A flushing hydrant on a dead-end line can allow water operators to regularly flush old water from the pipe as a means of re-introducing fresh water into the dead-end line as is the case at the Sacajawea Center.

Additional alternatives involve making changes to the existing treatment system. Because the chemical used for disinfectant is involved in the formation of DBPs, the City could evaluate transitioning to another means of disinfection – typically moving from chlorine to chloramine, permanganate, or another oxidant. Another method is to treat the naturally occurring organic compounds that are reacting with the current disinfectant. Doing so can involve using an ozone generator and bubbler to break down the organic compounds prior to introducing the disinfectant. Other options involve reducing the amount of organic material in the source water by capturing flows directly from a spring rather than a spring fed creek, or reducing algal influences in pre-sedimentation basins.

Because the issue is transient rather than a constant problem and the issue has occurred on the long dead end line to the Sacajawea Center, it is recommended that the City develop and subscribe to a routine flushing and maintenance program as part of their general system maintenance. Such a plan would require no additional cost to the City as hydrants are already located on most dead-end lines and all system hydrants and valves should be routinely exercised as part of general maintenance of the system.

Environmental Impacts:
There are no associated environmental impacts with this alternative.

5.5 WATER STORAGE ALTERNATIVES

Water storage is typically required when the source supply does not meet the system demand. However, in the case of Salmon, storage is a critical component as the entire water system 'floats' off of the single storage tank. In addition, water storage provides water for fire protection and emergency needs. In systems relying on groundwater wells, storage can help meet demands without additional water sources.

5.5.1 Water Storage Alternative 1 - No Action Alternative

The existing storage tank in Salmon has a capacity of 1.5 MG and was constructed in the 1979-1980. The tank has aged reasonably well; however, some minor cracking was observed during the last cleaning and inspection. Additionally, significant amounts of fine material had settled out and collected in the bottom of the tank and it was recommended that maintenance intervals be adjusted to accommodate more frequent cleanings.

Flows from the treatment plant enter the tank directly before feeding the distribution system. As part of the treatment plant design, the tank was intended to act as both storage reservoir and chlorine contact tank to achieve required CT credits. The City should plan to have the tank inspected and routine maintenance conducted at regular intervals; however, routine maintenance is not considered as a separate storage alternative.

The City could elect to continue operating the system as is and make no changes to the existing storage capacity; however, it has been shown that, in the event of a significant power outage at the water treatment plant, the tank will not have capacity to supply average day demands for 8 hours as is required. Therefore, this alternative is not assumed to be in the best interest of the City.

Environmental Impacts:
This alternative would not have any direct environmental impacts.

5.5.2 Water Storage Alternative 2 – Future Tank

The existing storage tank in Salmon has a capacity of 1.5 MG and is now over 40-years old. While the tank appears to be aging well, by the year 2039 the tank will be nearing the end of its anticipated life and the City will need to begin considering options for its replacement. Additionally, as the water system reaches the substantial modification milestone set forth by the State of Idaho, the City will also have to comply with new minimum pressure standards that will cause a significant portion of the upper pressure zone to be in violation.

It is therefore recommended that the City consider the short-term installation of an emergency generator of sufficient size to power operations at the water treatment plant, in order to provide treatment capacity in the event of a significant power outage. It is also recommended that the City begin considering a higher elevation tank as a replacement or supplement to the existing tank, and that the timing of its completion coincide with the date of substantial modification based on additional footage of pipe required to service a growing population.

Alternatively, the City could also elect to forego the installation of an emergency generator and instead could construct the additional storage capacity now. In either case, by beginning to plan now, the City has the opportunity to put money away to either supplement or cover the construction costs.

Environmental Impacts:
Additional disturbance would be required near the existing 1.5 MG tank. However, the area has been previously disturbed by the construction of the existing tank and treatment works, so environmental impacts of an additional tank would be minimal, localized, and limited to the duration of construction activities.

5.5.3 Water Storage Alternative 3 – Backup Generator for WTP

In the event of a significant power outage at the water treatment plant, the tank will not have capacity to supply average day demands for 8 hours as is required. With a backup generator for the WTP, the plant could continue to function as designed and the additional storage would not be needed.

Environmental Impacts:
This alternative would not have any direct environmental impacts.

5.6 DISTRIBUTION SYSTEM ALTERNATIVES

As discussed in Chapter 3 and Chapter 1, several deficiencies have been identified within the distribution system. Extremes in pressure, both high and low, are experienced in the upper and middle pressure zones and entire neighborhoods lack sufficient fire flows or hydrants to protect citizens in the event of an emergency. A significant portion of the distribution system is also known to be aging ductile iron, cast iron, or steel lines; some of which were installed in the 1940s and have been in service for over 80 years.

The City has made several recent upgrades to lines throughout the City, and 6-inch PVC lines now make up more of the system than any other line size or pipe type. These upgrades remain in good condition.

5.6.1 Distribution Alternative 1 – No Action Alternative

The no action alternative is not considered to be a viable option due to the violations to IDAPA standards within the Salmon Distribution System (I.E. some fire hydrants connected to 4-inch lines, system pressure greater than 100 psi). For this reason, this alternative is not discussed in detail. Additionally, this alternative is not considered to be in the best interest for the City as upgrades do need to be made, particularly regarding lines that have been in service since the 1940s and which could now be contributing to the higher than expected water use in Salmon.

5.6.2 Water Meters

Measurement accuracy tends to degrade as water meters age. The City of Salmon has been using the current batch of water meters for almost 30 years, well passed the anticipated lifetime at the time of installation. In order to more accurately determine water usage at each connection, the City should plan to begin a replacement program which limits impact to City budgets but provides new meters for the City to install within a relatively short time-frame.

Under this alternative, the City would work to develop a replacement plan that limits impact to City budgets but allows for the regular maintenance and replacement of City meters now and in the future. It is anticipated that as the meter pits, setters, and other appurtenant equipment is in place that the City will be able to procure new meters and perform a majority of the installation efforts themselves.

Environmental Impacts:
There are no direct environmental impacts as part of this alternative.

5.6.3 Distribution Alternative 2 – Leak Detection & Conservation Programs

As discussed in Chapter 3, there is potential for considerable losses in the water distribution system due to such high system pressures and as evidenced by higher than anticipated water demands. Instituting a leak detection program would require hiring a leak detection service to evaluate the City's water distribution system. Through a leak detection service, pipes could be identified for repair and replacement, thus improving the integrity of the distribution system and reducing water loss due to leaking pipes. The leak detection program will also allow the City to focus resources on the sections of the system that are in the most need of repair. Through the identification of leaking system piping, Salmon will be able to develop a distribution repair plan based upon the extent of the leak, and whether the section of leaking pipe violates IDAPA regulations. An opinion of probable costs for employing a leak detection service is shown in Table 5-1.

Table 5-1 Estimate of Probable Project Cost – Leak Detection Service

Item Description	Probable Cost
Leak Detection Service	$11,240
Construction Sub-Total	**$11,240**
Concept Level Factor (25%)	$2,810
Final Total	**$31,150**

This alternative has the potential to increase the water available to the system and decrease operation and maintenance costs associated with treatment. The information provided in a leak detection survey would provide water system operators with information that could be used to improve the operation and maintenance of the City's current system.

In addition to employing a leak detection service, a water conservation program could include a public education program will be used to educate consumers regarding conservation practices such as installing low flow faucets, using effective irrigation methods, and utilizing low water consumption landscaping. An opinion of probable costs for instituting such a program is not provided as the associated costs would be determinate on the extent of the outreach conducted by the City.

Leak detection and water conservation has the potential to provide additional supply redundancy and decrease the demands on the supply and distribution system by increasing citizen awareness. The goal of this improvement is to decrease water usage in Salmon to levels that reflect the average domestic consumption in Idaho (210 gpcd). Table 5-2 provides an estimate of projected water use and the potential savings if this goal could be met.

Table 5-2 Water Conservation Program Potential Savings

	Projected 2039 Demands	Estimated Demands W/ Conservation	Daily Savings (gallons)
ADD	2.00 MGD	0.85 MGD	1,150,000
MDD	3.45 MGD	1.41 MGD	2,040,000
PHD	4.84 MGD	1.98 MGD	2,860,000
Annually	729.8 MG	298.1 MG	431,700,000

To provide context for the potential water savings, if the Salmon ADD could be decreased to the Idaho average, the volume of water that would be saved each day is roughly equivalent to Salmon's water storage tank.

Environmental Impacts:
Additional water conservation would prevent additional flows being diverted from the Salmon River Basin and reduce the energy costs associated with treatment of water at the Salmon Water Treatment Plant.

5.6.4 Distribution Alternative 3 – Distribution System Improvements

Due to the size of the Salmon water system, this alternative is broken up into six groups that focus on the most critical needs first and then systematically address deficiencies in specific regions of the City. Individual improvement groups are shown in Figure 5-1. The City plans on installing some pipe with their crew which are shown on the figure as City Improvements and are not included in the six groups. Grouping system improvements into phases allows the City to address the most severe issues before improving secondary elements, and provides the City with a means for planning to replace the remaining system components. Each phase will improve compliance with State and Federal Standards as well as the overall hydraulic performance of the water system. Eventually all of the old 4" pipe should be replaced as well. Table 5-3 shows the linear feet of pipe to be replaced as part of this alternative.

Table 5-3 Water Line Improvements

Improvement	Linear Feet of Pipe
City Improvements	4,600
Improvement Group A	8,100
Improvement Group B	6,900
Improvement Group C	1,600
Improvement Group D	6,600
Improvement Group E	6,500
Improvement Group F	1,300
All Remaining Diameter 4" & Less	26,100
Total	**61,700**

<u>Distribution Phase I Improvements</u>
The City should begin planning to improve some portions of the distribution system, including installing two new PRVs to regulate pressures within the middle pressure zone and thereby creating a fourth pressure zone and upgrading distribution lines in some neighborhoods which are currently deficient with respect to fire flow.

Under this alternative, the City would install two new PRV vaults on the 10-inch lines located along Washington Street between 4th and 5th Avenue and along Fairmont St. in the alley connecting Cannon Ave to State St. The PRV settings will allow flow to pass through both PRVs under normal operation, and having two separate PRV vaults will provide system redundancy and improved hydraulic capacity in the event of a PRV failure or fire flow event. For planning purposes, Improvement Group A will also be completed as part of this initial project. As these sections of pipe are replaced, additional fire hydrants should be added to those areas without adequate fire hydrant coverage.

Distribution Phase II Improvements

Additional improvements would be made in the remaining improvement groups as funding allows to address concerns regarding the age of lines, undersized lines, and restricted fire flows. As these sections of pipe are replaced, additional fire hydrants should be added to those areas without adequate fire hydrant coverage.

5.7 SYSTEM CLASSIFICATION, STAFFING, & OPERATOR LICENSURE

Idaho DEQ classifies drinking water systems on two levels: treatment and distribution, and the complexity of each system is evaluated separately. Classification worksheets can be found on Idaho DEQ's website (Idaho Dept. of Environmental Quality, 2019). The distribution system is evaluated based on the population served by the system. The breakdown of population is shown in Table 5-4.

Table 5-4 Idaho DEQ Distribution System Classification

Classification	Population
Very Small Public Drinking Water System	* See definition below
Class I	1,500 or less
Class II	1,501 to 15,000
Class III	15,001 to 50,000
Class IV	50,001 and greater

*** Very Small Public Drinking Water System –** A Community or Non-transient Non-community Public Water System that serves five hundred (500) persons or less and has no treatment other than disinfection** or has only treatment which does not require any chemical treatment, process adjustment, backwashing or media regeneration by an operator (e.g. calcium carbonate filters, granular activated carbon filters, cartridge filters, ion exchangers.) (IDAPA 58.01.08.003.79)

**** Disinfection –** Introduction of chlorine or other agent or process approved by the Department of Environmental Quality, in sufficient concentration and for the time required to kill or inactivate pathogenic and indicator organisms. (IDAPA 58.01.08.003.22)

The treatment system classification is based on the following eight criteria:

- System Size
- Water Supply Source
- Average Raw Water Quality
- Treatment Process
- Disinfection
- Sludge / Backwash Water Disposal
- Bacteriological / Biological Laboratory Control
- Chemical / Physical Laboratory Control

Alternatives not eliminated by screening should be compared for any potential impacts on system classification. For distribution system classification, the population is not projected to exceed 15,000 so there will be no change in classification. For the treatment system, no alternatives were evaluated which would require a change to treatment classification. Since none of the alternatives will impact system classification and required operator licensure, no additional consideration of system classification will be given in comparing the proposed alternatives.

5.8 FINAL SCREENING OF ALTERNATIVES

Viable alternatives were compared based on estimated project cost, regulatory compliance, reliability, and public health and safety. For each alternative, the categories were ranked using a numerical ranking system (1 through 5), with 5 representing the best rating. Cost breakdowns for each of the considered alternatives discussed in the following section are included in Appendix H. Costs include contingency and estimated professional fees.

The cost estimates are based on the perception of current conditions at the project location. This estimate reflects an opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the cost presented herein.

5.8.1 Final Screening of Water Supply Alternatives

The viable supply alternatives include the no action alternative, leak detection/conservation, and DBP Reduction alternatives. A summary of each is provided below:

No Action

The "no action" alternative would currently meet the needs of the City and therefore is a viable option. The City would be prudent in monitoring water rights transaction in the area and obtaining additional rights as they come available due to the increasingly difficult water right acquisition process.

Leak Detection and Water Conservation

Currently the City has sufficient water sources, but the system consumes water at a higher than average rate. This could be an indication of large leaks within the distribution system that could be costing the City additional in operation and maintenance costs. Leak detection and water conservation could significantly decrease consumption and in so doing decrease operation costs related to operating the water treatment plant. The planning level cost estimate for a leak detection program and water conservation program is $17,100 but depends largely on the amount of outreach the City ultimately chooses to perform. This cost includes "listening" leak testing services for a 1-man crew for approximately 1 week.

DBP Reduction

Several options could be considered to reduce the formation of DBPs in the Salmon water distribution system. It is recommended the City develop and institute a hydrant flushing program which focuses on flushing dead-end lines routinely and exercises all other City hydrants throughout a calendar year.

The City should also review their backwash pond recycling practices. Recycle of water that contains algae can introduce organics that are DBP precursors. This practice should be practiced carefully to avoid unintentional introduction of DBP, taste, and odor problems. If practiced, the coagulant feed and pH should be optimized to accomplish enhanced coagulation.

5.8.2 Final Screening of Storage Alternatives

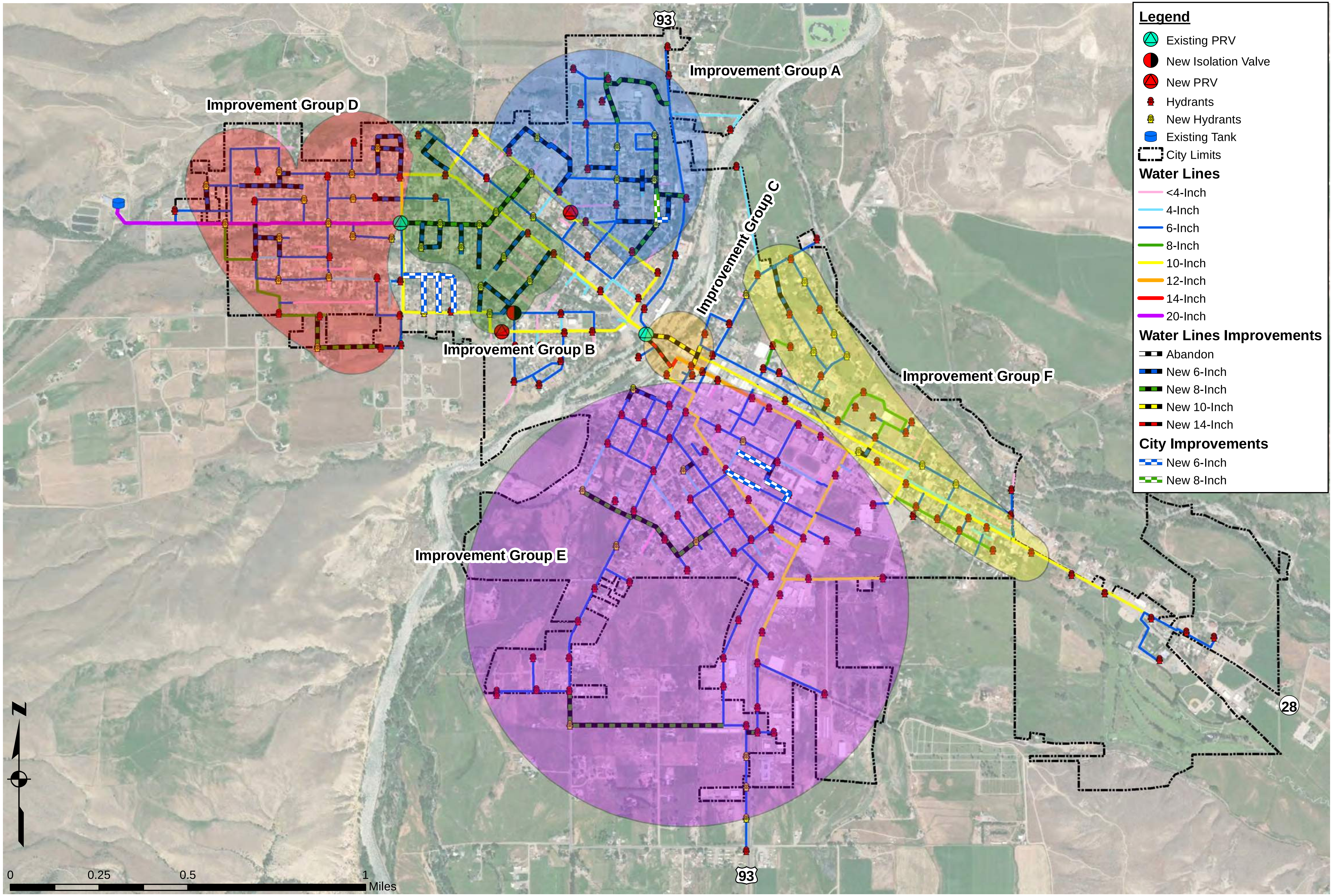
The viable storage alternatives include the "no action" alternative and the installation of an emergency generator as well as the building of a new tank in the future. The no action alternative is the least cost alternative but is not in the best interest of the City due to the potential for major disruption due to a significant power outage.

5.8.3 Final Screening of Distribution Alternatives

Viable distribution alternatives include phased upgrades to the City's distribution system, including various waterline improvements throughout the City and the installation of two new PRV vaults to create a 4th pressure zone. Additional fire hydrants would also be installed to provide additional hydrant coverage.

5.8.4 Public Participation

40 CFR Part 25 discusses objectives and requirements for public participation. The public refers to, in the broadest sense, the general populace. This may include any special interest groups. This process helps responsible officials become aware of public attitudes by allowing the public to communicate their views.



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PROJECT NO. 217105

FILENAME Improvements.mxd

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City of Salmon

Water Facilities Planning Study

Water Distribution Improvements

FIGURE NO. 5-1

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