AMMON WATER FACILITIES PLANNING STUDY

DRAFT MARCH 2018, FINAL JUNE 2018

KELLER ASSOCIATES

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Introduction

Purpose and Need for Project

The last system-wide water study for the City of Ammon was completed in 2006 as part of a Regional Water Planning study that included Falls Water and Ucon. Since that study, The City of Ammon has completed several major water projects and has seen significant growth. Major water projects since the 2006 study include the Well 8 tank and booster station, the Hill Tank and booster station, the Well 9 improvements, and various transmission line projects. The City of Ammon has completed several localized studies recently that looked at portions of the water system. These studies include the Well 6 Pump Station Evaluation completed in 2014 and the Communities Master Plan completed in 2016. These studies identified water system deficiencies and made recommendations for improvements, but did not look at the water system as a whole.

The City of Ammon commissioned this Water Facilities Planning Study to evaluate and make recommendations for the water system as a whole. The recommendations from this study will allow the City Council to prioritize, plan, and budget system improvements for the system as a whole rather than piecemeal. The recommendations from prior localized studies have been incorporated into this study.

Plan of Study and Report Organization

Chapter 1 describes the City of Ammon's existing drinking water system consisting of wells, tanks, booster stations, and transmission and distribution piping. Chapter 2 describes the existing environmental conditions in the planning area. Chapter 3 outlines the planning criteria which form the basis of the water system evaluation and resulting recommendations. Chapter 4 forecasts water system demands by establishing current production and applying current per capita usage to growth projections. Chapter 5 describes the results of the computerized system analysis that was used to identify distribution system deficiencies. Chapter 6 contains a supply, storage, and delivery evaluation for the system as a whole and for each individual pressure zone. Chapter 7 includes the initial and final screening of alternatives to address deficiencies that were identified in Chapters 5 and 6. Chapter 8 lists prioritized improvements with costs in the Capital Improvements Plan. Chapter 9 is a discussion of funding and user rates.

Project Implementation

The City recognizes that they must maintain their water system infrastructure in order to be able to continue providing reliable water service to current residents, and to be able to provide water service to new businesses and developments who want to locate in Ammon. Growing system demands, calls on water rights, and water system repairs have kept water system issues forefront for City elected officials.

In order to better inform the public and to gather support for needed improvements, the Mayor appointed a water committee comprised of residents from varying backgrounds. This committee met several times in 2017, and again in 2018 to discuss water conservation measures including water meters and implementing meter-based user rates. As this Water Facilities Planning has progressed, the Mayor invited us to come present early findings and alternatives to the water committee for their consideration. Discussions in these water committee meetings and subsequent City Council meetings have led to a plan to implement a meter-based user rate structure with an increase in user rates that will allow the City to pay for water system improvements as they are needed rather than borrow the money to pay for improvements.

The City has the technical, financial, and managerial resources to implement the recommendations of this study.

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1 EXISTING SYSTEM

This chapter summarizes existing source, storage, and distribution conditions for the City of Ammon's drinking water system. As part of this description, Keller Associates compiled system documentation from the City's records into a system inventory included in Appendix A: Water System Facilities Records. Regulatory requirements and design criteria are presented in Chapter 3 as they pertain to the City's water system. The Idaho Department of Environmental Quality (IDEQ) 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."[1]

The City's water system, which is described in greater detail in the following sections, is comprised of five pressure zones (only 3 of which are currently active), nine ground water wells (three are currently inactive), three water storage tanks (one is currently inactive), and four booster stations (one is currently inactive). Figure 1.1 shows the locations of the wells, tanks, and boosters, and Figure 1.2 shows the pressure zone boundaries which are discussed further in Section 1.3.2.

1.1 WATER SOURCES

Currently, all of Ammon's potable water supply comes from groundwater from the Eastern Snake River Plain Aquifer. Recharge of the aquifer comes from the Snake River, the Teton River, and numerous small streams and canals. Water is removed from the aquifer by numerous small groundwater users (such as private wells serving individual homes), industrial wells, and large scale agricultural pumping, in addition to public wells operated by municipalities.

Ammon has nine wells to meet the water demands of the City. Wells 3, 5, and 6 are currently inactive due to needed repairs and changes in the operation of the system. Table 1.1 summarizes attributes of each of the wells. While there is currently no treatment taking place in the Ammon water system, the Well 6, Well 8, and Hill Tank pump stations are outfitted with chlorination equipment should the need arise.

[1] Idaho Department of Environmental Quality. (2012). Idaho Rules for Public Drinking Water Systems. Retrieved April 13, 2017 from https://adminrules.idaho.gov/rules/2012/58/0108.pdf

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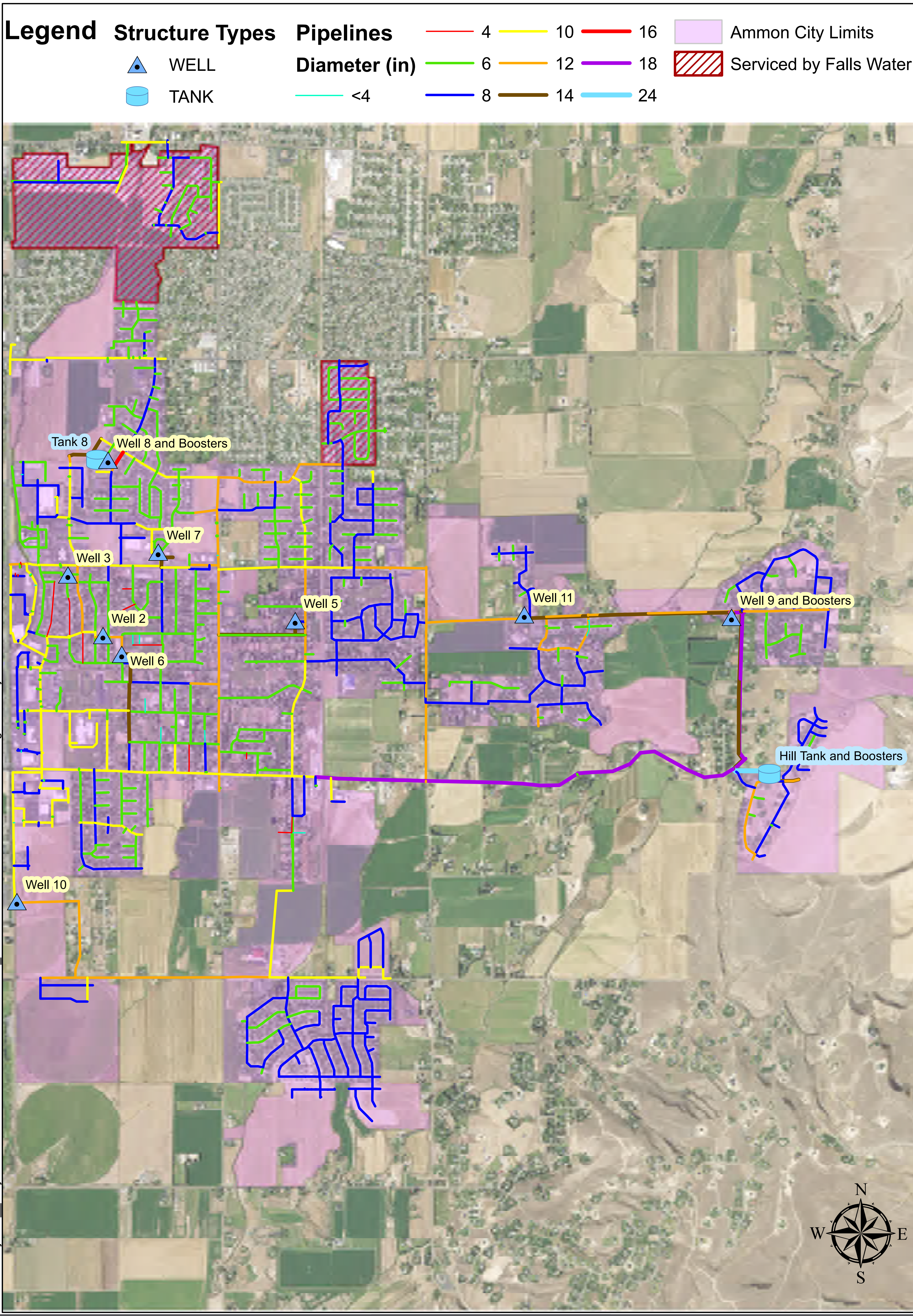

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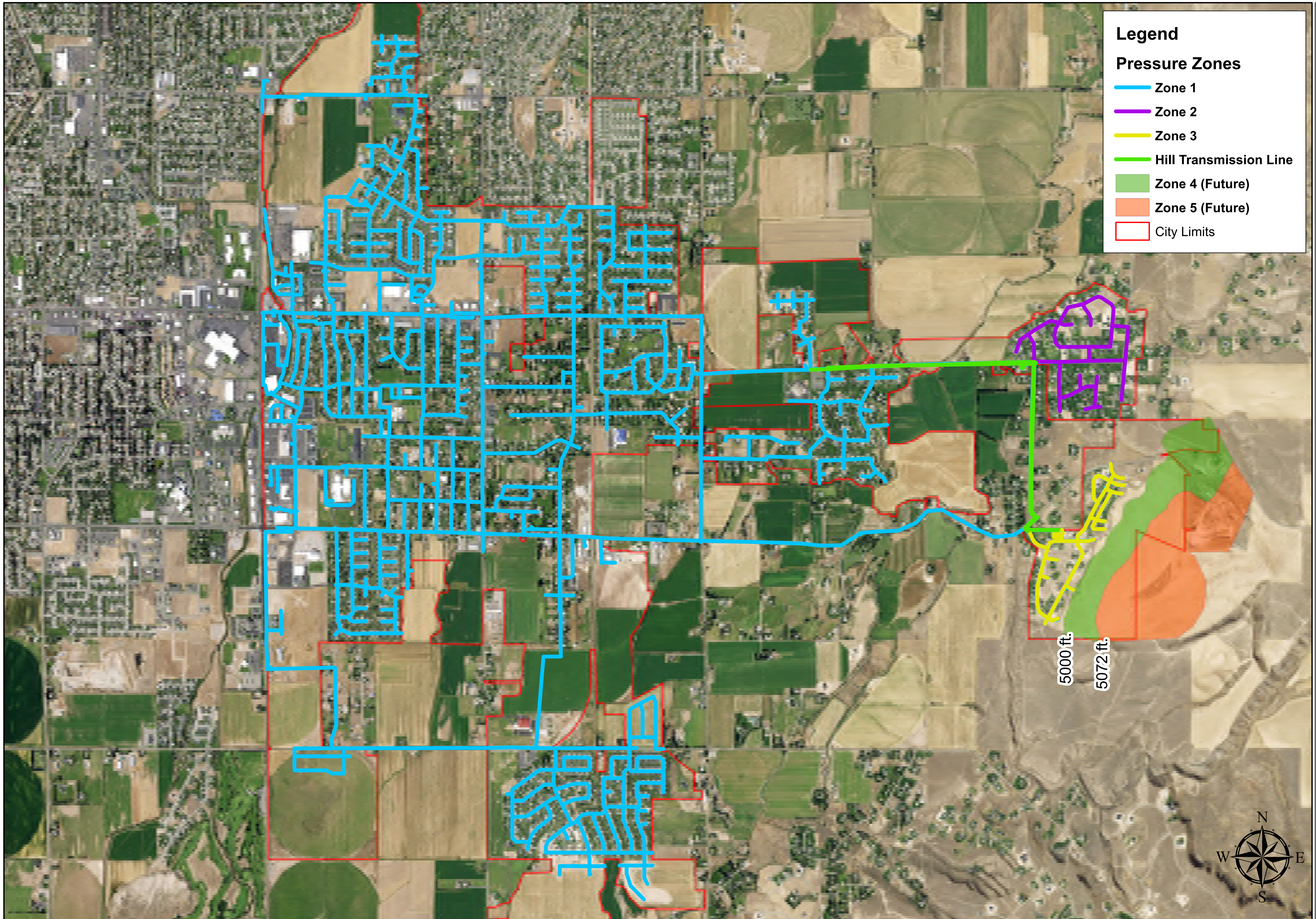
Print Date: 3/13/2018

Figure:	Title:	Project:	Prepared for:
1.1	Existing Water System	Water Facilities Planning Study	CITY OF Ammon
		Keller Project: #216102-000	KELLER ASSOCIATES

Print Date: 5/15/2018



Prepared for:

City of Ammon

KELLER ASSOCIATES

Project: Water Facilities Planning Study

Keller Project: #216102-000

Title: Pressure Zone Map

Figure: 1.2

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Table 1.1: Well Attributes

Well ID	Production (gpm)	Motor hp	VFD	Emergency Power?	Year Drilled
Well 2	325	25	No	No	1952
Well 3 (inactive)	500	50	No	No	1957
Well 5 (inactive)	1000	100	No	No	1967
Well 6 (inactive)		75	Yes	Yes	1973
Well 7	1850	200	No	No	1968
Well 8	4200	400	Yes	Yes	1996
Well 9	1850	200	Yes	Yes	2001
Well 10	3000	400	Yes	Yes	2008
Well 11	3000	500	Yes	Yes	2008
Total Well Pumping Capacity:	**15,725 gpm**				

The well logs are included in Appendix A: Water System Facilities Records. Further evaluation of the wells is presented in Chapter 6.

1.2 WATER STORAGE & BOOSTER STATIONS

The City of Ammon has three storage tanks with a total storage volume of 4.0 MG. These tanks supply five pressure zones throughout the City. The tank at Well 6 is inactive due to the addition of the Hill Tank which raised system pressure and made the booster pumps at Well 6 unable to pump into the system. Pump Station 9 receives water from Hill Tank #1 through a gravity-fed transmission line. This water is then pumped to Pressure Zone 2, consisting primarily of the Quail Ridge subdivision immediately east of the pump station (see Figure 1.1 and Figure 1.2). This pressure zone spans a total elevation change of roughly 100 feet. Pump Station 9 pumps at a pressure of 95 psi in order to provide adequate pressure at the upper end of Pressure Zone 2. This requires some of the homes serviced at the lower end of Pressure Zone 2 to install individual pressure reducing valves. The pressure in Zone 1 is set by the water level in the Hill Tank. The pressure in Zone 2 is set by the booster station set points at Well 9, and the pressure in Zones 3 through 5 is set by the booster station set points at the Hill Tank. A summary of the tanks and pertinent information is presented in Table 1.2: Storage Tank Summary.

Table 1.2: Storage Tank Summary

Tank	Pressure Zone	Type	Capacity (MG)	Inside Diameter (ft)	Year Built
Well 6 Tank (inactive)	Zone 1	Pre-stressed Concrete	0.5	60	1970's
Well 8 Tank	Zone 1	Pre-stressed Concrete	1.5	100	2011
Hill Tank	Zone 1, 2, 3, 4 & 5	Pre-stressed Concrete	2.0	118	2010

There is a booster station located at each tank. Information regarding the booster stations and their functions is summarized in Table 1.3 Booster Station Summary.

Table 1.3: Booster Station Summary

Booster Station Location	Pressure Zone	Pumps	Capacity	Function
Pump Station 8	Zone 1	(3) 125 hp	5,550 gpm w/ all pumps running	Pressurize Zone 1
Pump Station 9	Zone 2	(2) 30 hp (2) 75 hp	5,200 gpm w/ all pumps running	Pressurize Zone 2
Hill Tank #1	Zone 3	(2) 60 hp (1) 25 hp	1,680 gpm w/ all pumps running	Pressurize Zone 3
	Zone 4	(1) 40 hp (2) 100 hp	1,680 gpm with all pumps running	Pressurize Zone 4
	Zone 5	(2) 350 hp (1) 125 hp (1) 50 hp	4,980 gpm with all pumps running	Pressurize Zone 5 and provide for Zone 3 and 4 in case of an emergency

The City uses a SCADA system to control the on/off status of most of the wells to fill the tanks. The remaining wells are operated manually to meet the seasonal demands of the City.

The water storage tank at Well 6 was last inspected in November 2013. The inspection found the tank with an accumulation of sediment in the bottom, structurally sound, but in need of roof, interior wall, and piping repairs. A copy of the inspection report is included in Appendix A. The Hill Tank and the tank at Well 8 are relatively new and have not been inspected yet.

1.3 DISTRIBUTION SYSTEM

1.3.1 Piping

Ammon's distribution system can be categorized into transmission mains and distribution mains. Transmission mains consist of components that are designed to convey large amounts of water over great distances, typically between major facilities within the system. Ammon has several transmission mains that transport water to and from storage tanks and major pumping facilities. Individual customers are usually not served from transmission mains. In general, transmission lines are larger than 12-inches.

Distribution mains are the portion of the system that delivers water to the customers. Distribution mains are smaller in diameter, and typically follow the general alignment of the streets. Elbows, tees, crosses, and numerous other fittings are used to connect and redirect sections of pipe. Fire hydrants, isolation valves, control valves, blow-offs, and other maintenance and operational appurtenances are frequently connected directly to the distribution mains.

Services, also called service lines, transmit the water from the distribution mains to the customers' homes or facilities.

The City's water distribution system is comprised of a network of ductile iron and PVC pipes ranging from 1 to 24 inches in diameter. The distribution system, wells, and storage reservoirs are shown on Figure 1.1. The majority of the system is 6-inch and 8-inch diameter pipe. Table 1.4 lists the total length of each pipe diameter and percentage of the system as a whole. Table 1.5 shows the estimated amount of ductile iron versus PVC pipe in the system.

Table 1.4: Water Distribution Pipe Summary

Size (in)	Length (ft)	% of Total
≤3	2,858	0.6%
4	7,482	1.6%
6	148,927	32.4%
8	136,555	29.7%
10	57,794	12.6%
12	54,427	11.8%
14	17,117	3.7%
16	566	0.1%
18	17,055	3.7%
24	2,118	4.6%
Total	**459,422 feet**	**87 miles**

Table 1.5: Water Distribution Pipe Material Summary

PVC	Ductile Iron	Unknown
8.4%	74.5%	17.1%

The estimated ages of the pipes in Ammon's distribution network are presented in Figure 1.3. These pipe ages were taken from the City's GIS database and are a combination of data from plans on file and the approximate age of the neighborhoods where pipes are located.

City of Ammon Water Facilities Planning Study

Estimated Pipe Installation Time Frames

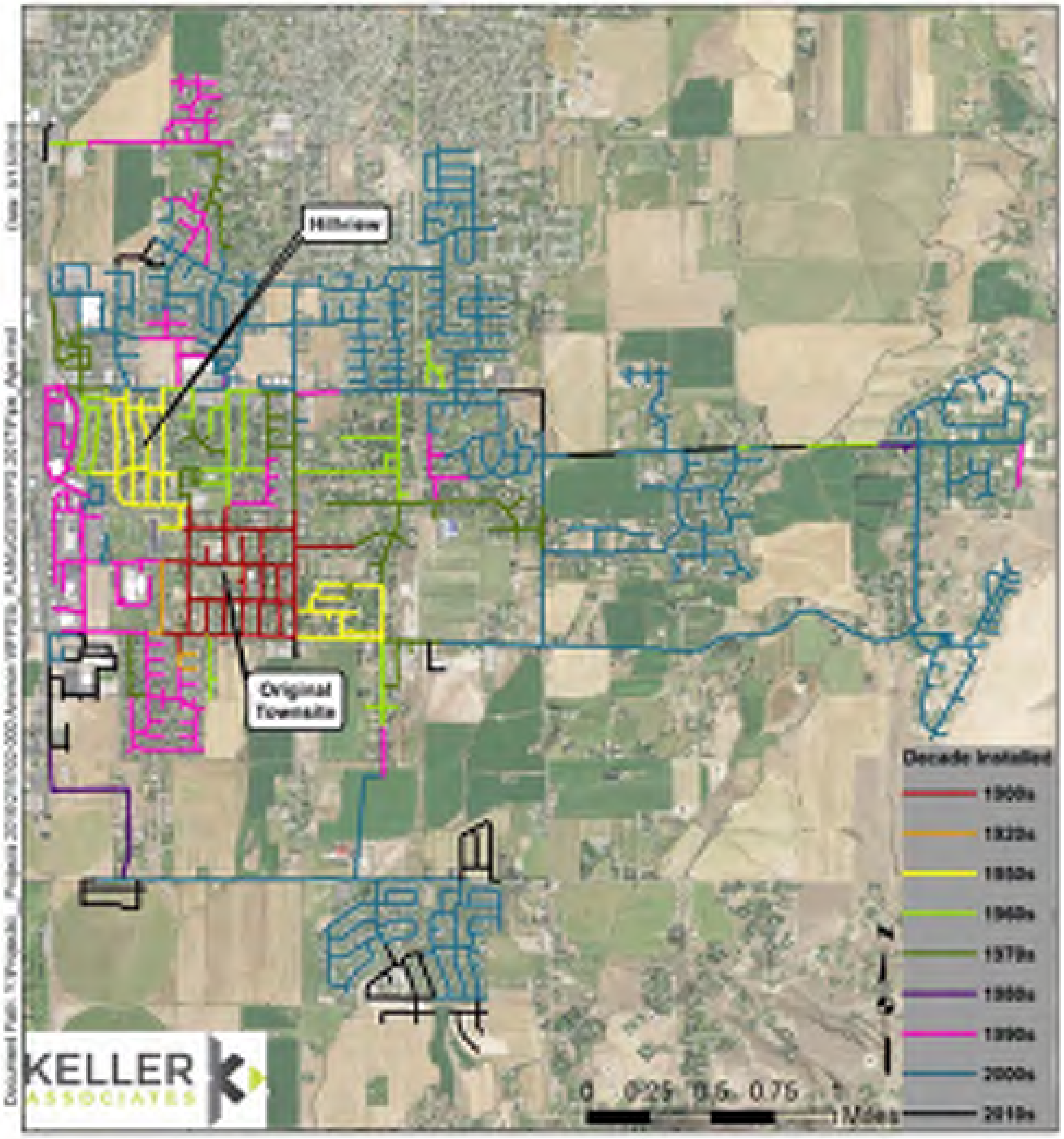

Figure 1.3: Estimated Pipe Age

1.3.2 Pressure Zones

The water system is divided into five pressure zones as seen in Figure 1.2. Typical pressures in each zone range from 45 psi to 90 psi. The majority of the population is served by Zone 1. Wells 2, 3, 5, 7, and 10 pump directly into the Zone 1 distribution system. The Hill Tank gravity flows to Zone 1 and Well 8 uses booster pumps. Booster pumps located at Well 9 supply Zone 2 and those booster pumps are supplied by the Hill Tank. Wells 9 and 11 supply the Hill Tank through a dedicated transmission line which then supplies Zone 1 via gravity flow and Zones 3, 4, and 5 through three different sets of booster pumps located at the Hill Tank. Wells 9 and 11 have bypasses that they can feed Zones 2 and 1 respectively, if necessary. There is also a bypass at Well 8. Pressure Reducing Valves (PRVs) are located on the bypass of Well 11 to Zone 1, and on the Hill Tank's Zone 5 boosters that can provide water to Zones 3 and 4 in case of low pressures in those zones.

Figure 1.4 provides a schematic diagram showing how each pressure zone is supplied and how zones are interconnected through PRVs and by-pass valves.

1.3.3 Fire Hydrants

There are over 600 fire hydrants throughout the water system. In 2016, 111 hydrants were exercised, 5 were repaired or replaced. Keller Associates conducted a hydrant survey in 2014 of the hydrants located in the one-square-mile area between Sunnyside Rd, Hitt Rd, 17th St, and Ammon Rd that identified some of the oldest hydrants on the system as being early 1950s Pacific States 2-nozzle models (see Appendix A).

1.4 SUPERVISORY CONTROL AND DATA ACQUISITION

Supervisory Control and Data Acquisition (SCADA) systems are used to collect data and to control the operation of the equipment using programmed logic. It also enables an operator to remotely view real-time measurements, such as the level of water in a tank or flow rate from a pump, and remotely initiate the operation of network elements such as pumps.

SCADA systems can be set up to sound alarms when an unwanted condition (e.g. low reservoir level, pump failure, or low/high pressure) within a water supply system is identified. They can also be used to keep a record of variables in the system such as reservoir levels and pumping rates.

The City of Ammon uses a SCADA system to control most of the wells and booster pumps in the system based on reservoir level and system pressure and to collect, store, and record well pump flows, pressures, booster pump operation, and storage volume within the system.

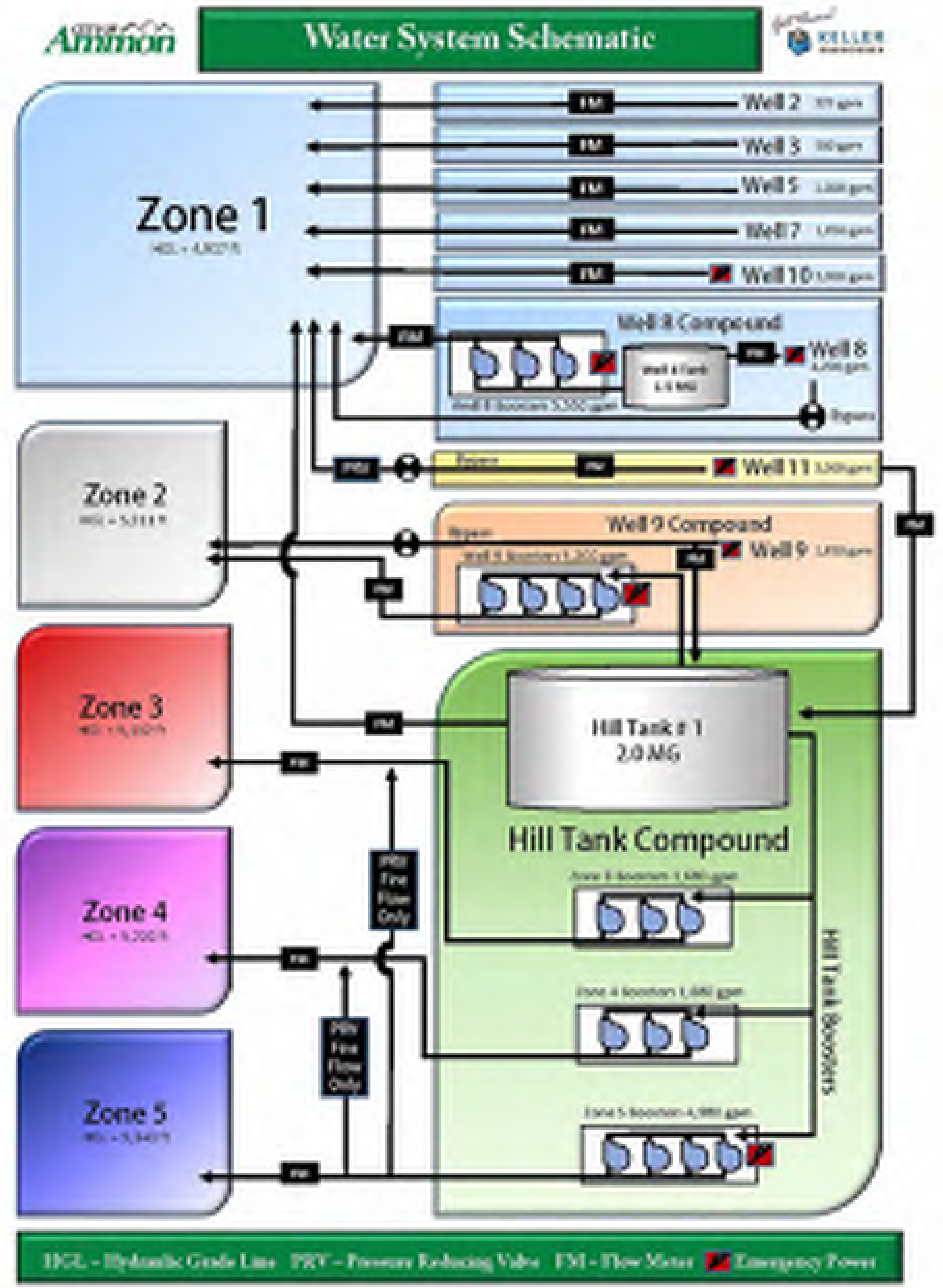

Figure 1.4: Water System Schematic

1.5 PRESSURIZED IRRIGATION SYSTEM

The City of Ammon does not have a Public Pressurized Irrigation System designed for non- potable uses. Pressurized irrigation systems can help communities stretch valuable municipal water rights by distributing surface water for irrigation needs. These systems are not required to meet potable water standards.

1.6 WATER QUALITY

Water quality standards are based on the U.S. Environmental Protection Agency (USEPA) Safe Drinking Water Act (SDWA), and its revisions, which includes primary standards (legally enforceable) and secondary standards (not legally enforceable). Primary standards are defined to protect public health while secondary standards are defined for contaminants that pose no public health risk, but may cause corrosion, odor, unpleasant taste, or staining (aesthetic concerns). Primary standards exist for microorganisms, disinfectants, disinfection byproducts, inorganic chemicals, organic chemicals, and radionuclides. These primary constituents are required to be measured and reported on a regular basis.[2] A list of the drinking water regulations for primary and secondary standards is included in Appendix B: Existing Facilities Reference Information, along with water quality test results for the City.

In response to the SDWA, the EPA has developed rules to further address water quality. The following drinking water rules are considered priority rulemakings by the EPA. The rules presented below are those typically of concern to potable water systems. The summaries that follow contain only an overview of the associated rule. For additional information consult the EPA's Current Drinking Water Regulations page[3].

1.6.1 Testing

Testing of over 80 contaminants is performed annually on Ammon's wells and distribution system. Of these, only a portion tested positive and none were greater than the maximum contaminant level (MCL). The maximum contaminant level goal (MCLG), is the level of a contaminant in drinking water below which there is no known or expected health risk are listed next to the MCL. Table 1.6 and Table 1.7 below lists the parameter, the maximum contaminant level (MCL) allowed by IDEQ and/or USEPA, the units of measure, the measured level, and other information related to the contaminant. These tables were provided by the City of Ammon in their annual water quality report (Consumer Confidence Report, a.k.a. CCR). A brief description of each of the regulated contaminants follows.

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[2] U.S. Environmental Protection Agency. (2012, March 6). Current Drinking Water Regulations. Retrieved March 14, 2014, from Safe Drinking Water Act: http://water.epa.gov/lawsregs/rulesregs/sdwa/currentregulations.cfm

[3] U.S. Environmental Protection Agency. (2017). Drinking Water Contaminants – Standards and Regulations. Retrieved April 14, 2017 from https://www.epa.gov/dwstandardsregulations

Table 1.6: Traceable Contanimants Found In Ammon's Water Distribution System in 2014

Contaminant (units)	MCL	MCLG	Levels in Ammon's Water	Violation	Typical Source
Hardness	n/a	n/a	≤226	No	Hardness is a measure of minerals in the water supply
Nitrate (ppm)	10	10	1.74-2.460	No	Run off from fertilizer
Lead (ppb)	0	15	≤0.003	No	Erosion of natural deposits
Copper (ppm)	1.3	1.3	≤0.153	No	Natural corrosion of home plumbing may contribute to contaminants
Radium (pCi/l)	5	0	0.98-4.90	No	Erosion of natural deposits
Radon/Uranium (pCi/l)	15	0	.5-5.50	No	Erosion of natural deposits
Arsenic (ppm)	.01	0	0.002	No	Erosion of natural deposits
Barium (ppm)	2	2	0.112-0.154	No	Discharge from drilling wastes, metal refineries, erosion of natural deposits

AL: action limit
ppm: parts per million or milligrams per liter
ppb: parts per billion or micrograms per liter
pCi/l: picocuries per liter (a measure of radiation)
(<): non-detectable or below the detection level of the instrumentation of the lab and does not have to be reported.

Table 1.7: Traceable Contaminants Found in Ammon's Water Distribution System In 2015

Contaminant (units)	MCL	MCLG	Levels in Ammon's Water	Violation	Typical Source
Barium (ppm)	2	2	.112-.154	No	Erosion of natural deposits
Nitrate (ppm)	10	10	0-2.57	No	Run off from fertilizer
Chromium (ppb)	100	100	1-2	No	Erosion of natural deposits
Uranium	0	30	2.8-3.1	No	Erosion of natural deposits
Radium (pCI/l)	0	5	.98-4.9	No	Erosion of natural deposits
Radon/Uranium (pCi/l)	0	15	.5-5.5	No	Erosion of natural deposits
Fluoride (ppm)	4	4	.3-.4	No	Naturally occurring
Arsenic (ppb)	0	10	2	No	Erosion of natural deposits
Di(2-ethylhexyl) (ppb)	0	6	≤0.832	No	Discharge from rubber and chemical factories
Nickel	.1	-	-	No	------

nd: not detectable at testing limit AL: action limit
ppm: parts per million or milligrams per liter
ppb: parts per billion or micrograms per liter
pCi/l: picocuries per liter (a measure of radiation)
(<): non-detectable or below the detection level of the instrumentation of the lab and does not have to be reported

Coliform bacteria are organisms that are present in the environment and in the feces of all warm-blooded mammals including humans. Coliform bacteria will not likely cause illness. However, the presence of coliform bacteria in drinking water indicates that disease-causing organisms (pathogens) may be present in the water system. Most pathogens that can contaminate water supplies come from the feces of humans or animals. Testing drinking water for all possible pathogens is complex, time-consuming, and expensive. It is relatively easy and inexpensive to test for coliform bacteria. If coliform bacteria are found in a water sample, steps are taken to find the source of contamination and eliminate it.

Nitrate reflects the influence of some types of fertilizer (chemical or organic), chemical processing or human/animal waste. It migrates very quickly through the aquifer and is expensive to remove from drinking water.

Health effects from nitrate affect infants or young children. Nitrate is converted to nitrite in the body and can cause methemoglobinemia or “blue-baby syndrome”. The oxygen in the blood is replaced by nitrite and this result in serious, immediate complications. EPA currently limits the amount of nitrate that can be in the system to 10 milligrams per liter (mg/L). While each of the wells measured some level of nitrate, it is well below the IDEQ action level of 10 ppm.

Lead, a metal found in natural deposits, is commonly found in household plumbing materials and water service lines. The greatest exposure to lead is swallowing or breathing in lead paint chips and dust. Lead in drinking water can cause a variety of adverse health effects. In babies and children, exposure to lead in drinking water above the action level can result in delays in physical and mental development, along with slight deficits in attention span and learning abilities. In adults, it can cause increases in blood pressure. Adults who drink lead contaminated water over many years could develop kidney problems or high blood pressure.

Lead is rarely found in source water, but enters tap water through corrosion of plumbing materials. Homes built before 1986 are more likely to have lead pipes, fixtures, and solder. In 2011, The Reduction of Lead Drinking Water Act was enacted and made it illegal, as of January 4, 2014, to use plumbing materials that do not meet the new definition of lead free which was changed to <0.25%.[4] The most common problem is with brass or chrome-plated brass faucets and fixtures which can leach lead into the water, especially hot water.

Copper and its compounds are common in the environment. Exposure to copper occurs by breathing air, eating food, or drinking water containing copper. Exposure can also occur by skin contact with soil, water, or other copper-containing substances. Copper forms different compounds when it joins with one or more other chemicals. These may be naturally-occurring or man-made. Most copper compounds found in air, soil, and water are strongly attached to dust or embedded in minerals, and cannot easily enter the body. These forms are not likely to affect your health. Other forms become dissolved in water and are not attached to other particles. In this form, copper is more likely to affect your health.

Levels of copper found naturally in ground water and surface water are generally very low; about 4 micrograms of copper in one liter of water (4 µg/L) or less. However, drinking water may contain higher levels of a dissolved form of copper.

High levels of copper occur if corrosive water comes in contact with copper plumbing and copper-containing fixtures in the water distribution system. If corrosive water remains motionless in the plumbing system for six hours or more, copper levels may exceed 1,000 µg/l. The level of copper in drinking water increases with the corrosivity of the water and the length of time it remains in contact with the plumbing.

Radium (Ra) is a naturally occurring radioactive element that is present in varying amounts in rocks and soil within the earth's crust. Small quantities of radium derived from these sources can also be found in groundwater supplies. Radium can be present in several forms (isotopes). The most common isotopes in groundwater are Ra-226 and Ra-228. The primary form of radiation emitted by radium is the alpha particle. Surface water is usually low in radium but groundwater can contain significant amounts of radium due to local geology. Deep bedrock aquifers used for drinking water sometimes contain levels of Ra-226 and Ra-228 that exceed regulatory standards.

[4] American Water Works Association. (2017). Definition of Lead-free Plumbing. Retrieved April 14, 2017 from https://www.awwa.org/legislation-regulation/regulations/contaminants/lead-copper.aspx#3691305-definition-of-lead-free-plumbing

Alpha radiation is a type of energy released when certain radioactive elements decay or break down. For example, uranium and thorium are two radioactive elements found naturally in the earth's crust. Over billions of years, these two elements slowly change form and produce "decay products" such as radium and radon. During this change process, energy is released. One form of this energy is alpha radiation. Alpha radiation normally exists everywhere: in the soil, in the air, and also in water. Because the earth's bedrock contains varying amounts of radioactive elements, the amount of alpha radiation in water also varies. As the radioactive elements decay, alpha radiation continues to be released into groundwater. Groundwater is a common source of drinking water. The alpha radiation in drinking water can be in the form of dissolved minerals, or in the case of radon, as a gas.

Fluoride is an anion mineral added to some drinking water systems to minimize occurrence of dental cavities. However, concentrations greater than about 10 ppm fluoride can cause the opposite effect known as fluorosis. Fluorosis causes staining of teeth and at higher concentrations can cause bone softening. Some fluoride was measured in each of the wells, but below the IDEQ action level.

Arsenic occurs naturally in rocks and soil, water, air, and plants and animals. It can be further released into the environment through natural activities such as volcanic action, erosion of rocks and forest fires, or through human actions. Approximately 90 percent of industrial arsenic in the U.S. is currently used as a wood preservative, but arsenic is also used in paints, dyes, metals, drugs, soaps, and semi-conductors.

High arsenic levels can also come from certain fertilizers and animal feeding operations. Industry practices such as copper smelting, mining, and coal burning also contribute to arsenic in our environment.

Higher levels of arsenic tend to be found more in ground water sources than in surface water sources (i.e., lakes and rivers) of drinking water. The demand on ground water from municipal systems and private drinking water wells may cause water levels to drop and release arsenic from rock formations. Compared to the rest of the United States, western states have more systems with arsenic levels greater than USEPA's standard of 10 ppb Source Water Assessment

In December of 2001, IDEQ completed its Source Water Assessment for the City of Ammon.[5] This report summarizes the nature of the ground water source, lists known and potential contaminants, and then ranks the susceptibility of each source (well) to contamination. The report is included in Appendix B: Existing Facilities Reference Information. A general summary of this assessment is provided below in Table 1.8.

[5] Idaho Department of Environmental Quality. (2017) Idaho Source Water Assessment. Retrieved April 13, 2017 from http://www2.deq.idaho.gov/water/swaOnline/Search

Table 1.8: Well Susceptibility Rankings from IDEQ Source Water Assessment

Well	Hydrologic Sensitivity	Final Susceptibility Ranking			
		IOC	VOC	SOC	Microbial
Well # 2	H	H	H	H	H
Well # 3	H	H	H	H	H
Well # 5	H	H	H	H	H
Well # 6	H	H	H	H	Auto High
Well # 7	M	H	H	H	H
Well # 8	H	H	H	H	H
Well # 9	M	M	Auto High	M	M
Well # 10	H	H	H	H	H
Well # 11	M	Auto High	M	Auto High	M
H = High Susceptibility, M = Moderate Susceptibility, L = Low Susceptibility					

1. IOC = Inorganic Chemical (i.e. nitrates, arsenic)
2. VOC = Volatile Organic Chemical (i.e. petroleum products)
3. SOC = Synthetic Organic Chemical (i.e. pesticides)
4. Auto High = Several situations cause automatic assignment of a high susceptibility score (1) detection of a contaminant at a concentration greater than the drinking water maximum contaminant level (MCL) set by EPA, or (2) any detection of a VOC or SOC, or (3) a confirmed microbial detection at the drinking water source, or (4) the presence of potential contaminant sources within 50 feet of a well. Despite the land use of the area, any of these four conditions will trigger an auto-high score because a pathway for contamination already exists. Note that MCLs, detections, and potential contaminants can change over time and are not automatically updated in the score.

Susceptibility rankings take many factors into consideration and should not be considered a complete assessment of the risk of contamination at a particular well. Rather they "provide data to local communities to develop a protection strategy for their drinking water supply system." The assessment identifies natural and man-made conditions and land uses that could potentially contaminate City groundwater sources. Hydrologic factors, such as soil/rock layers and depth to water table, and agricultural land usage factored heavily into the rankings in Table 1.8.

Overall water quality in the City of Ammon is excellent. The City of Ammon monitors its water quality according to guidelines set by the U.S. Environmental Protection Agency and the State of Idaho. Some contaminants are tested for multiple times per month, while others that are not prone to rapid change are tested for only annually or even less frequently. These test results are reported to IDEQ and are also distributed to Ammon’s residents each year through Consumer Confidence Reports (see Appendix B for Consumer Confidence Reports for the City of Ammon for 2011-2015). Although violations were reported in 2011, 2012, and 2013 for combined Rads (Radium 226/228) and gross alpha Radon and Uranium, these violations were due to failure to collect samples for a single quarter and not due to an actual detected violation. In all three of these cases, the levels of these contaminants for the three quarters that were recorded in that year were in compliance. Data for 2016 has not been compiled yet.

The City has the capability to chlorinate at Pump Station 6 (currently inactive), Pump Station 8, and the Hill Pump Station, where the water storage tanks are located, but does not employ chlorination at this time. It is not anticipated that the City of Ammon will need to deviate from this practice except to respond to an unexpected contamination event.

1.7 WATER RIGHTS

A water right is authorization to use water in a prescribed manner, not to own the water itself. Water rights provide the statutory mechanism allowing diversion of water from either surface or groundwater for a beneficial use. Allocation, inventory, and maintenance of water rights assure an unencumbered supply of water.

Components of a water right include a Priority Date (date when the right was established, older rights have a higher priority), Source (groundwater or surface water), Beneficial Use (Municipal, Irrigation, or other), Period of Use (some rights may only allow diversion during a certain time of the year; for example, during the irrigation season for an irrigation right), Diversion Rate, Point of Diversion, Volume limitation (not all rights have this), Point of Diversion (place or places where the diversion takes place), Place of Use, and conditions of approval.

Water rights are classified by where the Point of Diversion (POD) is drawing the water and are usually divided into two categories. If the POD is taking water from a river, canal, or lake, it is classified as a surface water right. A POD can also be a well, which would require a groundwater right. Water right management is important since municipalities are required to manage their water delivery system in such a manner that the pumping does not exceed the water rights. There are advantages and disadvantages for municipalities to have groundwater rights and surface water rights collectively.

Surface water is heavily influenced by precipitation, snow melt, and springs, thus making surface water susceptible to periods of drought. Untreated surface water can typically be used for irrigation if a separate irrigation system exists. A water treatment plant would be required to treat surface water to drinking water standards if it was used as a potable water supply.

Some advantages of groundwater include:

- Often more reliable in dry seasons or droughts due to the large storage of the aquifer.
- It can be less expensive to develop assuming the water does not require treatment.
- The source of the water can be located where it is needed.
- If well managed, groundwater can be a sustainable resource.

Groundwater is an important resource for water supply in Ammon. However, groundwater is coming under increasing pressure as growth is experienced. Evidence is showing that aquifer levels are declining in the Ammon area. This happens as groundwater withdrawals exceed aquifer recharge.

Ammon's water rights are summarized in Table 1.9. A more detailed breakdown is included in Appendix B: System Reference Information.

Table 1.9: Water Right Summary

Water Right #	Priority Date	Diversion Rate		Source	Water Use
		CFS	GPM		
25-4297	1946	0.78	350.09	Groundwater	Municipal
25-4295	1952	0.67	300.72	Groundwater	Municipal
25-14384	1952	0.21	94.25	Groundwater	Municipal
25-14386	1952	0.25	112.21	Groundwater	Municipal
25-14405	1953	0.21	94.25	Groundwater	Municipal
25-4294	1957	1.5	673.25	Groundwater	Municipal
25-14331	1966	0.81	363.55	Groundwater	Municipal
25-14396	1971	0.28	125.67	Groundwater	Municipal
25-14397	1971	0.03	13.46	Groundwater	Municipal
25-14333	1972	0.57	255.83	Groundwater	Municipal
25-7023	1973	2.79	1,252.24	Groundwater	Municipal
25-14380	1973	0.23	103.23	Groundwater	Municipal
25-14381	1973	0.19	85.28	Groundwater	Municipal
25-7168	1979	6.13	2,751.33	Groundwater	Municipal
25-14406*	1980	0.14	62.84	Groundwater	Municipal
25-7498	1989	2.32	1,041.29	Groundwater	Municipal
25-7634	1995	6.69	3,002.67	Groundwater	Municipal
25-13964	2001	6.7	3,007.16	Groundwater	Municipal
Total		**30.36**	**13,627**		

* Water rights 25-14405 and 25-14406 have a combined diversion rate of 0.21 cfs. Water right 25-14406 was removed from the total to reflect this

Obtaining new or additional rights can be a lengthy and difficult process so planning these needs is imperative. One of the purposes of this study is to identify the service area of the City, create a population forecast for a planning horizon, and establish anticipated water demands at the end of the planning horizon. With this information, IDWR can be approached to discuss Reasonably Anticipated Future Needs (RAFN) for water rights.

Figure 1.5 compares the City of Ammon's peak day pumping rate for 2016 with the allowable combined diversion rate of the City's water rights. At the highest demand times of the year, the City is pumping the maximum amount allowed by its water rights. The figure shows how this pumping rate is projected to increase as the City grows emphasizing the need to conserve and obtain additional water rights.

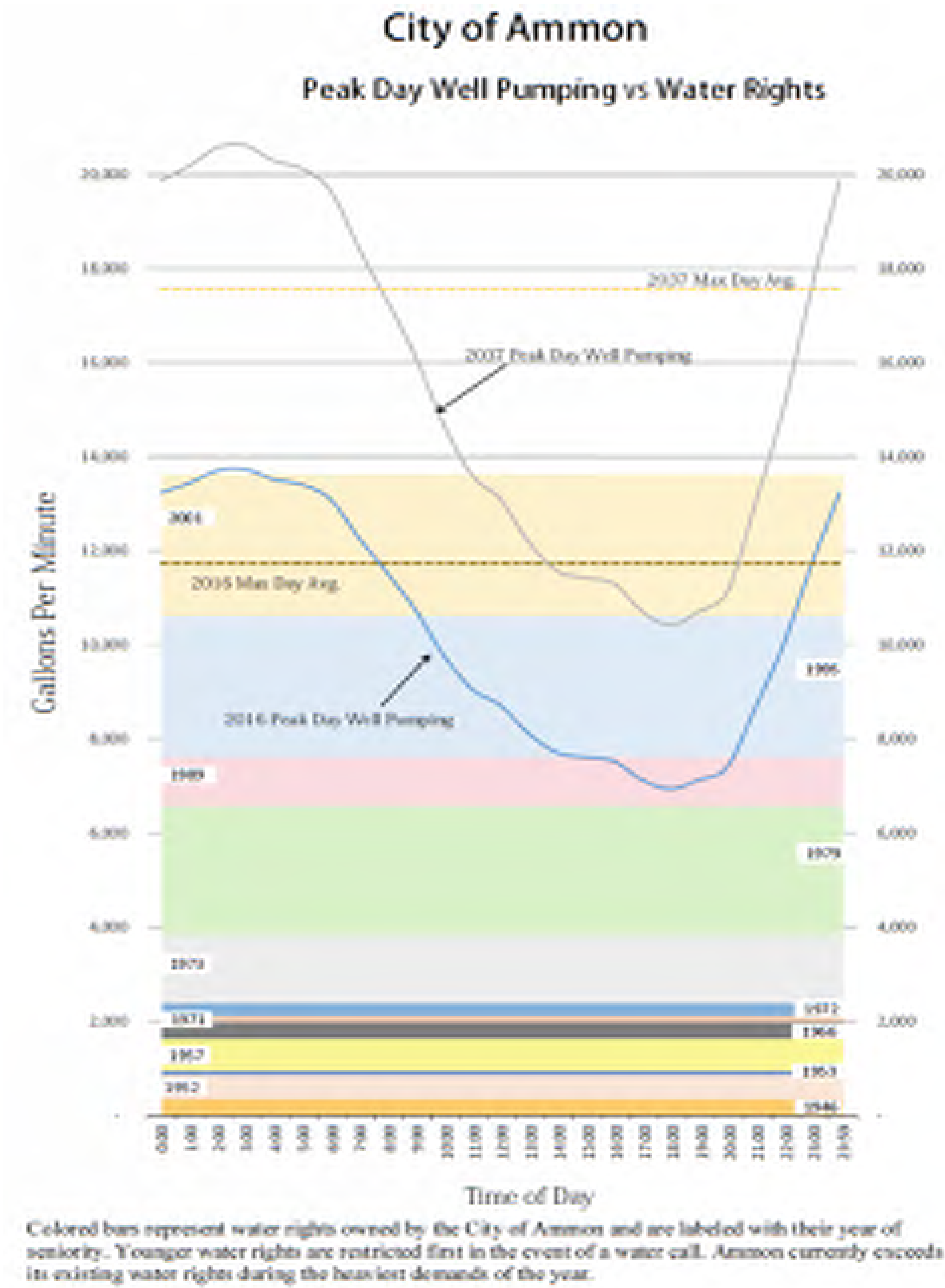

Figure 1.5 Peak Day Well Pumping vs. Water Rights

1.8 USER RATE & BUDGETS

The residential water rate structure as of 2017 includes a flat rate of $45.75 per month for the RP/RPA/RE zones and all other zones are a rate of $38.25 per month

Part of the user rate is to cover depreciation for replacement of existing assets as well as a capital improvement budget. A copy of the latest Operation and Maintenance budget is included in Appendix B.

1.9 OPERATION & MAINTENANCE CONDITIONS

Operation and maintenance (O&M) duties comprise a major part of the City Water Department's daily requirements. O&M can be defined as the prudent and necessary tasks to operate and maintain the water treatment (disinfection) processes, groundwater supply sources, transmission lines, booster pumping, storage, distribution facilities and networks, and provide customer service. Examples of specific O&M activities include: fire hydrant maintenance, service connection and water meter maintenance/replacement, cross connection control, and Pressure Reducing Valve (PRV) station maintenance.

The Water Department is staffed with five licensed operators:

- Travis J Munns License No.: DWD2-18502
- Nathan Riblett License No.: DWD2-18495
- James Key License No.: DWD1-18876
- Brandon Russell License No.: DWD2-21416
- D Ray Ellis License No.: DWD2-18651

The system currently has no treatment classification as it is supplied entirely through wells and does not need to disinfect at present. It is classified as a Class II distribution system, which is based solely on population. Once a population exceeds 15,000 the system is upgraded to a Class III distribution system. Ammon will likely reach this threshold within the next few years and its operators will need to have a Class III license once the system's classification is upgraded.

1.10 CROSS CONNECTION CONTROL

The City of Ammon has a cross connection control ordinance for connections to the water system. 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. 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. A copy of the cross connection control ordinance is included in Appendix B: System Reference Information.

1.11 SANITARY SURVEY

The most recent sanitary survey for Ammon's water system was conducted on January 24, 2014. A copy of the report is included in Appendix B: System Reference Information. The system was found to be in good order. No significant deficiencies were found during the survey. Recommendations are made as an item to consider in order to improve the overall operation of the water system. A deficiency, as defined by IDEQ is an item “as identified during a sanitary survey, the systems design, operation, maintenance, or administration, as well as any failure or malfunction of any system component, that the Department determines are not in compliance with the drinking water rules and do not cause or do not have the potential to cause, risk to health or safety, or that could not affect the reliable delivery of safe drinking water.

2 ENVIRONMENTAL CONSIDERATIONS

2.1 PLANNING AREA

The proposed project planning area of this study is the established Impact Area of the City of Ammon illustrated in Figure 2.1.

2.2 ENVIRONMENTAL CONDITIONS

2.2.1 Physiography & Topography

The planning area is located in the Upper Snake River Valley. The physiography, or physical features on the earth's surface, is characterized as the Eastern Snake River Plain. Of the Eastern Snake River Plain, about one-half of the total area is forest and grazing land, about one-third is irrigated land, and the remaining area is barren. The predominant vegetation is fir, pine, and aspen forests in the mountains and sagebrush and bunchgrass in the hills, on the plain and in the valleys. Also, various canals and ditches bisect the area.

Blackfoot Mountain range begins ten miles to the south of the planning area and the Caribou Mountain Range lies 20 miles to the east. Part of the City is located on a bench and the remainder lies on the plain. There is approximately 420 ft of elevation difference within the existing planning area. See the topographic map in Figure 2.2.

2.2.2 Soils & Geology

The dominant soils in the area are the Ammon Silt Loams, Paul Silty Clay Loams, Paesl Silty Clay Loam, and the Potell Silt Loam. All of these soil types, including the minor soil groups have a parent material of mixed alluvium or loess. All of these major soil types are classified as well drained. Paesl Silty Clay Loam, Ammon Silt Loam and Paul Silty Clay Loams are considered prime farmland if irrigated.[1] Appendix C: Environmental Reference Information contains the NRCS soil survey which includes descriptions of all of the soil types found in the area of interest and their corresponding properties and limitations.

Southeastern Idaho is seismically active. Most remembered is the 7.2, Mount Borah earthquake in October of 1983, which resulted in serious damage and loss of life. Figure 2.3 shows the Class A Quaternary Faults, divided by age of last known movement and their corresponding color:

- *Historic* are the most recent, known movement less than about 150 years. (Red)
- *Holocene-Latest Pleistocene* is younger than 15,000 years. (Yellow)
- *Late Quaternary* is younger than 130,000 years. (Green)
- *Mid to Late Quaternary* is younger than 750,000 years. (Blue)
- *Quaternary* are younger than 1,600,000 years. (Black)
- *Class B* is defined as having geologic evidence demonstrates the existence of Quaternary deformation, but either (1) the fault might not extend deeply enough to be a potential source of significant earthquakes, or (2) the currently available geologic evidence is too strong to confidently assign the feature to Class C but not strong enough to assign it to Class A.

[1] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Retrieved March 23, 2017 from http://websoilsurvey.sc.egov.usda.gov/.

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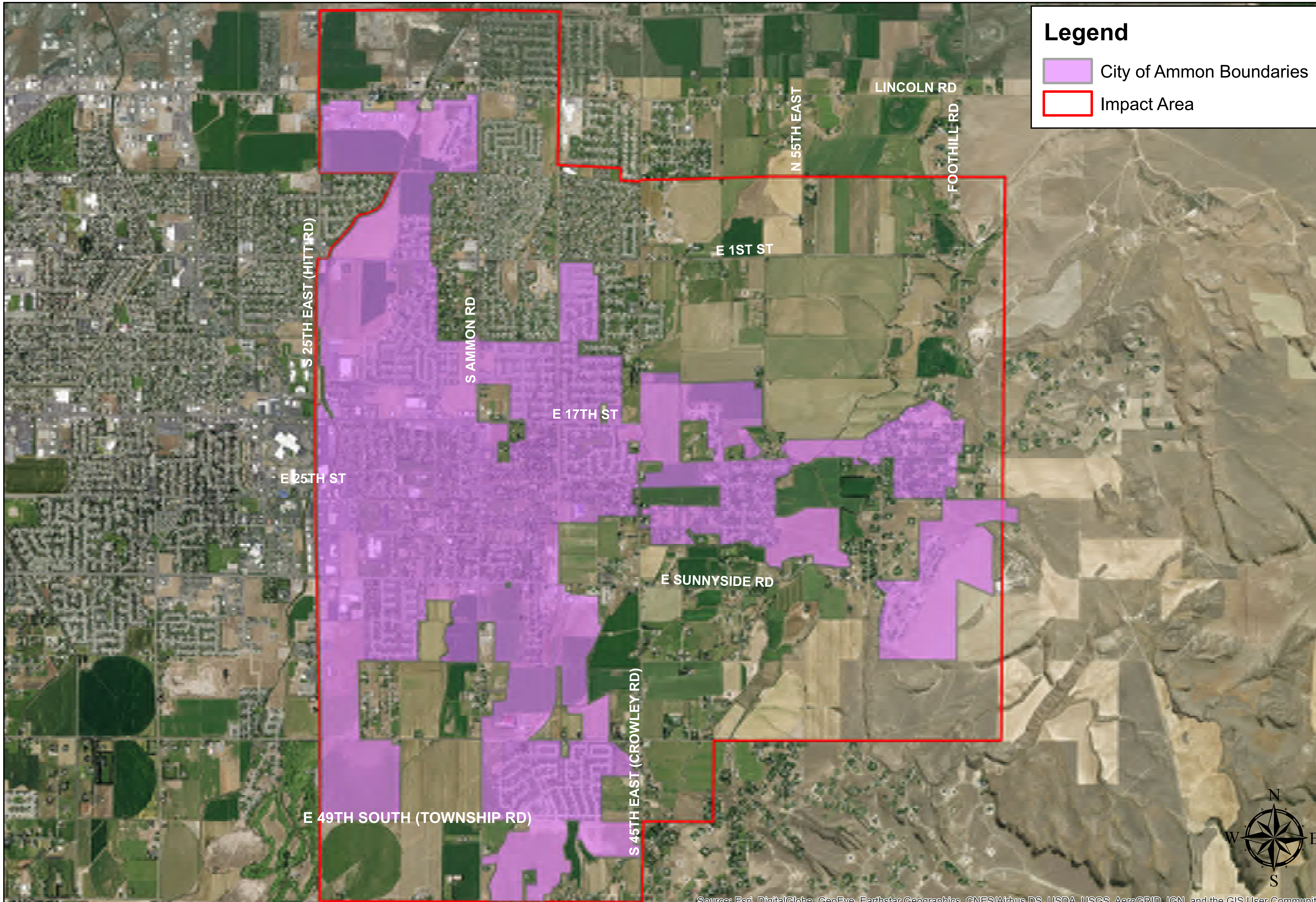

Prepared for: City of Ammon

KELLER ASSOCIATES

Project: Water Facilities Planning Study

Keller Project: #216102-000

Title: Proposed Project Planning Area

Figure: 2.1

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Print Date: 3/14/2018

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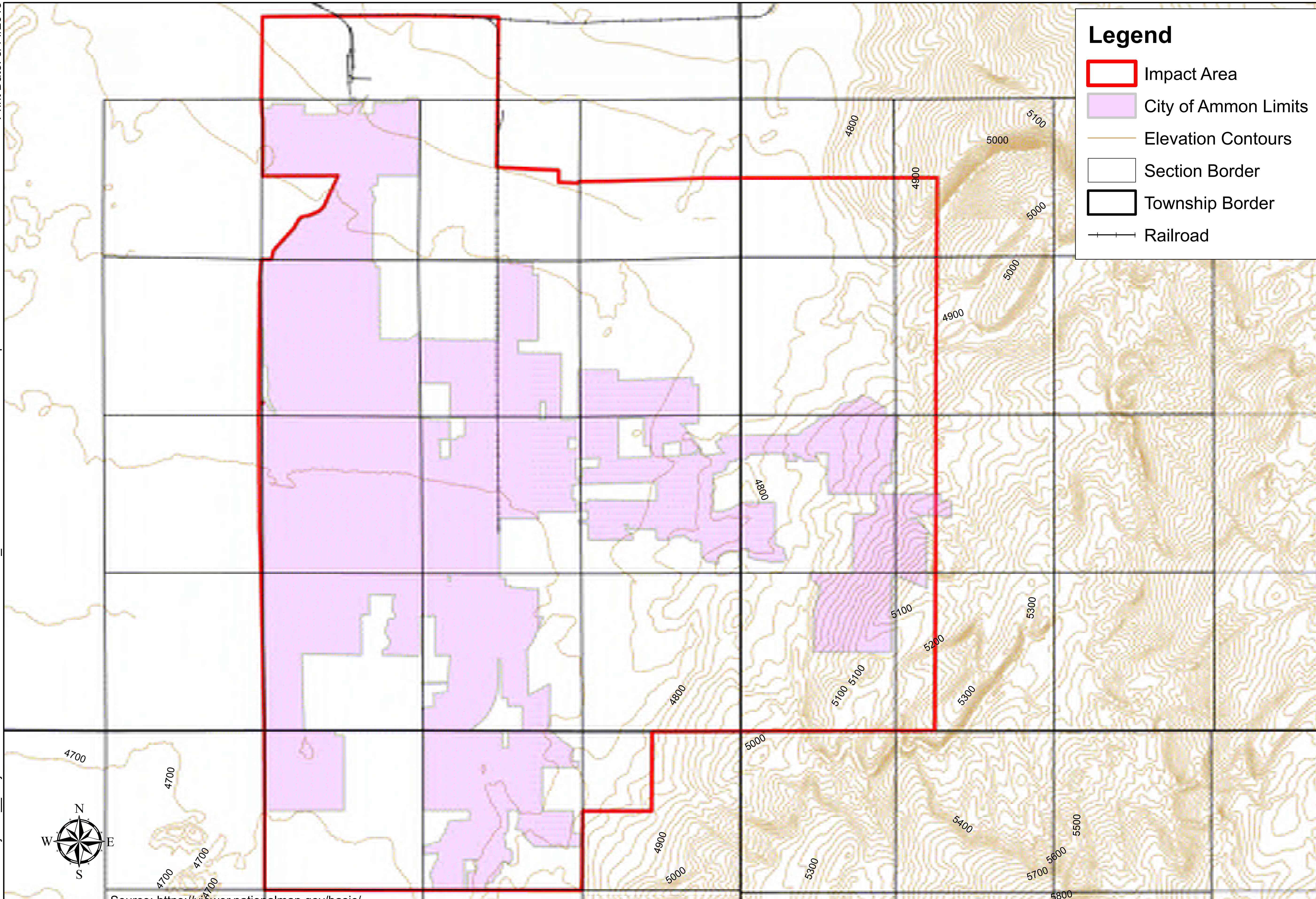


Prepared for: City of Ammon

KELLER ASSOCIATES

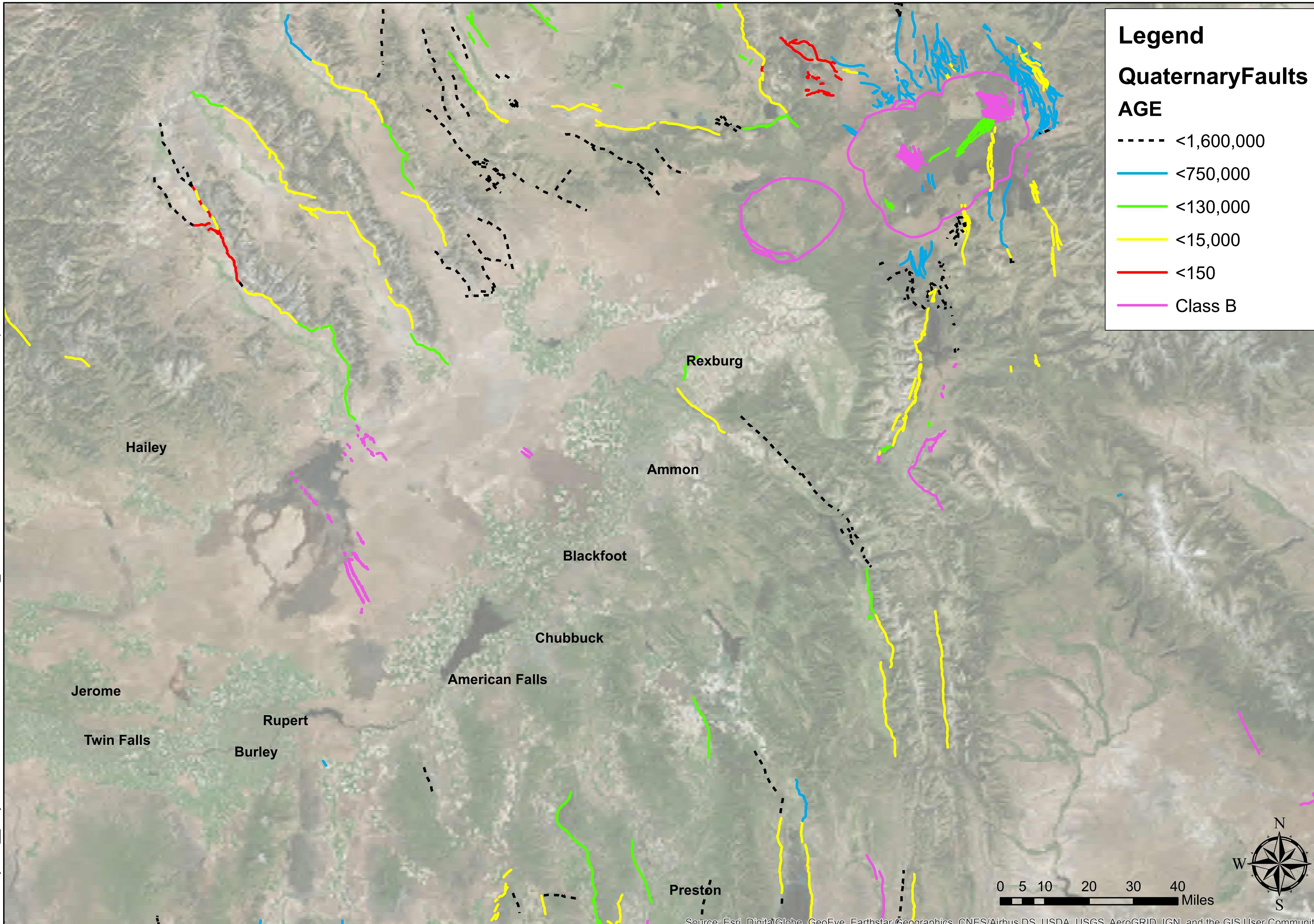
Project: Water Facilities Planning Study

Keller Project: #216102-000

Title: Topographic Map

Figure: 2.2

Print Date: 3/14/2018



Source: https://earthquake.usgs.gov/hazards/qfaults/

Path: Y:\Projects__Projects 2016\216102-000 Ammon WFPS\b_PLAN\zGIS\WFPS 2017\Ammon Fault Map.mxd

Prepared for: City of Ammon

KELLER ASSOCIATES

Project: Water Facilities Planning Study

Keller Project: #216102-000

Title: Fault Map

Figure: 2.3

According to the United States Geological Survey (USGS), Quaternary faults are believed to be the sources of earthquakes larger than 6.0 in magnitude. The Quaternary faults shown in Figure 2.3 have the most potential for future large earthquakes and provide a fairly accurate picture of earthquake hazards in the area[2].

The Rexburg Fault which runs directly through Rexburg is a late quaternary fault. The Heise Fault runs along the South Fork of the Snake River to the South and is a Holocene-Latest Pleistocene fault. The Swan Valley section of the Grand Valley fault runs from Palisades Reservoir towards Heise along the river and is a quaternary fault. Sufficient emergency power and a diversified water supply system are necessary to mitigate potential disaster hardships for municipalities like Ammon.

2.2.3 Surface & Groundwater Hydrology

A sole source aquifer is 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 aquifer is it supplies more than 50% of the drinking water for the service area and if there is no other alternative drinking source is available if the aquifer were to become contaminated.[3] 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.[4]

Ammon pulls from the Eastern Snake River Plain Aquifer. The City has no surface water rights and there are no major rivers within the study impact area. Ammon is located on the eastern edge of the Snake River Aquifer, which is a sole source aquifer, as shown in Figure 2.4. The Snake River aquifer is hosted in fractured basaltic lava beneath the eastern Snake River Plain. The Snake River Aquifer tends to have lower hardness and dissolved mineral contents because of its unique mineralogy and very high groundwater flow rate.

[2] U.S. Geological Survey. (2017, March). Quaternary Fault and Fold Database for the United States. Retrieved April 12,2017 from http://pubs.usgs.gov/fs/2004/3033/

[3] U.S. Environmental Protection Agency. (2016, October 27). Sole Source Aquifer Maps. Retrieved April 12,2017 from https://www.epa.gov/dwssa/overview-drinking-water-sole-source-aquifer-program#What_Is_SSA

[4] Idaho Department of Environmental Quality. (2017). Sole Source Aquifers. Retrieved April 12, 2017 from http://www.deq.idaho.gov/water-quality/ground-water/sole-source-aquifers/

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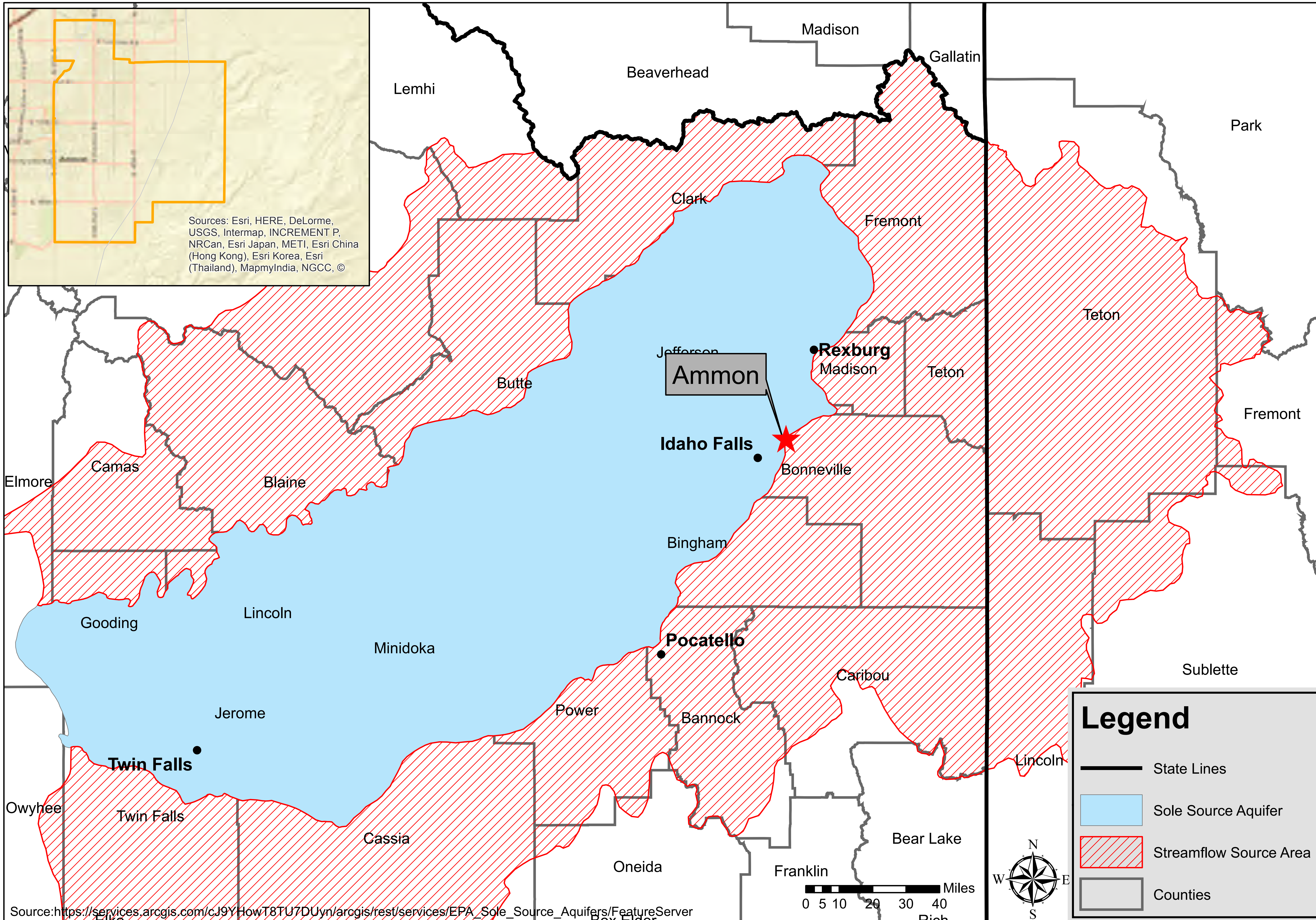

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Prepared for: City of Ammon

Keller Associates

Project: Water Facilities Planning Study

Keller Project: #216102-000

Title: East Snake River Plain Aquifer Map

Figure: 2.4

2.2.4 Fauna, Flora & Natural Communities

The Yellow-billed Cuckoo is the only endangered species that could be potentially harmed by activity in this area.[5] However, there is no critical habitat listed for this area.

2.2.5 Land Use & Development

Figure 2.5 shows an estimate of land uses across Ammon's Area of Impact. The majority of this area is either developed land or cultivated crops, with some areas of grasslands and scrub on the foothills.

Ammon continues to grow in size and population. Housing, industrial, and commercial development have all grown relatively in proportion with one another. Section 2.2.12 further discusses land use and development.

2.2.6 Cultural Resources

There are no buildings listed by the National Register of Historic Places.[6]

2.2.7 Utility Use

Culinary water is provided to the residents of Ammon exclusively by groundwater pumped from wells (either through the City or through Falls Water Company). The City of Ammon planning area is served by Rocky Mountain Power for all of its electrical needs. Minimizing electrical consumption is an important consideration when considering system upgrades or expansion. In cases where it is necessary to utilize electrical power for purposes such as pumping, it is important to consider efficient components and operational procedures. The City's operational strategy is intended to minimize unnecessary start and stop of pumps to avoid excess power use.

Much of the system's water connections are metered and the City plans to eventually meter all usage. The water meters are typically read year round on a monthly basis. See Chapter 4 for more information on the state of the City's metering efforts.

[5] U.S. Fish & Wildlife Service. Information for Planning and Consultation. Endangered Species. Retrieved March 23, 2017 from https://ecos.fws.gov/ipac/location/B567NFROCVGJXLUUYMCDN34G74/resources#endangered-species

[6] National Park Service. (2015, September). National Register of Historic Places. Retrieved April 12, 2017, from http://www.nps.gov/nr/research/

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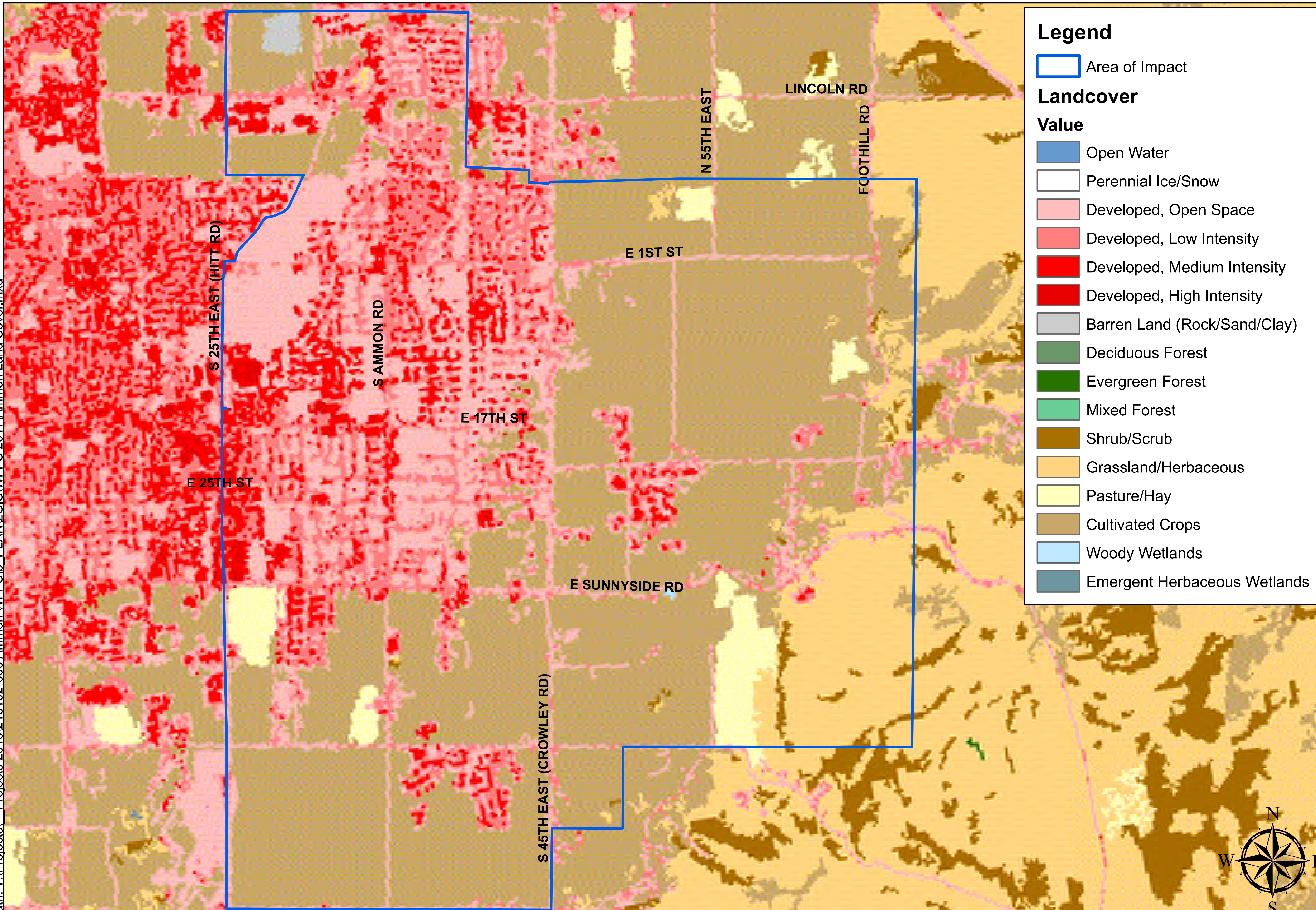

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Prepared for: City of Ammon

KELLER ASSOCIATES

Project: Water Facilities Planning Study

Keller Project: #216102-000

Title: Landcover Map

Figure: 2.5

source: https://www.mrlc.gov/nlcd11_data.php (Multi-Resolution Land Characteristics Consortium)

2.2.8 Floodplains & Wetlands

There are several sources of potential flooding in and around the planning area. Figure 2.6 shows the floodplains mapped for this area[7].

[7] Department of Homeland Security. (2002, April 2). FEMA Flood Map Service. Retrieved from April 12, 2017 from http://msc.fema.gov/portal/search?AddressQuery=Ammon%2C%20Idaho#searchresultsanchor

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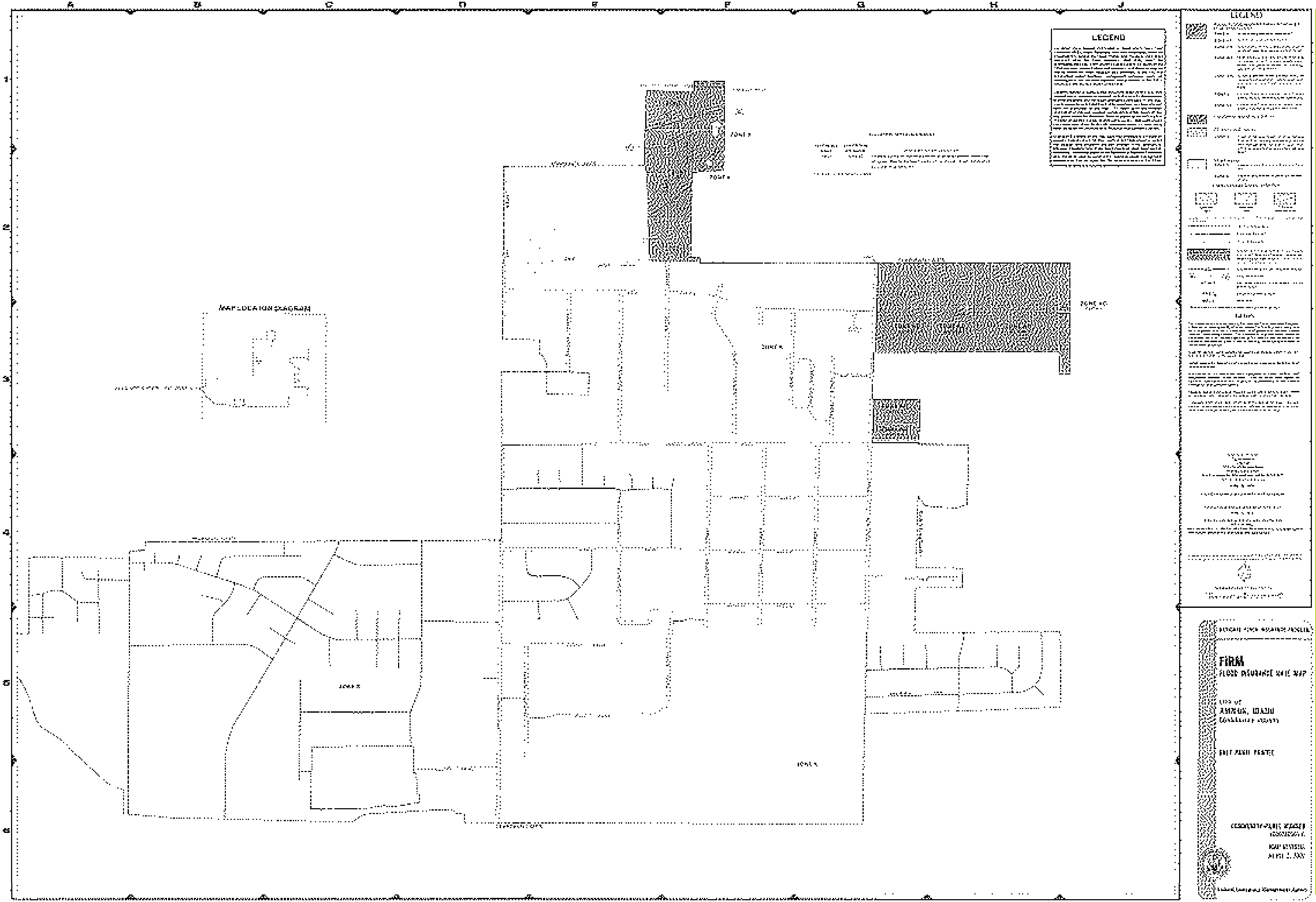

KELLER ASSOCIATES

Ammon Water Facilities Planning Study

Figure 2.6a: FEMA Flood Map - Ammon

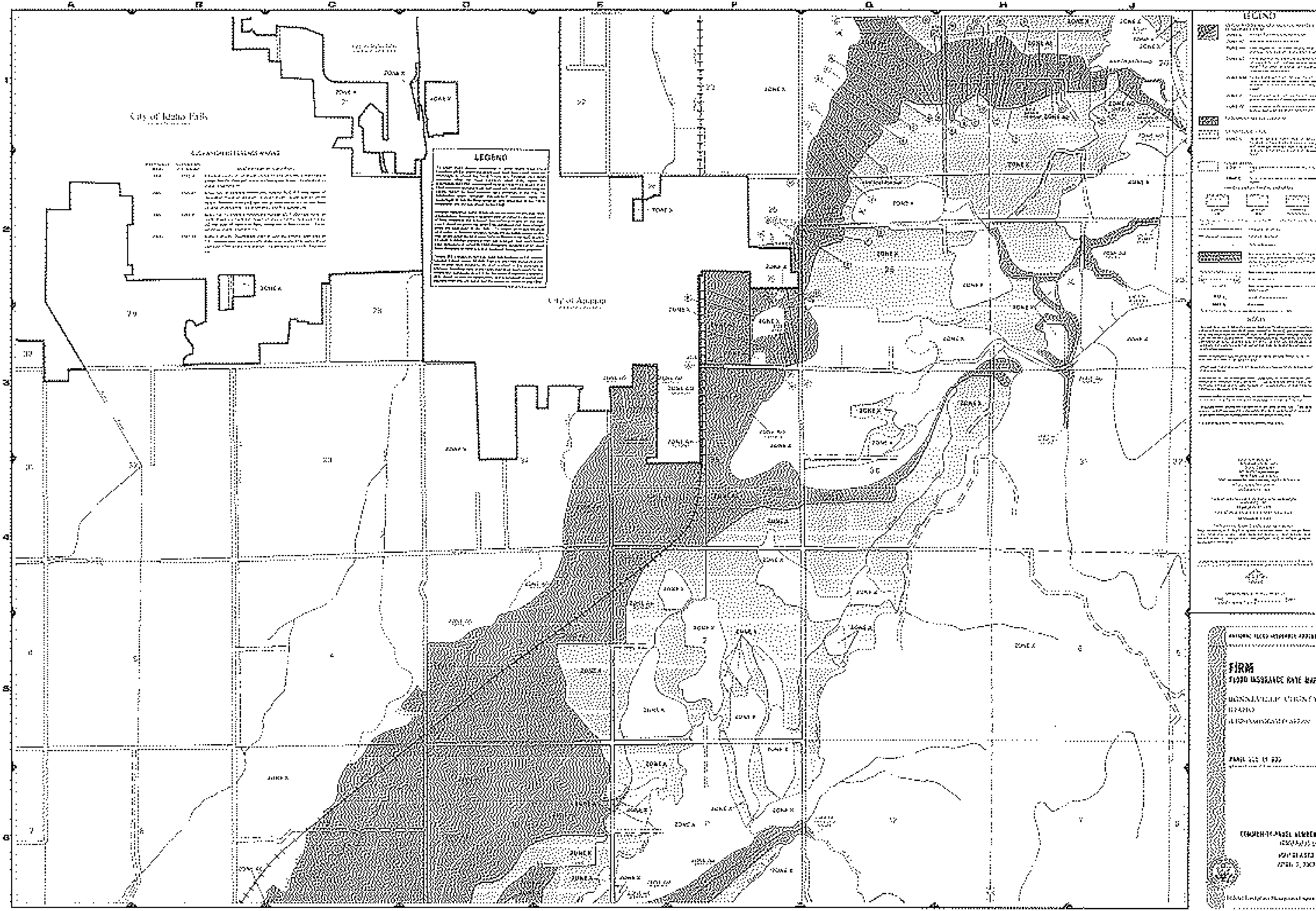

Figure 2.6b: FEMA Flood Map - Bonneville Co.

The City does have potential flooding problems in the southeast area of the city limits and including the impact area southeast of the existing incorporated limits. Flooding of the valley from sheet flow run off from the foothills is a consideration and should be addressed with each new development proposed both in the foothills and the valley. Normally there is an advance warning of this type of flooding. The primary source of such flooding is the runoff from the foothills east of town. During periods of winter thaw when the ground is still frozen and the snow is melting, the runoff is considerably higher than normal. When heavy rains accompany such a period, the result is flooding in the lower valley. By the time the water reaches the Ammon area most of the problems are from inundation rather than the force of moving water. With the flood depth approaching three feet in some areas, it is a factor that definitely needs to be considered.

There are several canals running north to south through Ammon. Much of the floodplains between the Central Canal and Taylor Extension are identified as Zone AE, meaning a detailed analysis has been conducted and elevations assigned to the floodplain. The floodplains located between the Taylor Extension and Highline canal in the south are predominantly Zone AO, meaning there are anticipated flood depths of 1 to 3 feet, usually in a sheet flow or on sloping terrain. There are also a few in this area defined as Zone AH meaning the flood depths could reach between 1-3 ft and are usually areas of ponding. A majority of the in the southeast corner of the Ammon city limits and extend into the land immediately south which will likely limit city expansion to the area just south of the far eastern section of Ammon.

Mudslides or slipping of land, soil creepage and soil movements in the foothills is a possibility as development occurs and again should be addressed with each new proposed development in the foothills. The threat of flooding from dam failure no matter how unlikely is also a consideration. According to the Bonneville County Emergency Management Office, the failure of the Ririe Dam would flood the City of Ammon. It is estimated that flood waters would take approximately four hours to reach the City of Ammon. The best evacuation route for residents of the city would be to the foothills east of the city. The failure of the Palisades dam which would reach large portion of the City of Idaho Falls would not be expected to reach the City of Ammon.[8]

For regulatory purposes under the Clean Water Act, the term wetlands means "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."[9]There are no Wetlands that will be affected by the proposed project.

For any projects that involve disturbances to jurisdictional wetlands, formal consultation with the U.S. Army Corps of Engineers and the Idaho Department of Water Resources will be required to obtain nationwide 404 permits for stream crossings or wetland alteration.

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[8] Comprehensive Plan (City of Ammon). (2012). Hazardous Areas, Hazards Identified. Retrieved April 12, 2017 from http://www.cityofammon.us/pdf/departments/planning/04052012AmmonCompPlan.pdf

[9] U.S. Environmental Protection Agency. (2016, September 26). Section 404 of the Clean Water Act: How Wetlands are Defined and Identified. Retrieved April 13, 2017 from http://water.epa.gov/lawsregs/guidance/wetlands/definitions.cfm

2.2.9 Wild & Scenic Rivers

The Wild and Scenic Rivers Act protects designated free-flowing rivers that have "outstanding remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural and other similar values." The act states that these rivers "shall be preserved in free- flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations".[10] There are no designated or proposed wild and scenic rivers in Ammon or within the vicinity of the planning area[11].

2.2.10 Public Health and Water Quality

Public health is of the utmost concern when operating a water utility. Regular sampling as required by IDEQ and USEPA is conducted to ensure that the water quality is safe for consumption. IDEQ conducted a Source Water Assessment in 2001, included in Appendix B: System Reference Information, which evaluated the source of water from the Snake River Aquifer, quality of the water, well construction and potential sources of contamination, and discusses options for source water protection. Water quality was found to generally be good. However, in a susceptibility analysis most of the wells rank high for IOCs, VOCs, SOCs, and microbial contaminants, stressing the need to be diligent about protection of source water.[12]

2.2.11 Important Farmlands

"Prime farmland, as defined by the U.S. Department of Agriculture, is 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 does not urban, built-up, or water areas.

"Prime farmland" is important in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of the Nation's prime farmland"[13]

Land near Ammon is predominantly agricultural. Of the 14,904.6 acres in the planning area, 66% is considered prime farmland.[14] A map showing these farmlands is included in the soil report found in Appendix C: Environmental Reference Information. Surrounding the City, agricultural landscape yields to uncultivated sage-steppe habitat.

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[10] U.S. Fish & Wildlife Service. About the WSR Act. Retrieved April 12, 2017 from National Wild & Scenic Rivers System: http://www.rivers.gov

[11] Wild & Scenic Rivers Council. Idaho. Retrieved April 12, 2017, from National Wild and Scenic Rivers: http://www.rivers.gov/idaho.php

[12] Idaho Department of Environmental Quality. (2017) Idaho Source Water Assessment. Retrieved April 13, 2017 from http://www2.deq.idaho.gov/water/swaOnline/Search

[13] Natural Resource Conservation Service. (2013). Retrieved April13, 2017, from https://www.nrcs.usda.gov/wps/portal/nrcs/detail/pr/soils/?cid=nrcs141p2_037285

[14] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Retrieved March 23, 2017 from http://websoilsurvey.sc.egov.usda.gov/

2.2.12 Land Use & Zoning

The City of Ammon has established various land use categories within the City with certain restrictions or allowances for each. Table 2.1 shows the distribution of zoned acreages in Ammon's Area of Impact. It is assumed that existing agricultural areas will eventually infill with development. A large portion of the area is designated for residential. The City's zoning map is included as Figure 2.7.

Table 2.1: Acreage by Zoning Types

General Category	Description	Area (acres)	% of Total Area	Subtotal (acres)	Subtotal %
Residential	RE	58.75	1%	3,604.01	76%
	RP	756.72	16%		
	RP-A	1,074.40	23%		
	R-1	1,151.05	24%		
	R-1A	284.03	6%		
	R-2	99.53	2%		
	R-2A	35.56	1%		
	R-3	8.98	0%		
	R-3A	86.53	2%		
	RMH	48.45	1%		
Industrial	IM-1	162.27	3%	162.27	3%
Park	PSC	288.31	6%	288.31	6%
Commercial	C-1	131.79	3%	697.61	15%
	CC-1	135.50	3%		
	GC-1	94.36	2%		
	HC-1	335.97	7%		
Total		**4,752.21**	**100%**		

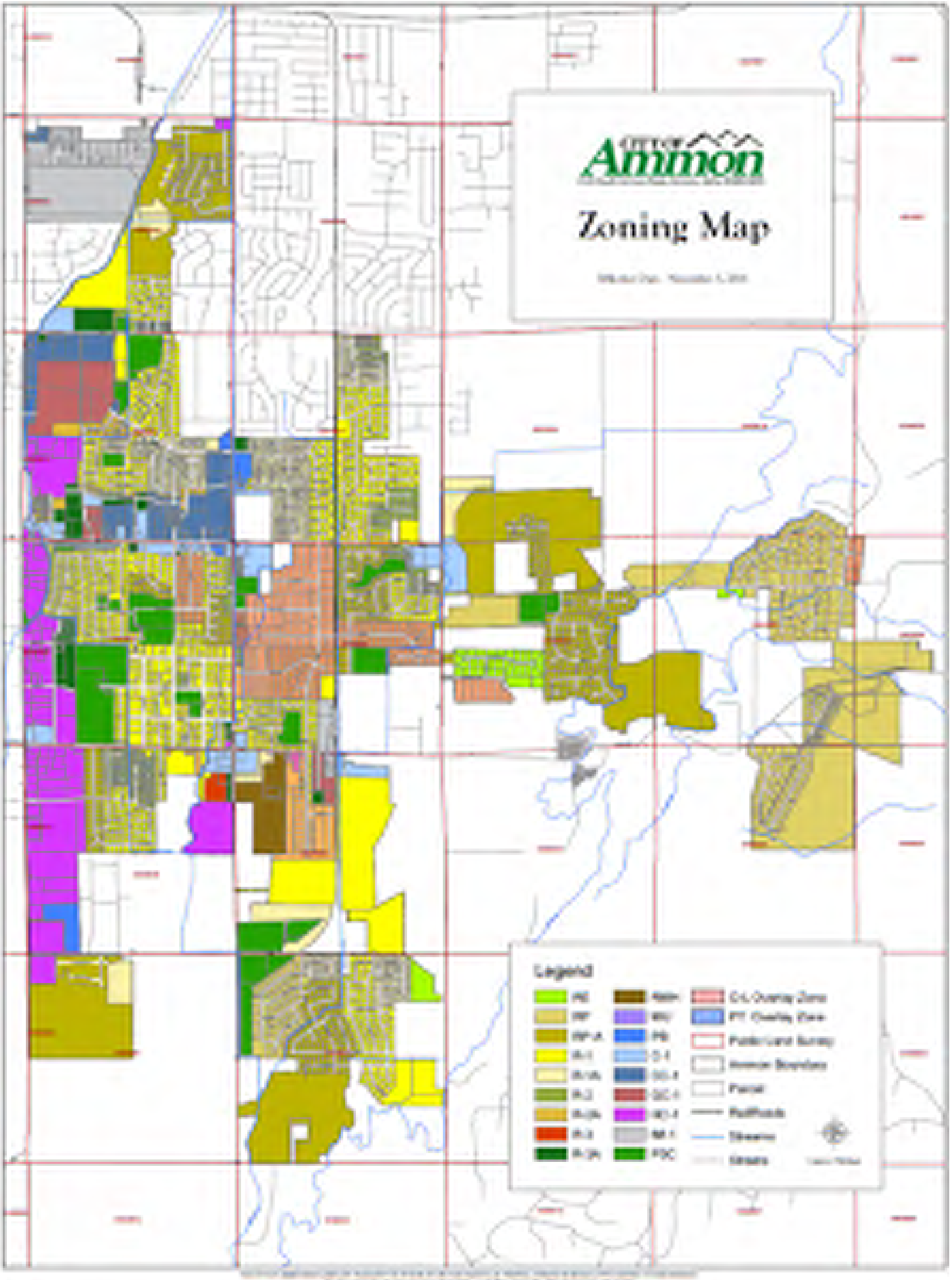

Figure 2.7: Zoning Map

2.2.13 Precipitation, Temperature, & Prevailing Winds

The climate summary (May 1952 through June 2016) for the 2 ESE Idaho Falls weather station shows monthly average minimum temperatures ranging from 13.2°F to 52.6°F and average maximum temperatures ranging from 30.2°F to 87.1°F. Over this period, the total annual precipitation averaged 12.11 inches with an average annual snowfall of 26.8 inches. The coldest month is typically January, the hottest month is typically July, the wettest month is usually May, and the driest month is typically August.[15] A summary of average monthly climate data is given in Table 2.2. The prevailing wind direction is from the southwest during the summer and north during the winter.

Table 2.2: Climate Data

Month	Average Maximum Temp (°F)	Average Minimum Temp (°F)	Average Precipitation (inches)	Average Total Snowfall (inches)
January	30.2	13.2	1.04	7.7
February	36.6	17.5	0.90	4.9
March	47.4	25	1.01	2.8
April	58.3	31.9	1.17	0.9
May	68.3	39.7	1.62	0.3
June	77.7	46.8	1.26	0.0
July	87.1	52.6	0.53	0.0
August	85.7	50.4	0.71	0.0
September	75.4	41.8	0.82	0.0
October	61.6	32.4	1.02	0.5
November	43.9	23.5	1.01	3.1
December	32	14.6	1.04	6.4
Annual	**58.7**	**32.4**	**12.11**	**26.8**

2.2.14 Air Quality & Noise

Idaho is among the states that have delegated authority from EPA to issue air quality permits and enforce air quality regulations. IDEQ's air protection efforts are intended to ensure compliance with federal and state health-based air quality regulations. The Clean Air Act of 1970 identified six common air pollutants of concern, called "criteria pollutants." These criteria pollutants are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide. Fugitive dust is also closely regulated as it contributes to particulate matter.

[15] Western Regional Climate Center. (2016). Idaho Falls 2 ESE, Idaho (104455). Retrieved April 13, 2017 from Western Regional Climate Center: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?idif46

IDEQ monitors air quality and publishes air quality information and the air quality of Idaho Falls measured “good”.[16] No noise issues have been identified for the area. A map of areas with sensitive air quality is shown in Figure 2.8[17].

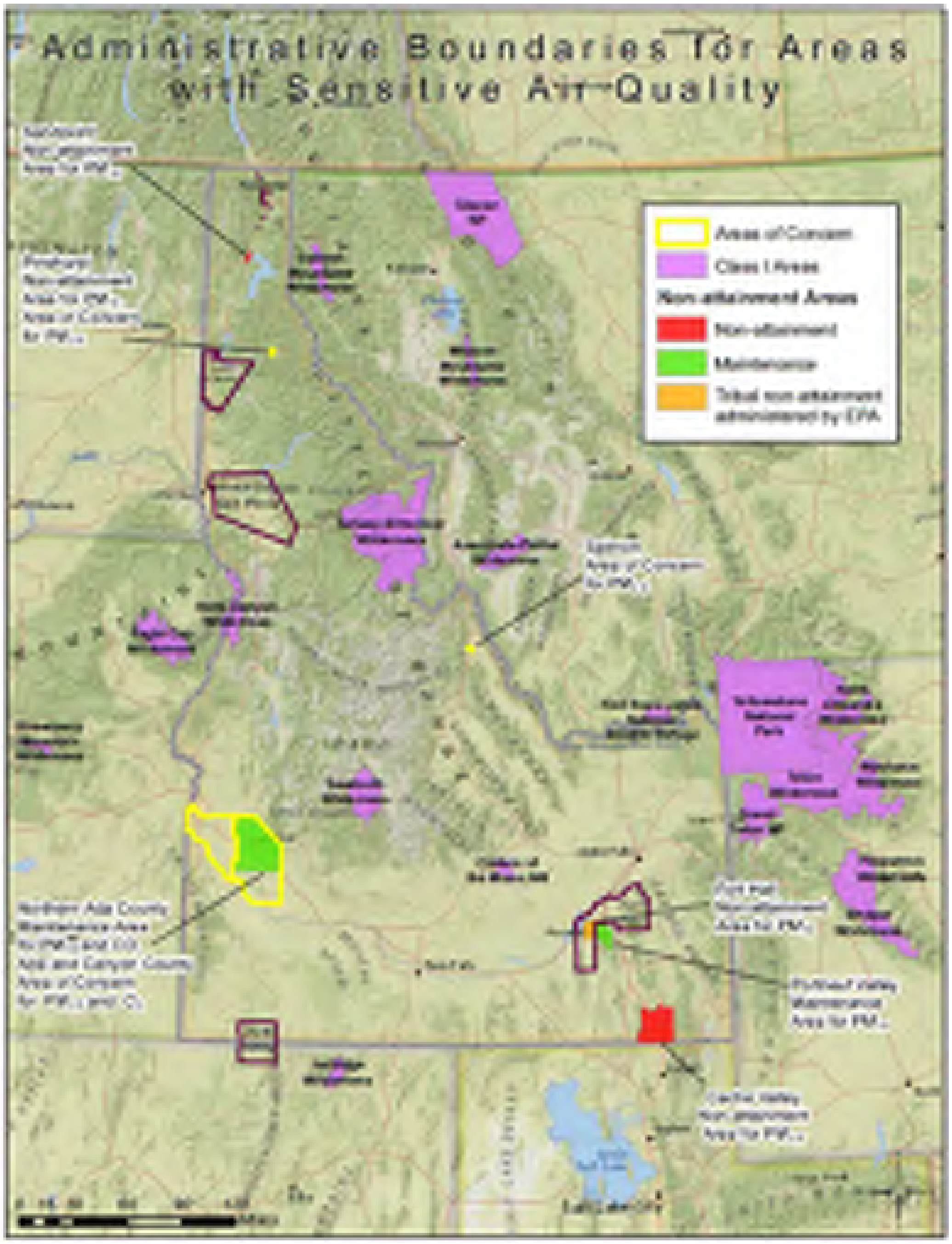

Figure 2.8: Sensitive Air Quality Map

[16] Idaho Department of Environmental Quality. (2017). Daily Air Quality Reports and Forecasts. Retrieved April 13, 2017 from https://www.deq.idaho.gov/air-quality/monitoring/daily-reports-and-forecasts/

[17] Idaho Department of Environmental Quality. Administrative Boundaries for Areas with Sensitive Air Quality. Retrieved April 13, 2017 from https://www.deq.idaho.gov/media/662796-nonattainment_map.pdf

There are no anticipated long-term adverse impacts to the air quality and noise levels from any proposed improvements. Proposed improvements may have a temporary local impact on noise and air quality (dust) during construction. Best Management Practices during construction can mitigate airborne dust during construction.

2.2.15 Energy Production & Consumption

The City of Ammon does not produce any energy. Energy use by the City's drinking water system is comprised primarily of pumping from groundwater wells and from booster pump stations. The well pumps range in size from 25-500 hp and booster pumps range in size from 30-350 hp.

2.2.16 Socioeconomic Profile

The 2010 Census[18] reports the population of Ammon to be 13,816 people. Historical and projected populations are found in Chapter 4 of this study. The median age is 29.6 with 63.7% of the population being 18 years and over.

There are 4,671 housing units in Ammon. The average household size is 3.05 people per house which is larger than the average Idaho household size of 2.66.

The estimated per capita income is $61,725. The population below the poverty level is 8.5%. Approximately 3.1% of the population of Bonneville County over 16 years old was reported as unemployed.[19] Additional socioeconomic and population information is included in Appendix C: Environmental Reference Information.

2.2.17 Transportation

Ammon is adjacent to Idaho Falls, the largest city in Eastern Idaho. Because it is so close, traffic patterns of Ammon are largely affected by the traffic in Idaho Falls. Transportation needs are met through available rail, air, interstate, and US Highway systems.

The city is bisected by the Eastern Idaho Railroad Inc. US HWY 20 and I-15 are accessible through Idaho Falls which offers multiple transportation options for regional, continental, and international markets. Eastern Idaho Railroad Inc. provides freight service to Ammon but not passenger service. E 17th St., Sunnyside, Ammon, and Hitt Roads are main roads.

Ammon is serviced by one local airport. The Idaho Falls Regional Airport has three scheduled carriers on its 9,000 foot long runway. The Idaho Falls Regional Airport is about ten miles from Ammon.

2.2.18 Maps, Site Plans, Schematics, Tables, & Letters from Consulted Agencies

Relevant state and federal agencies will be contacted to provide comment on the environmental effects of the preferred alternatives presented later in the study. A brief summary of any responses received will be given in Chapter 9.

[18] U.S. Census Bureau. (2010). American Fact Finder. Retrieved April 14, 2017 from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF
[19] Idaho Department of Labor. (2017, March). Idaho Economic Situation Report. Retrieved from https://labor.idaho.gov/publications/econsitrep.pdf on April 13, 2017

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3 PLANNING CRITERIA

The planning criteria used by this study include regulatory requirements stipulated in the Idaho Administrative Code, IDAPA 58.01.08, also known as the Idaho Rules for Public Drinking Water Systems[1]. The portion of this code which recommends standards for public water works design (IDAPA 58.01.08.002.02.c) also draws upon standards commonly referred to as the "10 States Standards" published by the Great Lakes – Upper Mississippi River Board of State Provincial Public Health and Environmental Managers. These references, along with input from City staff and the engineers at Keller Associates, have been used to establish the planning criteria by which Ammon's system is evaluated in this report. This chapter outlines the key criteria which were used as the standard in evaluating Ammon's drinking water system.

3.1 WATER RIGHTS

To avoid exceeding its water rights, the City must not let the cumulative pumping rate of its wells, at any given time, exceed the total water rights owned by the City. Some water rights may also have a limit on the total volume that may be pumped over the course of a year. The water supply and corresponding water right need to provide the peak hour demand (PHD) if equalization storage is not provided. If sufficient equalization storage exists to make up the difference between PHD and max day demand (MDD), the system only needs to have sufficient water rights to supply the MDD. The practice of proper water management would also imply that water rights are secured or are being pursued to meet future demands. Water rights and storage implications will be discussed further in the following sections and in Chapter 6.

3.2 WATER SUPPLY

Most communities in Southeast Idaho supply drinking water to their residents by pumping groundwater wells. IDAPA rules state that all community water systems shall have at least two ground water sources if they serve more than 25 connections or equivalent dwelling units (EDUs). The ground water sources must be able to meet either PHD or a minimum of MDD supplemented with equalization storage, and these conditions must be met with any one ground water source out of service (IDAPA 58.01.08.501.17)[1]. The total source capacity with the largest source (pump) out of service is called the system's "firm capacity." New sources should be obtained such that the system's firm capacity meets or exceeds the conditions above.

During a power outage, if the ground water source pumps are the sole means of delivering water to the system (i.e. no storage or booster pumps), the ground water source pumps must be able to supply average day demand (ADD) for a period of 8-hours plus fire flows, utilizing either the well sources with emergency power (such as with a backup generator) or a stand-by storage component (IDAPA 58.01.08.501.07)[1].

3.3 WATER STORAGE

It is recommended that minimum storage capacity be equal to the operational, equalization, dead, fire suppression, and standby storage needs of the system[2]. A description of these storage components follows:

[1] Idaho Department of Environmental Quality. (2016). Idaho Rules for Public Drinking Water Systems. Retrieved June 8, 2017 from https://adminrules.idaho.gov/rules/2016/58/0108.pdf

[2] American Water Works Association. (2012b). Computer Modeling of Water Distribution Systems. In *M32*. American Water Works Association.

Operational storage refers to the difference in the tank level from when the pump(s) filling the tank turn on, to when they turn off. This volume has the potential to change throughout the year depending on system demands and water stagnation, but typically this is around 10% of the total storage volume.

Equalization storage is quantified by the volume of water consumed by the City during high demand times of day that exceed the firm capacity of the system's sources. Equalization storage is a function of the City's diurnal demand pattern. The diurnal curve in Figure 3.1 illustrates how equalization storage makes up the difference between demand and pumping capacity and was developed using information from the City's supervisory control and data acquisition (SCADA) system for daily use from August 3rd-9th, 2016. This is the period of summer 2016 that had the highest 7-day demand average.

Dead storage is storage that is either not available for use in the system (e.g. lies below the tank's outlet elevation) or can provide only substandard flows and pressures.

Fire suppression storage is the volume required for City fire protection to fight a fire at the flows and duration recommended by local fire marshal, the international fire code, or the Idaho Surveying and Rating Bureau (ISRB). The range of flows and locations requiring these flows throughout the City are listed in Table 3.3. The highest requirement reported by the ISRB for Ammon is 3,500 gpm for three hours. This fire flow requirement equates to 630,000 gallons.

Standby storage is an adjustable volume based on the system susceptibility to extenuating circumstances or unanticipated emergencies such as extended power outages or main line ruptures. IDEQ requires that a system be able to deliver average day demand (ADD) for a period of 8 hours during a power outage. Having emergency power for booster pumps and well pumps can mitigate the need for this storage.

Water storage is typically evaluated using a 20-year planning horizon understanding that the storage structure will have a 50-year design life.

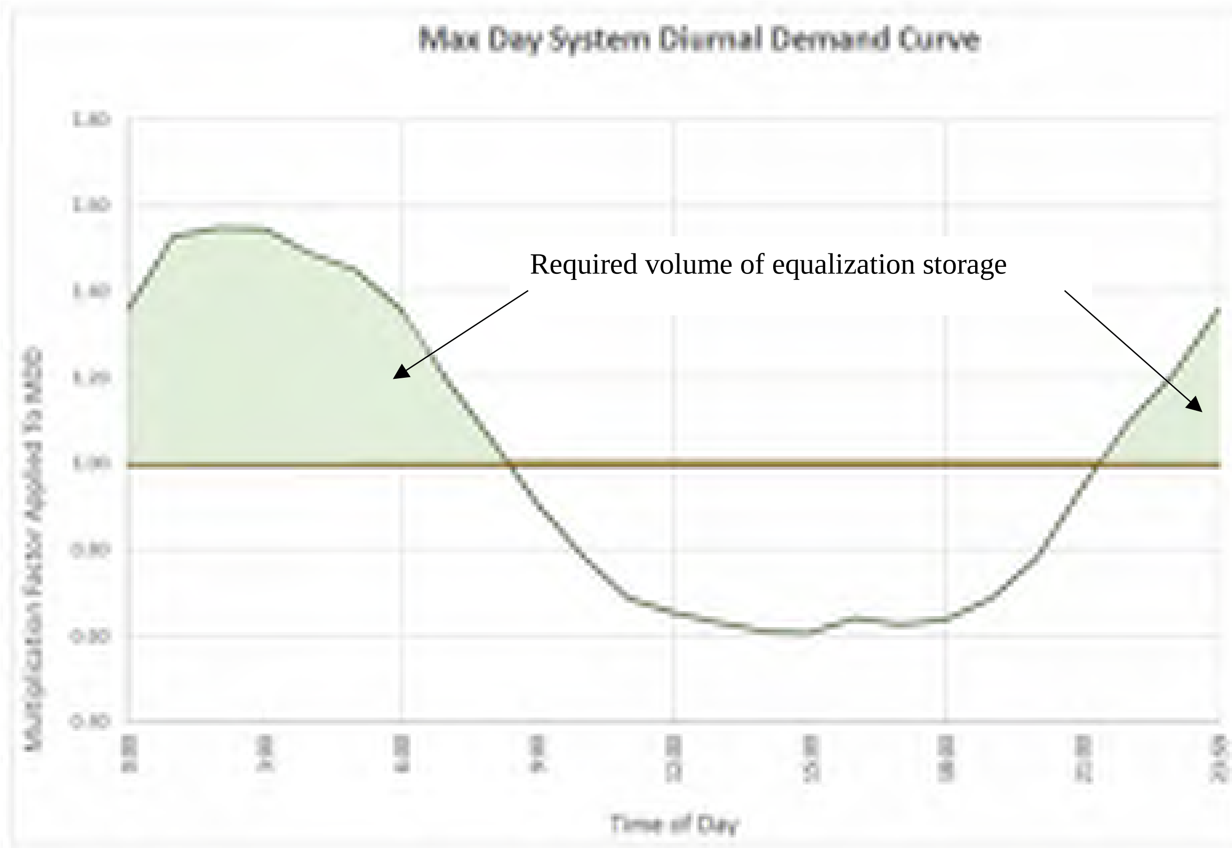

Figure 3.1: Diurnal Curve Used to Calculate Ammon's Peaking Storage Requirements

3.4 WATER DELIVERY

Water delivery is the system's ability to supply water at the flows demanded by the end users and at the pressures required by the Idaho Drinking Water Rules (IDAPA 58.01.08)[3]. For Ammon's system, the ability to deliver water is dependent upon the relationship between the water sources, water storage, pumping stations, and transmission and distribution pipelines.

As specified in IDAPA 58.01.08.552, IDEQ requires a minimum design working pressure of 40 psi (excluding fire flows). During a fire suppression event, the pressure shall not be less than 20 psi anywhere in the distribution system. If the pressures drop below 20 psi, there is an increased risk of contamination of the drinking water. The water system should also be protected against high pressures. State code requires that static pressure in the system be kept below 100 psi, and ordinarily below 80 psi. For pressures above 80 psi, the Uniform Plumbing Code requires that individual pressure regulators be installed at residences[4]. When system pressures exceed 100 psi, special provisions for mainline materials and construction should be considered (IDAPA 58.01.08). Table 3.1 summarizes water system pressure requirements.

[3] Idaho Department of Environmental Quality. (2016). Idaho Rules for Public Drinking Water Systems. Retrieved June 8, 2017 from https://adminrules.idaho.gov/rules/2016/58/0108.pdf
[4] International Association of Plumbing and Mechanical Officials. (2015). 2015 Uniform Plumbing Code. Retrieved December 6, 2017 from http://codes.iapmo.org/home.aspx?code=UPC.

Table 3.1: Water System Pressure Requirement Summary

Demand Event	System Pressure
Fire Flow	Minimum of 20 psi
Peak Hour	Minimum of 40 psi
Average Day	Preferred Maximum of 80 psi
Winter Day	Maximum of 100 psi

A municipal water system needs to have the capacity to deliver water to satisfy pressure requirements during the specified demand events as described above. Booster pump stations and well pumps are sized to deliver water at the desired pressure and flow to a defined area.

If no equalization storage component exists within a system, the pumps in combination must be able to produce the PHD. If a storage component exists (as is the current mode of operation in Ammon) and equalization storage is sized properly, the source pumps must be able to supply at least MDD. IDAPA 58.01.08.541.04 states that these delivery requirements must be met with any pump out of service.

In general, there are two types of storage components that can provide equalization storage to maintain flow and pressure as required in Table 3.1. The two types of storage described below are shown in Figure 3.2. Ammon's system uses both types.

- An elevated storage tank (either a high level ground tank or a structurally elevated tank) develops the required pressures by virtue of the tank elevation. In Ammon's system there is a high level ground tank located in the Founder's Pointe subdivision.
- A ground level tank with booster pumps to supply flow and pressure to the system. With ground level storage, the booster pumps must be able to supply peak hour demands with any pump out of service. Ammon's Well 8 tank and booster station is an example of this type of storage.

The size and "looping" of the distribution and transmission pipelines within a system will affect the ability of the pumping and storage facilities to maintain pressure throughout the system. If a pipeline is not adequately sized, the water velocity in the pipe increases to meet the imposed demand. As pipeline velocities increase, there is a decrease in pressure due to increased friction losses in the pipe. Appropriate "looping" of the distribution system and adequately sized pipes allow water to reach any one location from multiple directions and will result in better pressure. Looping also prevents water from stagnating in dead-ends that can lead to water quality problems.

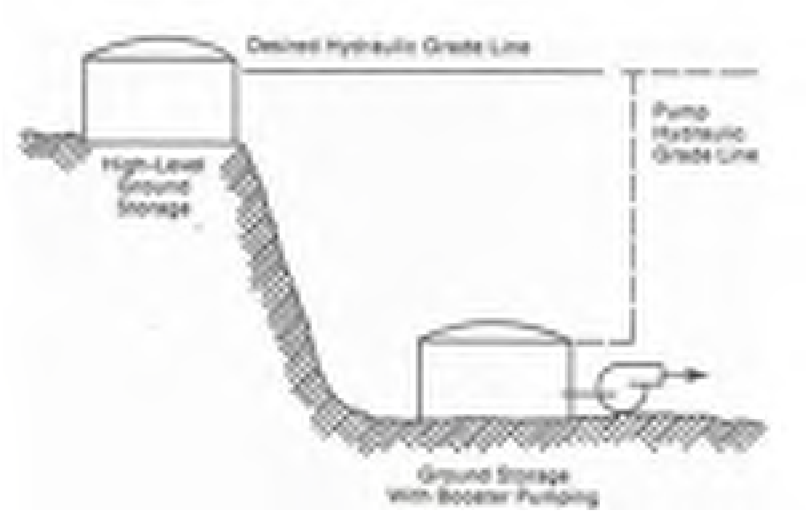

Figure 3.2: Examples of the Storage Tanks Found in Ammon's Distribution System

3.5 WATER TRANSMISSION AND DISTRIBUTION

Transmission lines are those water mains that primarily allow movement of water from one area of the system to another with relatively few end-use connections between. Transmission lines feed distribution lines, which carry water to various end-users. The adequacy of transmission and distribution lines is a combination of two factors: 1) physical condition, and 2) hydraulic capacity.

Physical condition is affected by age, environmental factors (such as corrosive soils), pipe material, water chemistry, and quality of installation. City crews are often well aware of the pipes in their system that have physical problems. Problem areas may require more frequent repairs relative to the rest of the system. This study relied on input from the Ammon Public Works Department to identify pipelines with physical issues.

Hydraulic capacity refers to the system’s ability to move water where it is needed without causing issues with pressure, quality, reliability, or efficiency. Whereas the previously described evaluations of supply, storage, and delivery evaluate system- or zone-wide needs, a hydraulic analysis of the system is likely to identify needs that are area specific. Hydraulic analysis is typically performed using hydraulic computer modeling software. A further description of hydraulic analysis criteria, procedure, and results is presented in Chapter 5.

There are many undeveloped areas surrounding the City of Ammon which will require water pipelines to be extended to serve them as the community grows and expands. These pipelines should be large enough to deliver maximum day demands and fire protection demands while maintaining adequate system pressures and maintaining relatively low velocities in the pipe. The following are additional design criteria that are recommended when extending new waterlines to these areas:

- The distribution system must be capable of delivering fire demands while maintaining 20 psi residual pressure throughout the system.
- Pipeline diameters should not restrict the system from delivering PHD while maintaining 40 psi throughout the system.

- Fire demands for residential areas are typically between 1,000 and 1,500 gpm depending on the size of the home.

- Fire demands for commercial and industrial areas are typically between 2,500 and 4,000 gpm, particularly if fire sprinklers are not present or required.

- Build-out demands should be considered in sizing new waterlines, due to the potential 75+ year life of the pipe.

- As a general rule for new residential development, Keller Associates recommends a grid layout with 12-inch pipelines on section lines (mile), 10-inch pipelines on half-section lines (half-mile), and 8-inch distribution system piping within that grid. Areas zoned for commercial or industrial development may require larger pipelines.

- As a general rule for transmission line sizing, Keller Associates recommends the following for minimum water line sizes:

    a) 24-inch or parallel line equivalent for any future storage to transmission lines
    b) 16-inch or parallel line equivalent for transmission lines into commercial and industrial zones and along section lines.

- Approving new development with these guidelines in mind provides a network of larger diameter lines that have capacity carry flow effectively to areas within the survey section. The City may consider paying the developer for the difference in cost between a standard 8-inch distribution line and an upsized transmission line.

- In preparing the Facilities Planning Study, some pipelines may be oversized to allow for flexibility in future land use and where future development is expected to occur.

3.6 FIRE PROTECTION

Table 3.2 shows general guidelines for fire flows by land use. These guidelines are only used for planning purposes. The International Fire Code can be used to properly design fire flow requirements for specific buildings.

Table 3.2: Guidelines for Required Fire Flows for Municipal Zones

Zoning	Required Fire Flow @ 20 psi (gpm)	Fire Flow Duration (hours)	Fire Flow Required (gallons)
Residential	1,500 gpm	2	180,000
Commercial	2,500 gpm	3	450,000
Industrial	4,500 gpm	4	1,080,000

Fire flow requirements are dictated by size, spacing, type of construction, and building use. Typical residential housing requires 1,000-1,500 gpm. The Ammon Fire Marshal was contacted regarding required fire flows in the City. He indicated that the study should target 1,500 gpm for residential fire flow demands, however, 1,000 gpm may be adequate for smaller homes. The Idaho Surveying and Rating Bureau (ISRB) specifies higher fire flow recommendations for specific buildings within the city. Table 3.3 is a list of needed fire flow values for those locations listed by ISRB that are higher than the lowest residential threshold of 1,000 gpm (full list in Appendix D – Hydraulic Modeling).

Table 3.3: Idaho Insurance Rating Bureau Fire Protection Requirements (March 2017)

Needed Fire Flow (gpm)	Duration (hours)	Owner	Address
3500	3	PEARL HEALTH CLINIC	2705 E 17TH ST
3500	3	AMMON TOWN SQUARE	1779-1851 HITT RD
3500	3	KEVIN DONOHUE	1675 CURLEW DR
3000	3	BONNEVILLE SCHOOL DISTRICT #93	2900 CENTAL ST
2500	2	SUNNYSIDE TESORO	2523 E SUNNYSIDE RD
2500	2	SKIDMORE MILLWORK, INC.	3920 E SUNNYSIDE RD
2500	2	AMMON POINT SHOPPING CENTER	3320 3350 E 17TH ST
2000	2	WALKER PRODUCE	3965 E SUNNYSIDE RD
2000	2	SCOTT HINSHENBERGER BLDG.	3544 E 17TH ST
1750	2	TGI FRIDAYS	2665 HITT
1250	2	KVO CABINETS	8968 E SUNNYSIDE RD
1250	2	RICH HARDY-ID TRAFFIC SAFETY	3400 E SUNNYSIDE RD

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4 SYSTEM DEMAND FORECAST

This chapter evaluates the existing and future water system demands for the City of Ammon.

4.1 METHODOLOGY

Demand forecasts were developed using a combination of current water demands for existing residential users, population and household data, anticipated growth rates within the defined study area, and estimated per capita demand rates for different user groups.

A review of different methodologies and available data was conducted to determine the best approach to estimate existing and future demands. Keller Associates worked closely with City staff to review actual operational data and develop future demand estimates that reflect historical demand growth but still provide a modest amount of conservatism. In determining existing and future demands, the following methodology was used:

1. Historical system demands from 2014-2016 were used to define the existing average day and peak day water usage for the system.
2. Recent SCADA data was reviewed to develop a 24-hour diurnal demand pattern during high demand periods. This information was used to estimate the peak hour demand and peaking storage needs.
3. Existing demands per household and household population densities were used to project future demands.

4.2 POPULATION AND HOUSEHOLD DATA

Two sources of historical population data were reviewed as part of this study. These include US Census Bureau information and population projections provided by the City of Ammon from their 2012 Comprehensive Plan[1]. The census data is believed to be an accurate source of population data, but is only available for 10-year increments. The data provided by the City gives projected populations from 2015 to 2037 in 1 year increments[2]

Table 4.1 summarizes historical growth rates and the corresponding compounded 10-year average annual growth rates from 1970 to 2010. Even with the recession conditions that started in 2008, the City of Ammon averaged an approximate 8.4% annual population growth rate from 2000 to 2010.

[1] US Census Bureau. (2010). American Fact Finder. Retrieved June 8, 2017 from https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml
[2] City of Ammon. 4-5-2012. Comprehensive Plan

Table 4.1: Historical Population Summary

Year	Census	
	Population	Growth Rate[1]
1970	2,545	-
1980	4,669	6.2%
1990	5,002	0.7%
2000	6,187	2.1%
2010	13,816	8.4%

1. Average annual growth rate

Table 4.2 summarizes the growth of housing unit and household size from federal census data.

Table 4.2: Historical Household Summary

Year	Census Housing Units[1]	Census Household Size[2]
2000	1,947	3.27
2010	4,476	3.05
2000-2010 Annual Growth	8.68%	-0.7%

1. Total housing units includes occupied and vacant housing units.
2. Average household size of occupied housing units.

According to the census data, the number of households increased from 1,947 to 4,476 between 2000 and 2010. This corresponds to an average annual growth rate of approximately 8.68% for households. This high growth rate in households reflects the change in household density (3.27 and 3.05 people per household reported in 2000 and 2010, respectively).

Future growth projections are illustrated in Figure 4.1. For planning purposes for this study, the City's furnished population projections were used through 2035 and extrapolated to 2037. Based on the City's population projections, the total population growth between 2015 and 2037 varies from 1.5% to 2.0% annually.

Figure 4.1 illustrates the population projections for the City of Ammon. Water is provided to a portion of the City of Ammon by Falls Water Company. In 2014, there were approximately 1,028 people in Ammon City limits being served by Falls Water, all of which would be in Ammon's Pressure Zone 1 if they were being served by the City of Ammon.

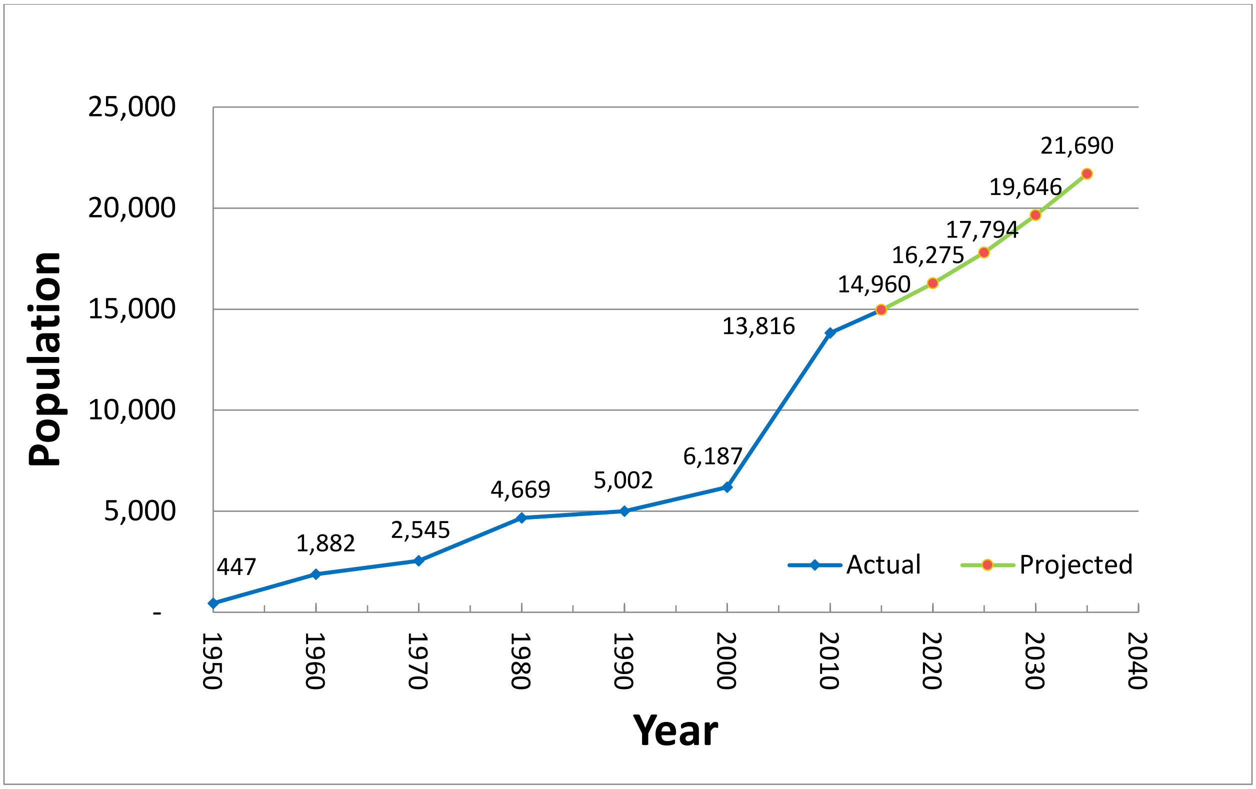

Figure 4.1: City of Ammon Growth Projections

Table 4.3 summarizes the projected population for the entire Ammon Service Area (ASA), and each pressure zone.

Table 4.3: Forecasted 2037 Ammon Service Area Population

	Population
Entire ASA	21,432
Zone 1	19,548
Zone 2	409
Zone 3	736
Zone 4	467
Zone 5	272

4.3 WATER PRODUCTION DATA AND EXISTING DEMAND SUMMARY

Daily water production data was reviewed from 2014 to 2016 to establish annual average, seasonal, and maximum day demand patterns. This data has been compiled for each pressure zone, and for the system as a whole, in Table 4.4. The average summer day flow for the entire system increased from 2014-2016, which corresponds to the increase in population. Maximum day water demands for the entire system peaked in 2016 at 11,900 gpm. The majority of the City's population, demand, and water sources are located in Zone 1.

Table 4.4: Finished Water Production Summary (gpm)

	2014	2015	2016
Population (ASA)	13,641	13,883	14,125
Zone 1			
Average, gpm	3,370	3,560	3,590
Minimum Month, gpm	710	1,040	1,000
Maximum Month, gpm	8,680	7,170	8,770
Maximum Day, gpm	10,210	9,440	10,590
Peak Hour, gpm	14,130	14,927	15,052
Zone 2			
Average, gpm	300	310	340
Minimum Month, gpm	60	70	80
Maximum Month, gpm	720	660	780
Maximum Day, gpm	870	1310	870
Peak Hour, gpm	1,258	1,300	1,426
Zone 3			
Average, gpm	80	110	90
Minimum Month, gpm	7	9	8
Maximum Month, gpm	180	240	270
Maximum Day, gpm	230	320	260
Peak Hour, gpm	335	461	377
Total System			
Average, gpm	3,740	3,970	4,010
Minimum Month, gpm	780	1,130	1,130
Maximum Month, gpm	9,570	8,070	9,800
Maximum Day, gpm	11,320	11,080	11,730
Peak Hour, gpm	15,681	16,646	16,872

For comparison purposes, Table 4.5 shows the water production data on a per capita basis. Existing baseline system demands are summarized in Table 4.6.

Table 4.5: Finished Water Production Summary (gpcd)

	2014	2015	2016	2014-2016 Average
Zone 1				
Est. Population (ASA)	13,128	13,327	13,527	---
Average	369	384	382	379
Minimum Month	78	113	106	99
Maximum Month	952	774	934	887
Maximum Day	1,120	1,020	1,128	1,089
Peak Hour	1,550	1,613	1,602	1,588
Zone 2				
Est. Population	330	347	363	---
Average	1,302	1,282	1,346	1,310
Minimum Month	282	296	322	300
Maximum Month	3,143	2,751	3,090	2,955
Maximum Day	3,816	5,455	3,470	4,247
Peak Hour	5,489	5,394	5,655	5,513
Zone 3				
Est. Population	183	209	235	---
Average	626	744	525	632
Minimum Month	58	59	51	56
Maximum Month	1,427	1,636	1,635	1,566
Maximum Day	1,844	2,232	1,591	1,889
Peak Hour	2,639	3,178	2,312	2,710
Total System				
Population (ASA)	13,641	13,883	14,125	---
Average	395	412	409	405
Minimum Month	83	117	115	105
Maximum Month	1,010	837	999	949
Maximum Day	1,195	1,149	1,195	1,180
Peak Hour	1,657	1,728	1,720	1,702

Table 4.6: 2016 Baseline System Demands

Demands	Per Capita Demand[1] (gpcd)	2016 System Demand (gpm)
Yearly Average	406	4,010
Minimum Month	105	1,130
Maximum Month	949	9,800
Maximum Day	1,180	11,730
Peak Hour	1,702	16,872

1. Per capita demands shown for reference are 2014 to 2016 average values.

4.4 SCADA DATA AND EXISTING PEAK HOUR DEMANDS

Monthly water production was taken from well production data provided by the City. Figure 4.2 summarizes the water usage for each month for 2014-2016. High water usage occurs during the summer months.

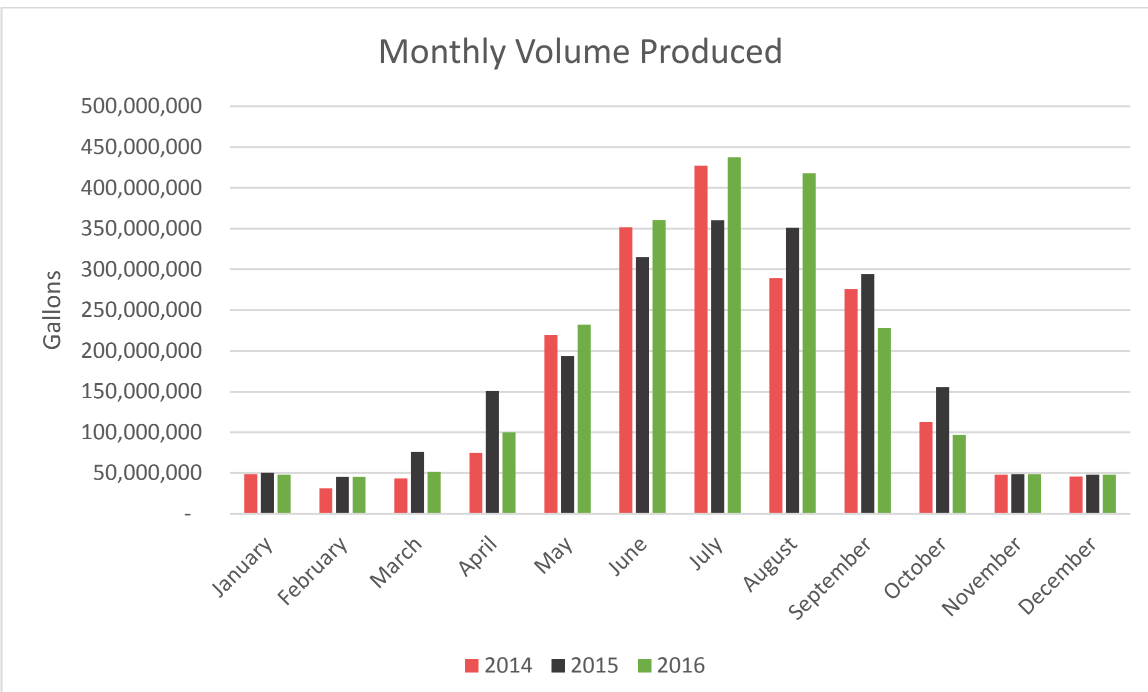

Figure 4.2: Monthly Water Usage for 2014-2016

Peak hour demands were taken from supervisory control and data acquisition (SCADA) data provided by the City for the highest usage week of August 2016. Figure 4.2 illustrates the water usage patterns for the system during the peak summer periods. The high water usage during the night-time and early morning hours reflect irrigation usage within the City (see Figure 4.3).

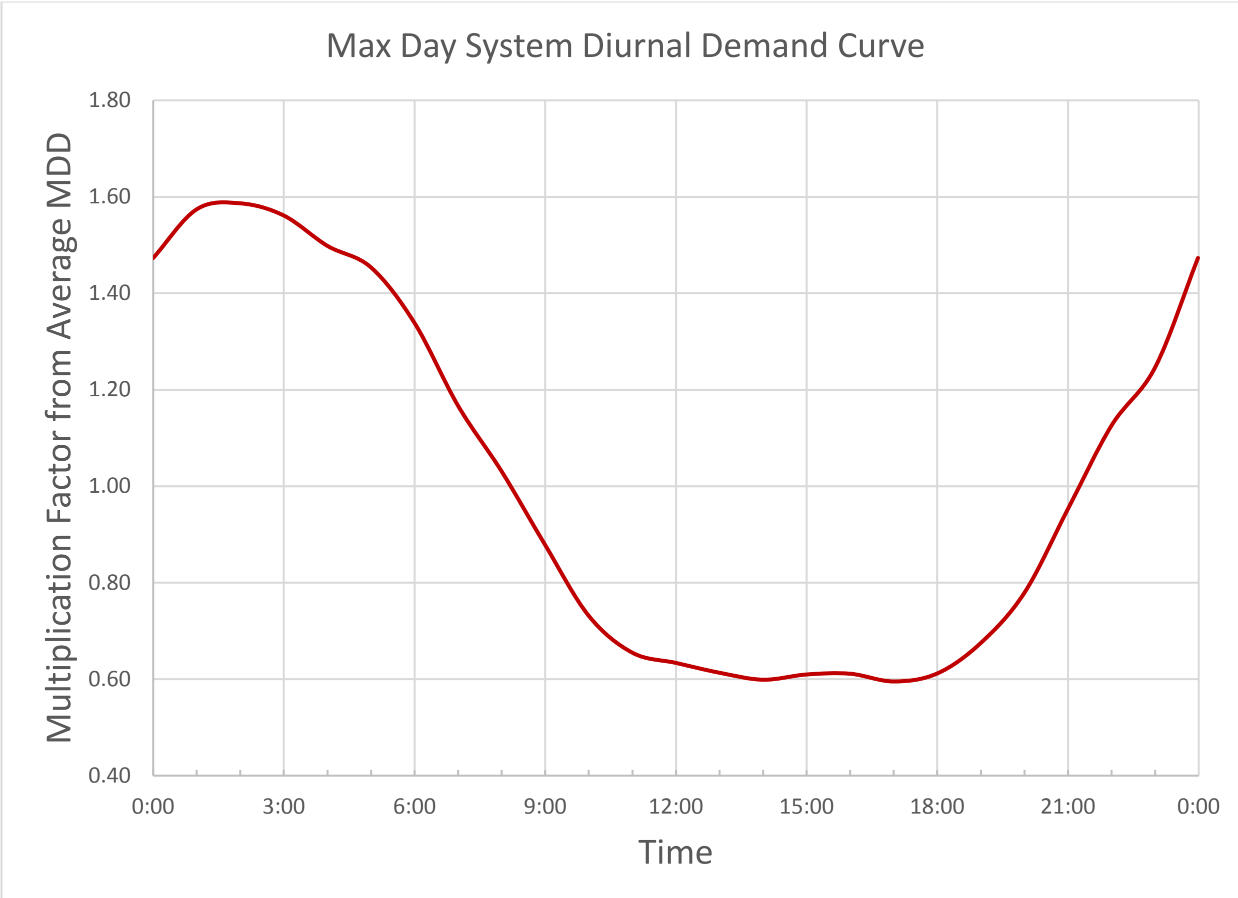

Figure 4.3: Summer Water Usage Pattern

A peak hour demand equivalent of approximately 1.59 times the corresponding daily average demand is anticipated around 2:00 a.m. during the summer months. The lowest system demands are about 0.6 times the corresponding average daily demand and occur from around noon until 5:00 p.m.

4.5 WATER METER DATA

The City of Ammon requires installation of meters on all new residential or commercial construction or when such properties are being renovated if no meter is present[3]. The water department has a stockpile of meter pits and meters. These are installed whenever a service line with no meter is repaired or replaced. In addition to these new installations, the water department is also working their way through existing meters to fix meters that were incorrectly installed, are hard to access, or that show signs of inaccuracy.

Table 4.7 shows the progress of meter installation as reported by the City in early 2017 when Keller Associates obtained current metering data. Residential and commercial meters are read year round on a monthly basis and most of the City's meters are the radio-read type. The City has the ability to tie metered usage to their customer billing program but does not currently report usage or charge base on consumption (see Chapter 9 for more detail regarding the City's rate structure). Keller

[3] City of Ammon. (2014). City Code Title 8 Chapter 3. Retrieved March 16, 2018 from http://public.cityofammon.us/weblink/.

Associates' experience with other communities in Idaho has been that the implementation of a flow-based rate structure leads to reductions in usage of as much as 20-30%.

Table 4.7: Ammon Metering Progress

Water User Type	Estimated % Metered
Commercial/Institutional	59%
City Landscaping	100%
Residential (small lot)	55%
Residential (large lot)	66%
Apartments	30%
Parks	17%
City Overall	**60%**

With a significant portion of users still to be metered, a reliable breakdown of consumption by water user type is not yet available. Such an analysis would be just one benefit of many to having all customers metered:

- Equitable assessment of monthly service fees based on usage; small users would no longer be subsidizing large users
- Track trends and changes in usage among different user types
- Homeowner awareness of consumption and effects of conservation
- Ability to bill based on actual usage; financial incentive to conserve
- Awareness of users who water in excess or who may have leaks
- Ability to gauge the effectiveness of conservation education efforts
- Target conservation education efforts to neighborhoods with excessive use
- Allow for water auditing procedures which help to identify non-revenue water

Non-revenue water, mentioned in the last bullet, is water produced by the system that is not delivered to paying customers. Some non-revenue water goes to authorized uses (e.g. hydrant flushing, park watering), while some does not (e.g. water theft, loss to system leaks, metering inaccuracies, etc.). Better metering data is key to identifying non-authorized, non-revenue water usage so that the City can maximize the amount of production costs that are recouped.

Metering also allows City staff to identify excessive water use. From the metering data provided by the City, Keller Associates was able to identify the twenty metered connections with the highest peak month usage for the summer of 2016. These values are presented in Table 4.8 and were later used in the hydraulic model developed in Chapter 5. Addresses have been removed to protect privacy; however, customer numbers are included for City use. More than half of the accounts shown below are residential, almost all of which are on larger, RP or RPA zoned lots. These lots used an average of 16,000-67,000 gallons per day in July of 2016.

Table 4.8: Summer 2016 Highest Usage Accounts

Customer Number	Total (gal)			Type of User	Model Junction
	June	July	August		
1.3490.03	1,106,118	2,075,334	1,549,099	Residential	J-529
40.2400.01	1,594,894	1,664,385	1,758,334	Commercial	J-1626
1.7019.01	1,128,581	1,372,989	1,331,627	Residential	J-989
40.0850.01	1,395,631	1,316,429	1,197,920	City	J-1413
40.2396.01	825,159	1,261,932	1,010,078	Industrial	J-1699
40.1705.22	479,274	1,209,393	800,209	Apartments	J-532
14.1170.01	1,043,981	1,127,693	295,624	Residential	J-297
1.7041.01	1,058,208	1,096,206	887,537	Residential	J-128
40.1684.01	753,924	1,037,142	1,033,609	Residential	J-1117
1.3500.01	1,844,340	993,602	4,113,144	Residential	J-1118
1.7019.01	737,124	980,902	660,725	Residential	J-989
1.1805.01	813,512	929,066	921,118	Residential	J-657
40.2007.01	736,117	849,095	833,288	School	J-494
1.7083.01	625,232	814,542	793,639	Residential	J-657
1.0851.02	337,894	755,867	681,824	Residential	J-48
40.2004.01	414,256	690,807	643,959	School	J-691
41.0073.00	317,500	653,000	686,500	Church	J-1123
2.0516.01	413,009	522,695	501,669	Residential	J-48
40.1142.01	26,000	517,700	746,100	Commercial	J-1147
21.0143.01	555,214	507,754	566,769	Residential	J-1118

4.6 WATER DEMAND FORECAST

Consistent with the methodology presented earlier, the water production demand for 2037 has been estimated for each pressure zone, and for the system as a whole. Table 4.9 summarizes the future demands for all users within the City of Ammon. Zone projections assume that the population in the City develops proportionally into the future (i.e. the percentage of the total population living in each zone will remain relatively constant.)

Table 4.9: 2037 System Demands (gpm)

Scenario	Total System	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Population (ASA)	21,432	19,548	409	736	467	272
Average, gpm	6,040	5,000	380	330	210	120
Minimum Month, gpm	1,560	1,400	90	30	20	20
Maximum Month, gpm	14,130	11,650	860	810	510	300
Maximum Day, gpm	17,560	14,400	1,210	970	620	360
Peak Hour, gpm	25,330	20,970	1,570	1,390	880	520

5 Distribution System and Hydraulic Analysis

Determining the adequacy of a distribution system requires looking at both hydraulic capacity (see Chapter 3) and physical condition. An assessment of physical condition relied primarily on the observations of City staff. Keller Associates utilized a digital hydraulic model to determine the hydraulic capacity of the system. This chapter also provides a description of modeling results that relate to pumping and delivery. Modeling performed to determine optimal locations for new storage and supply locations will be discussed in Chapter 7.

5.1 Model Development

Haestad Methods' WaterCAD was used to create the hydraulic model for the Ammon water distribution, storage, and delivery system. Hydraulic modeling can be used as a tool to identify potential causes of pressure or flow issues throughout a system. It also allows engineers and city staff to better understand the effects of proposed changes to system infrastructure, determine the optimal sizes and locations for improvements, and identify operational changes that can improve system performance. Hydraulic modeling is useful for developing multiple pressure zones within a system such as Ammon's as it can predict system pressure at different locations within the city under different zone boundary, pumping, and demand scenarios.

Keller Associates has maintained a working water model for the City of Ammon over the past several years. The last major rebuild of the City's hydraulic model occurred in 2011 in order to better reflect major system improvements, including the Hill Tank and Booster Station, the Well 8 Tank and Booster Station, Wells 10 and 11, and multiple associated transmission line projects[1]. The 2011 model utilized earlier modeling efforts, city maps and records, and field verification to create a reasonably accurate representation of the system. This model was used in the following years to inform City capital improvement decisions and to help determine the impacts of development.

For this study, it was determined that a review and update of the existing model was sufficient. City staff reviewed maps, plans, and as-built drawings from previous infrastructure and development projects in order to provide an up-to-date map of water line diameters and locations. Pump sizes, capacities, and operational settings were also reviewed with the City and updated in the model. The location of pressure zone boundaries and closed valves were also confirmed.

Existing model demands (flows) were increased to match the existing and future demands presented in Chapter 4 and demand locations were adjusted to reflect areas of new growth. As part of this effort, the 20 metered connections with the highest summertime usage were entered individually into the model (see Table 4.8). Site specific fire flow requirements from the Idaho Surveying and Rating Bureau (ISRB) (see Table 3.3) were also entered into the model at their various locations. See Appendix D for additional details regarding model inputs.

5.2 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.

[1] Keller Associates, Inc. (2011). "Technical Memorandum: City of Ammon Water Model Update," #207059, Meridian, ID.

A series of hydrant flow tests were conducted on July 12, 2017 by Keller Associates and City of Ammon water department staff. Static (hydrant closed) and residual (hydrant flowing) pressures and flows were recorded for each of the tests. The status of the various pumps operating within the system during the tests was monitored by city staff through the SCADA system. Hydrant and pump conditions were then forced in the model and resulting pressures observed.

The calibration target for this study was that the model and flow test conditions differ by no more than 5 psi. On the initial model run about two-thirds of the cases met this criteria. Model parameters were then adjusted to improve these results. Calibration results and comments, flow testing data, and a map of test locations are included in Appendix D.

One observation made was that hydrant pressures in Zone 3 did not correlate well with pressures reported at the Zone 3 Boosters. The booster pumps read 6 psi lower than would be expected to produce the hydrant pressures that were measured in the field. As a result, pump set points in the model were raised to 6 psi higher than reported by SCADA. We recommend the City investigate the accuracy of the Zone 3 Boosters pressure transducer.

The City of Ammon has expressed an interest in maintaining their water model in-house. Keller Associates provided a copy of the updated water model to Ammon's City Engineer. 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 within the water system as it grows and changes. The City or its consultant could then quickly identify possible causes for problems they see in the system or the impacts of proposed development. Many of these system changes may alternately be tracked using the City's GIS database and then be brought over into the model.

With the calibrated model, the current distribution system was evaluated for compliance with the pressure and flow planning criteria previous identified in Chapter 3. The following sections summarize the results. The system was analyzed using a steady state evaluation.

5.3 Hydraulic Analysis

5.3.1 Maximum Day Demand plus Fire Flow Demand

This model scenario evaluates heavy usage conditions (maximum day demand or MDD) in combination with emergency demands at a single point (fire flow demand or FFD). A base fire flow demand of 1,500 gpm was selected and individual Idaho Surveying and Rating Bureau (ISRB) requirements added at their corresponding locations, as described in Chapter 3.

Under maximum day demands in each zone (see Chapter 4) and the FFD requirements stated, the model iteratively determines the maximum flow available at each node before pressure somewhere in that pressure zone is caused to drop below 20 psi. Per IDEQ requirements, system conditions were stressed further during this analysis by taking "any given pump" offline. State code also requires that MDD plus FFD be modeled with operational, equalization, and fire suppression storage all depleted (IDAPA58.01.08.552.01.b.viii)[2]. Critical flow sources were identified on an area by area basis; the following results include turning off the most impactful

[2] Idaho Department of Environmental Quality. (2016). Idaho Rules for Public Drinking Water Systems. Retrieved September 22, 2017 from https://adminrules.idaho.gov/rules/current/58/0108.pdf.

pump for each area. Figure 5.1: Fire Flow Failures shows the resulting system performance at each existing fire hydrant. Green nodes are able to meet the base fire flow demand of 1,500 gpm. Yellow nodes can meet a fire flow of 1,000 gpm and red nodes can provide less than 1,000 gpm. While the results show what the system can deliver at each node, this does not mean there is a fire hydrant at that node. If there is a fire hydrant at that node, the hydrant may have physical limitations that prevent delivery of the amount of water suggested by the model.

One of the water operators related an instance in 2017 when there was a fire in the Original Townsite, and the fire department could not get enough flow out of the hydrant to fight the fire even though the model showed the system should be able to deliver the water. The fire hydrant was an old Pacific States hydrant with two hose nozzles, but no steamer port.

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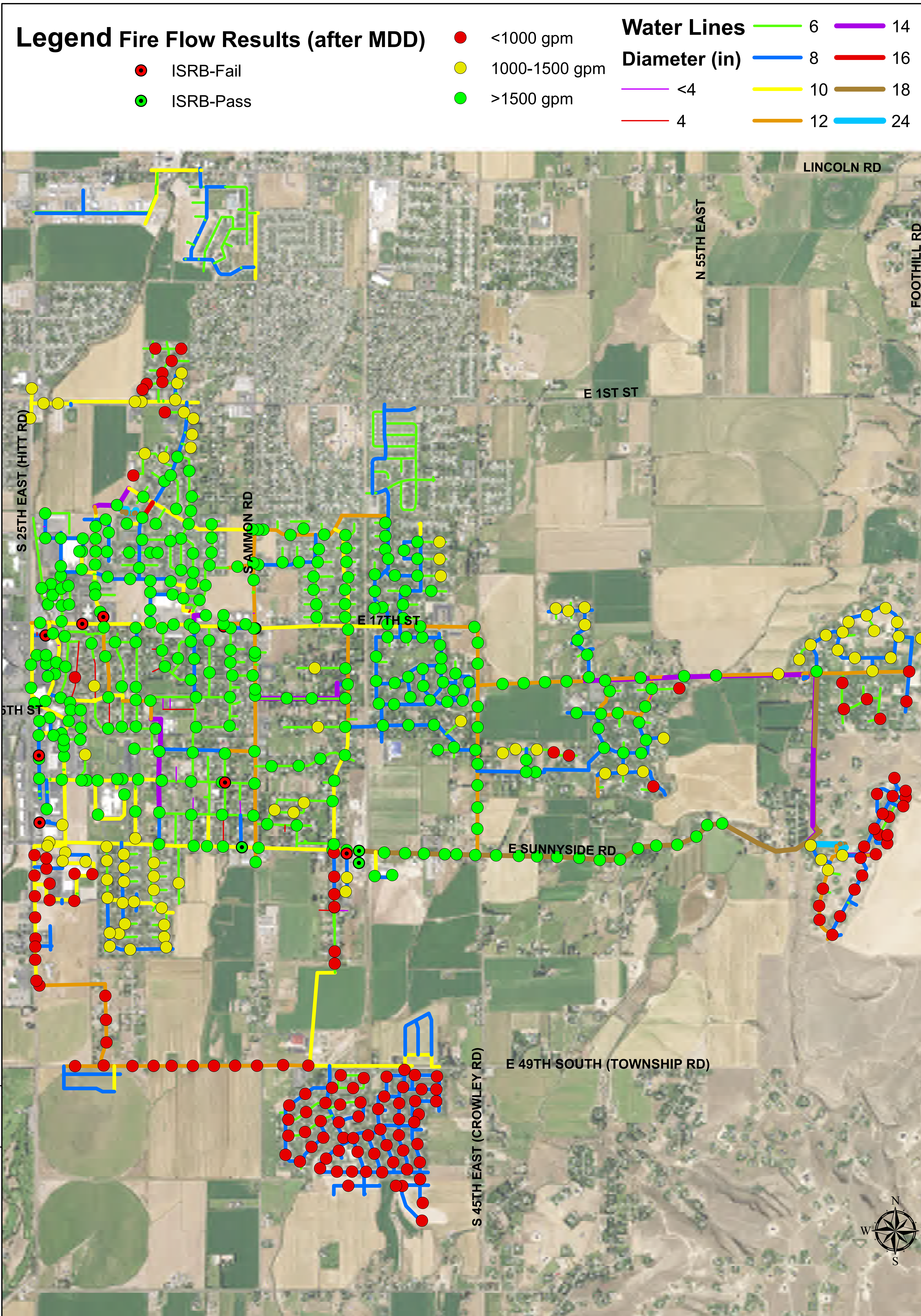

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Figure:	Title:	Project:	Prepared for:
5.1	Fire Flow Failures	Water Facilities Planning Study	CITY OF Ammon
		Keller Project: #216102-000	KELLER ASSOCIATES

Figure 5.1 highlights some apparent deficiencies in the distribution network:

Fox Hollow: The Fox Hollow subdivision (north of 1st Street) struggles to meet higher flow demands even though it is in relatively close proximity to the Well 8 Booster Station to the south. This is a result of this area being supplied solely by a single 8-inch distribution line on Tie Breaker Drive. This means that not only does the area have limited flow capacity, but if that 8-inch line were to go out of service water would be cut off entirely to that area.

Quail Ridge: Quail Ridge (Pressure Zone 2) cannot meet fire flow due to multiple factors. The hydrants south of 21st Street are supplied by 6-inch and 8-inch dead end lines which restrict flow. Pumping capacity is also an issue. Current pump pressure set points are programmed in a descending manner, such that the target pressure of the booster station lowers as each new pump is turned on. With the IDEQ requirement of “any pump out of service” taking out Pump 3, the pressure set point is governed by Pump 4, which is currently set at 64 psi. This creates insufficient pumping head to fully pressurize the higher elevations of Zone 2. Beyond this operational limitation however, the pumps do not appear to be sized adequately to meet the needs of the top of the zone even if allowed to run without constraint. The range of elevations spanned by the subdivision (over 100 ft) is large enough that maintaining a single pressure zone in Quail Ridge is not ideal.

Woodland Hills: Woodland Hills and the other areas south of Sunnyside Road fared particularly poorly. This is due to the isolated nature of this area. Only two water lines feed the area around the Woodland Hills subdivision, and one of them (Ross Ave.) bottle necks to a 6-inch pipe. After these lines join there is a short section of 10-inch pipe which, if taken out of service, would shut off supply to the entire Woodland Hills subdivision. Even more limiting to available flows is the fact that supply on the south end of town is limited to Well 10 and the gravity line coming from the Hill Tank. During a fire flow event, these sources are drawn upon so heavily that other adjacent areas which rely on them are quickly deprived and lose pressure. With Well 10 turned off for the analysis to meet the IDEQ requirements described previously, flow to this area is extremely limited.

The Cottages: The Cottages subdivision has six hydrant locations that did not meet 1,500 gpm. These are the result of elevation, dead end lines, and lack of transmission to this area.

Hawk’s Landing/Founder’s Point: These two subdivisions make up Pressure Zone 3. The poor performance of this zone during fire flow is a result of current pump set points at the Hill Tank Booster Station, not a lack of supply or pumping capacity. With the Zone 3 Boosters governed by the lowest set point of the three (65 psi, 71 psi in the model, see Section 5.2) the pumps were able to produce the necessary flows at that pressure, but in order to maintain 20 psi in the zone, a pump production of at least 71 psi (77 psi in the model) is necessary. The two 2,000 gpm Zone 5 fire pumps at the booster station are designed to turn on in this case, but did not as their set points are at 40 and 45 psi. The pressure produced by the two max day pumps for Zone 3 never dropped down that low during fire events, even though locations within the Zone did, due to their higher elevation.

ISRB Locations: Many locations that have higher fire flows specified by ISRB do not pass fire flow. This is due to either flow limitations imposed by undersized pipes or lack of supply looping.

Miscellaneous Other Failures: A handful of other failed nodes are scattered across Figure 5.1. These are primarily due to undersized pipes and dead end lines.

5.3.2 Peak Hour Demand

The system was also modeled under Peak Hour Demands (PHD) to check for pressures in the system dropping below the IDEQ minimum pressure requirement of 40 psi (see Chapter 3). The intent of this analysis is to determine areas of the system that suffer at the highest regular demands (exclusive of emergency demands such as fire flow). State code requires that PHD be modeled with both operational and equalization storage depleted (IDAPA 58.01.08.552.01.b.viii)[3].

The locations of PHD failures resulting from this analysis are shown in Figure 5.2. As with maximum day plus fire demand, the pressure requirements must be met with any pump offline. Many of the areas that struggled with meeting maximum day plus fire demand also struggled to meet PHD requirements, specifically The Cottages, Quail Ridge, and Woodland Hills and other areas south of Sunnyside Road. These failures are the result of the same limiting issues that were previously discussed.

[3] Idaho Department of Environmental Quality. (2016). Idaho Rules for Public Drinking Water Systems. Retrieved September 22, 2017 from https://adminrules.idaho.gov/rules/current/58/0108.pdf.

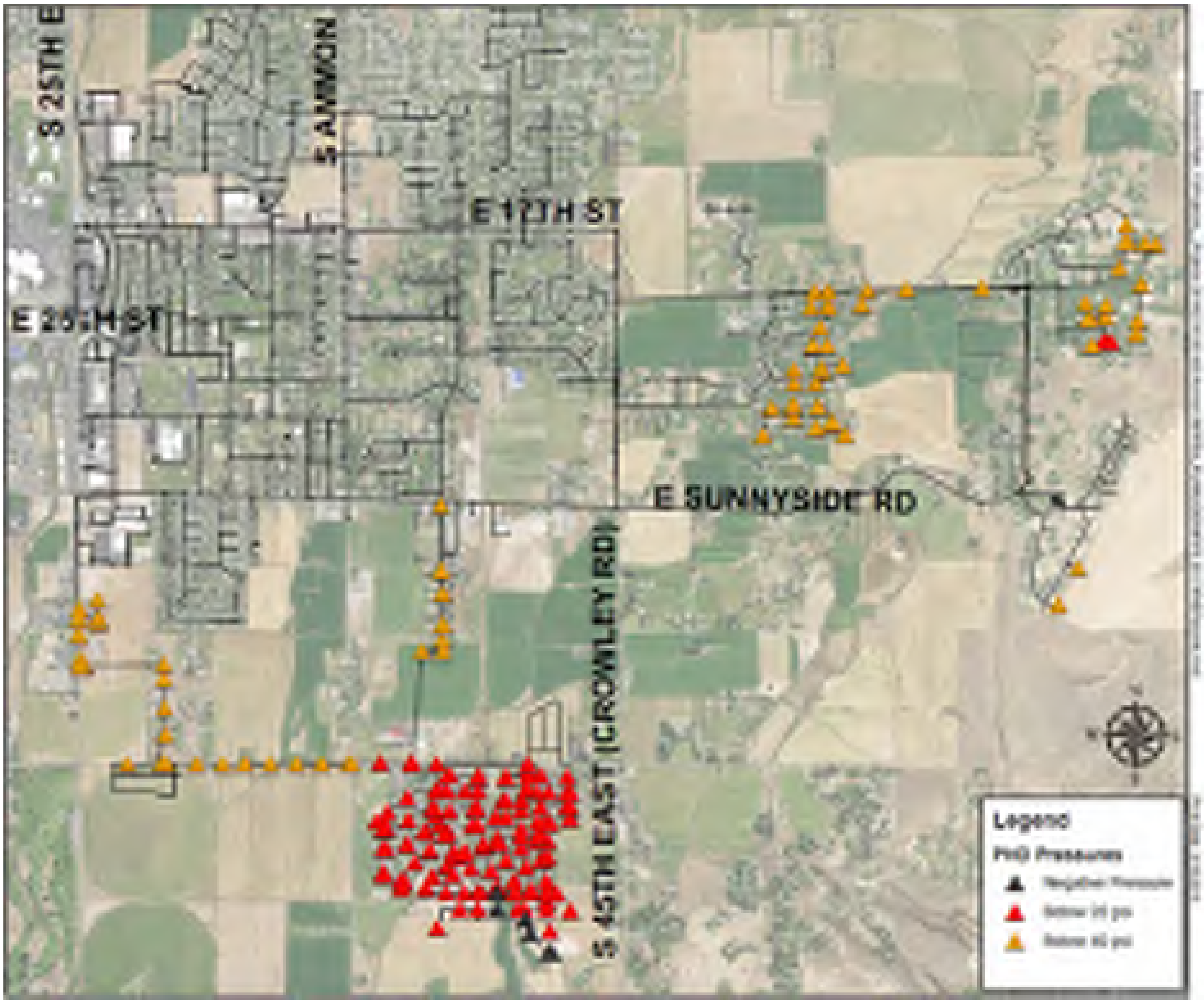


Figure 5.2: Peak Hour Demand Failures

5.4 Distribution System Physical Condition

Apart from the hydraulic analysis provided by the model, input was sought from city staff on areas where physical condition of the transmission/distribution pipes is thought to be an issue. Estimated pipe ages were given in Figure 1.3. The water department logs repairs electronically and is able to watch for emerging maintenance patterns. Figure 5.3 shows the pipeline repairs that have been tracked since 2014.

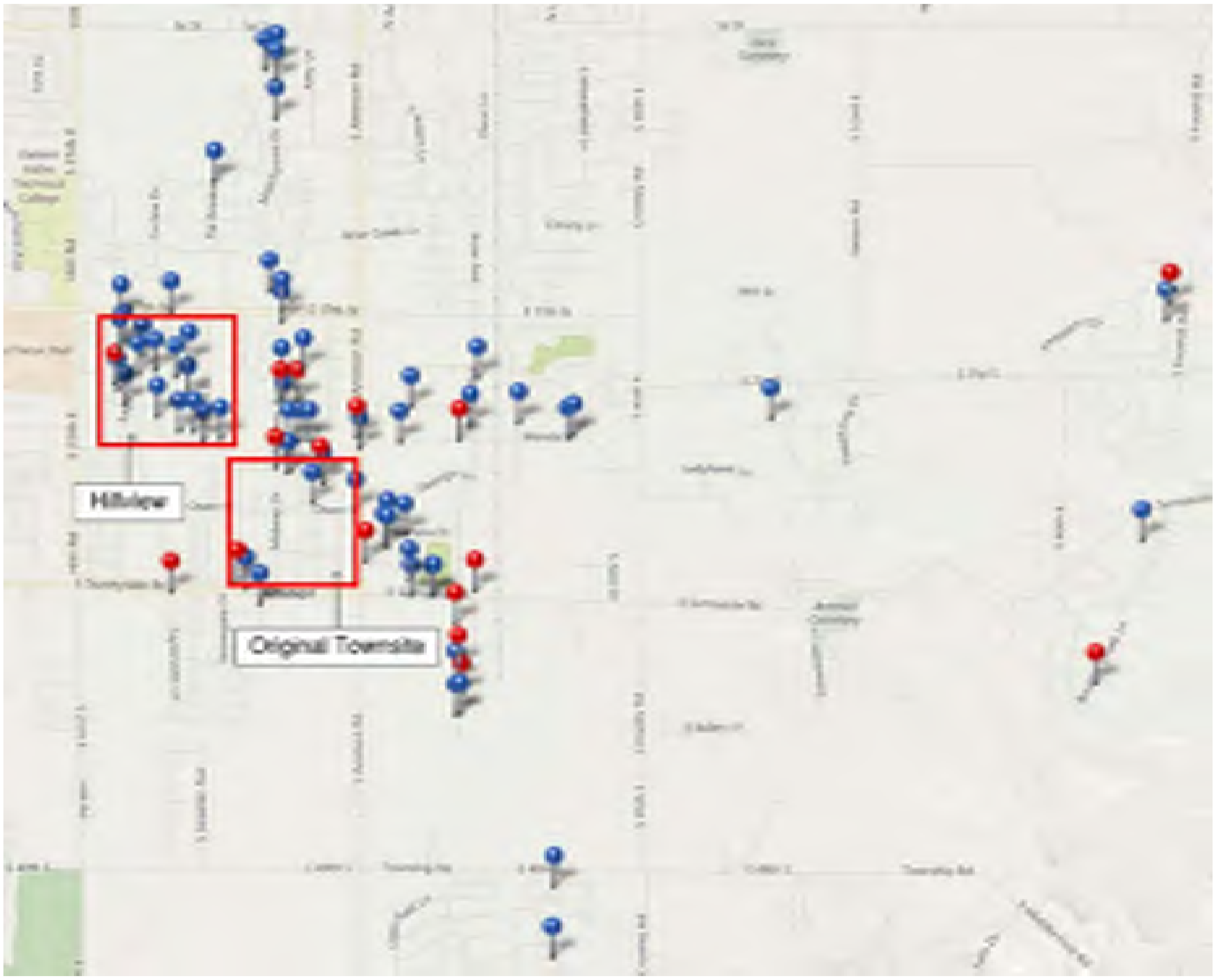
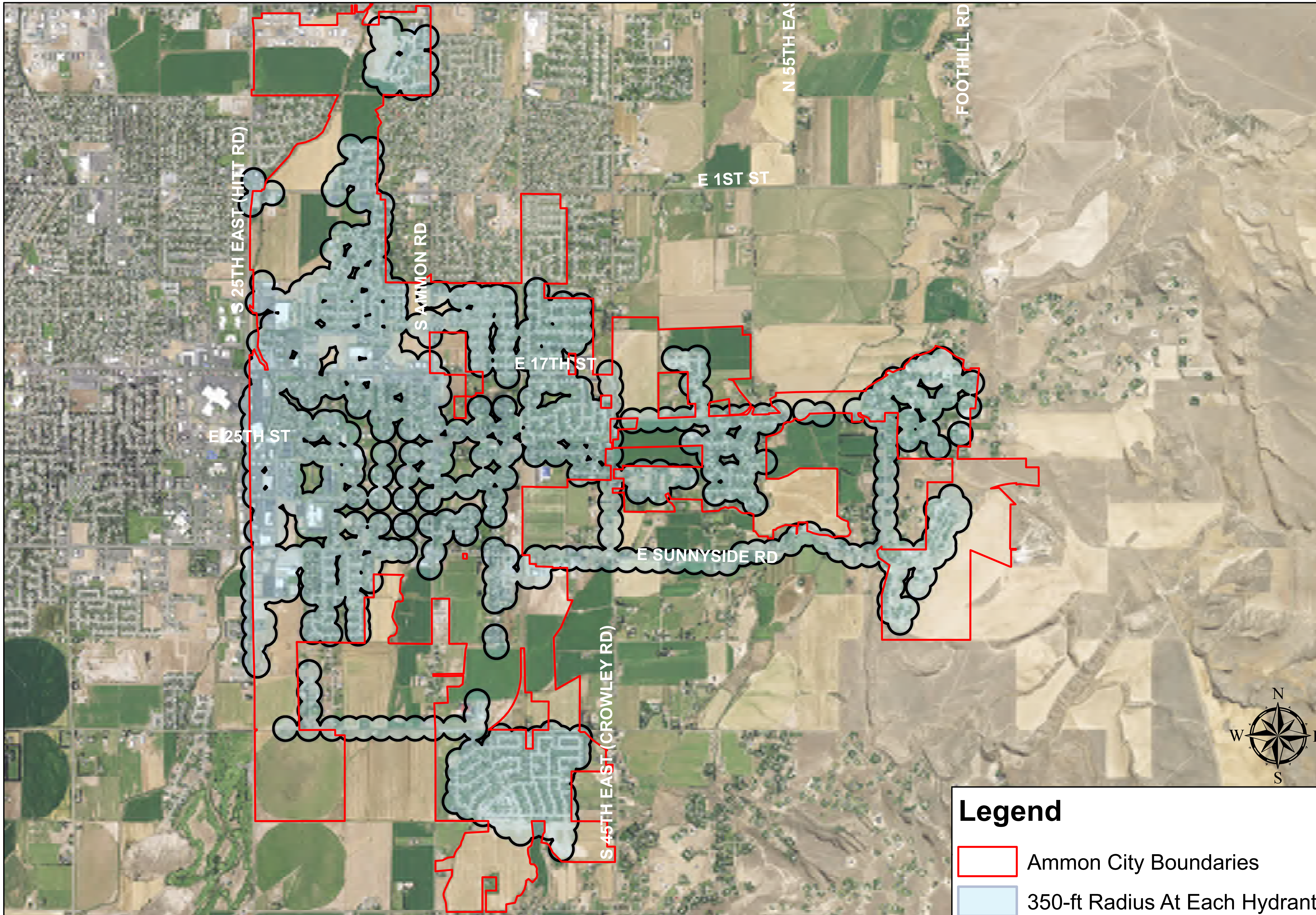


Figure 5.3: Pipeline Repairs Logged by Water Department

While isolated breaks occurred throughout the system, the majority of breaks addressed by the City's water staff were located in the sections of town with the oldest lines (pre-1980s). This map shows a string of breaks stretching from 17th St. and Hitt Road southeast to Sunnyside Rd. and Ross Ave. These repairs seem to primarily be in areas of pipeline installed from 1950-1970, particularly in the Hillview neighborhood and on Midway Avenue. The Original Townsite, believed to have been installed pre-1920s, has relatively few breaks in comparison. Midway's distribution line was replaced from Sunnyside Rd. to 17th Street in 2017.

5.5 Hydrant Coverage

Hydrant coverage across the city was evaluated to identify any significant gaps in access to fire hydrants during an emergency. Figure 5.4 shows hydrant coverage based on the location of hydrants included in the City's GIS system and a service radius of 350-ft. Coverage is generally quite good, especially in areas of newer construction. The City may wish to coordinate with the fire department to identify whether any current gaps need immediate attention.



Prepared for: City of Ammon

KELLER ASSOCIATES

Project: Water Facilities Planning Study

Keller Project: #216102-000

Title: Hydrant Coverage Map

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6 SUPPLY, STORAGE, AND DELIVERY ANALYSIS

This chapter documents the analysis of Ammon's drinking water supply, storage, and delivery facilities. Capacities and general recommendations for addressing deficiencies are discussed here. More detailed improvement alternatives are evaluated in Chapter 7.

6.1 SUPPLY ANALYSIS

The City of Ammon currently relies on groundwater from eight wells to supply the drinking water system. As Well 6 is not operational, it is not included in the following evaluation of existing supply or delivery. While Well 3 and Well 5 are currently non-operational, the capacity of these wells was included in analysis as the City plans to complete the improvements necessary to bring them back online sometime within the next year (the operational issues at these three wells are discussed in Chapter 1.

System supply was evaluated for the entire system for compliance with the Idaho Drinking Water Rules, which state that a drinking water system must have adequate firm capacity to supply peak hour demand or at least a minimum of max day demand if adequate equalization storage is provided (IDAPA 58.01.08.501.17)[1]. Firm capacity of the overall system is 11,525 gpm. This supply analysis assumes that storage requirements are met or will be met. Storage requirements will be discussed later in this chapter. Table 6.1 compares firm capacity with projected system demands.

Table 6.1: Projected Demands vs. Firm Capacity

	2016	2037
Max Day Demand, gpm	11,730	17,560
Firm Capacity, gpm	11,525	11,525
Surplus (Deficiency), gpm	(205)	(6,035)

The City's current firm capacity can provide the current maximum day demand for each zone separately, but cannot provide max day demand for all of the zones together. New sources will need to be developed to keep pace with future demands as the City grows and will be needed in the near future. The deficiency shown in Table 6.1 assumes storage will be added (discussed later) to meet equalization storage requirements. If equalization storage requirements are not met, firm capacity must increase to meet Peak Hour Demand (16,872 gpm), or the portion of PHD that is not being met by equalization storage. City water operators have observed this deficiency which manifests itself during high summer demands when fire suppression storage in the tanks is compromised in order to meet equalization storage needs.

System supply was also evaluated for each pressure zone as a management tool for the City. Transfers between zones are an acceptable means of meeting system demands in extreme conditions such as for fire suppression. The City manages the system to minimize higher pressure zone to lower pressure zone transfers for normal operating conditions. In order to minimize zone to zone transfers, firm capacity should be equal to or greater than max day demand in each zone.

[1] Idaho Department of Environmental Quality. (2016). Idaho Rules for Public Drinking Water Systems. Retrieved June 8, 2017 from https://adminrules.idaho.gov/rules/2016/58/0108.pdf

Table 6.2 shows the firm capacity for pressure Zone 1. Pressure Zone 1 serves the valley floor elevations (the majority of the city). Table 6.3 summarizes the firm capacity for the “upper” zones: Zones 2, 3, 4, and 5. Since the Hill Tank floats on Zone 1 system pressure, all Zone 1 wells could contribute to tank supply. For this reason, the firm capacity for Zone 1 was used in the analysis for all pressure zones.

Pressure Zone 1 is supplied in a number of different ways. Wells 2, 3, 5, 7, and 10 all supply Zone 1 directly. Well 10 is equipped with emergency backup power. Well 8 supplies Zone 1 through 3 booster pumps that pump water from Well Tank 8. There is a bypass direct from Well 8 to Zone 1, however, it is unknown whether Well 8 could develop sufficient head to pump directly to Zone 1 at normal system pressures. The Well 8 compound has an emergency generator.

Well 11 supplies Zone 1 by pumping water past Well 9 to the Hill Tank. This water is then supplied by gravity from the Hill Tank to pressure Zone 1. There is a bypass from Well 11 through a PRV to Zone 1 for emergency situations. Well 9 also supplies Zone 1 by pumping into the transmission line coming from Well 11 to the Hill Tank. There is a bypass at Well 9 that allows Well 9 to pump directly to Zone 2.

Table 6.2: Zone 1 Supply

Well Designation	Capacity (gpm)
Well 2	325
Well 3	500
Well 5	1,000
Well 7	1,850
Well 8*	4,200
Well 9*	1,850
Well 10*	3,000
Well 11*	3,000
Total	**15,725**
Firm Capacity	11,525
*Well Capacity w/Standby Power	12,050

Table 6.3: Zones 2, 3, 4, and 5 Supply

Well Designation	Capacity (gpm)
Well 9*	1,850
Well 11*	3,000
Total In Each Zone	**4,850**
Firm Capacity In Each Zone	1,850
Firm Capacity Used in Analysis[1]	11,525
*Well Capacity w/Standby Power	4,850

[1] Wells 9 and 11 are the only wells that typically pump directly into the Hill tank for distribution to all zones. Since the Hill Tank floats on Zone 1 system pressure, all Zone 1 wells could contribute to tank supply. For this reason, the firm capacity for Zone 1 was used in analysis for all pressure zones.

Pressure Zones 2, 3, 4, and 5 are all supplied through the Hill Tank. The Hill Tank receives all of its water primarily from Wells 9 and 11. Wells 9 and 11 both have emergency generators for backup power.

Zone 2 receives its water from the Hill Tank. The water from the Hill Tank is supplied to Zone 2 through the four booster pumps at Well 9. Well 9 has a bypass to supply Zone 2 directly, but could only do so at sub-standard pressures (42 psi at the bottom of Quail Ridge, and 0 psi at the top of Quail Ridge).

Water is supplied to Zone 3 through the Hill Tank. The water from the Hill Tank is transmitted through 3 booster pumps for Zone 3. Zone 3 can also be supplied in emergency situations through a bypass line with a PRV from the Zone 5 booster pumps.

Zone 4 is supplied in a similar way as Zone 3. Water from Hill Tank # 1 is supplied to Zone 4 through the 3 Zone 4 booster pumps. The Zone 5 booster pumps also can supply Zone 4 for extenuating circumstances. This emergency transmission line from Zone 5 booster pumps contains a PRV.

Pressure Zone 5 is supplied solely through the Zone 5 booster pumps from the Hill Tank. The Zone 5 booster pumps have emergency backup power.

Zone 1 wells can supply all pressure zones through the Hill Tank. Zone 1 firm capacity was also compared to the MDD of all zones combined. The comparison of MDD and firm capacity by zone, see Table 6.4, shows that additional supply will be needed in Zone 1. Ammon's water system is capable of supplying MDD for each zone separately, but cannot supply MDD for all the zones together.

Table 6.4: MDD vs. Firm Capacity by Zone

Zone	Firm Capacity (gpm)	Projected Maximum Day Demand	
		2016	**2037**
Zone 1	11,525	10,590	14,400
Surplus (Deficit)		935	(2,875)
Zone 2	11,525	870	1,210
Surplus (Deficit)		10,655	10,315
Zone 3	11,525	260	970
Surplus (Deficit)		11,265	10,555
Zone 4	11,525	-	620
Surplus (Deficit)		11,525	10,905
Zone 5	11,525	-	360
Surplus (Deficit)		11,525	11,165
All Zones	11,525	11,730	17,560
Surplus (Deficit)		(205)	(6,035)

Notes:
-As Zone 1 wells can supply all pressure zones via the Hill Tank, Zone 1 firm capacity was also compared to the MDD of all zones combined.
- Zones 4 and 5 are not currently active. Per capita demands are assumed to be similar to Zone 3.

Recommendations

Keller Associates recommends that the City develop one 2,200 gpm well in pressure Zone 1 as the City grows for every 3,000 additional people. A new water source could be from the existing Well 6 compound. Other potential well locations are to be determined by modeling.

6.2 STORAGE ANALYSIS

In the tables that follow, we have listed the nominal storage of each reservoir. Actual available storage depends on dead storage, which is a function of tank geometry, and allocation of operational, equalization and fire suppression storage. Definitions of these storage components are given in Chapter 3. This storage analysis was completed by zone in order to identify storage requirements for each zone and minimize transfers between zones. In emergency or fire conditions, available storage in upper zones may be used to supplement storage in lower zones. In each zone there is a fire suppression storage requirement. This fire suppression requirement is placed to ensure that there is an allotted storage for fire suppression at all times. This means that even if the equalization and operational storage of the tank is empty there will still be enough water in the storage tank to meet fire suppression needs.

Operational storage should be no less than 10% of total storage volume. Operational storage represents the difference between pump ON and pump OFF. The City has indicated that it would like to maintain operational storage of at least 25% to minimize pump cycling. 25% has been assumed for 2037 in Zone 1 and for all other zones. Standby storage is not required for all zones since there is adequate well and booster pump capacity with standby power to supply average day demand for eight hours to all zones.

Table 6.5 gives the existing storage in Zone 1. Table 6.6 identifies the storage requirements of Zone 1. Additional storage is required now as well as in 2037. The fire suppression component of storage in Table 6.6 is based on 3,500 gpm for three hours. This allocates a portion of the storage tank solely for fire suppression. Operational storage currently used in Zone 1 by the City is shown for 2016 (approximately 50%). If operational, the Well 6 Compound would be able to store an additional 0.5 MG of water for Zone 1. This will reduce the amount of storage needed in Zone 1, but will not satisfy all of the storage needs of Zone 1.

Table 6.5: Existing Zone 1 Storage

Storage Reservoir	Volume (MG)
Well 8 Tank	1.5
Hill Tank #1	**2.00**
Total	**3.5**

Table 6.6: Zone 1 Storage Needs[1]

Storage Component	2016 (MG)	2037 (MG)
Equalization	2.8	3.9
Fire Suppression	0.63	0.63
Standby	Not Required[2]	Not Required
Subtotal – Required Storage	3.4	4.5
Operational[3]	1.7	1.5
Dead	0.03	0.04
Total – Required Storage	**5.1**	**6.1**
Available	3.5	3.5
Additional Storage Needed	1.6	2.6

1-As all storage currently operates in pressure zone 1, Zone 1 storage demands include the storage demands of the entire system.
2-- Standby Storage is not required as Ammon has enough well capacity with backup power to provide average day demand (ADD).
3- Should be no less than 10 % of total storage volume. Represents the difference between pump ON and pump OFF. For Zone 1, operational storage currently used by the City is shown for 2016 (about 50%). The City has indicated that it would like to maintain operational storage of at least 25% to minimize pump cycling. 25% has been assumed for 2037 in Zone 1 and for all other zones.

The Hill Tank is the sole means of storage for pressure zones 2, 3, 4, and 5. Table 6.7 lists available storage in the Zone 2. Table 6.8 shows the storage needs associated with Zone 2. Equalization storage is not required in Zone 2 since delivery capacity exceeds peak hour demand (PHD). However, in 2037 there will be a need for equalization storage. An evaluation of delivery capacity is given in Section 6.3. Fire suppression storage is based on 1,500 gpm for two hours. As shown in Table 6.8, there is no additional storage needed for Zone 2.

Table 6.7: Existing Zone 2 Storage

Storage Reservoir	Volume (MG)
Hill Tank	2.00
Total Available	**2.00**

Table 6.8: Zone 2 Storage Needs

Storage Component	2016 (MG)	2037 (MG)
Equalization	Not Required[4]	0.27
Fire Suppression	0.18	0.18
Standby	Not Required[2]	Not Required
Subtotal – Required Storage	0.18	0.45
Operational[3]	0.07	0.16
Dead	0.02	0.02
Total – Required Storage	**0.27**	**0.63**
Available	2.00	2.00
Additional Storage Needed	0.00	0.00

2 - Standby Storage is not required as Ammon has enough well capacity with backup power to provide average day demand (ADD).
3- Should be no less than 10% of total storage volume. Represents the difference between pump ON and pump OFF. For Zone 1, operational storage currently used by the City is shown for 2016 (about 50%). The City has indicated that it would like to maintain operational storage of at least 25% to minimize pump cycling. 25% has been assumed for 2037 in Zone 1 and for all other zones.
4 - Equalization storage for this zone is not currently needed as firm pumping capacity can meet peak hour demands.

Table 6.9 lists the storage existing in Zone 3. Table 6.10 summarizes the storage needs for Zone 3. As shown in Table 6.10 no equalization storage is required as the firm capacity for Zone 3 can meet PHD. In 2037 there will be a need for equalization storage. The fire suppression storage is based on 1,500 gpm for two hours. Table 6.10 shows that no additional storage is needed for Zone 3.

Table 6.9: Existing Zone 3 Storage

Storage Reservoir	Volume (MG)
Hill Tank	2.00
Total Available	**2.00**

Table 6.10: Zone 3 Storage Needs

Storage Component	2016 (MG)	2037 (MG)
Equalization	Not Required[4]	0.22
Fire Suppression	0.18	0.18
Standby	Not Required[2]	Not Required
Subtotal – Required Storage	0.18	0.40
Operational[3]	0.07	0.14
Dead	0.02	0.02
Total Required Storage	**0.27**	**0.56**
Available	2.00	2.00
Additional Storage Needed	0.00	0.00

2 - Standby Storage is not required as Ammon has enough well capacity with backup power to provide average day demand (ADD).
3- Should be no less than 10% of total storage volume. Represents the difference between pump ON and pump OFF. For Zone 1, operational storage currently used by the City is shown for 2016 (about 50%). The City has indicated that it would like to maintain operational storage of at least 25% to minimize pump cycling. 25% has been assumed for 2037 in Zone 1 and for all other zones.
4 - Equalization storage for this zone is not currently needed as firm pumping capacity can meet peak hour demands.

Table 6.11 shows the available storage in Zone 4. Table 6.12 identifies the storage requirements of Zone 4. Zone 4 is not currently active, so only projected needs are given. 1,500 gpm for two hours is used as the basis for fire suppression storage for Zone 4. As shown in Table 6.12 there is no additional storage needed in Zone 4.

Table 6.11: Existing Zone 4 Storage

Storage Reservoir	Volume (MG)
Hill Tank	2.00
Total Available	**2.00**

Table 6.12: Zone 4 Storage Needs

Storage Component	2016 (MG)	2037 (MG)
Equalization	-	0.14
Fire Suppression	-	0.18
Standby	-	Not Required[2]
Subtotal – Required Storage	-	0.32
Operational[3]	-	0.11
Dead	-	0.02
Total Required Storage	**-**	**0.46**
Available	-	2.00
Additional Storage Needed	-	0.00

2 - Standby Storage is not required as Ammon has enough well capacity with backup power to provide average day demand (ADD).
3- Should be no less than 10% of total storage volume. Represents the difference between pump ON and pump OFF. For Zone 1, operational storage currently used by the City is shown for 2016 (about 50%). The City has indicated that it would like to maintain operational storage of at least 25% to minimize pump cycling. 25% has been assumed for 2037 in Zone 1 and for all other zones.

The existing storage for pressure Zone 5 is shown in Table 6.13. Table 6.14 summarizes the storage needs for Zone 5. Currently pressure Zone 5 is not active, but the projected storage needs for 2037 are shown. The fire suppression storage for Zone 5 is based on 1,500 gpm for two hours. Table 6.14 shows that no additional storage is required in pressure Zone 5.

Table 6.13: Existing Zone 5 Storage

Storage Reservoir	Volume (MG)
Hill Tank	2.00
Total Available	**2.00**

Table 6.14: Zone 5 Storage Needs

Storage Component	2016 (MG)	2037 (MG)
Equalization	-	0.08
Fire Suppression	-	0.18
Standby	-	Not Required[2]
Subtotal – Required Storage	-	0.26
Operational[3]	-	0.09
Dead	-	0.02
Total Required Storage	**-**	**0.38**
Available	-	2.00
Additional Storage Needed	-	0.00

2 - Standby Storage is not required as Ammon has enough well capacity with backup power to provide average day demand (ADD).
3 - Should be no less than 10% of total storage volume. Represents the difference between pump ON and pump OFF. For Zone 1, operational storage currently used by the City is shown for 2016 (about 50%). The City has indicated that it would like to maintain operational storage of at least 25% to minimize pump cycling. 25% has been assumed for 2037 in Zone 1 and for all other zones.

Recommendations

We recommend constructing 2.6 MG of additional storage in the Zone 1 to satisfy equalization storage needs through 2037. Add 1 MG of storage for every 2,800 additional people. Rehabilitating the tank at Well 6 could provide 0.5 MG of storage.

6.3 DELIVERY ANALYSIS

The delivery evaluation consists of determining whether the system can deliver the larger of maximum day demand (MDD) plus fire flow as required in IDAPA 58.01.08.501.18.a, or peak hour demand (PHD)[2]. We evaluated delivery requirements by zone, but allowed zone to zone transfers to meet emergency conditions.

For system wide analysis worst-case scenario conditions were assumed. The worst-case scenario conditions are when all of the operational and equalization storage of the system has been depleted. This limits the delivery of the system to the allotted fire suppression storage in the tank and the direct supply from the remaining wells.

Table 6.14 compares existing and projected MDD plus fire demands with PHD in Zone 1. PHD was determined by multiplying the hourly peaking factor from the City's diurnal demand curve (see Figure 3.1) by MDD. We used the PHD in the Zone 1 delivery evaluation, because it is greater than MDD plus fire demand.

[2] Idaho Department of Environmental Quality. (2016). Idaho Rules for Public Drinking Water Systems. Retrieved June 12, 2017 from https://adminrules.idaho.gov/rules/2016/58/0108.pdf

Table 6.15: Zone 1 Peak Demands

Demand Type	2016 (gpm)	2037 (gpm)
Fire Demand	3,500	3,500
MDD	10,590	14,400
Total MDD + Fire	14,090	17,900
PHD	**15,052**	**20,970**

Table 6.16 shows delivery capacity of Zone 1. Zone 1 is supplied from Wells 2, 3,5,7,8,9,10, and 11. Since Well 8 has the largest pumping capacity in Zone 1, it was excluded from the analysis to reflect firm pumping capacity as defined in Chapter 3.

Table 6.16: Zone 1 Delivery

Delivery Component	2016 (gpm)	2037 (gpm)
Well 2	325	325
Well 3	500	500
Well 5	1,000	1,000
Well 7	1,850	1,850
Well 8[1]	4,200	4,200
Well 9	1,850	1,850
Well 10	3,000	3,000
Well 11	3,000	3,000
Tank Fire Suppression Storage[1]	3,500	3,500
Total Delivery	**19,225**	**19,225**
Largest Pump Off Line	4,200	4,200
Firm Pumping Capacity	15,025	15,025
Surplus/(Deficit)	(27)	(5,945)

[1]The Hill Tank and Well 8 Tank can provide fire flow if operated such that fire suppression storage is available. For the Zone 1/System-wide analysis, the booster pumps at Well 8 were not included, as worst-case conditions were assumed at the tanks (operational and equalization storage depleted), limiting their capacity to that contributed by fire suppression storage and the wells supplying them.

Zone 1 needs an additional 27 gpm of delivery now and 5,945 gpm by 2037 in the form of increased transmission line size, additional storage, booster pumps and/or wells in order to provide peak flow requirements. The Well 6 compound could be utilized to satisfy the delivery needs of Zone 1 if it were operational.

Table 6.17 compares MDD plus fire with PHD demands for Zone 2. Since the PHD was less than MDD, MDD was used in the evaluation of Zone 2 delivery needs.

Table 6.17: Zone 2 Peak Demands

Demand Type	2016 (gpm)	2037 (gpm)
Fire Demand	1,500	1,500
MDD	870	1,210
Total MDD +Total	**2,370**	**2,710**
PHD	1,426	1,570

Table 6.18 shows Zone 2 delivery capacity. Zone 2 is supplied through the Well 9 booster pumps pulling from the Hill Tank, and can also be supplied through a bypass straight from Well 9 for emergency situations, though at substandard pressure. The largest pump in Zone 2 is one of the Well 9 booster pumps. The pump produces 2,000 gpm. As shown in Table 6.18 the delivery capacity of Zone 2 is adequate now and for 2037.

Table 6.18: Zone 2 Delivery

Delivery Component	2016 (gpm)	2037 (gpm)
Well 9 Boosters	5,200	5,200
Total Delivery	**5,200**	**5,200**
Largest Pump Off Line	2,000	2,000
Available Pumping Capacity	3,200	3,200
Surplus/(Deficit)	830	490

Table 6.19 compares MDD plus fire demands with PHD in Zone 3. Since MDD plus fire suppression demands are greater than PHD, MDD is used in the evaluation of delivery capacity of Zone 3.

Table 6.19: Zone 3 Peak Demands

Demand Type	2016 (gpm)	2037 (gpm)
Fire Demand	1,500	1,500
MDD	260	970
Total MDD + Fire	**1,760**	**2,470**
PHD	377	1,390

Table 6.20 summarizes the delivery capacity in Zone 3. Zone 3 is supplied by the Hill Tank's Zone 3 and Zone 5 Booster pumps. The Zone 5 booster pump is designed to provide fire flow to Zone 3. The largest pump offline for Zone 3 is the Hill Tank's Zone 5 booster pump. The capacity for this pump is 2,000 gpm. As shown in Table 6.20, Zone 3 meets the delivery capacity requirements now and for 2037.

Table 6.20: Zone 3 Delivery

Delivery Component	2016 (gpm)	2037 (gpm)
Hill Tank Zone 3 Boosters	1,680	1,680
Hill Tank Zone 5 Boosters*	3,500	3,500
Total Delivery	**5,180**	**5,180**
Largest Pump Off Line	2,000	2,000
Available Pumping Capacity	3,180	3,180
Surplus/(Deficit)	1,420	710

Table 6.21 compares PHD with MDD plus fire in Zone 4. Zone 4 is not currently active. As shown in Table 6.21, MDD plus fire flow demand is greater than PHD. MDD was used in the analysis of the delivery capacity for Zone 4.

Table 6.21: Zone 4 Peak Demands

Demand Type	2016 (gpm)	2037 (gpm)
Fire Demand	1,500	1,500
MDD	-	620
Total MDD + Fire	**1,500**	**2,120**
PHD	-	880

Table 6.22 summarizes the delivery capacity of Zone 4. Zone 4 is supplied by Zone 4 and 5 booster pumps. The Zone 5 booster pump is designed to provide fire flow to Zone 4 in emergency situations. The largest pump in Zone 4 is the 2,000 gpm Zone 5 booster pump. As shown in Table 6.22 Zone 4 has adequate delivery capacity now and in 2037.

Table 6.22: Zone 4 Delivery

Delivery Component	2016 (gpm)	2037 (gpm)
Hill Tank Zone 4 Boosters	1,680	1,680
Hill Tank Zone 5 Boosters*	3,500	3,500
Total Delivery	**5,180**	**5,180**
Largest Pump Off Line	2,000	2,000
Available Pumping Capacity	3,180	3,180
Surplus/(Deficit)	1,680	1,060

Table 6.23 compares MDD plus fire flow demand with PHD for Zone 5. Zone 5 is currently not active. MDD plus fire flow demand is greater than PHD, therefore MDD is used in the delivery capacity analysis.

Table 6.23: Zone 5 Peak Demands

Demand Type	2016 (gpm)	2037 (gpm)
Fire Demand	1,500	1,500
MDD	-	360
Total MDD + Fire	**1,500**	**1,860**
PHD	-	520

Table 6.24 shows the delivery capacity of Zone 5. Zone 5 is supplied through the four Zone 5 booster pumps. The largest booster pump in Zone 5 produces 2,000 gpm. The Zone 5 booster pumps are connected to an emergency power supply. Table 6.24 shows Zone 5 has adequate delivery capacity now and in 2037.

Table 6.24: Zone 5 Delivery

Delivery Component	2016 (gpm)	2037 (gpm)
Hill Tank Zone 5 Boosters*	4,980	4,980
Total Delivery	**4,980**	**4,980**
Largest Pump Off Line	2,000	2,000
Available Pumping Capacity	2,980	2,980
Surplus/(Deficit)	1,480	1,120

*Zone 5's two 2000 gpm boosters were designed with the intent of also providing fire flow to Zones 3 and 4 through PRVs. As use of these PRVs is undesirable under regular system conditions, the contribution of these two pumps was limited to meeting the redundancy requirement and providing the stated fire flow.

Recommendations

Keller Associates recommends that the City add 5,900 gpm pumping capacity by 2037 for Zone 1. This equates to about 3,000 gpm of capacity added for each additional 3,000 people added to Zone 1. Pumping capacity could be addressed by bringing the Well 6 booster station online or another well or tank project.

6.4 SUMMARY OF RECOMMENDATIONS

The recommendations resulting from the supply, storage, and delivery analyses are summarized in Table 6.25. Improvement alternatives designed to address these recommendations are developed in Chapter 7.

Table 6.25: Supply, Storage, & Delivery Recommendations

System Component	Recommendations
Water Supply	1. Need additional Firm Capacity now (200 gpm deficit) 2. Deficit projected to increase to 5,600 gpm by 2037 population target of 21,432 people in service area 3. Add one 2,200 gpm well in Pressure Zone 1 for every 3,000 additional people Potential well locations: see Chapter 7
Water Storage	1. Need 1.6 MG in Zone 1 now to satisfy equalization storage needs 2. Deficit projected to increase to 2.6 MG in Zone 1 by 2037 population target (1.0 MG beyond current deficit) Potential storage tank locations: see Chapter 7
Water Delivery	1. Delivery currently at capacity in Zone 1, surplus in other zones 2. Add 5,900 gpm pumping capacity in Zone 1 by 2037 population target 3. Equivalent to adding 3,000 gpm for every 3,000 person increase in Zone 1 Potential pumping locations: see Chapter 7

7 IMPROVEMENT ALTERNATIVES

This chapter outlines the development and screening of specific supply, storage, delivery, and transmission improvement alternatives proposed to address the deficiencies identified in Chapters 5 and 6. In addition to construction of new facilities, this chapter evaluates whether optimization of existing infrastructure is an option and what the consequences of taking no action might be.

7.1 REGIONALIZATION

Ammon's water system is surrounded by four adjacent water systems: Idaho Falls to the west, Falls Water Company to the north, Comore Loma Water Corporation, and Blackhawk Water to the southeast. Comore Loma and Blackhawk are located in close enough proximity that a regionalization effort would be attractive, though this may be an option later on if the two systems expand to touch each other. Falls Water provides service to certain areas of Ammon that were previously unannexed (see Figure 1.1). At this point, no serious discussion of a possible regionalization effort between Idaho Falls, Falls Water, and/or Ammon has taken place. With no need for a centralized treatment facility in any of these systems, storage and supply assets are localized and there would likely be little "economy of scale" type of benefit to regionalizing. This alternative will not be considered further.

7.2 SUPPLY ALTERNATIVES

These alternatives address the deficit between firm capacity and maximum day demand.

7.2.1 No Action

The City's supply firm capacity is currently at a slight deficit as compared to maximum day demand. Without additional sources of supply or a reduction in demand, the system will be out of compliance with state regulations. In this scenario the City would not be able to issue a "Will Serve" determination to new development seeking access to the municipal water system, essentially stopping further growth.

7.2.2 Optimization of Existing Facilities

There are multiple options available to maximize the impact of Ammon's existing supply infrastructure:

Water Metering: Ammon's current metering status was discussed in Chapter 1. The City is currently pursuing the implementation of a flow-based user rate and anticipates that a reduction in demand will follow. Knowing that the volume consumed directly impacts one's bill tends to incentivize conservation. Keller Associates has seen such results in multiple communities throughout the region that have taken a similar course of action (as much as 20-30% in some cases). As the actual long-term reduction in demand resulting from a flow-based rate is uncertain, its effects have not been included in the evaluation made by this study.

If significant usage reduction is achieved, this could serve as a short term supply deficit solution; however, reductions are not likely to be sufficient over the entire 20-year planning horizon. If the City adopts a flow-based rate, change in usage should be tracked over several years (once customer usage patterns have stabilized) to determine the long-term impacts to per capita demand. The future demands presented in this study could then be decreased accordingly, if appropriate, effectively prolonging the sufficiency of any new supply constructed to meet current deficiencies.

Public Education and Resources: The Ammon Parks Department is currently preparing materials for educational efforts to help residents better understand the irrigation needs of their yards. Information regarding water-conscious landscaping practices will also be presented. Though the ultimate impacts of education outreach are hard to anticipate, these efforts address the direct cause of high summertime usage: landscape irrigation.

Well 6: The City commissioned a study in 2014 to evaluate the viability of rehabilitating Well 6[1]. It was found that rehabilitating the well would be more cost effective than replacing it. This would entail installation of a screen and filter pack to eliminate the sand problems. Demolition and reconstruction of the well house would be required for well access. Although the well could be redesigned to directly supply the system, given the urgent need for additional storage capacity it is unlikely that this source would be rebuilt without also rebuilding the adjacent tank and booster station.

7.2.3 New Sources

Surface water is rarely given serious consideration as a source of drinking water in southeast Idaho due to the high quality and relative abundance of groundwater. Ammon has no significant rivers or lakes from which surface water could be drawn. New water sources are currently limited to ground water. As the need for new supply through 2037 is entirely in Zone 1, any new wells should be located such that they can supply that zone.

New Well to Feed Hill Tank: The City reports that during peak summer usage, Well 9 and Well 11 (which are intended to be the main source of supply for the Hill Tank) struggle to keep the tank full. One new well option would be to consider a location that could help maximize the use of the Hill Tank.

New Well at Woodland Hills: The hydraulic model revealed that the system is particularly sensitive to a supply failure on the south side of town (see Chapter 5). If Well 10 is offline then pressure suffers extensively during a fire event. Placing a new well on the south end of the system would help to address this vulnerability. It is likely that the fill/drain issues at the Hill Tank mentioned above would also be improved by a well to the south, as the tank's gravity line on Sunnyside Road is currently a primary source of supply for the south side of the system.

The population center of this area of Ammon is currently the Woodland Hills subdivision. There are near-future plans for additional growth adjacent to this subdivision as well. A well placed in this vicinity would directly address PHD and fire flow issues in the area (whether as a stand-alone source or as part of a tank and booster station).

For these reasons, a well south of Sunnyside Rd at Woodland Hills is considered to be the most advantageous location for new storage.

7.2.4 Initial Screening of Supply Alternatives

An initial evaluation of the previously described alternatives was made to eliminate alternatives that were not feasible or had significant environmental or other concerns. This evaluation is summarized in Table 7.1.

[1] Keller Associates, Inc. (2014). "Well 6 Pump Station Evaluation," #213072-000, Idaho Falls, ID.

Table 7.1: Initial Screening of Supply Alternatives

Alternative	Viable?	Comments
No Action	No	Placing a moratorium on growth is undesirable.
Optimization	Yes	**Metering**, **education**, and **rehabilitation of Well 6** are all viable alternatives and could all be pursued simultaneously. For Well 6, environmental impacts would be those typical of demolition and construction. This would capitalize on existing infrastructure assets and provide a strong source in Ammon's oldest neighborhoods.
New Sources	Yes	A single productive new well would likely provide sufficient firm capacity for at least the first half of the planning horizon. As will be discussed in the next section, an **additional hill tank** is unlikely. A new source is badly needed on the south side of town to minimize system vulnerability and address fire flow and PHD issues. A **new well south of Sunnyside Rd** is the preferred alternative.

7.3 STORAGE ALTERNATIVES

These alternatives address the current shortage of water storage in Ammon's system for equalization and fire suppression.

7.3.1 No Action

The City currently has a severe storage deficit and has already felt their capacity strained at times during the past couple summers. Taking no action will not only limit the system's ability to serve any additional growth, but will ensure that the current equalization and fire suppression storage deficiencies continue to get worse. This alternative is not considered to be an option.

7.3.2 Optimization of Existing Facilities

Two options exist for optimization of existing storage facilities:

Decrease Operational Storage: The amount of operational storage used by the City was previously discussed in Chapter 6. It may be possible for the City to increase available equalization and fire suppression storage by decreasing the amount of operation storage used to as low as 10% (minimum recommendation). The Public Works Department has indicated that they would like to stay at around 25% (the system currently uses around 50%). There has been some concern however regarding the system's physical ability to decrease operational storage. City staff report that Well 9 runs 50% of the time and Well 11 runs nearly continuously during peak summer usage to try and keep the tank filled. Additionally, even if the City were able to reduce operational storage down to the minimum of 10% there would still be a shortage of approximately 300,000 gallons in total.

Rehabilitation of Tank at Well 6: The 500,000 gallon tank at Well 6 was found to be in structurally sound condition when it was inspected by Keller Associates in 2013. This is an existing asset to the City that will only deteriorate further if left unused. Bringing this tank back online would require rehabilitation or replacement of Well 6 to fill it and the adjacent booster station to deliver its volume to the system.

7.3.3 New Storage Tanks

New storage facilities could be constructed to make up the current 1.6 MG storage deficit. As discussed in Chapter 6, new storage addressing future growth should be positioned to service Zone 1 unless additional storage is needed in Zones 2, 3, 4, and 5 as a result of limited firm capacity. Possible locations considered include:

Well 6 Complex: In addition to the rehabilitation of the existing 500,000 gallon tank at Well 6, there is adjacent City-owned property to the north that could host a new tank of approximately the same size. This tank would supplement the existing tank’s capacity and would only be feasible if the other improvements at Well 6 were completed. The advisability of a second tank at Well 6 may depend in part on the production rate of Well 6 after it has been screened to limit sand production. It should be noted that rehabilitating the tank at Well 6 adds storage to the system, but is not enough to correct the immediate storage deficiency by itself.

Tank Above Hill Tank: Original concepts in previous studies for the pressure zones on the hill included the eventual completion of another hillside tank, higher in elevation than the first. This tank could gravity feed the upper pressure zones if located high enough in elevation. It could also serve as a supply for future zones constructed further up the hill from Zone 5. Such a tank would only be suited to supplying the upper pressure zones without burning excessive energy through Pressure Reducing Valves (PRV’s) to reach Zone 1. Presumably, greater pumping head would be required to fill this tank, whether from existing sources or from the development of a new groundwater source. With the Hill Tank Booster Station already sized to meet the buildout needs of Zones 2, 3, 4 and 5, it appears that the pumping head associated with this alternative renders it impractical.

Tank Level with Hill Tank: If left open to the distribution system, a new tank set at equal elevation with the existing Hill Tank would “float” on the system pressure set by the Hill Tank, filling and draining based on system demands. The tank would need to be designed such that a master-slave relationship existed between it and the Hill Tank, so that one doesn’t fill and drain preferentially over the other. It may be preferable to fill the tank directly from an adjacent well. A new well on the hill would likely have to be a deeper well than one on the valley floor making it more expensive to construct, and the pump would have a deeper setting making it a more expensive pump.

Tank at Woodland Hills: As was noted for the supply alternatives, the south side of Ammon is home to relatively little water infrastructure. Placing a tank here would add an element of resiliency by spreading storage more evenly across the city. It would also allow for a booster station to be constructed in order to address the critical fire flow and peak hour delivery deficits identified for this area in Chapter 5. City officials predict that the majority of growth in Ammon will occur to the south. A tank placed south of Sunnyside Road would be better able to directly serve these areas of growth. As was discussed in the delivery section, Woodland Hills is a hydraulically beneficial location for this improvement alternative. A tank in this location could be sized to address all of the current storage deficiency (1.6 MG) in the system. As a result, improvements at Well 6 could be postponed until additional growth occurs.

7.3.4 Initial Screening of Storage Alternatives

An initial evaluation of the previously described alternatives was made to eliminate alternatives that were not feasible or had significant environmental or other concerns. This evaluation is summarized in Table 7.2.

Table 7.2: Initial Screening of Storage Alternatives

Alternative	Viable?	Comments
No Action	No	The severe lack of fire suppression storage in the system is not considered acceptable.
Optimization	Partially	**Operational storage** can be modified with no cost to the City as a non-exclusive short term solution. The **Well 6 Tank** has been previously evaluated and deemed to be a cost effective means of adding storage to the system. This alternative would capitalize on existing infrastructure assets and provide key infrastructure in Ammon's oldest neighborhoods. However, it would only relieve a third of the existing storage deficiency.
New Storage	Partially	A **tank above the existing Hill Tank** has minimal benefits unless future growth continues to push further above Zone 5 or the demands in Zones 3-5 grow to exceed what is available at the Hill Tank. A **tank level with the existing hill tank** would provide valuable storage, however its location would require higher construction costs. Either of these first two options would likely be located on previously undeveloped land. Placing a **new tank at Woodland Hills** (with associated well and booster station) would add a critical source to this underserved area of the system where significant growth is also expected. A new tank here could be sized to correct the entire storage deficit (1.6 MG). This tanks site would likely be a conversion of agricultural property. **A second tank at Well 6** could capitalize on the available well (if rehabbed) and has land available. It would be limited in size to approximately 0.5 MG.

7.4 DELIVERY ALTERNATIVES

Ammon's water system currently has an overall delivery deficit of 27 gpm with that number growing to 5,945 gpm by 2037. In addition to this analysis from Chapter 6, the hydraulic modeling in Chapter 5 identified specific areas that struggle to meet required pressures during certain demand scenarios. This section discusses alternatives for addressing these issues.

7.4.1 No Action

If no action is taken to address the fire flow and peak hour demand (PHD) pressure deficiencies identified in Chapters 5, Ammon's water system will be out of compliance with state code in some locations regarding required PHD operating pressures. Zone 2 would continue to see excessive pressure on one end and low pressures on the other. The system will be unable to reliably supply fire flows without dropping system pressures below minimum limits as prescribed by the state code (see Chapter 3 for discussion of required system pressures). No additional growth in Ammon could reasonably be accommodated in this scenario.

7.4.2 Optimization of Existing Facilities

Well 6 Booster Station: As has been mentioned in the Supply and Storage sections, the City may be able to realize some cost savings by rehabilitating the inoperative Well 6 Tank and Booster Station site. If the well and tank (and possible second tank) are brought online, a rebuild of the booster station would be required to access the stored water. This site is strategically located near major transmission lines.

Pump Set Points: One pumping and delivery trend that was observed to contribute to high demand pressure problems is the descending nature of the pump set points in Ammon's booster stations. Table 7.3 list the pump set points in all three of Ammon's currently operational booster stations:

Table 7.3: Booster Station Pump Set Points (as of September 2017)

Pump Station	Set Points (psi)				Pressure Drop from Lead to Final Lag
	Lead	Lag 1	Lag 2	Lag 3	
Pump Station 8	79	75	72	-	7
Pump Station 9	93	88	80	64	29
Hill Tank Zone 3[1]	84/90	80/86	65/71	-	19
Hill Tank Zone 4[2]	74	65	58	-	16
Hill Tank Zone 5	70	60	45	40	30

[1] Set points were modeled at 6 psi higher than shown in SCADA (see the calibration section of Chapter 5)
[2] Zone 4 Pumps are not currently active
[3] Only the two 2,000 gpm fire pumps (Lag 2 and Lag 3 here) are currently active

City staff report that these descending set points were initiated avoid frequent on and off cycling of pumps; however, once the next lag pump in line is activated the pressure target for the entire pump battery is reduced to its set point. For example, in Zone 2 (Pump Station 9) pressures are maintained at acceptable levels when only the lead pump is running, but if the final two (larger) pumps are brought on to meet peak demands, the pressure target for the boosters as a group is reduced to 64 psi. If the set point on the Lag 3 pump were set to 74 psi, zone performance would improve by 10 psi while still maintaining a 6 psi buffer between set points.

In areas where maintaining pressure during high demand is an issue, pump set points should be grouped as closely as possible to minimize pressure drop. The City may wish to look at what would be necessary from a programming standpoint to have sets of booster pumps to share a single desired set point. Additional pumps would then be turned on or off depending on whether the SCADA determines that the set point is being met.

Chapter 5 documented how Zone 3 failed the maximum day plus fire flow modeling scenario because the lowest set point of the Zone 3 Boosters is lower than sufficient to produce passing pressure. If these set points could be more closely grouped around that of the lead pump, or all serve with the same set point, the fire flow failures disappear. If this is not practical, the Zone 5 set points and the PRV connecting Zone 5 to Zone 3 should be evaluated and set so that the Zone 5 fire pumps are capable of contributing to Zone 3 flows. Supplementation from the Zone 5 pumps will become more necessary as Zone 3 approaches buildout.

Metering, Conservation, and Public Outreach: These alternatives, described previously in Section 7.2.2, could also serve to extend available delivery capacity by reducing maximum day demand and peak hour demand. Again, the impact of these alternatives is uncertain and would need to be observed over a number of years. This could serve as a short term delivery solution if significant reductions are seen, but is not likely to be sufficient over the whole 20-year planning horizon.

7.4.3 New Delivery Infrastructure

The overall delivery deficit of 27 gpm in 2016 and 6,135 gpm by 2037 can be addressed by adding more pumping capacity to the system. This results from three possible scenarios: construction of new wells, construction of booster pumping stations at tanks, or gravity flow from elevated tanks.

New Wells: Any wells added to the system would increase delivery capacity if they pump directly to the system. If a new well is designed to pump only into a tank then its production capacity is not counted towards delivery as that water is actually delivered to the system via booster pumps, or gravity flow in the case of an elevated tank. While the effects on delivery of constructing new wells should be kept in mind for future supply projects, it is likely that one new well installed in the near future would be built in connection with a tank project, given the pressing need for additional storage.

Woodland Hills Booster Station: Unless the City elects to build another elevated tank on the hill, a tank in Zone 1 would require a booster station to pressurize the stored water. The booster station would be sized appropriate to the size of the tank and the production capacity of the well that fills it. As described in previous sections, a well, tank, and booster facility could be strategically placed near the Woodland Hills Subdivision. The hydraulic model was used to compare the performance of different means of supplying Woodland Hills. In a comparison of a booster station on the south end of the existing subdivision and further south on Township Road, the location adjacent to Woodland Hills provided the best fire flow performance. This location is just south of Tawzer Way where the developer has indicated there are options for a tank site.

The Cottages Booster: One other location where a booster station was considered was on Sunnyside Rd with a connection to the Cottages. If optimization efforts are unsuccessful or unsustainable, a new booster station that draws from the Sunnyside gravity line with PRV's at the bottom of the Cottages could be constructed to create a sub-pressure zone at The Cottages. The model suggests that while pressure problems in the Cottages are partly due to elevation, pressure can be improved by improving transmission to the area. A gravity line from Sunnyside to the Cottages and opening the bypass at Well 11 were two alternatives that were modeled that would improve performance in that area. As a result the construction of a booster station for the cottages is not recommended unless either of those options proves infeasible or ineffective.

Add Pumps to Existing Booster Station: In some cases it may be possible to add to existing pumping capacity. While it does not appear that any of the existing booster stations were designed with expansion in mind, the City may wish to consider phased pump installation options for future projects. Zones 2, 3, 4, and 5 have sufficient booster flow capacity to meet demands through 2037. The only booster station currently serving Zone 1 is at the Well 8 Tank. Without adding a new well to feed the Well 8 Tank, it is unlikely that any real benefit would be gained from adding pumping capacity there.

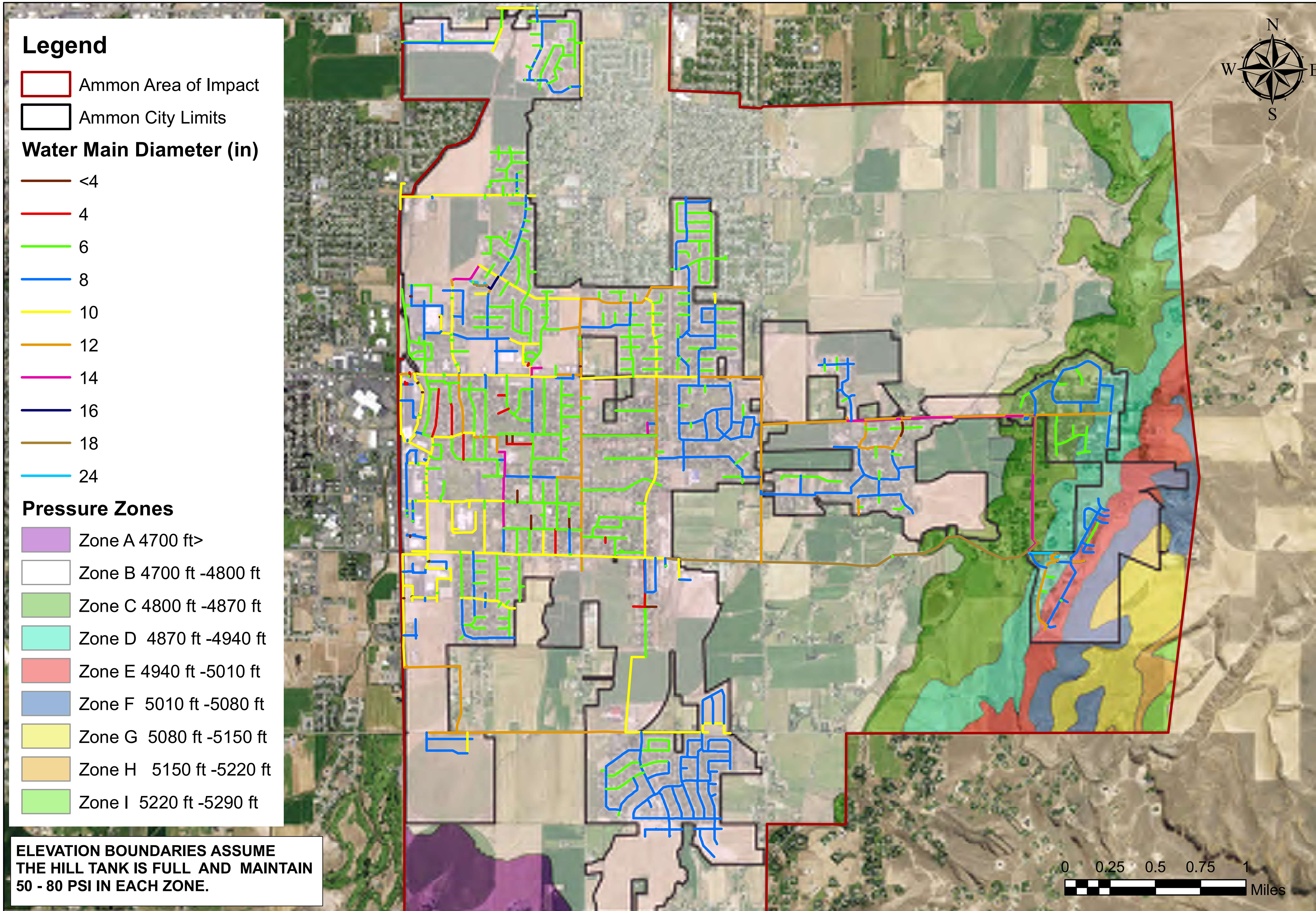
One alternative for addressing pressure problems in Zone 2 would be to deliver higher pressure flow directly to the top of the zone by adding a pump(s) to Pump Station 9 and a dedicated line on 21st Street. It was hoped that friction losses in the distribution lines between the top and bottom of the zone would reduce excess pressures at the bottom. This occurred to a slight degree within the model; however, when the top was pressurized to 40 psi at PHD, pressures in the lower portion of the zone were still experiencing pressures of 89 psi during ADD. While still higher than IDEQ's standard of 80 psi max for normal operation, this represents a 5 psi drop from current operations (see pressure results included in Appendix D as "Supply from Top of Quail Ridge").

One caution with this solution is that different sets of pumps with different target pressures located within a small zone may battle for control of system pressure and may not pump efficiently together. It has also been our experience that such systems are prone to large pressure fluctuations due to varying daily demand patterns.

Individual Pressure Regulators in Zone 2: As stated in Chapter 3, state code requires that system pressures be restrained to not *regularly* exceed 80 psi. Existing high pressures on the low end of Quail Ridge during average day demand will only become more frequent during high demand times if alternatives are selected that raise peak hour pressures at the high end of the zone. One way to address these resulting high pressures is the installation of individual pressure regulators on each service that is expected to exceed 80 psi. Based on a scenario in which zone pressures are raised to meet PHD needs and no seasonal changes are made to pump settings, approximately 62 properties in Zone 2 would need individual pressure regulators to stay at or below 80 psi during ADD.

7.4.4 Pressure Zone Boundary Adjustments

Chapter 5 noted how the PHD and Fire Flow issues in the Zone 2 (Quail Ridge) highlight the difficulty of serving a pressure zone that spans such a large range of elevations (approx. 107-foot difference). Producing a standard pressure of 60 psi at the top of this range results in a static pressure of 106 psi at the bottom. The upper pressure zones' boundaries were developed partly based on the location of existing or proposed housing developments. As the Hill Tank sets the pressure for Zone 1, an analysis was made of where pressure zone boundaries would naturally fall based on ground contours, the Hill Tank's full water level, and zones maintaining pressures between 50 psi and 80 psi (roughly a 70-ft elevation difference in each zone). Figure 7.1 shows what such boundaries might look like.



Prepared for: City of Ammon

Keller Associates

Project: Water Facilities Planning Study

Keller Project: #216102-000

Title: Theoretical Pressure Zone Boundaries

Figure: 7.1

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Print Date: 3/22/2018

While these boundaries are approximations only, they give a sense of the location and size of naturally progressing pressure zones. Figure 7.1 shows that The Cottages are well within Zone 1's service boundary, indicating that fire flow and peak hour failures there are not as much a result of elevation as they are dead ends and transmission deficiencies.

Zone 3 (Founder's Point/Hawk's Landing) would also straddle two pressure zones as shown here; however, it's actual boundaries are somewhat shifted, as pump set points move the boundaries to closer align with the boundaries of existing development. When set by pumps, zone boundaries can be adjusted to any desired elevations. The City should keep in mind that from a future development standpoint, a standardized pressure zone plan would keep the total number of zones (and thereby complexity and cost) to a minimum.

As expected, Quail Ridge covers more than a full pressure zone. One way of permanently addressing the pressure disparities within the existing zone would be to split it into two separate pressure zones. This would allow for a more consistent and desirable range of pressures within the two zones. The Zone C and Zone D boundaries shown in Figure 7.1 were used as the basis for the zone split concept shown in Figure 7.2.

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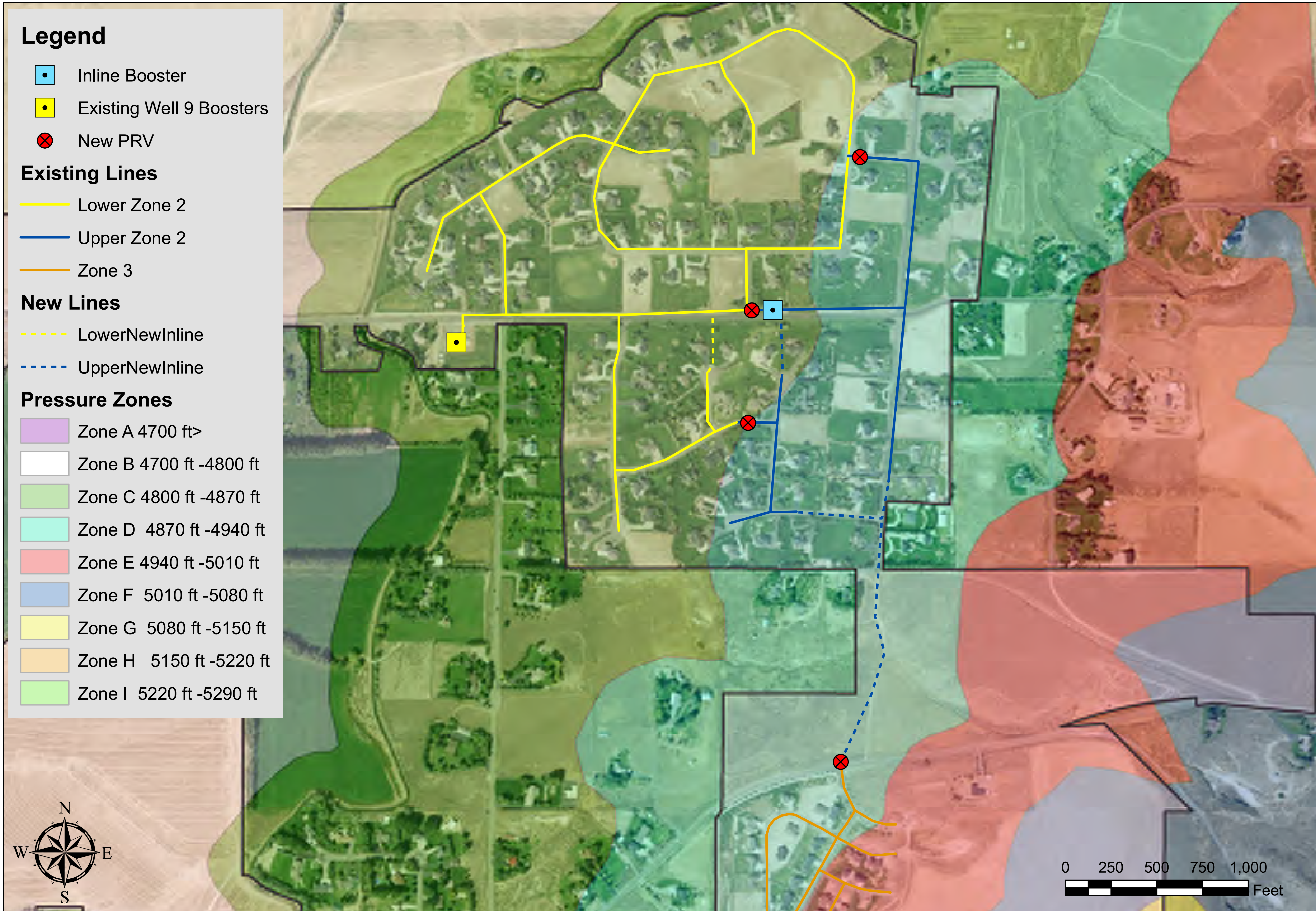

Prepared for: City of Ammon

Keller Associates

Project: Water Facilities Planning Study

Keller Project: #216102-000

Title: Zone 2 Split Alternative

Figure: 7.2

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Print Date: 3/26/2018

This concept involves pumps sized to the MDD of the new upper zone being added to Pump Station 9. A new dedicated line would then be run up 21st Street to Hungarian Way, where the existing 12-inch line would be split with a PRV to form the zone boundary and allow for emergency transfers. Three additional PRVs would be placed as shown to further separate the two zones.

It may be possible to avoid oversizing pumps for fire flow or needing additional fire flow pumps for the upper zone if the pumping capacity of Zone 3 (roughly 1,000 ft south of Foothill Rd) could be accessed. There is a small gulley that would need to be crossed to accomplish this. This should not pose any major difficulty for construction as the topographic relief is approximately 36 feet from Sunnyside to the bottom of the gulley and the area is already crossed by an unimproved dirt road.

A PRV located at the connection point on Sunnyside Rd would allow interzone transfers in the case of a fire event in upper Zone 2. While the combination of Zone 3 pumps and new MDD pumps for upper Zone 2 should be more than enough for to cover a fire event in upper Zone 2 and MDD in both zones, the Zone 5 pumps will still be set up to supplement these two zones through their PRV into Zone 3.

A variation on the alternative to install additional booster pumps in the Well 9 pump station would be to install inline booster pumps in 21st Street above Hungarian Way. Pressure reducing valves would be installed in the locations described earlier. Booster pumps in this location would boost system pressure from 65 psi to 90 psi. These pumps would be sized to pump 500 gpm each to meet peak hour demand for the homes in upper Zone 2. These pumps would be 10 hp each. Benefits of inline booster pumps include no need to install a parallel line in 21st Street, no need modify the Pump Station 9, and the pumps can take advantage of the system pressure from the boosters at Pump Station 9, and can thus be much smaller. It would be necessary to purchase a small amount of property along 21st Street, but if a pitless booster station were used with submersible pumps, the footprint of the station would be fairly small, perhaps 15’ X 15’, would not require a building, and the pump panel could be mounted on unistrut in a fenced enclosure.

7.4.5 Initial Screening of Delivery Alternatives

An initial evaluation of the previously described alternatives was made to eliminate alternatives that were not feasible or had significant environmental or other concerns. This evaluation is summarized in Table 7.4.

Table 7.4: Initial Screening of Delivery Alternatives

Alternative	Viable?	Comments
No Action	Partially	While not addressing low/high pressures in the system does not bring the system into conformance with state code requirements, the affected areas are accustomed to these suboptimal conditions. No action may be tolerable in the short term, but is not recommended as a long term solution.
Optimization	Yes	**Improvements at Well 6** and **metering** and **educational efforts** are viable alternatives for reasons previously discussed. **Adjustment of pump set points** requires no capital cost and can quickly be evaluated for effectiveness.
New Delivery Infrastructure	Partially	A **new well** or a **new booster station** is likely to happen in conjunction with a tank project. A **new booster station serving The Cottages** could be a viable alternative if the optimization alternative described in Section 7.5.2 proves to be insufficient. **Adding pumps to supply Zone 2** addresses low pressure problems, but exacerbates the zone's high pressure issues. If combined with installation of **individual pressure regulators**, this option may be viable; however, this alternative may result in undesirable pressure swings. Consequently, the Zone 2 boundary change alternative is preferred.
Zone Boundary Changes	Yes	This alternative would be a permanent solution to Zone 2's pressure issues and would allow both new zones to maintain more desirable pressures. Environmentally, this alternative would involve construction on undeveloped land and would potentially open up some of the adjacent unserved areas to service.

7.5 DISTRIBUTION SYSTEM ALTERNATIVES

7.5.1 No Action

The no action alternative, in the case of distribution, results in no observable benefit to the City. Physical condition of aged pipes will continue to deteriorate and areas with flow restrictions or pressure issues will continue to fail fire flow and peak hour situations.

7.5.2 Optimization of Existing Infrastructure

The only real alternative for optimizing existing infrastructure from a distribution standpoint is the operation of PRV's and other valves:

The Cottages and Quail Ridge: The water department has already been experimenting with system changes to improve the pressures in these two areas during high demand times. A valve was closed on the gravity transmission line coming down from the Hill Tank on 21st Street. This line is currently the only source of supply for Pump Station 9 and City staff closed the valve just downstream of the booster station as it was thought that demands further downstream were starving the supply to the boosters.

The City has also tried to boost pressure in The Cottages by supplementing flow available to the area with water released through the Well 11 Bypass PRV. This practice does significantly improve pressure in The Cottages, but may be part of the reason why the Hill Tank struggles to fill during high demand, even with Well 11 running constantly.

The merits of dedicated lines between Well 11, Well 9, and the Hill Tank, versus an operational philosophy where both of the transmission lines in 21st St are interconnected was considered in order to determine the optimal valve configuration for this area. Model scenarios were run during PHD with combinations of the 21st St valve either open or closed and the Well 11 By-Pass closed, active (throttling to maintain pressure/flow setting), and full open. The results are summarized below in Table 7.5 and pressure maps showing the full results are included in Appendix D as "Operational Changes at The Cottages and Quail Ridge).

Table 7.5: Cottages and Quail Ridge Operational Changes

Scenario	Well 11 Bypass	21st St Valve	Interconnect at Well 9	Cottages Reference Point (southeast end of Tildy Ln)	Quail Ridge Reference Point (south end of Foothill Dr)
1	Closed	Open	None	32	31
2	Closed	Closed	None	20	41
3	Active	Open	None	40	36
4	Active	Closed	None	34	41
5	Full Open	Open	None	49	43
6	Full Open	Closed	None	50	41
7	Full Open	Open	Present	51	46

As shown in scenarios 3 and 4, under current operations closing the valve on 21st St boosts pressures in Quail Ridge by about 5 psi. The tradeoff with this operational maneuver is that The Cottages, downstream of the valve, sees a reduction in pressure of about 6 psi.

Both The Cottages and Quail Ridge performed worst with the Well 11 Bypass closed. The modeling results shown in scenarios 5-7 demonstrate that the best performance in both of these problematic areas results when the system is allowed to run open and interconnected. This arrangement boosts supply to The Cottages via Well 11 and performance at Quail Ridge improves as a result of improved pressure on the suction side of the boosters at Pump Station 9. Scenario 7 features a hypothetical interconnection at Well 9 between the two lines in 21st St so that they are interconnected at both The Cottages and the supply line into Pump Station 9. This interconnection does not currently exist, but further shows that these two areas perform better if the Hill Tank

One caveat to this arrangement is that raising pressures at Quail Ridge raises pressures at both the top and bottom, resulting in pressures as high as 94 psi at the west end of Pheasant Drive during average day demand. With the lead pump at Pump Station 9 set to maintain 93 psi, there is no difference between this arrangement and current operations at lower demands.

Another significant benefit that results from an interconnected transmission line concept was the change in pumping head observed in the model at Well 11. Under current conditions with the bypass active, Well 11, which turns on an off based on tank level, pumped out at 91 psi in order to push flow up to the Hill Tank. With the bypass full open and the valve on 21st St open, Well 11 produces flow at 73 psi. This is the result of Well 11having direct access to Zone 1 rather than forcing all of Well 11 flows through the transmission line to the Hill Tank. In this scenario, Well 11 can supply local demands directly while the remaining flows push up the hill to the Hill Tank. This reduces flow (and headloss) in the Hill Tank transmission line and improves supply to the Cottages. Well 11 runs closer to local zone pressures rather than at the head necessary to overcome frictional losses at higher flows through a dedicated transmission line. This results in greater pumping efficiency: cost is lowered as required head is lowered and the well is able to produce a higher flow rate as its operating point moves further down the pump curve. Preliminary estimates suggest the City could save $8,000/year in power costs with Well 11 pumping at 73 psi instead of 91 psi. Calculations are included in Appendix D.

One side effect of interconnected transmission lines to the Hill Tank is that the City loses the ability to chlorinate at Well 11 and Well 9 and pump the chlorinated water through a dedicated supply line to the tank where the required residence time can be achieved prior to the first service connection. However, if there were a contamination event, the interconnections could be closed and revert back to a dedicated transmission line that would allow disinfection to take place in the Hill Tank prior to distribution.

It is recommended that these preliminary modeling results be verified with field testing before any permanent implementation. Further model analysis could also be performed if additional questions remain.

7.5.3 New Distribution Infrastructure

The goal of new distribution infrastructure is to install new pipe as a means of solving system performance issues, or supplementing the solutions presented by pumping or storage improvements.

Replacements Based on Physical Condition: The oldest lines in the system, located in the Hillview and Original Townsite areas, were identified for replacement in an area-specific study completed by Keller Associates in 2016[2]. The Hillview neighborhood in particular has shown a high density of repair calls in the last four years (see Chapter 5). Replacement of these lines would provide a cost effective opportunity to install meters in these areas, which have relatively few meters installed. The City would also like to replace the existing 2-inch galvanized line in Aspen Lane, which is likely to be over 50 years old based on Figure 1.3. City staff have indicated that there are no other areas of the system that are of immediate concern in regards to pipe physical condition.

[2] Keller Associates, Inc. (2016). “Communities Master Plan,” #214026-000, Idaho Falls, ID.

Addition of Looping Lines: Ensuring that the system is adequately looped (fed from more than one pipeline) is essential to maintaining available flow, pressure, and water quality. Dead ends should be regularly flushed to avoid stagnation. Many of the PHD and fire flow failures observed were either the result of, or were exacerbated by, a lack of looping. The following locations are recommended for looping improvements:

- Fox Hollow
- 1st Street
- White Pine Charter School
- Lady Hawk Lane
- Foothill Road
- Ammon Road or Crowley Road from Sunnyside Road to Township Road
- Line connecting The Cottages to Sunnyside

Associated sizes and lengths are presented in the cost estimates for these improvements (Appendix E).

The line between Sunnyside Rd and Township Rd could be located at either Ammon Rd or Crowley Rd. as both provide a second transmission line to Woodland Hills and other areas served off of Township Rd. and the cost difference between the two would be minimal. The City has indicated it may have an opportunity to partner with Bonneville County on the road repair if placed in Ammon Rd. Placing the line in Crowley would hold a hydraulic advantage in that it would allow Woodland Hills to be fed from both the west and east. Under current conditions, a line break on Township Rd between Ammon Rd and Millcreek Ln would cut off all supply to Woodland Hills. A transmission line on Crowley would also improve resiliency by addressing this issue. It is likely that both roads will eventually include a transmission line as the area develops if the development guidelines in Section 3.5 are followed.

Replacements of Undersized Lines: The only undersized lines that were identified to have contributed to fire flow or PHD failures are in Hillview and Fox Hollow. The Hillview lines are slated for repair based on their age, as noted above. The deficiencies in Fox Hollow will be addressed through the addition of looping lines, so as to leave its relatively young 6-inch pipe in place.

7.5.4 Initial Screening of Delivery Alternatives

An initial evaluation of the previously described alternatives was made to eliminate alternatives that were not feasible or had significant environmental or other concerns. This evaluation is summarized in Table 7.6.

Table 7.6: Initial Screening of Distribution Alternatives

Alternative	Viable?	Comments
No Action	No	No benefits to the City.
Optimization	Yes	This represents a cost-free operational adjustment that could be used to improve pressures in these two areas in the short term. For The Cottages, adding a new booster station may become unnecessary if these operational changes are effective.
New Distribution Infrastructure	Yes	**Pipe replacement** was recommended in a previous study and provides an opportunity to further the City's metering goals. This alternative addresses infrastructure needs in Ammon's oldest neighborhoods. **Looping lines** improve pressure, flow, and water quality and would reduce vulnerability in the areas noted. Pressure issues are thereby addressed without additional pumping and energy use.

7.6 WATER RIGHTS ALTERNATIVES

The water rights exceedance shown in Figure 1.5 is an issue of top concern for Ammons' leaders. Water rights are a hot topic right now among many local government leaders and utility staff. In recent years "water calls" have been issued by senior water rights holders due to limited supply. With most of the senior water rights belonging to agriculture, municipalities are often vulnerable to these calls. Options available to the City in dealing with its current and future water rights deficits include:

7.6.1 Purchase Additional Water Rights

While it is possible to buy more water rights, the process is often lengthy and expensive. Available groundwater rights are limited. An analysis of water rights purchased by the City was used to estimate an approximate cost to purchase additional water rights. The five irrigation water rights for which purchase information was readily available cost an average of $289,851/cfs or $645,792/1,000 gpm.

Cost to Purchase Rights for 2016 Deficit (107 gpm) = $69,100
Cost to Purchase Rights for 2037 Deficit (6,992 gpm) = $4,515,380

These are numbers meant to provide perspective only. These purchases were made in the last 10 years. If the City elects to purchase water rights, thorough research into availability and cost will be required.

The City may have opportunities to acquire existing ground or surface water rights by requiring that new development support itself by transferring ownership of existing agricultural water rights for the property to the City. Groundwater rights are easiest to use by the City, but surface water rights may also be used to mitigate groundwater pumping. The transfer of water rights would have to include a transfer of ownership and location of points of use and points of diversion. The transfer is done through formal application to the Idaho Department of Water Resources and typically requires modeling using the Eastern Snake Plain Aquifer Model (ESPAM) to determine the impacts of the transfer.

7.6.2 Water Banking and Mitigation

In light of the recent water calls, options are being developed to mitigate the effects of water shortage. The City is currently investigating the merits of some of these options.

7.6.3 Reduce Peak Diversion Rate

The alternative to purchasing more rights is to reduce the City's diversion rate. While this would not forestall the need for more rights indefinitely, it could buy the City more time. The majority of Ammon's rights are limited by diversion rate rather than by volume. A reduction in pumping rate could be accomplished to a degree by encouraging irrigation habits that avoid running sprinklers at the same times of day (early morning hours typically). This has the effect of flattening the diurnal curve shown in Figures 1.5 and 4.3. The City could choose to have large irrigators (parks, schools, churches, etc.) water during off-peak hours. The drawback to this method is that these off hours are typically during the hottest parts of the day when irrigating is least efficient. More water would be used overall, but peak usage would decrease.

Of greater potential benefit would be the continued installation of meters and the implementation of a flow-based rate structure, as discussed in Section 7.2.2.

7.6.4 Initial Screening of Water Rights Alternatives

An initial evaluation of the previously described alternatives was made to eliminate alternatives that were not feasible or had significant environmental or other concerns. This evaluation is summarized in Table 7.7.

Table 7.7: Initial Screening of Water Rights Alternatives

Alternative	Viable?	Comments
Purchase More Water Rights	Yes	Though costly, additional water rights will ultimately be needed before the end of the planning horizon. Every chance to acquire rights from new development should be pursued.
Water Banking and Mitigation	Yes	Investigation of this alternative is beyond the scope of this study but is being spearheaded by the Mayor and City staff.
Reduce Peak Diversion Rate	Yes	This alternative relies on changing behavior. While possible, time and effort would need to be applied over multiple years to see results. This could be combined with other conservation efforts

7.7 FINAL SCREENING OF ALTERNATIVES

This section proceeds to identify which alternatives will be selected for inclusion in the Capital Improvement Plan.

7.7.1 Results of Initial Screenings

Table 7.8 provides a summary of the viable alternatives discussed in the respective initial screening in previous sections of this chapter.

Table 7.8: Summary of Initial Screening

Supply	Storage	Delivery	Distribution	Water Rights
Metering and Conservation Education	Operational Storage Adjustments	Metering and Conservation Education	Optimize Transmission to The Cottages and Quail Ridge	Metering and Conservation Education
Well 6 Rehab	Well 6 Tank Rehab	Optimize Pump Set Points	Aging Line Replacement	Purchase Additional Water Rights
Woodland Hills Well	Second tank at Well 6	Well 6 Booster Rehab	Looping Lines (various locations)	Water Banking and Mitigation
	Woodland Hills Tank	Woodland Hills Booster Station		
		Zone 2 Split (both options)		

As storage capacity is the most critical existing need, it is unlikely that the City will want to pursue a well project that does not also include a tank. The Well 6 rehabilitation projects (tank, well, and boosters) would all need to be completed together to be advantageous. The Woodland Hills projects are likewise essentially a single project for this reason. In comparing these two alternatives it became clear that although there are cost efficiencies to rehabilitating the existing infrastructure at Well 6, this alternative is not capable of providing enough storage to correct the existing deficit of 1.6 MG (1.0 MG available if second tank at Well 6 were constructed). If the Well 6 improvements were constructed, a second well and tank project would also need to take place to make up the difference. Additionally, the Well 6 complex does little to correct the system supply and pressure issues that are experienced by the more isolated areas on the south end of Ammon.

In discussions with the City this led to the conclusion that while improvements at Well 6 should still be pursued at some point in the future, the Woodland Hills alternative (which could be sized to cover the entire storage deficit) would be the City's preferred well, tank, and booster alternative for correcting current system deficiencies.

There are several good options for optimizing existing infrastructure. There is also a category of alternatives that are purely operational or that have relatively small capital costs. As there is minimal cost to pursuing these, we recommend that these alternatives be pursued and that only new construction alternatives (including rehabilitation of existing infrastructure) be considered in the final cost and environmental screening process. This simplified approach is shown in Table 7.9.

Table 7.9: Alternatives Moving to Final Screening

Low Cost/Operational	New Construction/Purchase
Metering and Conservation Education	Woodland Hills Complex
Operational Storage Adjustments	Well 6 Complex Rehabilitation and Expansion[2]
Optimize Pump Set Points	Purchase Additional Water Rights
Optimize Transmission to The Cottages and Quail Ridge	[3]Zone 2 Split: Pumps at Pump Station 9
Water Banking and Mitigation[1]	[3]Zone 2 Split: Inline Pumps on 21st St
	Aging Line Replacement
	Looping Lines

[1] The Water Banking and Mitigation alternative is currently shown in the "low cost" category as the City is still in the investigational phase and exploring what options are available at this point.
[2] The Well 6 Complex was eliminated as a final alternative, but will be included in the Capital Improvement Plan and constructed at a later date.
3 A selection between the two "Zone 2 Split" options will be made in following sections.

As Table 7.9 indicates, only the Zone 2 Split options result in competing alternatives that require further evaluation through cost comparison and environmental impact. The environmental analysis will be completed for all new construction projects to identify any critical concerns.

7.7.2 Capital Costs

Table 7.10 provides a comparison of the capital costs associated with the two Zone 2 Split alternatives. As both alternatives would require approximately the same net pumping horsepower to achieve the target upper zone pressures, it is expected that the difference in electrical pumping costs will be minimal. The effective lifespan of respective pump and control components is also believed to be comparable. Because of the resulting similar nature of O&M costs between these two alternatives, it was decided that a present worth analysis (taking cost over time into account) was not warranted and that a comparison of capital costs would be sufficient.

Table 7.10: Zone 2 Split Alternative Cost Comparison

	Pumps at Pump Station 9	Pumps Inline on 21st Street
Pumps	$80,000	$200,000
Controls and Site Improvements	$60,000	$11,500
PRVs	$40,000	$40,000
Service Line Redirection	$20,000	$20,000
Distribution Piping	$257,240	$144,380
Land Purchase	$0	$20,000
Mobilization, Contingency, Engineering, and CMS	$205,301	$195,710
Total (rounded)	**$663,000**	**$632,000**

Installing the pumps inline on 21st Street results in a minor cost savings, making this the alternative of choice.

7.7.3 Reliability

The preferred alternatives improve system reliability in general by adding more supply, storage, and delivery capacity and improving system flows and pressures. In particular, pressure disparities in Zone 2 will be corrected and the vulnerabilities of the isolated areas on the south end of the system will be addressed. More reliable flow for firefighting will also result from the pumping and transmission projects proposed.

Other actions that increase reliability and that will be taken as improvements are planned include:

- A test well will be constructed first at the proposed Woodland Hills site in order to verify (as much as is possible) expected flow rates and water quality.
- Feasibility of including backup power capacity at pumping facilities (recommended)
- All pumping facilities must meet state redundancy requirements (included in costs presented)

7.7.4 Environmental Impacts

The general environmental impacts associated with the preferred alternatives are given in Table 7.11. Impacts documented include both impacts *to* the environment and special project considerations (beyond standard practice) resulting *from* the environment.

Table 7.11: Environmental Impacts of Viable Alternatives

Environmental Aspect	Woodland Hills Complex	Well 6 Complex Rehabilitation/ Expansion	Zone 2 Split	Distribution Improvements
Physiography, topography, geology, soils	No Impact	No Impact	Addresses issues caused by topography	No Impact
Surface & Ground Water Hydrology	Local drawdown	Local drawdown	No Impact	No Impact
Natural Communities	No Impact	No Impact	No Impact	No Impact
Housing & Development	Accommodates area of high growth	No Impact	Could serve adjacent unannexed land	Accommodates areas of high growth
Cultural Resources	No Impact	No Impact	No Impact	No Impact
Utility Use & Energy Consumption	Pumping electrical use	Pumping electrical use	Pumping electrical use	No Impact
Floodplains/Wetlands	Possible 500-yr	No Impact	Possible 100-yr	100-yr
W&S Rivers	No Impact	No Impact	No Impact	No Impact
Public Health	Improved reliability at system extents	No Impact	Greater pressure reliability	Improved fire flow and better circulation
Prime Farmland	Supports development of adjacent farmland	No Impact	No Impact	Temporary impacts
Sole Source Aquifer	Effects of well drilling	Effects of well drilling	No Impact	No Impact
Land Use	Supports development	No Impact	Supports development	Supports development
Climate	No Impact	No Impact	No Impact	No Impact
Air Quality	No Impact	No Impact	No Impact	No Impact
Socioeconomics	Situated in new development	Situated in older neighborhoods	Serves affluent neighborhoods	Supports possible new development

Most of the impacts noted are either beneficial or typical of these types of projects. However, The Woodland Hills complex and Zone 2 Split improvements are possibly located within flood plains based on the FEMA flood insurance rate map presented in Chapter 2. The City may wish to have these areas surveyed to provide a final determination. If located within a flood plain, the design of these improvements will need to take that into account. This environmental impact is not anticipated to be significant enough to warrant abandoning these alternatives. Some distribution improvements are located within the mapped 100-year flood; however, it is not anticipated that this determination will significantly affect design or construction of these improvements.

7.8 IMPACTS TO SYSTEM CLASS & LICENSURE

Ammon's distribution system is classified as a Class II system, although the population of its service area is likely to be very near the 15,000 population threshold that would move it to a Class III. While this classification is entirely population based and not impacted by the alternatives considered by this chapter, Ammon's operators should be ready to upgrade their licenses to Class III when that change comes. The City currently has no treatment system classification, as no treatment facilities (beyond the reserve chlorination systems) exist in the system. None of the alternatives considered incorporate addition of treatment facilities.

7.9 PUBLIC PARTICIPATION

Over the course of this study, multiple presentations have been given in public meetings (handouts, slides, and meeting minutes can be found in Appendix G). Study progress and findings were presented at the following City Council Meetings or Work Sessions:

October 19, 2017 City Council Meeting

December 14, 2017 City Council Work Session

February 8, 2018 City Council Work Session

Around the time the study was started, the City organized a volunteer citizen's advisory committee to research and inform water related decisions (with a focus on water rights and metering). Keller Associates presented study findings to this group on three occasions:

January 25, 2017 Citizen's Water Committee Meeting

November 30, 2017 Citizen's Water Committee Meeting

February 27, 2018 Citizen's Water Committee Meeting

The City also posted the preliminary details of the study's findings on the city webpage in February, 2018. Once this study is reviewed and approved by both the City and IDEQ, the public will be given a formal chance to comment on the study in writing or at a planned Public Hearing. Any such comments received will be documented and addressed in the final study.

7.10 SELECTED ALTERNATIVES

Section 7.7.1 presented the feasible alternatives that passed the initial screening effort. Table 7.9 provides a consolidated list of final alternatives, with the Zone 2 Split being the only potential capital project left with competing alternatives. The capital cost analysis in Section 7.7.2 identifies the inline pumping version of that project as being superior from a cost standpoint and that alternative will be considered as the recommended alternative. With that distinction, and after discussions between Keller Associates and the City Council and staff, this study recommends a preliminary selection of the alternatives presented in Table 7.9. Environmental implications identified in Section 7.7.4 will be addressed during project design but were not thought to be significant enough to change these recommendations. The public comment period described in Section 7.9 has yet to take place and this preliminary selection will be confirmed or altered depending on any significant public feedback received. The Woodland Hills Complex is the City's highest priority capital project as it accomplishes the most in terms of bringing the city into storage and supply compliance.

8 CAPITAL IMPROVEMENT PLAN

This chapter presents the capital improvement plan (CIP) developed for the City of Ammon water system. This CIP aids in the implementation of the selected alternatives by detailing cost estimates, priorities, and schedule for improvements.

8.1 CAPITAL IMPROVEMENT PLAN

The capital improvement plan shown in Table 8.1 summarizes the recommended system improvements that are anticipated to require capital beyond routine maintenance practices. A detailed description of these improvements and a breakdown of the associated cost assumptions can be found in Appendix E: Alternative Development/Capital Improvement Plan.

Table 8.1: Capital Improvement Plan

ID#	Item	Cost	Need Addressed
Contracted Improvements (Start in 2018)			
WH TANK AND BS	2.0 MG Tank and 3,000 GPM Booster Station	$ 3,849,000	Storage and Delivery
ZONE 2 SPLIT	Split Zone 2 into lower and upper subzones	$ 632,000	Low Pressure, Fire Flow
QL RDG LOOP	8-inch loop from Foothill Rd to Sharptail Rd	$ 69,000	Low Pressure, Fire Flow
ORIGINAL TOWNSITE	Replace undersized and failing water lines	$ 5,951,000	Undersized and Leaking Lines
WELL 6*	Well, Tank, and Booster Station Improvements	$ 1,015,000	Supply, Storage, and Delivery
W6 STORAGE*	Additional 0.5 MG Storage at Well 6	$ 1,457,000	Storage
	Total Contracted Improvements	***$ 12,973,000***	

ID#	Item	Cost	Need Addressed
City Improvements (Start in 2018)			
ASPEN LN	Replace 2-inch line with new 8-inch line and hydrant	$ 63,000	Undersized Line
1st ST LOOP	12-inch loop from Curlew to 1st St.	$ 294,000	Looping and Fire Flow
LDY HK LOOP	8-inch loop to Crowley Rd	$ 80,000	Looping and Fire Flow
SOUTH LOOP	16-inch loop from Sunnyside to Township	$ 888,000	Looping to South Side
COTTAGES LOOP**	12-inch connection from Sunnyside to Tildy Ln	$ 183,000	Low Pressure, Fire Flow
	Total City Improvements	***$ 1,508,000***	

ID#	Item	Cost	Need Addressed
Developer Improvements (Start in 2018)			
WH WELL	16-inch dia. X 350-foot, 2,600 gpm Well	$ 257,000	Supply on south side
WH WELLHOUSE	15' X 30' Wellhouse w/generator	$ 777,000	Supply on south side
FOX HLW LOOP**	8-inch loop in Fox Hollow Subdivision	$ 149,000	Looping and Fire Flow
	Total Developer Improvements	***$ 1,183,000***	

Total All Improvements $ 15,664,000

*Improvements at Well 6 are not required to meet immediate deficiencies but should be pursued as system demands warrant.
**To be completed only if developer activities (Fox Hollow) or optimization efforts (The Cottages) do not address these distribution issues.

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our 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.

Figure 8.1 is a map showing the locations of the improvements above, color coded to match the three categories shown.

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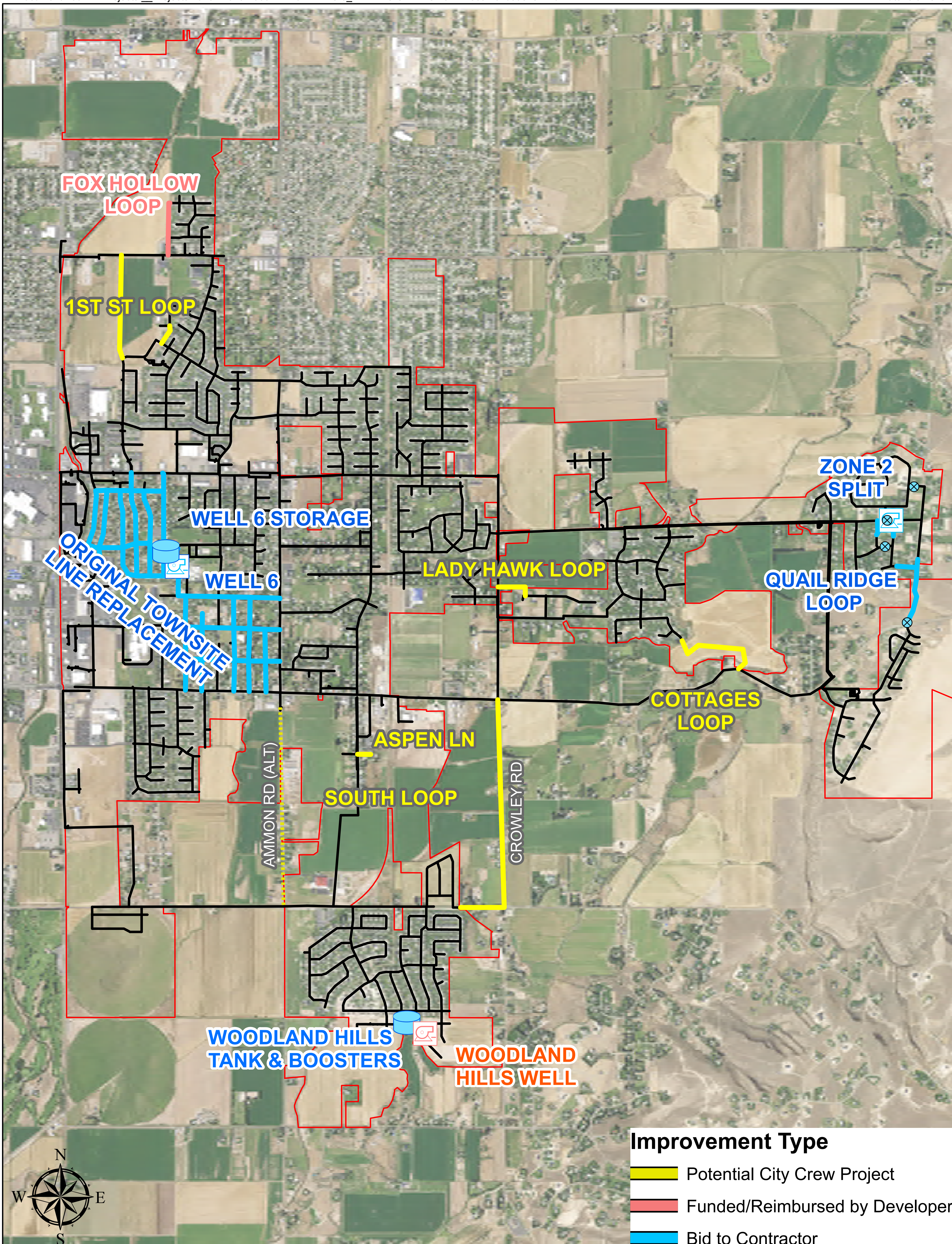

Figure:	Title:	Project:	Prepared For:
8.1	CIP MAP	Water Facilities Planning Study Keller Project: #216102-000	CITY OF Ammon KELLER ASSOCIATES

The CIP was organized into three categories:

- Contracted Improvements: Improvements beyond the capacity of the City crews to construct. These would be bid to qualified contractors.
- City Improvements: Projects that could possibly be completed by City staff at a cost savings (costs shown here are contractor prices for ease of comparison).
- Developer Improvements: Projects that the City feels could be funded by development.

Woodland Hills is anticipated to be a joint developer and City funded project. As part of the City's agreement with the developer seeking to develop the area immediately south of Woodland Hills, the developer will pay the cost of the new well. The City will then be responsible for the tank and booster station. It is likely that the City will have to cover the developer's costs up front and would then be paid back over time as the lots are sold and costs can be recouped.

8.2 SYSTEM MAINTENANCE & OPERATION

The City will need to plan for ongoing maintenance and replacement costs associated with infrastructure throughout the system. Planning for annual system replacement costs is vital to keeping the system functional over the next several decades. A detailed review of the City's operation and maintenance program was beyond the scope of this study; however, the City has recently evaluated replacement costs and timelines of major system assets as part of the rate consultation they are currently in the process of completing (see Chapter 9).

In addition to the replacement of aging equipment, the City's maintenance plan should include adequate performance of operational maintenance, including items such as exercising of hydrant, valve, and pumps, inspection of facilities, flushing, mapping, meter calibration, and data analysis. Accurate and complete system records are essential maintenance tasks as well. This effort behind this study was significantly aided by the available data and the insights of knowledgeable staff. The better the system's records regarding historical pumping, pump performance, system events, metering, etc., the more enabled the City and its consultants will be to make informed decisions.

The improvements included in the CIP will result in no immediate major changes to power costs, as no net change to pumping demands occurs as result of new infrastructure. Minor utility cost increases (electrical, heating, fiber, etc.) will result from the commissioning of new facilities. New facilities and their contents will need to be included in the City's maintenance and inspection plans. The City will see gradual increases in power and other operational costs as its service population grows. City administrators should also consider that as the system becomes larger and more complex, the need for adequate numbers of sufficiently trained staff also grows.

8.3 LAND AVAILABILITY

Land will need to be purchased for two of the capital improvement projects identified: the Zone 2 Split and the Woodland Hills complex. The Zone 2 Split's area needs are minor and it is anticipated that little difficulty will be had in obtaining a suitable area along 21st Street. The City has already been in talks with the developer who is seeking to develop the land immediately south of Woodland Hills. A suitable combination of lots has been identified for purchase and conversion into a new well, tank, and booster site. There are also some distribution improvements that will require creation of a utility right of way.

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9 FUNDING & IMPLEMENTATION

This chapter examines available funding options for financing the Capital Improvement Plan (CIP). It also provides a review of potential impacts to user rates resulting from financing of the plan. Finally, a project schedule and implementation guide is presented.

9.1 FUNDING ANALYSIS

Funding for implementing the system improvements could come from several sources:

City Funds: The City may pay for projects out of reserve funds or allotted capital outlay budget if such funds are available. This would constitute a “pay as you go” philosophy. Obvious benefits of this payment method are that debt and interest payments are avoided, saving the City money in the long run. Additionally, a permanent funding mechanism is put in place such that a portion of the rate is permanently set aside for funding capital projects, rather than needing to get approval to borrow funds each time a new project is approached. This method is challenging however in that most cities do not have large reserves in place once ready to begin projects. Rates must be increased enough that reserves build fast enough to complete projects in a timely manner.

Several members of the citizen’s water committee, formed in part to advise on the implementation of the findings of this study, have indicated that they would prefer this method if possible. The City has also expressed interest in pursuing a “pay as you go” approach and a willingness to increase water rates accordingly. Rate implications of paying for capital projects in this manner are discussed in the next section. While other funding sources are described here for reference, paying for water infrastructure projects out of city funds is considered the City’s selected funding method.

Local Improvement District: One method of funding projects whose benefits are specific to certain homes or streets is to create a Local Improvement District (LID). In this funding method, an assessment for the project is made against each home benefitted. Home owners may then either pay the amount up front or make annual payments to the City. The amount is treated as a lien against the individual home that would need to be paid off when selling the property. An LID gives the City Council legal authority to borrow money to fund the project with or without the support of the residents affected by the LID. For this reason, LID’s can sometimes be controversial. While this funding mechanism is less common to water projects, as the benefits of water infrastructure usually extend beyond a specific street, using an LID to pay for street repairs associated with distribution line replacement has been discussed as one possible use of this funding method.

State Revolving Fund Loan: One common source of funding for municipal capital improvement projects is from low interest loans through IDEQ’s State Revolving Fund (SRF) loan program. This program provides cities with low-interest loans to finance eligible water and sewer projects. Typical terms are 20 years at 2.75% interest. Use of these funds typically requires implementation of American Iron and Steel requirements and Davis Bacon wage requirements; often resulting in an increased total project cost. The City is currently paying off the SRF loan used to do the last round of major water system improvements (Well 8 Tank, Hill Tank, and others). In some cases, an amount of grant money, in the form of “principle forgiveness” is awarded with SRF loans. Given Ammon’s population and relative affluence, it is unlikely that any SRF principal forgiveness would be awarded to Ammon.

The selection process for being awarded one of these loans is competitive. To be eligible for and receive funding from the SRF program, a letter of interest must be submitted for the fiscal year, and the City must have an approved facilities planning study in place. IDEQ ranks all of the submitted applications and awards funds accordingly. Ammon submitted an LOI for FY 2019 in order to be considered for this list, in case the City elects to use this funding option.

USDA-Rural Development & Dept. of Commerce: Ammon has too large and/or affluent of a population to qualify for USDA-Rural Development or Department of Commerce-Community Development Block Grant funds.

Idaho Bond Bank Authority: Private project funding options for Ammon are limited to the Idaho Bond Bank Authority (IBBA). The Bond Bank typically pools loans from multiple participants, offers Federal and State Tax Exempt status, and pledges statewide sales tax revenues as security to bond holders – all of which results in competitive bonds for Idaho communities. The program is typically used to finance water and wastewater projects, and a variety of terms and financing strategies are available.

While loan terms are typically not as favorable as state and federal funding programs, they are better than going market rates. Use of the funding also does not trigger Davis Bacon and other federal requirements associated with subsidized loans/grants. Once the bonds are sold, the full amount of funds is immediately available to the municipality and the repayment obligation begins.

Other Federal Programs: Special Congressional Appropriations vary in amount, depend on political climate, and are difficult to predict. Homeland Security Grants are a new source of funds with special requirements, making eligibility and amounts uncertain for this type of funding as well. We do not recommend either of these as reliable sources of funding for the City's water infrastructure needs.

Incurring Debt: To incur indebtedness in any of the scenarios above, the City must either pass a bond election, implement a Local Improvement District, or go through the Ordinary and Necessary Judicial Confirmation process. Bond elections can only be held twice per year, once in May and once in November. The Judicial Confirmation process requires a hearing with a judge who will review the needs, proposed solutions, and impacts to the City and make a ruling on whether or not the project is ordinary and necessary. A Local Improvement District can be implemented at any time through a process specified by state law which includes a series of legal notices and public hearings.

9.2 RATE ANALYSIS

9.2.1 Operational Costs

At the request of City staff, Keller associates evaluated the current cost per gallon of Ammon's water system. After evaluating the water departments recent annual expense reports and adding up all costs directly related to the operation of the system this operating expense was compared to gallons produced in each of these years. Table 9.1 documents the results and provides a breakout of total costs and a few specific categories of interest. Not all categories that make up the total water system costs are presented. Note that approximately one third of the department's costs go to debt repayment.

Table 9.1: Ammon Water System Cost/Gallon

Fiscal Year	2013	2014	2015	2016	2017	5-Year Average
Billion Gallons Produced	1.79	1.94	2.04	2.17	2.04	
Total Cost	$2,733,216	$2,906,234	$2,811,998	$2,677,580	$2,748,815	
Total $/1000 Gal	$1.53	$1.50	$1.38	$1.23	$1.35	***$1.40***
Electrical Total Cost	$349,055	$329,419	$357,813	$370,675	$303,111	
Electrical $/1000 Gal	$0.20	$0.17	$0.18	$0.17	$0.15	***$0.17***
Employee Total Cost	$276,377	$332,362	$321,169	$288,629	$350,251	
Employee $/1000 Gal	$0.15	$0.17	$0.16	$0.13	$0.17	***$0.16***
Capital Outlay Total Cost	$29,919	$31,875	$10,911	$2,525	$651,043	
Capital Outlay $/1000 Gal	$0.0167	$0.0164	$0.0053	$0.0012	$0.3187	***$0.07***
Debt & Interest Total Cost	$935,372	$1,077,809	$957,737	$927,453	$909,551	
Debt & Interest $/1000 Gal	$0.52	$0.56	$0.47	$0.43	$0.45	***$0.48***

9.2.2 Rate Impacts of Borrowing

A rate impact analysis was run for the CIP items that address immediate needs (excludes improvements at Well 6 and the Fox Hollow and Cottages loops). Three different scenarios were considered involving borrowing from the SRF program. Terms were set at 20 years and 2.75% and 3% annual inflation on project costs:

- **Scenario 1:** Base Scenario: Project are completed and money spent over five years, after which annual loan repayments begin. Rates go up accordingly on year six.
- **Scenario 2:** The base scenario rate increase is immediately phased in over five years while construction is taking place. The amount accumulated is then paid toward the construction costs in year five and the initial size of the loan is reduced, thus reducing the size of the annual debt payment.
- **Scenario 3:** The base scenario rate increase is immediately phased in over five years while construction is taking place. Instead of being paid toward construction costs, the accumulated amount is paid as an extra payment on the loan, going completely toward principle and reducing total interest paid.

Table 9.2 summarizes the results of these three scenarios. Immediate implementation of the rate increase, even if incrementally phased in over five years, as was done in Scenarios 2 and 3, results in significant savings, showing that any amount the City can pay out of reserves is beneficial. Scenario 2 results in a lower monthly user rate increase, while Scenario 3 results in a significantly lower total loan cost. A detailed breakdown of this analysis is included in Appendix E.

Table 9.2: Rate Impacts of Borrowing

	Scenario 1	Scenario 2	Scenario 3
2017 Project Costs	$12,860,000	$12,860,000	$12,860,000
Amount Borrowed After Inflation	$13,655,097	$11,325,929	$13,655,097
Annual Payment	$945,932	$792,972	$945,932
Monthly Rate Increase	$16.77/account	$14.06/account	$16.77/account
Total Cost of Loan	$18,918,648	$18,638,531	$17,276,507
Cost in Interest	$5,263,551	$4,533,509	$3,621,409
Life of Loan	20 Years	20 Years	16 Years
Projects Completed In	5 Years	5 Years	5 Years

9.2.3 Rate Impacts of Saving for Projects

A rate impact analysis was run for the CIP items that address immediate needs (excludes improvements at Well 6 and the Fox Hollow and Cottages loops). Two different scenarios involving a “pay as you go” strategy were considered, with 3% annual inflation on project costs. In both cases a user rate increase of $16.77/month/account was used for easy comparison the loan alternatives:

- **Scenario 4:** The user rate is raised immediately, projects are completed as accumulated funds allow.
- **Scenario 5:** The user rate is phased in incrementally over five years, projects are completed as accumulated funds allow.

Table 9.3 summarizes the results of these two scenarios. Once again, the sooner money can be collected and applied to projects the better the end result. Significant differences between these results and Table 9.2 are that the savings-based scenarios have cheaper final project costs than the borrowing-based scenarios (with one exception). Due to the effects of inflation and the delay to start projects, the cost benefits of Scenarios 4 and 5 are not as extreme as would be expected. It is also important to note that the projects in the CIP, most of which are designed to fix current system deficiencies, aren’t completed until 16-18 years. Further, we would not recommend that the City issue any additional “will serve” letters until IDEQ compliance is achieved, essentially meaning that growth must be halted until 2023 (Scenario 4) or 2026 (Scenario 5). This coincides with the year during which the Woodland Hills Tank and Booster Station is completed. Note that this analysis assumes starting with no money in the capital fund. Any currently available reserves the City chose to apply to the project would shorten this timeline. A detailed breakdown of this analysis is included in Appendix E. The City has indicated that a funding strategy similar to Scenario 4 would be their preferred funding scenario.

Table 9.3: Rate Impacts of Saving

	Scenario 4	Scenario 5
Monthly Rate Increase	$16.77/account	$16.77/account
2017 Project Costs	$12,860,000	$12,860,000
Cost of Projects After Inflation	$17,086,918	$18,261,584
"Cost" of Inflation	$4,226,918	$5,401,584
Projects Completed In	16 Years	18 Years
IDEQ Compliant In	2023	2026

9.2.4 Rate Consultation

The City of Ammon has hired Econics to implement their Waterworth rate development software in an effort to create a water rate that is able to meet system needs going forward and that anticipates the implementation of a flow-based rate structure. As such, the rate analyses presented earlier in this chapter are meant to provide perspective and to help in justifying the Waterworth recommendations.

Keller Associates acted as a third party advisor to the City in the ongoing development of rate alternatives in Waterworth. The Waterworth program takes into account the departments' various cashflows, expenses, capital improvements, and asset replacement schedule. **The City has instructed the Econics team that they would like to pursue a savings based capital improvement approach in order to avoid debt (similar to Scenario 4).** Between existing City reserves and an understanding of how aggressively projects can be tackled based on cashflow, the rates thus far presented include completion of the Original Townsite Line Replacements and the Woodland Hills Well, Tank, and Booster projects within the next 10 years.

The City Council has yet to finalize a decision on which of the proposed rate structure alternatives they wish to proceed with. All rate alternatives are based on metered, flow-based rate structures.

9.3 PROJECT SCHEDULE

Based on discussions with the City the items listed in Table 8.1 have been listed in order of priority, within their respective categories. Potential project completion time frames associated with the City's preferred funding method of saving in order to finance projects from city funds were featured in Table 9.3. The timeframe for completion of the entire CIP will largely depend upon the final rate structure selected (see Section 9.2.4).

Completion of the Woodland Hills complex is crucial, as completion of this project will bring the system into compliance with state code regarding storage, supply, and delivery deficits. Acknowledging this, the City of Ammon has decided to move forward with the improvements in Woodland Hills immediately utilizing reserve funds and has already begun the process of securing design services. It is anticipated that design of this project will start in 2018, with completion in 2019. Potential dates for completion of major milestones for projects listed in the CIP include:

- May 2018 WFPS Public Comment Period and Public Hearing
- May 2018 Official Acceptance of WFPS and Proposed Alternatives/CIP
- May 2018 Procurement of Engineering Design Services for Woodland Hills Project
- May-June 2018 IDEQ Environmental Review
- June 2018 Test Well at Woodland Hills
- Summer 2018 Design of Woodland Hills Well
- Summer 2018 Design of Woodland Hills Tank
- Fall 2018 Construction of Woodland Hills Well
- Winter 2018 Construction of Woodland Hills Tank
- Winter 2018 Design of Woodland Hills Booster Station
- January 2019 New Rate Structure Takes Effect
- Summer 2019 Construction of Woodland Hills Booster Station

After this high priority project is complete, and assuming a savings-based funding approach, the other projects should be addressed as soon as funds are available. All the other items in the CIP are intended to address current deficiencies, with the exception of:

- Well 6 Complex Improvements: will be completed at a later date once funds are available or the need for storage/supply has increased as a result of growth.
- Cottages Loop: this improvement may or may not be necessary depending on how the recommended transmission optimization efforts turn out.
- Fox Hollow: This loop is being completed by development.

Potential completion dates for other CIP projects are shown below. These dates are based on the fund accumulation associated with the funding structure presented as Scenario 4 in Section 9.2.3. The City's actual timeframe for completing these projects (and any others identified beyond this study) will depend on the new rate implemented by the City.

- 2024 Aspen Lane and 1st Street Loop
- 2028 Original Townsite Line Replacements (50%)
- 2032 Original Townsite Line Replacements (100%)
- 2033 Zone 2 Split, Quail Ridge Loop, Lady Hawk Loop
- 2034 South Ammon Loop
- 2037 Well 6 Complex Improvements

9.4 OTHER IMPLEMENTATION CONSIDERATIONS

9.4.1 Agency Consultation

As part of the environmental approval process for completion of this study and commencement of the selected projects, various state and federal agencies must be contacted regarding the projects in order to provide an official determination regarding environmental impacts and required mitigation efforts. This will take place in coordination with state IDEQ staff and any significant comments received will be inserted here.

9.4.2 Public Comment

After this study receives technical approval from IDEQ, the public must be given a chance to review and comment on it before the City Council can officially accept it and move forward with construction and funding procurement. An open public comment period will be advertised and a public hearing will be held, at which anyone with concerns or comments can provide their input. Any public comment received at the public hearing or through other means will be included in Section 7.9.

CONCLUSION

The City of Ammon's water system is in generally good condition but is at the point where demand is exceeding capacity of its facilities. The most critical issue facing the City is a shortage of water storage. It is recommended that the City begin now with the implementation of the recommended improvements outlined in the Capital Improvement Plan. Most of these improvements address current needs and deficiencies.

As the city grows towards the population milestones set forth as the 2037 planning horizon, additional facilities will be needed in order to keep pace with growing demand. The recommendations in this study regarding distribution sizing and capacity needs (Sections 3.5 and 6.4) should be used as a guide in evaluating future development. We recommend that the City consider updating this planning study every five years in order to keep its findings and recommendations current and valid. Future growth patterns in particular may differ from assumptions made in this study and may require adaptation.

The planning tools created in connection with this study, such as the water model and the updates to the City's GIS mapping, should continue to be updated every 1-3 years to reflect repairs, replacements, and other changes to the water system that will inevitably take place. Maintaining the plan and the planning tools will help the City proactively manage their water system as a crucial component of the City's infrastructure.

Keller Associates would like to thank all those at the City of Ammon who participated in the development of this study, in particular the Mayor's office and the Public Works Department. The input and contributions of City officials and staff have been invaluable in making this facilities plan more relevant and useful to those responsible for providing drinking water services to the people of Ammon.

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