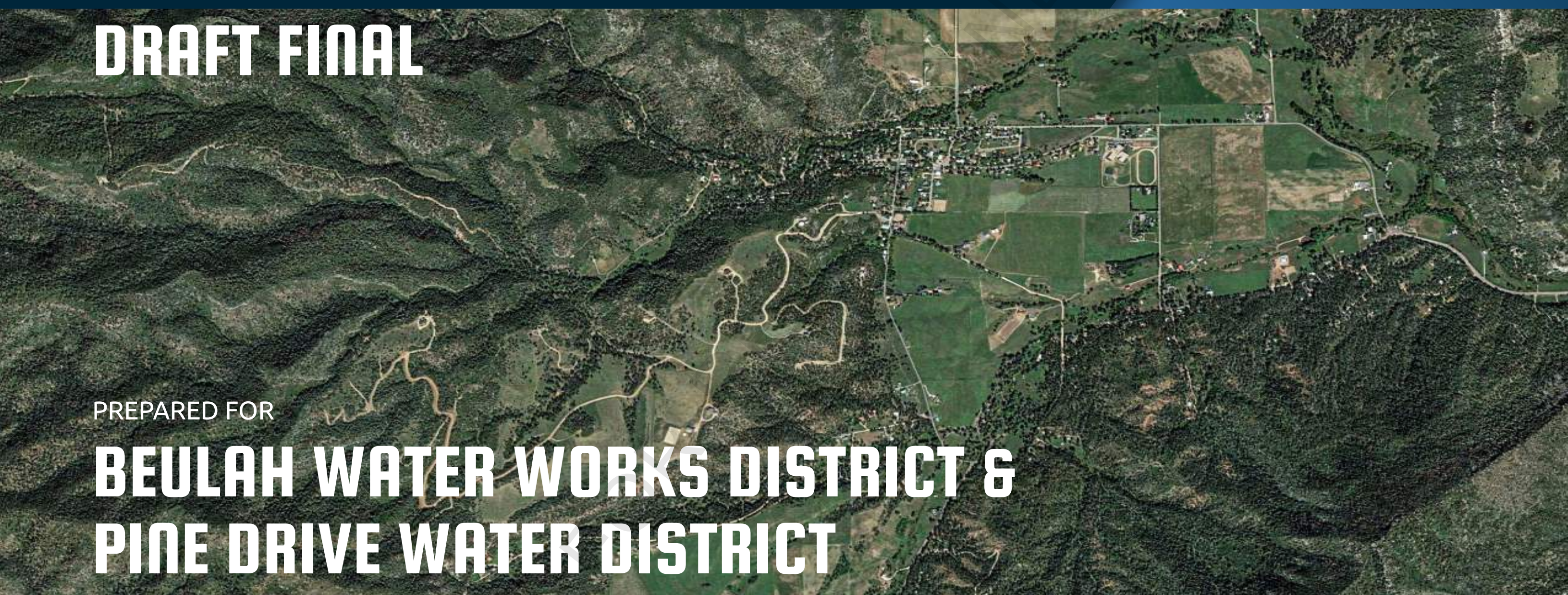
SEPTEMBER 30

2019

USDA PRELIMINARY ENGINEERING REPORT



DRAFT FINAL

PREPARED FOR

BEULAH WATER WORKS DISTRICT & PINE DRIVE WATER DISTRICT

WATER SYSTEM IMPROVEMENTS PROJECT

PROVIDENCE
INFRASTRUCTURE CONSULTANTS

Beulah and Pine Drive Water Districts

USDA Preliminary Engineering Report

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WATER SYSTEM IMPROVEMENTS PROJECT

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1 PROJECT PLANNING

The Beulah Water Works District (BWWD) and Pine Drive Water District (PDWD) are located in the Beulah Valley approximately 25 miles south west of Pueblo, CO. The Districts have operated independently since their creation and both have individual water supplies and water treatment plants (WTPs). The Beulah Valley is located near the headwaters of the North St. Charles River which is tributary the Arkansas River. Historically, drinking water for the two Districts has been obtained from surface water supplies. Drought and forest fires in recent years pose significant long-term threats to the water supplies for both Districts. A fire in the watershed could significantly impact or completely eliminate the existing sources of supply because of excessive debris and soil erosion which degrade the source water supplies such that they would not be able to be potable by the existing WTPs. These threats have previously been brought to the attention of the Colorado Department of Public Health and Environment (CDPHE) and the United States Department of Agriculture – Rural Development (USDA). Because of the fire threat, the Districts entered into an intergovernmental agreement on January 10, 2019 to work together in good faith towards the consolidation of the Districts into one new District. This consolidation process will take several years to fully complete. However, both Districts are jointly preparing this report which describes a consolidation plan for the new District. The consolidation will provide better emergency projection through the completion of a new Alternate Well Supply. Working together the Districts need outside funding to complete a project that addresses their water system and supply to achieve a sustainable and dependable water supply.

CDPHE organized and convened a meeting with both Districts and representatives from various State and Local agencies in Beulah on Thursday, August 9, 2018. A follow up meeting was held in CDPHE's Pueblo office on November 20, 2018. CDPHE's intent for the meeting was to facilitate information exchange among various regulatory and funding agencies. Subsequent to these meetings, BWWD conducted a thorough preliminary investigation to identify a suitable source of potable water that could be developed as the alternative emergency drinking water supply for the Beulah Valley (i.e., provide water to both BWWD and PDWD). The scope of the project described herein is prescribed based on the results of the preliminary investigation.

In addition to the need for an alternate emergency water source, other improvements need to be made to the systems to create a reliable water system. These include improvements to the Middle Creek Raw water diversion, the Beulah WTP, connecting pipes between the two systems and replacement of aging existing distribution system pipes, and the ability to move raw water from the points of diversion to utilize and maximize the use of all water rights.

A significant amount of the piping that makes up the BWWD distribution system needs to be replaced because it is deteriorating and leaking. Most of these pipes are metal or concrete installed in the 1960s and are passed their usable life for a number of reasons, highlighted below. Water leaks unnecessarily increase raw water supply demands. In past years, leaks have been addressed in a piecemeal fashion which has not addressed the overall long-term system reliability. The existing BWWD distribution system is composed of various line sizes and pipe materials. Not all of the water lines need replacing at this time. However, the pipelines that fall into one (or more) of the following categories are recommended for replacement:

- Pipeline material (i.e., steel) that is corroding and contributing to water quality degradation and/or leaking.
- Pipelines that are buried too shallow and prone to frost related leaks and failures.
- Pipelines with diameters smaller than they should be.

The PDWD distribution system piping is in better condition than the BWWD distribution system as evidenced by very minor water loss and does not need substantial improvement like the BWWD system. This piping system was installed starting in 1979 and was constructed using PVC pipe. Since it was constructed using PVC pipe, this system does not have major deterioration issues. However, there are two storage tanks in the PDWD system that do need minor upgrades to meet current regulatory requirements for tank appurtenances.

The proposed overall scope of work for the proposed project consists of the following Alternatives for water supply and treatment. These Alternatives will principally involve the following components for the two Alternatives described in this report:

1) Alternative 1 – Retain Both WTPs:
    a. Improvements at the Middle Creek diversion structure to protect the outlet pipe.
    b. Replacement of deteriorated and leaking distribution system pipelines within the BWWD service area.
    c. Improvements to two (2) PDWD potable water storage tanks.
    d. Improvements to both existing raw surface water diversions for use as supply.
    e. Improvements to the BWWD WTP and a new PDWD WTP.
    f. Potable water piping connections between both water District systems.
2) Alternative 2 – Retain Beulah WTP and Develop Emergency Well Supply:
    a. Upgrades to the Sellers Well for an alternate emergency raw water supply with a raw water pipeline to the Beulah WTP. The Sellers Well is an alluvial well that could be used when surface water supplies are of poor quality or dried up.
    b. Improvements to the Beulah WTP to provide drinking water to both the BWWD and PDWD service areas. The Pine Drive WTP would be decommissioned and raw water from this diversion location would be pumped to the Beulah WTP.
    c. Improvements to both existing raw surface water diversions for use as supply and augmentation.
    d. Replacement of deteriorated and leaking distribution system pipelines within the BWWD service area.
    e. New pipelines for moving raw water from both the PDWD Diversion and the Sellers Well to the upgraded BWWD WTP.
    f. Potable water piping connections between both water District systems.

This Preliminary Engineering Report (PER) has been prepared in accordance with guidance from the United States Department of Agriculture (USDA) Rural Utilities Service as contained in Bulletin 1780-2.

1.1 Location

The location of the project is in and near Beulah, CO as shown in Figure 1. The boundaries of the BWWD and PDWD service areas are shown in Figure 2.

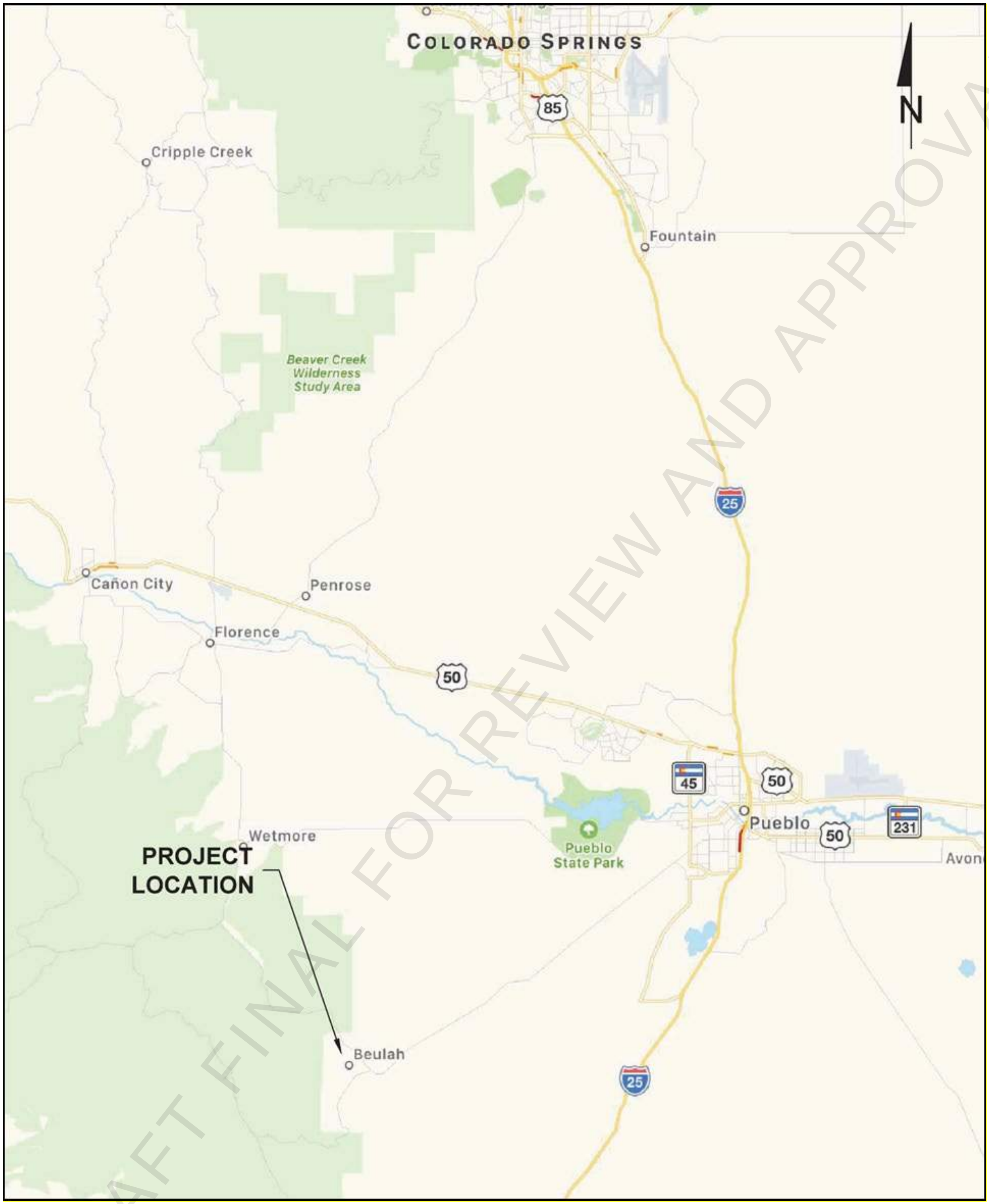

Figure 1 - Location Map[1]

[1] *A larger copy of this figure can be found in Appendix A.*

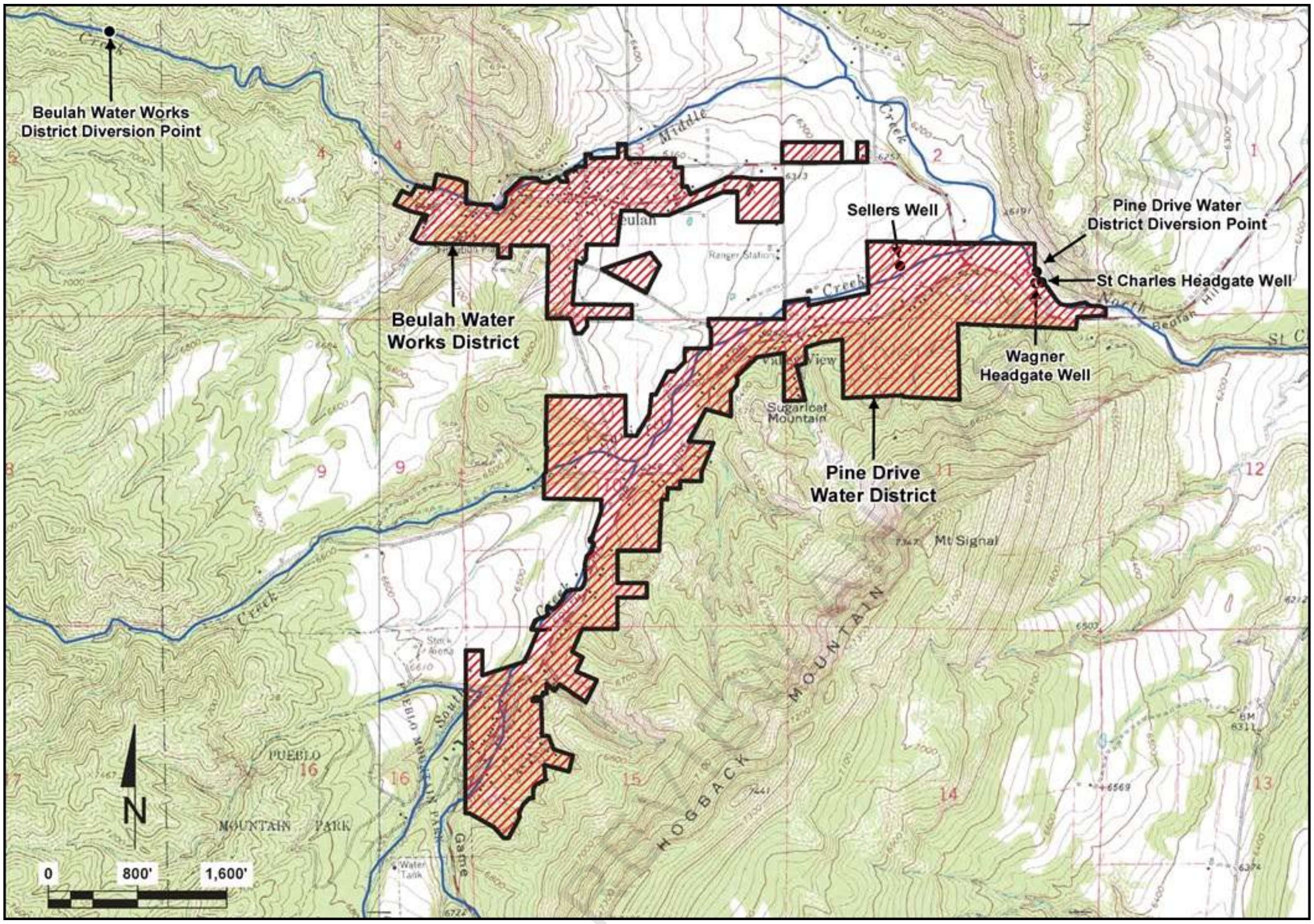

Figure 2 - BWWD & PDWD Service Areas[1]

The Beulah valley is located approximately 25 miles southwest of Pueblo, CO and sits at the base of the Wet Mountains between the Middle and Squirrel Creeks which flow through each side of the valley. The water service area elevations range from 6,100 to 6,600 feet above sea level. A summary of the size of each service area is shown in Table 1-1.

Table 1-1 - BWWD PDWD Service Area Description

District	Service Area Size	Total Number of Service Connections	Approximate Population Served
Beulah Water Works District	151.9 acres	160	400
Pine Drive Water District	483.3 acres	161	403

1.2 Environmental Resources Present

This project involves improvements to the Middle Creek Raw Water Diversion, Beulah WTP, construction of a new well, construction of new pipelines, and replacement of existing pipelines and other water distribution infrastructure. Replacement of most of the pipelines is expected to occur in existing easements and roadway Right of Ways (ROWs). However, the new raw water line from the new well and the connecting pipelines between the two Districts will require some new easements. The most significant potential impact expected is at two locations where pipelines cross creeks. Auger-boring, or directional drilling, construction will be employed to minimize impacts to the riparian areas; refer to Section 4.5.2 for additional information. The Sellers Well raw water pipeline will be constructed across existing hay meadows and along Squirrel Creek. Traditional open cut excavation will be used to install the raw water pipeline and the connecting potable water pipelines. The existing well will be rehabilitated in place with no major disturbance at the well site expected. The existing well house will be improved to provide an upgraded electrical service and equipment and security measures.

1.3 Population Trends

According to the 2010 Census[2], the population of "Beulah Valley" was 556; the majority of which are served by either BWWD or PDWD. Beulah is a small community composed primarily of retirees and workers who commute to Pueblo. The BWWD and PDWD service areas are "built out" and significant population growth with accompanying potable water demand increases, are not expected. Therefore, the combined system will be designed to meet the existing water demands and address the water losses due to the old and failing infrastructure in the BWWD distribution system.

1.4 Design Flows

Table 1-2 - Summary of Design Flows

	Average Daily Flow, gpd	Maximum Month Flow, gpd
Beulah Water District Existing Demands	28,000	57,800
Beulah Water District Future Demands After Distribution Improvements	*17,600*	*36,300*
Pine Drive Water District	*12,600*	*15,800*
Total for Consolidated System	**30,200**	**52,100**

1.5 Community Engagement

The elected boards of the BWWD and PDWD hold regular meetings that are open to the public. In accordance with USDA requirements, a public community meeting will be held describing the proposed scope and cost of the project. This Preliminary Engineering Report will be made available to the public for review prior to the meeting. The District will publish a notice of the meeting 10 days prior to the meeting and inform constituents of the meeting via a water bill insert.

2 EXISTING FACILITIES

The existing potable water system for BWWD consists of a river diversion, 70 gpm WTP, two at-grade storage tanks with a total volume of 625,000 gallons, a 130,000-gallon clearwell at the WTP and over 20,000 LF of buried distribution pipelines with diameters ranging from 3/4-inch to 6-inch. The PDWD water system consists of an infiltration gallery along the North St. Charles River, a 100 gpm WTP with 36,000-gallon clearwell, two (2) pump station facilities, four (4) storage tank sites and distribution system piping. Figure 3 below is a map showing the BWWD and PDWD potable water systems. Figure 4 provides and overview of the existing systems.

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[2] *Data for "Beulah Valley CDP, Colorado" obtained from https://factfinder.census.gov/*

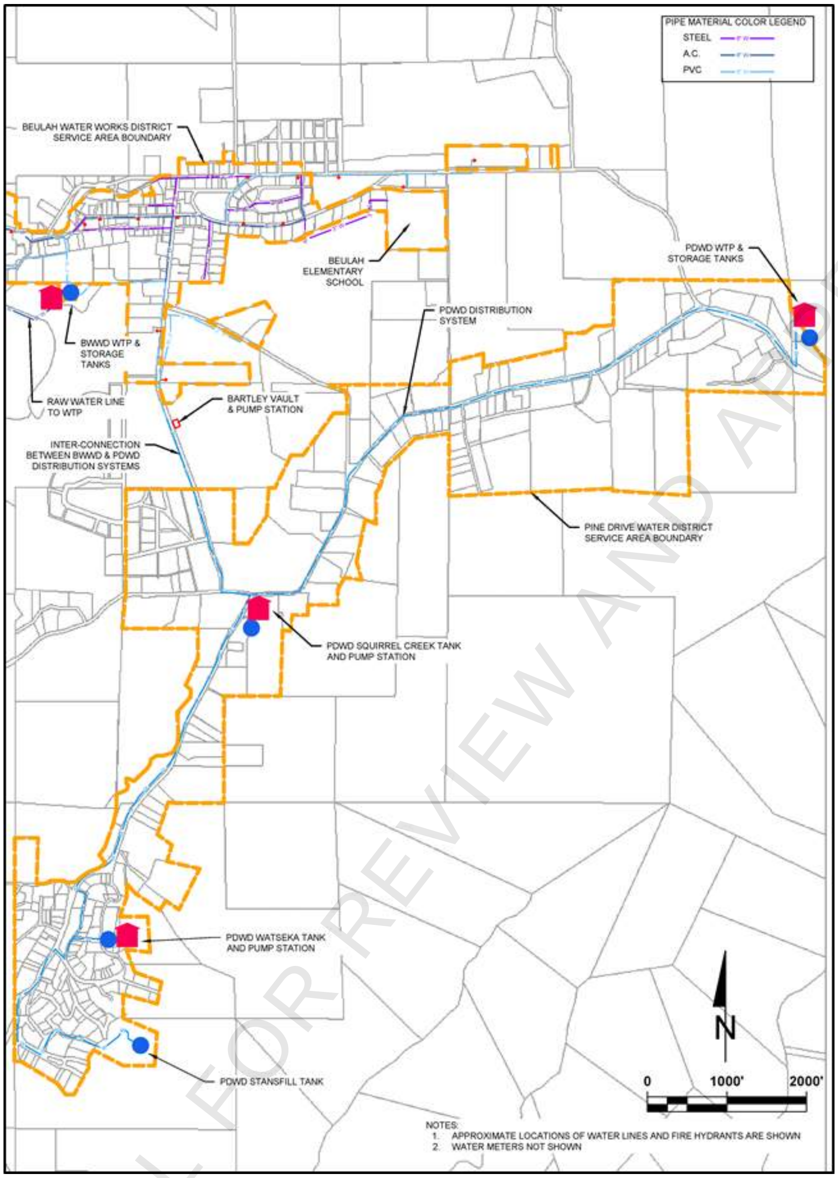


Figure 3 - Existing BWWD & PDWD Water Systems[1]

2.1 Location Map

A location map of the Beulah area is shown in Figure 1 and Figure 2 in Section 1.1 above.

2.2 History

2.2.1 Beulah Water Works District

The BWWD operates a water treatment plant which was constructed in the 1960's. The existing WTP is a conventional filter system package plant with flocculation, sedimentation and filtration processes. The initial installation included a 130,000-gallon clearwell. A 125,000-gallon above grade steel storage tank was added to the system in 1993 and a 500,000-gallon above grade steel storage tank was added in 2003. The water source is surface water taken from Middle Creek approximately 2 miles to the northwest. Because the water is directly diverted from Middle Creek it is vulnerable to poor water quality conditions during high run-off events in the watershed.

The treatment plant is operated part time and has an operating capacity of approximately 70 gallons per minute (gpm). It is run on automatic controls based on the water level in the storage tanks. The WTP typically operates 4-8 hours per day. The daily production typically ranges from 10,000 gallons per day (gpd) to 60,000 gpd, with an average of approximately 28,000 GPD. In the last year, distribution system leaks have increased significantly due to freezing and age-related breaks. Recently, the average daily production of the water treatment plant was 46,000 gpd. The recommended maximum daily production of the WTP is 67,000 gpd. For additional information regarding the WTP capacity and the increase in distribution system leakage, please refer to the reports included in Appendix C.

With the two at-grade storage tanks and the clearwell, the total water storage capacity is approximately 755,000 gallons. This equates to about 28 days of water storage capacity, if the tanks are kept full. However, concerns with disinfection byproduct (DBP) formation prevent BWWD from normally operating with completely full tanks.

2.2.2 Pine Drive Water District

PDWD operates a WTP which was constructed in 1979 and is very similar to the BWWD. The existing WTP is a conventional filter system package plant with flocculation, sedimentation and filtration processes. The initial installation included three (3) 12,000-gallon finished water storage tanks located at the WTP site. The water source is surface water taken from the North Fork of the St. Charles River adjacent to the WTP. The water is diverted from the river via infiltrations galleries along and under the river. Because of their close proximity to the river, the raw water is still susceptible to poor water quality conditions in the river.

The PDWD WTP is operated part time and has an operating capacity limited by the CDPHE Record of Approved Waterworks to 30 gallons per minute (gpm). It is run on automatic controls based on the water level in the storage tanks. The WTP typically operates 4-8 hours per day. The daily production typically ranges from 10,000 gallons per day (gpd) to 14,000 gpd, with an average of approximately 12,000 gpd[3]. The recommended maximum daily production of the WTP is 30,000 gpd[4]. With the three below-grade chlorine contact tanks, the total water storage capacity at the water treatment plant is approximately 36,000 gallons. The Squirrel Creek pump station has 36,000 gallons of water storage capacity. The Watseka pump station has 36,000 gallons of water storage capacity and the Stansfield water storage tank site has 48,000 gallons of water storage. This equates to about ten days of water storage capacity, if all the water storage tanks are kept full.

2.3 Condition of Existing Facilities

2.3.1 Beulah Water Works District

The BWWD distribution system consists of more than 20,000 feet of buried pipelines ranging in size from 3/4-inch to 6-inch diameter and includes asbestos cement (AC), steel (STL), and polyvinyl chloride (PVC) pipe. The majority of the distribution system was installed in the 1960s when the treatment plant was constructed. The BWWD system is depicted in Figure 4. A summary of the existing system pipeline inventory is shown in Table 2-1. Please refer to Figure 4 in conjunction with Table 2-1.

[3] *Based on potable water production records between October 2013 to September 2017.*
[4] *70 gpm (CDPHE Record of Approved Water Works) x 16 hrs x 60 min/hr per day = 67,200 gallons per day.*

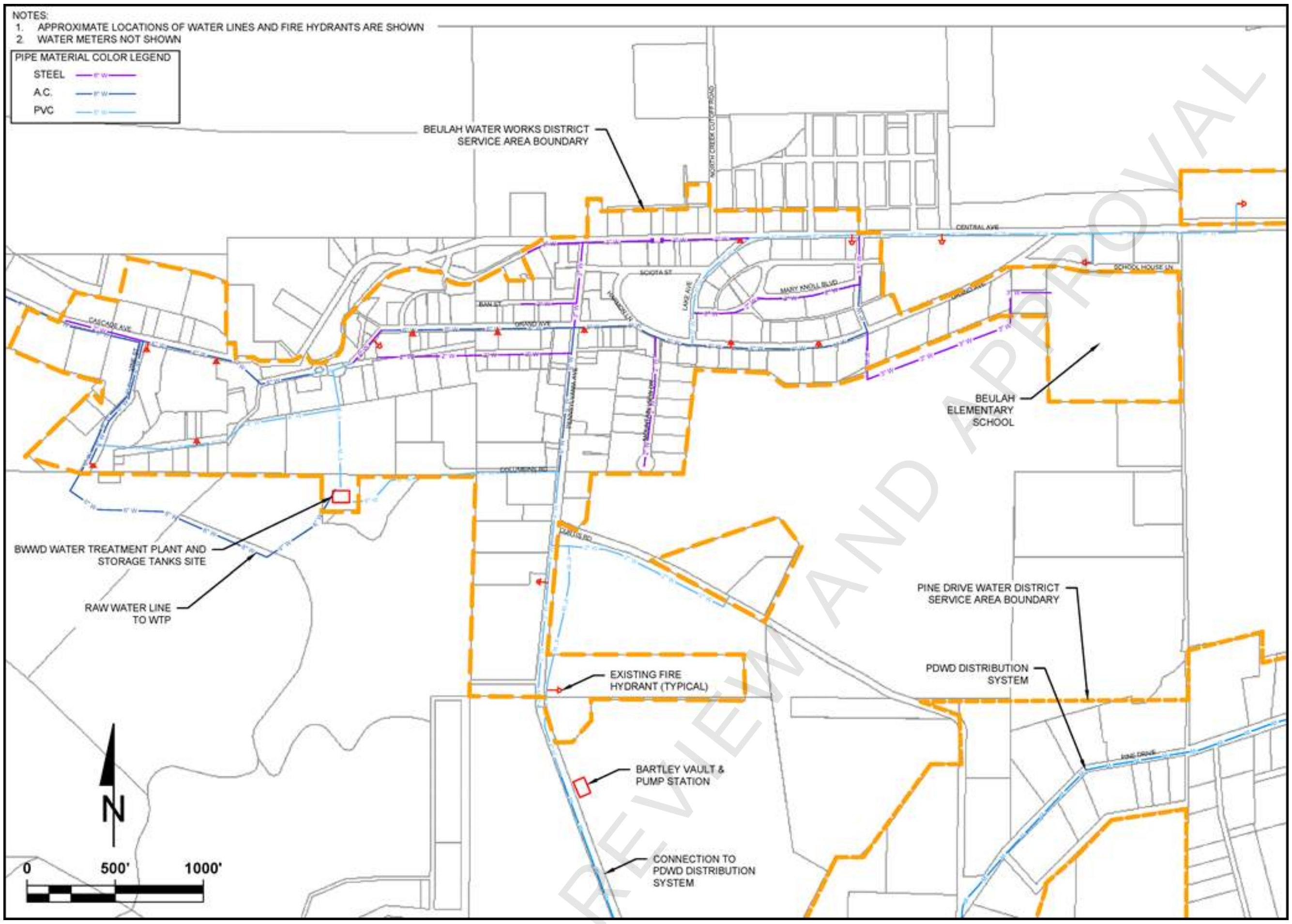


Figure 4 - Existing BWWD Distribution System[1]

Table 2-1 - Existing Distribution System Pipe Inventory

Diameter	Material	Approximate Installed Length (ft)
6-inch	AC	5,718
	PVC	2,878
	STL	246
4-inch	PVC	2,955
3-inch	STL	2,037
2-inch	STL	4,692
	PVC	1,777
3/4-inch	STL	321
	Total Length	**20,624**

The bulk of the BWWD distribution system is approaching 60 years old and some of the pipes are nearing the end of their useful life. Steel pipes are suffering from capacity limiting corrosion and become more fragile and prone to leaks as they age. In certain areas, the pipelines were not installed with sufficient bury depth and experience frost related breaks in winter. There is approximately 7,300 LF of steel piping installed, which makes up approximately 35 percent of the system. Rust and other related corrosion byproducts in the steel pipelines exert a chlorine demand on the water and create various water quality problems. The PVC piping that was installed in the 1960's is primarily glued joint pipe and does not conform to current AWWA C900 standards and should be replaced. For various water quality and pipe integrity reasons, a significant portion of the piping in the system will need to be replaced at some point in the near future. For reference purposes, an overview of pipe material and the percentage of the distribution system is shown in Table 2-2.

Table 2-2 - Distribution System Pipe Material Summary

Pipe Material	Total Linear Footage	Percent of System
Steel	7,296	35%
Asbestos Cement	5,718	28%
Polyvinyl Chloride	7,610	37%

2.3.2 Pine Drive Water District

The PDWD existing distribution system is in good condition and exhibits very minor water loss due to leaks. The system consist was constructed in 1979. The existing pump stations were upgraded in approximately 2011. The existing Watseka and Stansfield storage tanks need access hatch improvements. The access road to the Stansfield tank site needs improving to facilitate routine vehicle access for inspection and maintenance.

2.4 Financial Status of Existing Facilities

2.4.1 Beulah Water Works District

2.4.1.1 Water Rates Schedule

The BWWD water rate schedule is shown in Table 2-3. A copy of the BWWD rate schedule notice is included in Appendix B.

Table 2-3 - 2019 BWWD Water User's Rate Schedule

Rate Type	Present Monthly Base Fee to include first 1000 gallons	After first 1,000 gallons	Other
3/4-inch	$87.55	$ 10.00 per 1000 gallons beyond the first 1000 gallons	Fire Department is charged $0.00 for the first 2,500 gallons and $0.10 per each additional 1,000 gallons
Commercial	$87.55	$ 15.00 per 1000 gallons beyond the first 1000 gallons	

2.4.1.2 Water Users by Category

There are 145 residential water taps serving residential connections that are primarily detached, single-family residences. There are 15 "commercial" taps; of which there are five (5) "non-profit" users. This yields a total of 160 water taps within the BWWD service area. It is understood that a significant portion of the current residences are seasonally occupied, but water demands and use patterns for the District are stable with little foreseeable potential for increases.

2.4.1.3 2018 Financial Summary Report

In 2018, the District had approximately $5,000 in energy costs which primarily are associated with the water treatment plant. The District has no pump stations or other significant electric loads or facilities associated with the water distribution system. A brief summary of other expenses is shown in Table 2-4.

Table 2-4 - BWWD Summary of Expenses for 2018

Expense Description	Approximate Total Amount
General Administration	$73,150
Water Treatment Plant Management	$119,050
Distribution System Operation & Maintenance	$158,300
TOTAL	**$350,500**

The District holds no debt and had approximately $57,000 in unencumbered cash reserves from 2018. A more detailed financial accounting summary is provided in Appendix B.

2.4.2 Pine Drive Water District

2.4.2.1 Water Rates Schedule

The PDWD water rate schedule is shown in Table 2-5. A copy of the PDWD rate schedule notice is included in Appendix B.

Table 2-5 – Current PDWD Water User's Rate Schedule

Tap Size	Current Monthly Base Fee to include first 1000 gallons	After first 1,000 gallons
All	$108.00	$ 8.00 per 1000 gallons beyond the first 1000 gallons

2.4.2.2 Water Users by Category

There are 165 residential water taps serving residential connections that are detached, single-family residences. There is only one "special use" tap for the Pueblo Mountain Park. This yields a total of 166 water taps within the PDWD service area. It is understood that a portion of the current residences are seasonally occupied, but water demands and use patterns for PDWD are stable with little foreseeable potential for increases. A brief summary of other expenses is shown in Table 2-6.

Table 2-6 – PDWD Summary of Expenses for 2018

Expense Description	Approximate Total Amount
General Administration	$98,500
Water Treatment Plant Management	$102,600
Distribution System Operation & Maintenance	$75, 900
TOTAL	**$277,000**

Note that the District currently holds no debt and had approximately $130,000 in unencumbered cash reserves. Some more detailed financial accounting summary is provided in Appendix B for 2018.

2.5 Water/Energy/Waste Audits

The BWWD potable water distribution system has a number of leaks. Over the years, the water system operators have found and repaired leaks on a routine basis. The District reports that some of the water system was installed as early as 1938 and the water treatment plant was constructed in the 1960's.

All water systems will have minor leaks and unaccounted for water. According to the Water Research Foundation, the national median real water loss rate, per service connection, for small water utilities is 31.6 gallons per day[5]. A comparison of this national median value to the data reported by BWWD is shown Table 2-7.

Table 2-7 – Comparison of Expected and Reported Water Losses

Parameter	Value	Unit	Notes
Average Annual Daily Water Metered & Sold	14,663	gpd	June – December 2017 Data
Median Water Loss, expected	5,056	gpd	=No. Taps x Median Loss Value of 31.6 gpd
Reported Water Losses	31,146	gpd	June - December 2017 data
Exceedance Factor	6.2X	-	=Reported Loss / Median Expected Loss

This illustrates the magnitude of the water leaks plaguing the Beulah Water Works District system. The data shows the leakage rates have been increasing in recent years. As of the end of 2017, BWWD was leaking twice as much water as it was metering as used/sold which is approximately 6 times more than the national median for small systems. This level of leakage creates a substantial additional demand on the WTP.

The historical water losses for PWWD measure below the national median value and no replacements are recommended at this time.

[5] *WRF Report 4372b "Water Audits in the United States: A Review of Water Losses and Data Validity", 2015*

3 NEED FOR PROJECT

The need for the project is discussed in the sections below.

3.1 Health, Sanitation, and Security

In the past, vulnerabilities to both BWWD and PDWD water systems existed but each system could rely on the other as a back-up source of drinking water. The Junkins Fire of 2016 and the drought and thunderstorms of 2018 have made it clear to both Districts that their collective vulnerabilities cannot reliably supply each other in time of need.

3.1.1 Beulah Water Works District WTP Vulnerabilities

The BWWD WTP is also at risk of source water disruption due to the following conditions and vulnerabilities:

1) The BWWD raw water intake structure on Middle Creek has suffered damage in recent flood events and is at risk of catastrophic flood damage (See Figure 2 and Figure 5). There are eight (8) bridges which must be crossed to get to the raw water diversion. Should flood damage occur to the intake structure, the bridges will also likely be impacted. Therefore, it should be anticipated that a significant amount of time, effort and money will be required to repair the intake structure if it were to be damaged.

2) Even though the Junkins Fire had minimal impact to BWWD, the watershed remains at risk from fire damage.

3) The BWWD watershed is smaller than the PDWD watershed. It may be somewhat more susceptible to drought impacts. In recent years, BWWD reports that there have been multiple days when no water was physically available at the intake structure. This historical vulnerability gave rise to construction of the 500,000-gallon potable water storage tank in 2003. The addition of this tank provided BWWD with approximately 30 days of potable water storage. Today, the full volume of this storage should not be used because it creates excessive water age and disinfection byproduct challenges.

4) High organic content (TOC) in the water during run-off events contribute to the formation of DBPs in the distribution system. A TOC removal process, such as powdered activated carbon, should be considered to absorb some of the TOC thus reducing DBPs.

Figure 5 – May 2017 Flow at Beulah Water Works District Raw Water Diversion

3.1.2 Pine Drive Water District WTP Vulnerabilities

In the fall of 2016, the Junkins Fire was reported to have burned approximately 10 percent of the PDWD watershed. Drought conditions in recent years have led to very low base flows in the watersheds for both Districts. Thunderstorms burn scar area have resulted in silt and sediment flows into the watershed and degraded water quality. Background bacteriological contamination of the PDWD source water is appears to be elevated due to lack of run off retardation in the burned areas. During the summer of 2018, the Operator in Responsible Charge (ORC), in consultation with CDPHE, determined that the PDWD WTP could not be operated to provide drinking water in compliance with CDPHE finished water standards. Pathogen and particulate levels in the raw water were beyond what the WTP was designed to treat. The operations experience gained during 2018 indicate it is likely that the WTP may need to be taken off line for significant periods of time during the spring and summer seasons due to intermittent episodes of degraded source water quality. This condition is not expected to change for many years until revegetation in the watershed is mature enough to retard surface runoff and drainage. The WTP is also located adjacent to the North St. Charles River within the floodplain as shown in Figure 6. As such, the WTP is at risk of substantial or catastrophic loss due to flood.

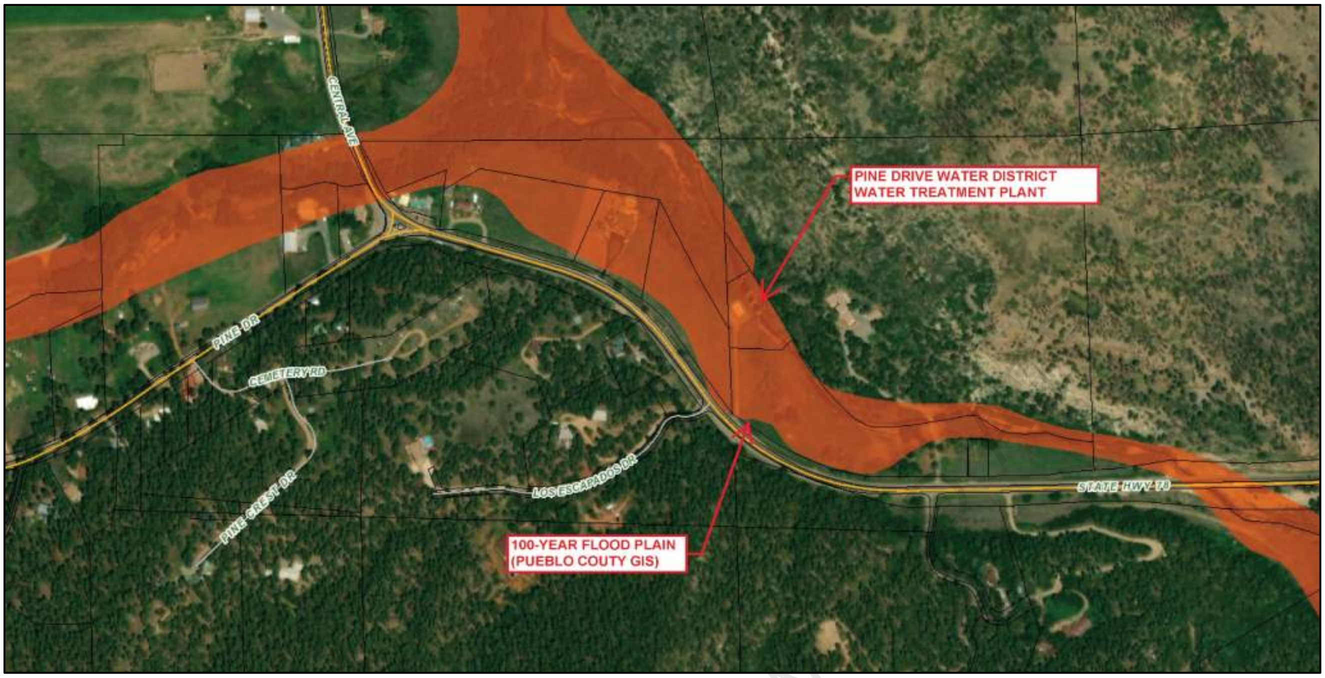


Figure 6 – Pine Drive Water District WTP and Floodplain Location[6]

In summary, the threats facing the PDWD WTP are as follows:

5) WTP operations are contingent upon raw water quality which may be impacted for the foreseeable future due to the burned area in the watershed. It would take a very significant and costly upgrade to the PDWD WTP to enable it to reliably treat the degraded raw water.

6) Catastrophic flood damage to the PDWD WTP is possible due to the burned area in the watershed not retarding heavy rain events. Therefore, investments to upgrade the existing WTP may not be prudent or recommended.

7) Source water availability has been and will likely continue to be impacted by drought or near-drought conditions in the foreseeable future.

8) High organic content (TOC) in the water during run-off events contribute to the formation of DBPs in the distribution system. A TOC removal process, such as powdered activated carbon, should be considered to absorb some of the TOC thus reducing DBPs.

3.1.3 Beulah Water Works District Distribution System Needs

The Beulah WTP and distribution system are operated in full compliance with all State and Federal regulations with no recent significant violations. However, compliance with the Disinfection Byproducts (DBP) Rule[7] is becoming increasingly more difficult for the following reasons:

1) The District must maintain a minimum 0.2 mg/L free chlorine residual in the at-grade storage tanks.

[6] *A larger copy of this figure can be found in Appendix A.*
[7] *Refer to Article 11.25 of the Colorado Primary Drinking Water Regulations*

2) Corrosion products in the distribution system exert a chlorine demand on the water.

As a result of both factors, increasing amounts of chlorine are needed to maintain a detectable residual throughout the system. Increasing the chlorine dose to meet this requirement also increases the amount of disinfection byproducts formed. Therefore, replacement of corroding steel pipes with pipes made of PVC will aid in maintaining compliance with the DBP rule because one source of chlorine demand will be removed from the system.

When waterlines break due to frost effects, both the leak and the repair effort present opportunities for contamination and pathogens to enter the water system. Replacement of water lines that are prone to frost related breaks will also provide a health, sanitation and security benefit to the system.

3.1.4 Pine Drive Water District Distribution System Needs

As was mentioned in Section 2.3.2, the PDWD distribution system is in generally good condition and repair at this time. No improvements are needed.

3.2 Aging Infrastructure

The BWWD WTP was originally constructed in the 1960's. The PDWD WTP was constructed in 1979. While both facilities are currently in good operational condition, it is expected that some facility upgrades would be necessary in the future due to the age of each facility. Many parts of the BWWD distribution system are nearing the end of their useful life as evidenced by corrosion and frost related line breaks. The pipelines replaced as part of this project will be constructed with PVC pipe meeting the requirements of AWWA Standard C900.

If the rate of water leaks and pipeline breaks continues unabated, the leak rate may exceed WTP capacity in the future. A summary of leak repairs accomplished in the past few years are shown in Table 3-1.

Table 3-1 - Summary of Recent Water Line Repairs

Date	Location	Pipe Size	Pipe Material	Comments
March 2014	Cascade & Grand	6"	AC	Main Froze and broke out the bottom of the water main
March 2015	Ban St	2”	Steel	Galvanized 2" water main leaking. Repaired
March 2016	5947 Pennsylvania	Fire Hydrant	4" PVC	Replaced Valve & Seat
December 2016	Cottonwood Ln	2”	PVC	2" PVC Main broke and was repaired
May 2017	About 8950 Grand Ave	6”	AC	3/4" Corp Stop Tapped in main coupling came out. Replaced 6 foot section of AC main with PVC and reinstall two 3/4" service lines
October 2017	9029 Cascade	3/4”	Steel	Replaced leaking 3/4" galvanized service line from main to meter pit
	9042 Cascade	2”	Steel	Excavated but no leak found, noise from coupling in Raw Water Main
	5855 Vine Mesa	Fire Hydrant		Replaced Valve & Seat
	5877 Vine Mesa	2”	Steel	Replaced leaking blow off piping with Post Hydrant

3.3 Reasonable Growth

The BWWD and PDWD service areas are near build-out capacity. The projections for growth within the service area boundaries are minimal. Therefore, this project is not needed to address growth; it is needed to address current problems with aging infrastructure and construction of a reliable water supply to meet the needs of both Districts. The existing BWWD pipelines will be replaced in, or adjacent to, their current locations. Expansion of the distribution system is not a part of the proposed project.

4 ALTERNATIVES CONSIDERED

4.1 Water Supply and Treatment

For comparisons purposes, we will present two main Alternatives:

- Alternative 1 – Retain Both WTPs
- Alternative 2: Retain Beulah WTP and Develop Emergency Well Supply

In both Alternatives the two existing distribution systems will be interconnected which would lead to the two Districts coming together as a new combined District.

Below is a Discussion of Sub-Alternatives related to the water supply and treatment (Sub-Alternatives T1 – T3) and the needed upgrades to the existing distribution systems (Sub-Alternatives D1 and D2). These will later be combined into a preferred Alternative for the project as Alternative 1 and/or 2 as presented above.

4.1.1 Sub-Alternative T1: Upgrade the Existing Two Districts at the Two Existing WTPs

The PDWD WTP lies within the 100-year floodplain. Improvements to the PDWD WTP could be made to protect it from flood damage. However, new construction within the floodplain is not advised. CDPHE Design Criteria[8] requires that facilities be located outside the 100-year flood plain or sufficient flood protection be provided. If flood protection improvements were made to the facility it would still not address the source water degradation problem. The existing facility is a “conventional” treatment process which is challenged at times to treat the raw water during runoff events. Additional treatment processes to deal better with such events will be necessary, such as a pre-settling tank and/or low-pressure membranes. Even if a more suitable treatment process were employed, the vulnerability of drought and reduced water supply remains. So, if significant treatment improvements were implemented, and alternate WTP site for the PDWD WTP out of the 100-year floodplain is assumed.

The BWWD WTP itself is not located in a flood zone. However, the diversion is susceptible to high turbidity events during periods of high run-off. For operation during all conditions, this WTP will require a pre-settling tank and/or membrane treatment. The existing raw water diversion intake is also in need of structural reinforcements and improvements. The BWWD watershed is at risk of impacts due to forest fire and drought. In 2003, BWWD constructed a 500,000-gallon storage tank to provide a sufficient quantity of potable water for supply during periods of low or no source water availability. Additional water storage capacity is not advised due to existing disinfection byproduct challenges.

Under this Alternative the project would also include potable water interconnections between the two Districts and the ability to move raw water from the two existing surface water Diversions to fully utilize the existing water rights and provide some redundancy/reliability to the systems. It is assumed that the two Districts would be combined into one District under this alternative to allow for a consolidated operation of the facilities and infrastructure.

[8] *Refer to Criteria 2.4 of State of Colorado Design Criteria for Potable Water Systems.*

4.1.2 Sub-Alternative T2: District Consolidation to one Upgraded BWWD WTP with Emergency Well Supply

This alternative consists of combining the two existing Districts into one District, consolidating the water treatment into the BWWD water treatment plant, decommissioning the PDWD water treatment plant, and rehabilitating an existing alluvial well (Sellers Well) for use as back-up water raw water supply. The Sellers Well has undergone a thorough evaluation process including water quality analysis, capacity potential and water rights assessment. This evaluation is included in Appendix C. This well would service as an emergency alternative raw water supply during periods of high water shed run-off. This would allow the existing Beulah WTP to operate as it currently does with little improvements needed.

As with Alternative T1, this Alternative the project would have potable water interconnections between the two Districts, but it would operate as one complete system. The two Districts would merge into one new district. The alternative, would also include a raw water pipeline to move raw water from the current PDWD Diversion location and the Sellers Well to the BWWD to fully utilize the existing water rights and provide significant redundancy to the system. Changing to one water treatment plant also provides consolidation of treatment and efficiencies while eliminating the risks that the PDWD WTP has in its current location in the flood plain.

4.1.3 Sub-Alternative T3: Construct a One New Groundwater Water Treatment Plant

This alternative was originally discussed and evaluated as a potential option for treatment by a new "Combined District", similar to Alternative T2 above. The Alternative involved abandoning both existing treatment plants and constructing one new WTP to treat the water from the Sellers Well as the primary source of water with the existing surface water rights needing to be changed to allow for their continued use at an alternate diversion point and/or as augmentation for the new source water. However, after looking into the details further, the costs of a new plant, lack of WTP sites that could be viably used, lack of support from the Districts, and the likely need to condemn land made this option economically and politically unfeasible. In addition, the existing water rights would be complicated, potentially decreased in value through transfers, and need for ongoing augmentation efforts for the new water rights diversion and associated accounting. This Alternative was therefore not carried any further in the analysis.

4.2 Water Distribution Pipelines

This project consists of replacing a significant portion of the BWWD's buried potable water pipelines. All new pipelines will be specified as 6-inch diameter AWWA C-900 PVC pipe. All pipe will be installed using open-cut construction, with the exception of creek crossings where auger-boring construction will likely be employed to minimize environmental impacts to creeks. The only alternatives considered for this project are whether to remove the existing pipe or abandon it in place. The two potable water distribution alternatives are discussed below.

4.2.1 Sub-Alternative D1 – Replace and Abandon Existing Potable Water Distribution Pipelines

For this alternative, the new pipeline would be installed parallel to the existing pipe and the old pipeline would be abandoned in place. The steps required for construction of this alternative include the following:

- Excavate trench parallel to existing.
- Shut down service to the system under construction.
- Install new pipeline.
- Perform disinfection, pressure testing and bacteria testing.
- Install and re-connect existing water services.
- Fill existing pipe at appropriate locations with flow-fill (low strength concrete).
- Backfill trench.
- Restore landscaping and pavement disturbed by construction activities.

In some locations, this alternative may require a slightly larger trench, but is commonly used because flow-filling existing, to-be-abandoned, pipes can be done quickly and at much lower cost than pipe removal. In many cases, the inconvenience to the public, from water service outages, is minimized because the existing system is left "online" and "in place" until the new reach of pipe is installed, tested and placed in service. Once this occurs, each water service is reconstructed with the typical water outage per tap lasting a few hours to a day.

4.2.2 Sub-Alternative D2 – Remove and Replace Existing Potable Water Distribution Pipelines

This alternative includes removing the existing pipeline followed by installation of the new pipeline in the same trench. The steps required for construction of this alternative include the following:

- Excavate existing pipeline and shut down service to the area under construction.
- Provide temporary service connections to customers.
- Remove existing pipeline.
- Install new pipeline.
- Perform disinfection, pressure testing and bacteria testing.
- Install and re-connect existing water services.
- Backfill trench.
- Restore landscaping and pavement disturbed by construction activities.
- Dispose of old pipe in accordance with all applicable regulations

This alternative potentially requires less space; however, pipe removal is more expensive and will impact the public for a longer period. The inconvenience to the public, from water service outages, is much more significant with this approach because the existing system is removed before the new reach of pipe is installed, tested and placed in service. It is critical to note that the new pipeline must be disinfected and tested prior to placing in service. This typically occurs on a block by block basis between water valves. The water service outage for impacted residents could last up to several days, depending upon construction progress, staging and testing.

4.3 Design Criteria

The criteria listed in Table 4-1 below will govern the design of the new and replaced potable water distribution system piping and was obtained from the Colorado Department of Public Health and Environment (CDPHE)[9].

Table 4-1 –Design Criteria for Water Lines

Parameter	Value
Minimum Recommended during Normal Operation	35 psi
Preferred Operating Pressure Range	60 – 80 psi
Minimum Pipe Size for Pipes that Contain Fire Hydrants	6-inch

A hydraulic model of the distribution system was constructed and used to evaluate the system based on the criteria listed in Table 4-1. The hydraulic model was constructed using InfoWater by Innovyze®. InfoWater is a GIS based water distribution modeling program. The model was developed by importing BWWD provided water line location and diameter information. The groundsurface elevations were estimated using USGS topographic data for the BWWD service area.

Under normal water demand scenarios, the model predicts low pipeline velocities and adequate pressures throughout the system indicating that 6-inch pipelines are suitable. Pressures ranged from 52 pounds per square inch (psi) in the west to 127 psi in the east side.

Much of the existing distribution system consists of improper pipe materials (subject to corrosion) or diameters or of pipes that have been installed at a shallow bury depth. As discussed previously, it is recommended that all new pipelines be constructed with PVC pipe meeting the requirements of AWWA Standard C900, and be sized at 6-inch diameter in accordance with CDPHE criteria for pipelines that contain fire hydrants. Services located in the east portion of the system should include pressure reducing valves to reduce the pressure at the residences to less than 80 psi.

4.4 Project Overview

The project evaluated the two main Alternatives that are shown in Figure 7 and Figure 8. A comparison of the improvements required for each alternative are shown in Table 4-2. The replacement of the potable water distribution pipelines for both Alternatives 1 and 2. The only differences in the between the distribution systems for Alternatives 1 and 2 are:

- Alternative 1 keeps and upgrades both exiting WTPs and Alternative 2 consolidates treatment at the upgraded BWWD WTP.
- Alternative 1 does not include the emergency back-up water supply from the Sellers Well and Alternative 2 does.
- Alternative 1 does is not able to move raw water between the PDWD Diversion and the Sellers Well to the BWWD WTP and Alternative 2 does.

[9] *Chapter 8 – Distribution System Piping and Appurtenances, Drinking Water Design Criteria, CDPHE, 2013.*

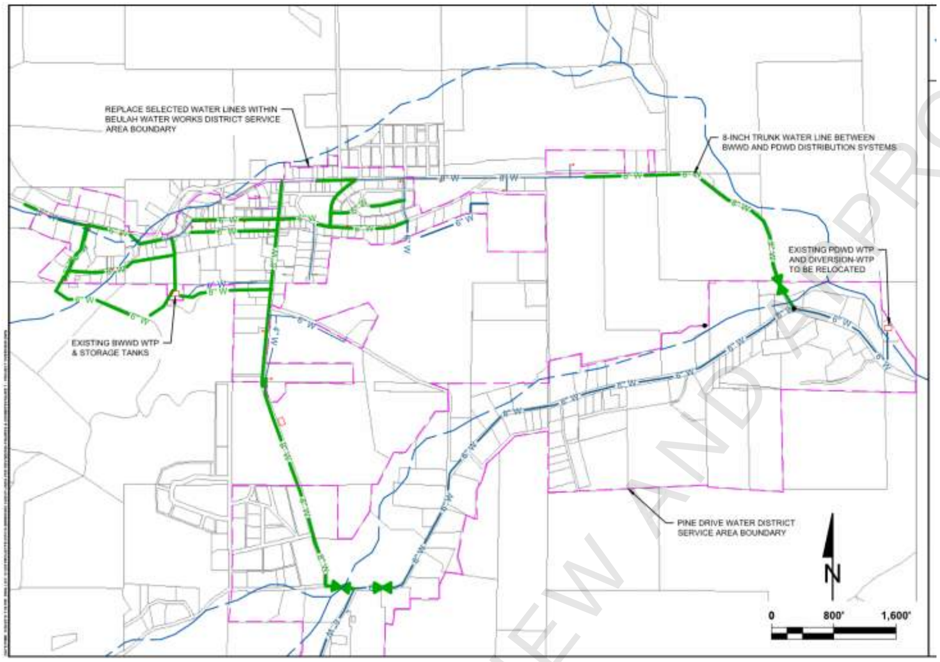


Figure 7 – Project Overview Map191 - Alternative 1

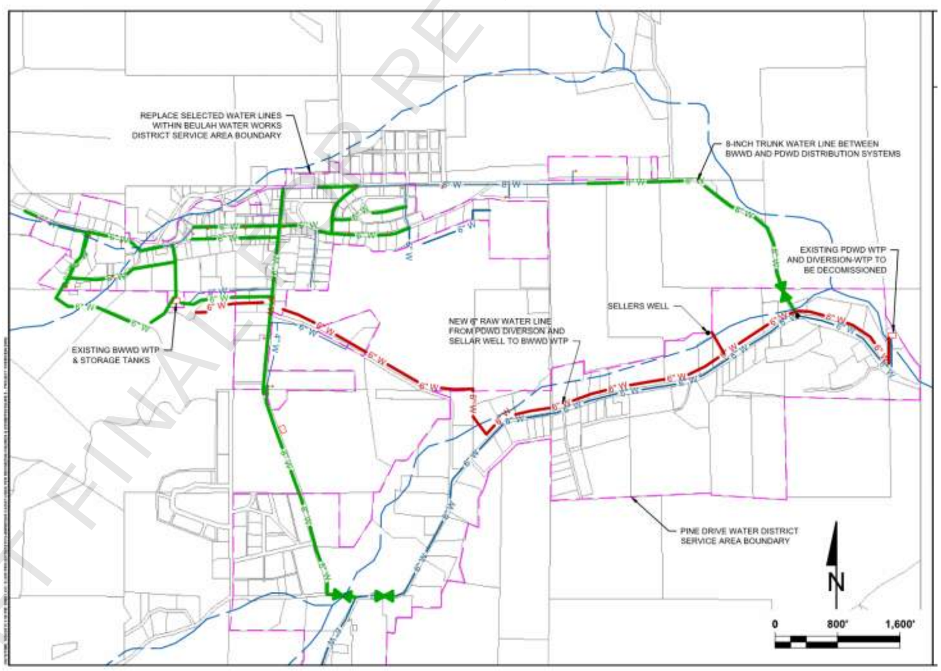
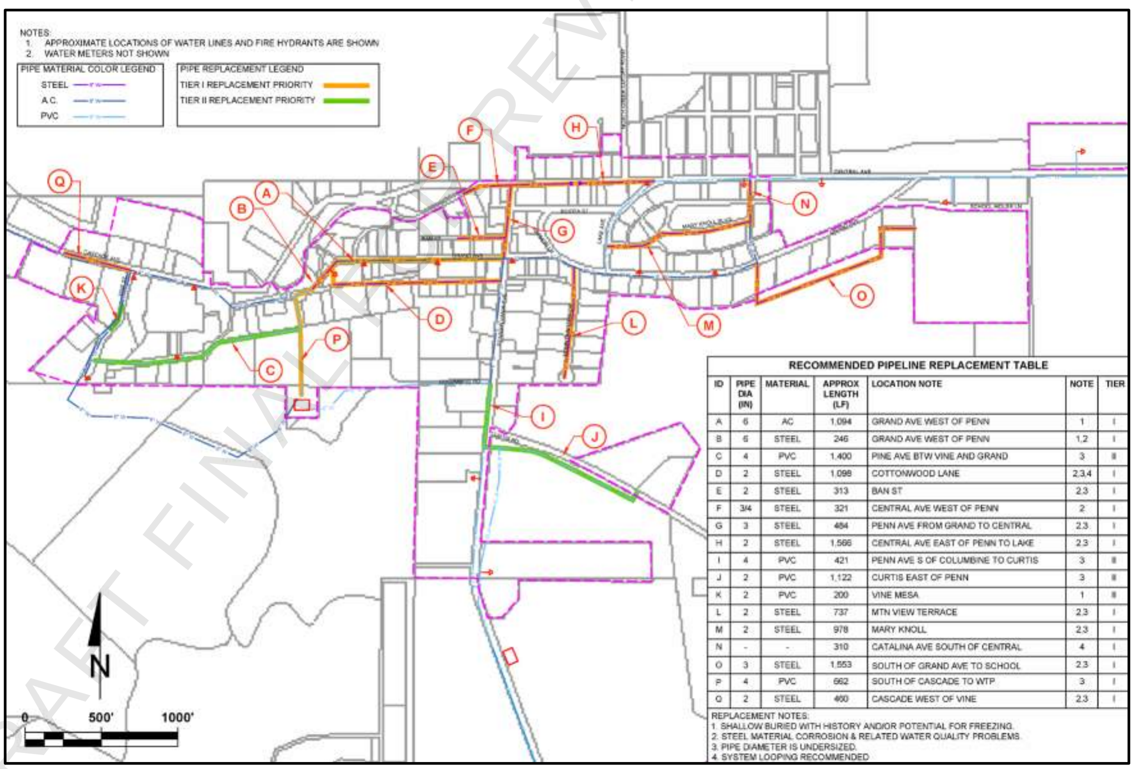


Figure 8 – Project Overview Map 1 – Alternative 2

Table 4-2 – Components of Alternatives 1&2 T and 1&2D

Project Component	Alternative 1 – Maintain Two Existing WTPs	Alternative 2 – One WTP and One Well
Treatment	Provide Advanced Treatment for Both BWWD and PDWD WTPs to treat poor quality high run-off water.	Consolidate all Treatment at Beulah WTP Abandon Use of PDWD WTP.
Diversions	Improve both BWWD and PDWD Diversions.	Improve both BWWD and PDWD Diversions.
Raw Water Supply	Maintain both the BWWD and PDWD raw water supplies only.	Maintain both the BWWD and PDWD raw water supplies. Add Alternate Emergency Supply with Sellers Well. Use This Supply During Poor Quality High Run-Off Events. New Raw Water Pipeline from PDWD and Sellers Well to Beulah WTP.
Distribution System	Complete Pipe Replacements for the Beulah System. Complete Interconnects between the Two Districts. Operate as Two Combined but Separate Systems.	Complete Pipe Replacements for the Beulah System. Complete Interconnects between the Two Districts. Operate as One Combined System.



RECOMMENDED PIPELINE REPLACEMENT TABLE

ID	PIPE DIA (IN)	MATERIAL	APPROX LENGTH (LF)	LOCATION NOTE	NOTE	TIER
A	6	AC	1,094	GRAND AVE WEST OF PENN	1	I
B	6	STEEL	246	GRAND AVE WEST OF PENN	1,2	I
C	4	PVC	1,400	PINE AVE BTW VINE AND GRAND	3	II
D	2	STEEL	1,098	COTTONWOOD LANE	2,3,4	I
E	2	STEEL	313	BAN ST	2,3	I
F	3/4	STEEL	321	CENTRAL AVE WEST OF PENN	2	I
G	3	STEEL	484	PENN AVE FROM GRAND TO CENTRAL	2,3	I
H	2	STEEL	1,566	CENTRAL AVE EAST OF PENN TO LAKE	2,3	I
I	4	PVC	421	PENN AVE S OF COLUMBINE TO CURTIS	3	II
J	2	PVC	1,122	CURTIS EAST OF PENN	3	II
K	2	PVC	200	VINE MESA	1	II
L	2	STEEL	737	MTN VIEW TERRACE	2,3	I
M	2	STEEL	978	MARY KNOLL	2,3	I
N	-	-	310	CATALINA AVE SOUTH OF CENTRAL	4	I
O	3	STEEL	1,553	SOUTH OF GRAND AVE TO SCHOOL	2,3	I
P	4	PVC	662	SOUTH OF CASCADE TO WTP	3	I
Q	2	STEEL	460	CASCADE WEST OF VINE	2,3	I

REPLACEMENT NOTES:
1. SHALLOW BURIED WITH HISTORY AND/OR POTENTIAL FOR FREEZING.
2. STEEL MATERIAL CORROSION & RELATED WATER QUALITY PROBLEMS.
3. PIPE DIAMETER IS UNDERSIZED.
4. SYSTEM LOOPING RECOMMENDED

Figure 9 – Proposed Existing Finished Water Pipe Replacements[1]

Figure 9 shows the BWWD distribution system with recommended pipe replacements. These improvements would be required for both alternatives. Pipes that need replacing are grouped into two (2) tiers of priory level. Tier I pipelines are shaded in orange and represent higher priorty replacements. Tier II pipelines are shaded in green and represent less critical lines to replace. The tiered priority rating is summarized in Table 4-3. A summary of the pipelines to be replaced is provided in Table 4-4.

Table 4-3 – Tiered Existing Finished Pipeline Replacement Priority Summary

Tier	Priority Level	Approximate Length	Contributing Factor(s)
I	High	9,200 LF 44% of System	• Pipeline bury depth is too shallow and is prone to frost related leaks and failures. • Steel pipe is corroding and contributing to water quality degradation and/or leaking. • Pipeline diameter is smaller than recommended.
II	Low	3,200 LF 15 % of System	• Pipeline diameter is smaller than they should be, otherwise material and bury depth are adequate

Table 4-4 – Existing Finished Water Pipeline Replacement Summary

ID	DIA (IN)	Material	Length (LF)	Location	Note	Tier
A	6	AC	1,094	GRAND AVE WEST OF PENN	1	I
B	6	STEEL	246	GRAND AVE WEST OF PENN	1,2	I
C	4	PVC	1,400	PINE AVE BTW VINE AND GRAND	3	II
D	2	STEEL	1,098	COTTONWOOD LANE	2,3,4	I
E	2	STEEL	313	BAN ST	2,3	I
F	3/4	STEEL	321	CENTRAL AVE WEST OF PENN	2	I
G	3	STEEL	484	PENN AVE FROM GRAND TO CENTRAL	2,3	I
H	2	STEEL	950	CENTRAL AVE EAST OF PENN TO LAKE	2,3	I
I	4	PVC	421	PENN AVE SOUTH OF COLUMBINE TO CURTIS	3	II
J	2	PVC	1,122	CURTIS EAST OF PENN	3	II
K	2	PVC	200	VINE MESA	1	II
L	2	STEEL	737	MTN VIEW TERRACE	2,3	I
M	2	STEEL	978	MARY KNOLL	2,3	I
N	-	-	310	CATALINA AVE SOUTH OF CENTRAL	4	I
O	3	STEEL	1,553	SOUTH OF GRAND AVE TO SCHOOL	2,3	I
P	4	PVC	662	SOUTH OF CASCADE TO WTP	3	I
Q	2	STEEL	460	CASCADE WEST OF VINE	2,3	I
REPLACEMENT NOTES 1. Shallow buried with history and/or potential for freezing. 2. Steel material corrosion & related water quality problems. 3. Pipe diameter is undersized. 4. System looping recommended						

4.5 Environmental Impacts

The potential impacts for each alternative on environment resources were researched using internet-based resources and tools relevant to the project area. The results of this research are documented in the sections below.

4.5.1 Terrestrial and Aquatic Plants and Wildlife

Lists of threatened and endangered species were obtained from the US Fish and Wildlife Service ECOS-iPaC website[10]. The lists are included in Appendix D. Results from the IPaC review are summarized below:

Endangered Species – The list included a total of four (4) threatened or proposed threatened species that *could* be encountered at the project location. However, project specific research documentation, included in Appendix A, from the US Fish and Wildlife Service iPaC website, states "there are no critical habitats at this location."

Refuges and Fish Hatcheries – Project specific research documentation, included in Appendix D, from the US Fish and Wildlife Service iPaC website, states "there are no refuges or fish hatcheries at this location."

Migratory Birds – According to the project specific research documentation, included in Appendix D, from the US Fish and Wildlife Service iPaC website, the area may include habitat for three (3) Birds of Conservation Concern. All construction activities will be located within roadway ROWs or existing easements. All disturbed areas will be restored to pre-construction conditions and revegetated to match pre-construction conditions. The existing vegetation will grow back, and the project will not pose permanent harm or change to any species or habitat.

4.5.2 Environmentally Sensitive Areas

Lists of potential wetlands and riparian areas were obtained from the ECOS-iPaC website[11]; this information is included in Appendix D. Figure 10 depicts environmentally sensitive areas such as wetlands[12], riparian areas[13], lakes and streams.

Most of the distribution system piping is located away from the wetland areas. However, there are a few locations where the pipelines may cross wetlands or creek beds. The pipeline design will include detailed requirements for crossing these areas utilizing directional drilling to avoid surface impacts. A preliminary review indicates that no wetlands exist in the vicinity of water lines slated for either Tier I or II replacement. This will be confirmed during final design phase.

The USFWS National Wetlands Inventory, shown in Appendix E, indicates there are temporarily flooded palustrine scrub-shrub wetlands type vegetation present at the existing Sellers well site. Impacts to wetlands in this area will be avoided by the following actions and design elements:

1) A new well will not be drilled; the existing well[14] will be reused. The existing well casing (48-inch diameter corrugated metal pipe) will remain in place but be improved by installing a stainless-steel well screen and gravel pack inside the corrugated metal pipe casing.

2) Pipelines will either be constructed within the existing roadway or routed around wetlands areas.

[10] *https://ecos.fws.gov/ipac/*
[11] *https://ecos.fws.gov/ipac/*
[12] *Data obtained from the https://www.fws.gov/wetlands/Data/Mapper.html*
[13] *Data obtained from the https://www.fws.gov/wetlands/Data/Mapper.html*
[14] *State of Colorado Well Permit 4679-F*

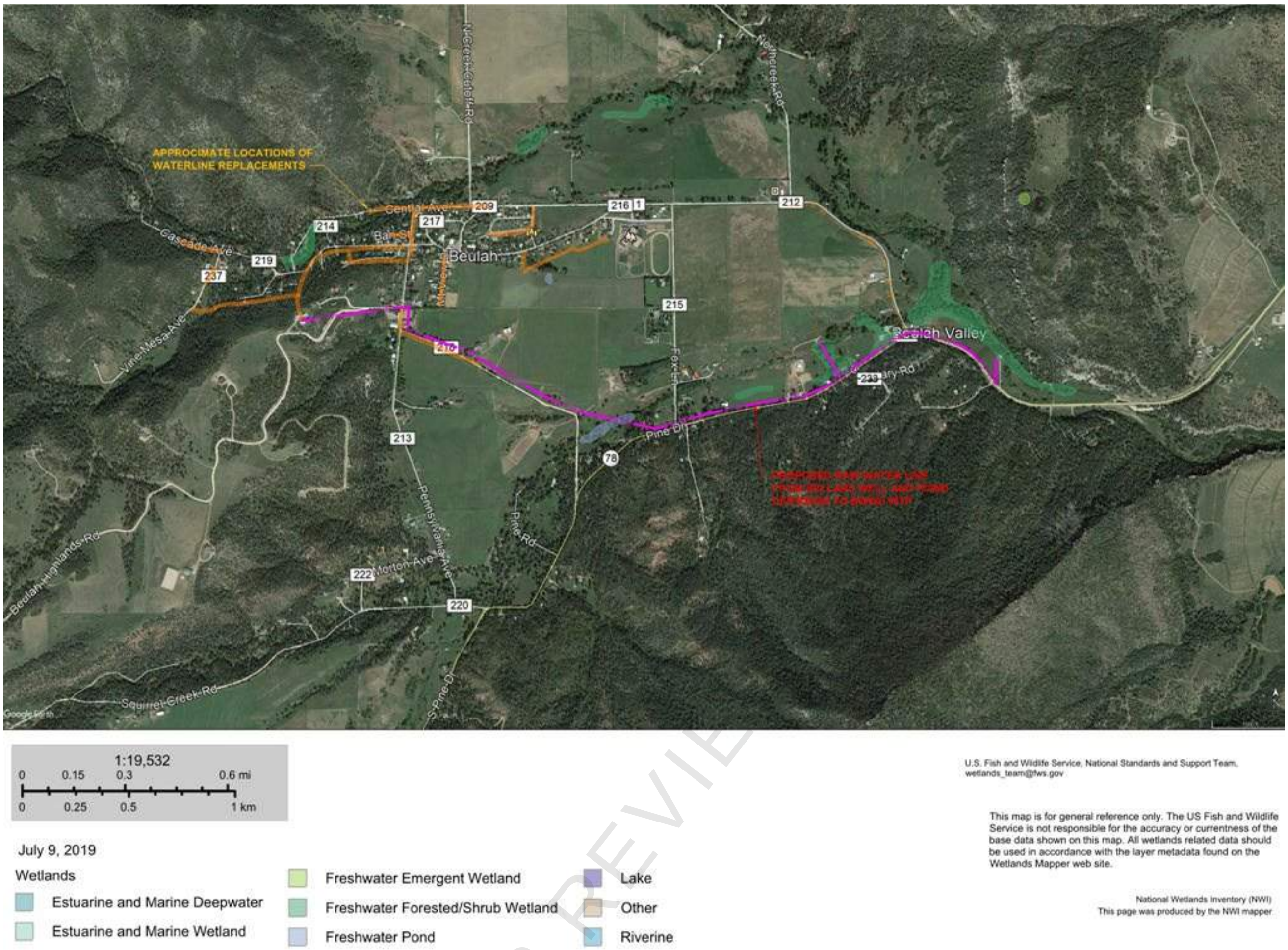


Figure 10 – Wetlands Inventory Overview[1]

4.5.3 Prime Farmland

A WebSoil survey[15] was obtained and reviewed to determine if prime farmland would be impacted by this project. The results of the survey are provided in Appendix E.

The distribution pipeline replacement work will occur in roadways and easement where the existing pipes are located. The project contract document will contain strict reclamation and revegetation requirements for all areas of pipeline construction. No permanent impacts to, or loss of, prime farmland will occur as a result of this project.

4.5.4 Cultural, Historical, and Archeological Resources

All construction activities will be confined to replacement of water lines at their current locations within their existing easements. The only exception to this will be a small portion of the new raw water line from the Sellers well and PDWD diversion which will need to be looked at closely during the design to minimize any impacts.

[15] *https://websoilsurvey.nrcs.usda.gov/app/*

Therefore, the need to perform a file search through the Colorado Office of Archeology and Historic Preservation is not anticipated.

4.6 Land Requirements

For the distribution pipeline replacements, all construction activities will be confined to replacement of water lines at their current locations within their existing easements with the exception of a small portion of the new raw water line from the Sellers Well and the PDWD diversion. The existing BWWD WTP will be upgraded in its current location and the existing PDWD WTP will be abandoned. As such, acquisition of new easements is not expected for this project component.

4.7 Potential Construction Problems

Since construction is predominately expected to be located within existing Rights of Way (ROWs) and easements, construction issues should be limited to possible high groundwater, possible conflicts with existing utilities, and traffic control. Temporary construction dewatering will be employed as needed. The pipeline will be routed around existing utilities to the maximum extent practical, but when necessary, some existing utilities (i.e., buried phone, power or gas lines) may need to be rerouted where necessary. Appropriate traffic control measures will be employed as needed.

4.8 Sustainability Considerations

Sustainability considerations are discussed in the sections below.

4.8.1 Water and Energy Efficiency

All water services in the town are billed on a metered basis. The District can and will impose watering restrictions when necessary.

4.8.2 Green Infrastructure

All new pipe will be specified as AWWA C-900 PVC. PVC pipe delivers high water quality water, has high corrosion resistance, and, if properly constructed, has a life expectancy in excess of 100 years[16].

4.8.3 Other – Simplicity of Operations

The existing surface water sources will continue to be used as the main raw water supply sources and are of a high quality except for when there are natural events such as excessive high runoff or other events such as fires that may cause the sources to have higher turbidity. In cases when the surface water sources are not of a quality that the BWWD WTP can handle the preferred Alternative system will allow for use of the low turbidity/high quality water from the Sellers Well. This allows for a much simpler treatment process in an existing facility verses trying to upgrade the existing facilities for high turbidity water while maintaining a reliable and sustainable water supply.

[16] *"Life Cycle Assessment of PVC Water and Sewer Pipe and Comparative Sustainability Analysis of Pipe Materials", April 2017. This document is backed by the Sustainable Solutions Corporation and can be found at this website: https://www.uni-bell.org/files/Reports/Life_Cycle_Assessment_of_PVC_Water_and_Sewer_Pipe_and_Comparative_Sustainability_Analysis_of_Pipe_Materials.pdf*

4.9 Capital Cost Estimates – for Comparison Purposes Only

4.9.1 Water Supply and Treatment

The two alternatives, as discussed above, for water supply and treatment are:

1) Improvements to two (2) existing water treatment plants, or

2) Construction of a raw water pipeline from PDWD WTP to the Sellers Well then to the Beulah WTP. Retain existing Beulah WTP with minor improvements.

Summary capital costs for each alternative, for comparison purposes, are shown in Table 4-5. Additional cost details are included in Appendix F.

Table 4-5 – Sub-Alternatives Cost Comparison for Water Supply and Treatment

Item	Description	Sub-Alternative 1T – Improvements to both Existing WTPs	Sub-Alternative 2T – Consolidation Alternative one WTP at BWWD
1	Alternative Base Cost for WTPs and support Infrastructure only	$9,100,000	$7,300,000

4.9.2 Water Distribution Pipelines

The cost estimates in this section presume that both Tier I and Tier II pipelines are replaced at one time as part of the proposed project. Table 4-6 presents a cost comparison for the two alternatives considered. Cost figures shown in Table 4-6 are presented for comparison purposes only and should not be used for project budgeting purposes. For project budgeting considerations, please refer to Section 6.5. The costs below do not reflect costs associated with engineering design and construction administration, contractor overhead and profit, and other related total project budget expenses. Additional cost details are included in Appendix F.

Table 4-6 – Sub-Alternatives Cost Comparison for Current Distribution System Pipeline Replacement

Item	Description	Sub-Alternative 1D – Replace and Abandon	Sub-Alternative 2D – Remove and Replace
1	ROUNDED BUDGET for COMPARISON PURPOSES ONLY	$3,300,000	$4,900,00

5 SELECTION OF AN ALTERNATIVE

5.1 Life Cycle Cost Analysis

5.1.1 Water Treatment Alternatives

The life cycle cost analysis for the water supply and treatment alternatives is summarized in Table 5-1. Supporting calculations are included in Appendix F.

Table 5-1 – Water Supply and Treatment Life Cycle Cost Comparison

Item	Sub-Alternative 1T Upgrade the Existing Two Districts at the Two Existing WTPs	Sub-Alternative 2T District Consolidation to one Upgraded BWWD WTP with Emergency Well Supply
Capital Cost	$9,100,000	$7,300,000
O&M Net Present Worth	$3,833,298	$2,171,065
Salvage Value Net Present Worth	$1,255,172	$1,510,345
Project NET PRESENT VALUE (NPV)	**$11,678,126**	**$7,960,720**

5.1.2 Potable Water Distribution Pipelines

This project consists of replacing approximately 12,400 linear feet of pipe with 6-inch diameter PVC. The primary difference between the two alternatives is whether to remove the existing pipe or abandon it in place. Once the new pipe is in place, the operations and maintenance (O&M) costs are the same for both alternatives. The salvage value for pipelines is zero because most pipes are abandoned in place. Pipe that is removed is beyond its useful life, typically broken up during the removal process, and cannot be salvaged. Other than capital costs, there is essentially no other life cycle cost difference.

5.2 Non-Monetary Factors

5.2.1 Water Supply and Treatment

The main consideration is the surface water sources for both existing treatment plants is subject to impacts from forest fire and drought. Improvements to the treatment plants cannot address the source water vulnerability. The proposed water source for the Sellers WTP is a shallow well that was constructed in 1963 which has proven production capacity. A brief list of advantages and disadvantages for the water supply and treatment alternatives is included in Table 5-2.

Table 5-2 – Advantages and Disadvantages of Water Supply and Treatment Alternatives

Sub-Alternatives	Advantages	Disadvantages
1T – Improvements to both Existing WTPs	• Minimal property or easement acquisition required. • Systems can continue to operate separately • Potable water Interconnects between systems is added to allow some flexibility in operations with agreements from both Districts. • Two WTPs. • One consolidated District operations and improvements.	• Operation of two treatment facilities required. Higher Operating Costs • Addition of advanced treatment processes at each WTP. • Need to move location of PDWD WTP to be out of flood plain. • Source water vulnerabilities to drought and water quality due to fire, larger runoff events, etc. remain. • Back-up supply limited to storage capacity and ability to fill this capacity when water is available. • Ability to move raw water from both water rights diversion points does not exist. • Additional environmental issues due to transmission of raw water. • Two WTPs.
2T- District Consolidation to one Upgraded BWWD WTP with Emergency Well Supply	• More sustainable water supply through diversity and redundancy. • Alternate Groundwater Source as Emergency Supply during high run-off and other events. • Leveraging fully existing water rights and existing infrastructure. • Consolidation to one WTP. • One consolidated District operations and improvements. • Interconnects between potable water systems is added to allow flexibility in operations. • Use of both water rights and diversions. • One WTP.	• New raw water lines needed to maximize water from the PDWD diversion location and Sellers Well. • Additional environmental issues due to transmission of raw water. • One WTP.

5.2.2 Potable Water Distribution Pipelines

Construction activities for both alternatives will negatively affect the public by causing street closures and water service outages. However, Alternative 1 will have a shorter construction duration because abandoning a pipeline in place takes less time than pipeline removal. Table 5-3 below summarizes the advantages and disadvantages for the two alternatives considered.

Table 5-3 – Advantages and Disadvantages of Potable Water Distribution Pipeline Alternatives

Sub-Alternative	Advantages	Disadvantages
1D – Replace and Abandon Existing Potable Water Distribution Pipelines	• The time required to abandon the existing pipe is significantly shorter • Shorter period of for street closures and water service outages.	• Old pipe remains in place.
2D – Remove and Replace Existing Potable Water Distribution Pipelines	• Old pipe is removed and disposed of in accordance with all applicable regulations.	• The time required to remove the existing pipe is significantly longer. • Longer time period that public is subjected to street closures and water service outages.

6 PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

6.1 Preliminary Project Design

Alternative 2 is recommended for water supply and treatment and Alternative. Alternative 2 is a combination of Sub-Alternative 2T for the Water Supply and Treatment and Sub-Alternative 1D for the Distribution Pipelines.

6.1.1 Water Supply and Treatment

The maximum month average daily demand for the combined service area is approximately 69,000 gallons per day[17]. Water production requirements should be met with the BWWD treatment plant running approximately 16 hours per day at its 70 gpm minimum design capacity.

Potable water quality must meet all State and Federal drinking water requirements. Water quality analyses for the two existing surface water sources and for the new Sellers Well source[18] indicate that no chemical constituents are present above their maximum contaminant level (MCL). The Sellers Well, if and when needed, produces a high quality, low turbidity water.

6.1.2 Potable Water Distribution Pipelines

This project consists of upgrading selected pipes in the system. As shown in Table 6-1, the existing finished water system consists of approximately 21,000 feet of buried pipelines ranging in diameter from 3/4-inch to 6-inch and includes AC, steel, and PVC pipe. All new pipes and replaced will be upgraded to 6 and 8-inch diameter AWWA C-900 PVC pipe. In addition to pipeline replacement, approximately 10 fire hydrants will be replaced. The tiered priority structure and discussion of pipelines to be replaced was incorporated into Section 4.4.

6.2 Project Schedule

The anticipated key project milestones are shown in Table 6-1.

Table 6-1 – Key Project Milestone Dates (Proposed)

Milestone	Target Date
Submittal of PER and ER to USDA	October 2019
Preliminary Design submittal to Owner, CDPHE and USDA	March 2020
Final Design and Bidding Documents	December 2020
Project Bidding and Award	January 2021
Begin Construction	February 2021
Completion of Construction	March 2022

[17] Refer to Table 7 in Beulah Water Works District Water Treatment Plant Capacity Evaluation report in Appendix C.
[18] Refer to water quality data presented in two (2) reports by Hemenway Groundwater Engineering in Appendix C.

6.3 Permit Requirements

The Colorado Department of Public Health and Environment (CDPHE) must review and approve the BWWD WTP upgrades prior to construction.

Other permit requirements are project specific; however, the following list represents permits that will most likely be required. The contract documents will assign responsibility for permit procurement, and compliance, to the Contractor. At a minimum, the following permits will be required.

- Storm Water Construction Permit
- Potential wetlands 404 permits
- Construction Dewatering Permit
- County Building Permit
- Electrical Permit

6.4 Sustainability Considerations

Sustainability considerations for continued water management are discussed in the sections below.

6.4.1 Water Rights

The consolidation of the WTPs to use only the existing BWWD plant under the District Consolidation Alternative 2 required a closer look at the existing water rights for each District including their points of diversion and augmentation during the use of the Sellers Well, if needed. This report assumes that both existing water rights be modified to allow diversions from each of the existing diversions including some upgrades. This will allow for flexibility during different flow situations as well as if augmentation as required for the Sellers Well. There are other options that can be looked at in more detail during project implementation, but other options will unlikely create any additional cost, schedule, or flexibility above those presented in this report.

A more thorough alternatives analysis for augmenting water use has been prepared by the District's water rights engineer and is included in Appendix C, including some work on Alternative 3 that was not carried forward in this report.

6.4.2 Water and Energy Efficiency

Both water Districts will continue metering all water usage and impose watering restrictions when needed. The existing steel pipes in the BWWD system are reported to have minor leaks in numerous locations. Replacing the steel pipelines with new PVC pipes represents a water efficiency gain as water losses, associated with leaking steel pipe, will be curtailed.

6.4.3 Green Infrastructure

All new pipelines will be 6-inch diameter AWWA C-900 PVC as discussed in Section 4.8.1 above.

6.5 Total Project Cost Estimate (Engineer's Opinion of Probable Cost)

A summary of the Engineer's Opinion of Probable Cost (EOPC) for the preferred Alternative 1 project is shown in Table 6-2 through Table 6-5. A more detailed EOPC is included in Appendix F. Note that all costs were developed with a 30% contingency. This is based upon using the Association for the Advancement of Cost Engineering (AACE) Cost Estimate Classification System (AACE System) which is the recognized standard for applying the general principles of estimate classification to engineering project cost estimates. This project is at the Class 4-5 level (Concept to Feasibility Level) that has a recommended contingency range from approximately 25% to 75%.

Table 6-2 – Opinion of Probable Cost for BWWD WTP Upgrades

No.	Description	Quantity	Unit	Unit Price	Cost
	WTP Building, Piping and Equipment				
1	Diversion Improvements	1	LS	$ 250,000	$ 250,000
2	Treatment Building Improvements	800	SF	$ 30	$ 24,000
3	Exterior Concrete Pads and Walks	1	LS	$ 5,000	$ 5,000
4	Powdered Activated Carbon Feed Equipment	1	LS	$ 20,000	$ 20,000
5	New Solids Pond Lining and Improvements	1	LS	$ 400,000	$ 400,000
6	Other Equipment Upgrades	1	LS	$ 20,000	$ 20,000
7	UV Disinfection	2	EA	$ 100,000	$ 200,000
8	Instrumentation (equipment and installation)	1	LS	$ 35,000	$ 35,000
9	Electrical Wiring & Cabinets, Etc.	1	LS	$ 40,000	$ 40,000
10	Raw Water Pumping from PDWD Diversion	1	LS	$ 60,000	$ 60,000
11	Raw Water Piping to PDWD Diversion	12,400	LF	$ 120	$ 1,488,000
	Subtotal				**$ 2,542,000**
	Contractor Mobilization, Overhead & Profit	15%			$ 381,300
	Project Subtotal				$ 2,923,300
	Contingency	30%			$ 876,990
	Total Construction Budget				$ 3,800,290
	ROUNDED CONSTRUCTION BUDGET				**$ 3,800,000**
	Bond Counsel Fees	0.5%			$ 19,000
	Design Surveying & Geotechnical	3%			$ 114,000
	Engineering Design & Bidding	10%			$ 380,000
	Engineering Construction Phase Services & RPR	6%			$ 228,000
	TOTAL WTP BUDGET				$ 4,541,000
	ROUNDED BUDGET WTP				**$ 4,600,000**

Table 6-3– Opinion of Probable Cost for Sellers Well Supply Well

Item	Description	Quantity	Unit	Unit Price	Item Cost
	Civil Site Work - Sellers Well				
1	6" Dia Well Discharge Line to Beulah WTP	7,300	LF	$ 80	$ 584,000
2	4" Floor Drain Pipe Outlet w/ Flap Gate	100	LF	$ 50	$ 5,000
3	Site Grading	1	LS	$ 2,500	$ 2,500
4	Pipeline Fencing Restoration	2,000	LF	$ 5	$ 10,000
5	Gravel Access Road (12'Wx3" CL 6)	1,200	LF	$ 40	$ 48,000
6	Bollards	4	EA	$ 750	$ 3,000
7	Security Fence	200	LF	$ 15	$ 3,000
8	Revegetation / Reseeding Allowance	1	LS	$ 2,500	$ 2,500
9	Silt Fence	2,500	LF	$ 3	$ 7,500
10	Raw Water Pumping	1	LS	$ 60,000	$ 60,000
11	Distribution to Raw Water Line Distrobution	1,100	LF	$ 110	$ 121,000
	Civil Site Work - Sellers Well			**Subtotal**	**$ 846,500**
	Sellers Well Improvements				
1	Existing Well Site Demolition	1	LS	$ 10,000	$ 10,000
2	Well House Rehabilitation (Slab Fdn, Structure, Finish	250	SF	$ 450	$ 112,500
3	Well Rehabilitation (Screen, Pack, etc.)	1	LS	$ 20,000	$ 20,000
4	40 hp Submersible Well Pump & Motor	2	EA	$ 30,000	$ 60,000
5	2.5" Sch. 40 Steel Pipe	40	LF	$ 10	$ 400
6	Motor Control Center	1	LS	$ 100,000	$ 100,000
7	480v Variable Frequency Drive	2	EA	$ 10,000	$ 20,000
8	VFD Harmonic Filter	2	EA	$ 2,500	$ 5,000
9	Level Transducer	1	EA	$ 6,000	$ 6,000
10	Well Pump, Piping & Support Installation	1	LS	$ 10,000	$ 10,000
	Sellers Well Improvements			**Subtotal**	**$ 343,900**
	Sellers Well Electrical and Controls				
1	Well Site Electrical Service	1	LS	$ 25,000	$ 25,000
2	Well Site Electrical Equipment Installation	1	LS	$ 40,000	$ 40,000
3	Fiber Optic Control Cable and Conduit (Well to WTP)	1300	LF	$ 15	$ 19,500
4	Instrumentation (equipment and installation)	1	LS	$ 15,000	$ 15,000
5	Electrical Wiring & Cabinets, Etc.	1	LS	$ 25,000	$ 25,000
	Sellers Well Electrical and Controls			**Subtotal**	**$ 124,500**
	Subtotal All				**$ 1,314,900**
	Contractor Mobilization, Overhead & Profit (18%)	15%			$ 197,235
	Project Subtotal				$ 1,512,135
	Contingency (30%)	30%			$ 453,641
	Total Construction Budget				$ 1,965,776
	ROUNDED CONSTRUCTION BUDGET				**$ 2,000,000**
	Bond Counsel Fees	0.5%			$ 10,000
	Design Surveying & Geotechnical	3%			$ 60,000
	Engineering Design & Bidding (10%)	10%			$ 200,000
	Engineering Construction Phase Services & RPR	6%			$ 120,000
	Sub Total Sellers Well Budget				$ 2,390,000
	ROUNDED SELLERS WELL BUDGET				**$ 2,400,000**

Table 6-4 – Opinion of Probable Cost for Recommended Water BWWD Distribution System Improvements

Item	Description	Quantity	Unit	Unit Cost	Item Cost
1	TIER 1 6" WATERLINE REPLACEMENT	9,200	LF	$120	$1,104,000
2	TIER 1 Water service reconnections	90	EA	$5,000	$450,000
3	TIER 2 6"WATERLINE REPLACEMENT	3,200	LF	$120	$384,000
4	TIER 2 Water service reconnections	12	EA	$5,000	$60,000
5	Landscaping & Asphalt Repair Allowance	12	EA	$10,000	$120,000
6	Fire Hydrants	10	EA	$7,500	$75,000
	Sub-Total				**$2,193,000**
	Contractor Mobilization, Overhead & Profit (15%)	18%			$328,950
	Project Subtotal				$2,521,950
	Contingency (30%)	30%			$756,585
	Total Construction Budget				$3,278,535
	ROUNDED CONSTRUCTION BUDGET				**$3,300,000**
	Bond Counsel Fees	0.5%			$16,500
	Design Surveying & Geotechnical	3%			$99,000
	Engineering Design & Bidding	10%			$330,000
	Engineering Construction Phase Services & RPR	6%			$198,000
	TOTAL BUDGET				$3,943,500
	ROUNDED BUDGET				**$3,900,000**

Table 6-5 – Opinion of Probable Cost for Recommended Water PDWD Distribution System Improvements

Item	Description	Quantity	Unit	Unit Cost	Item Cost
1	8" East Interconnecting Pipeline	3,800	LF	$120	$456,000
2	TIER 1 Water service reconnections	5,700	LF	$120	$684,000
3	TIER 2 6"WATERLINE REPLACEMENT	3	EA	$50,000	$150,000
4	TIER 2 Water service reconnections	10	EA	$5,000	$50,000
5	Landscaping & Asphalt Repair Allowance	8	EA	$10,000	$80,000
6	Fire Hydrants	12	EA	$1,500	$18,000
7	8" West Interconnecting Pipeline	3	EA	$6,000	$18,000
8	PRV Stations	4	EA	$6,000	$24,000
9	TIER 2 Water service reconnections	750	LF	$120	$90,000
10	Landscaping & Asphalt Repair Allowance	1	LS	$20,000	$20,000
11	Fire Hydrant Extensions	1	LS	$25,000	$25,000
12	Watseka Tank Access Hatch Improvements	1	LS	$10,000	$10,000
13	Stansfield Tank Access Hatch Improvements	1	LS	$20,000	$20,000
	Sub-Total				**$1,645,000**
	Contractor Mobilization, Overhead & Profit (15%)	15%			$246,750
	Project Subtotal				$1,891,750
	Contingency (30%)	30%			$567,525
	Total Construction Budget				$2,459,275
	ROUNDED CONSTRUCTION BUDGET				$2,500,000
	Bond Counsel Fees	0.5%			$16,500
	Design Surveying & Geotechnical	3%			$99,000
	Engineering Design & Bidding	10%			$330,000
	Engineering Construction Phase Services & RPR	6%			$198,000
	TOTAL BUDGET				$3,143,500
	ROUNDED BUDGET				**$3,100,000**

The Total Project EOPC is summarized in Table 6-6 and including the estimated augmentation plan costs.

Table 6-6 – Total Project Summary Opinion of Probable Cost for Recommended Alternative

Item	Description	Quantity	Unit	Unit Cost	Item Cost
1	Emergency Source Groundwater Well Subtotal	1	LS	$ 2,400,000	$ 2,400,000
2	Beulah Potable Water Distribution System Pipelines Subtotal	1	LS	$ 3, 900,000	$ 3,900,000
3	Pine Drive Potable Distribution System Pipelines Subtotal	1	LS	$ 3,100,000	$ 3,100,000
4	Beulah Water Treatment Plant Rehabilitation Costs	1	LS	$ 4,600,000	$ 4,600,000
	Subtotal				$ 14,000,000
	ROUNDED CONSTRUCTION BUDGET				**$ 14,000,000**
	Legal Fees for District Consolidation and Water Rights	1.5%			$ 210,000
	New District Establishment and Election	0.5%			$ 70,000
	Bond Counsel Fees	0.5%			$ 70,000
	TOTAL BUDGET				$ 14,350,500
	ROUNDED TOTAL BUDGET				**$ 14,400,000**

6.6 Annual Operating Budget

The estimated annual operating budget for Alternative 2, Combined Districts, is provided in the sections below. Note that the rates from the existing BWWD were used as a baseline for this analysis and these may need to be updated/changed upon the project approval and implementation based on actual conditions.

6.6.1 Income

Please see Appendix B for 2018 financial information and rate structures for both existing Districts. Future income will be based upon water user rates. Income from Monthly Base Fees alone is summarized in Table 6-7. It is expected that water usage may see a slight decrease due to the increase in water rates. Actual monthly income is related to quantity of water sold each month. Additional financial information is included in Appendix B.

Table 6-7 – Estimate of Base Income

Tap Size	No.	Monthly Base Fee	Months	Total Annual Income
3/4-inch to 1 1/2-inch	305	$100	12	$366,000
Commercial/larger than 1 ½ in.	16	$200	12	$38,400
		TOTAL ESTIMATED ANNUAL BASE INCOME		**$404,400**

The two District's 2018 budget projects total water use revenue from monthly base fees and water sold for the year was approximately $405,490.

6.6.2 Annual O&M Costs

In 2017 the two Districts incurred approximately $95,000 in O&M costs (not including labor) pertaining to the distribution system. When the proposed project is completed it is expected that this cost will be reduced by approximately 70%.

6.6.3 Debt Repayments and Reserves

The BWWD District currently holds no debt and had approximately $50,000 in cash reserves. The PDWD had a debt of approximately $53,000 at the end of 2018. A detailed financial accounting summary is provided in Appendix B.

7 CONCLUSIONS AND RECOMMENDATIONS

The surface water sources for both existing water treatment plants are vulnerable to impacts from fire, drought and flash flooding. Expenditure of resources on the PDWD WTP located in the flood plain will not be sustainable and not having a back-up emergency water supply will not satisfactorily address the surface source water vulnerabilities. Therefore, Alternative 2 that that is made up from Sub-Alternative 2T for Water Supply and Treatment and Sub-Alternative 1D for the Potable Water Distribution consolidates the two existing Water Districts, eliminates the PDWD WTP, consolidates the treatment at an upgraded BWWD WTP, provides the ability to treat and convey the existing surface water rights and an emergency back-up supply from the Sellers Well is recommended because it provides a for a sustainable and reliable water system for both services areas.

The existing distribution system piping in the Beulah Water Works District service area has reached the end of its useful service life and the majority needs replacement. Replacing the piping will address the ongoing challenges of leak repair and water loss.

USDA PRELIMINARY ENGINEERING REPORT

DRAFT FINAL

APPENDIX A

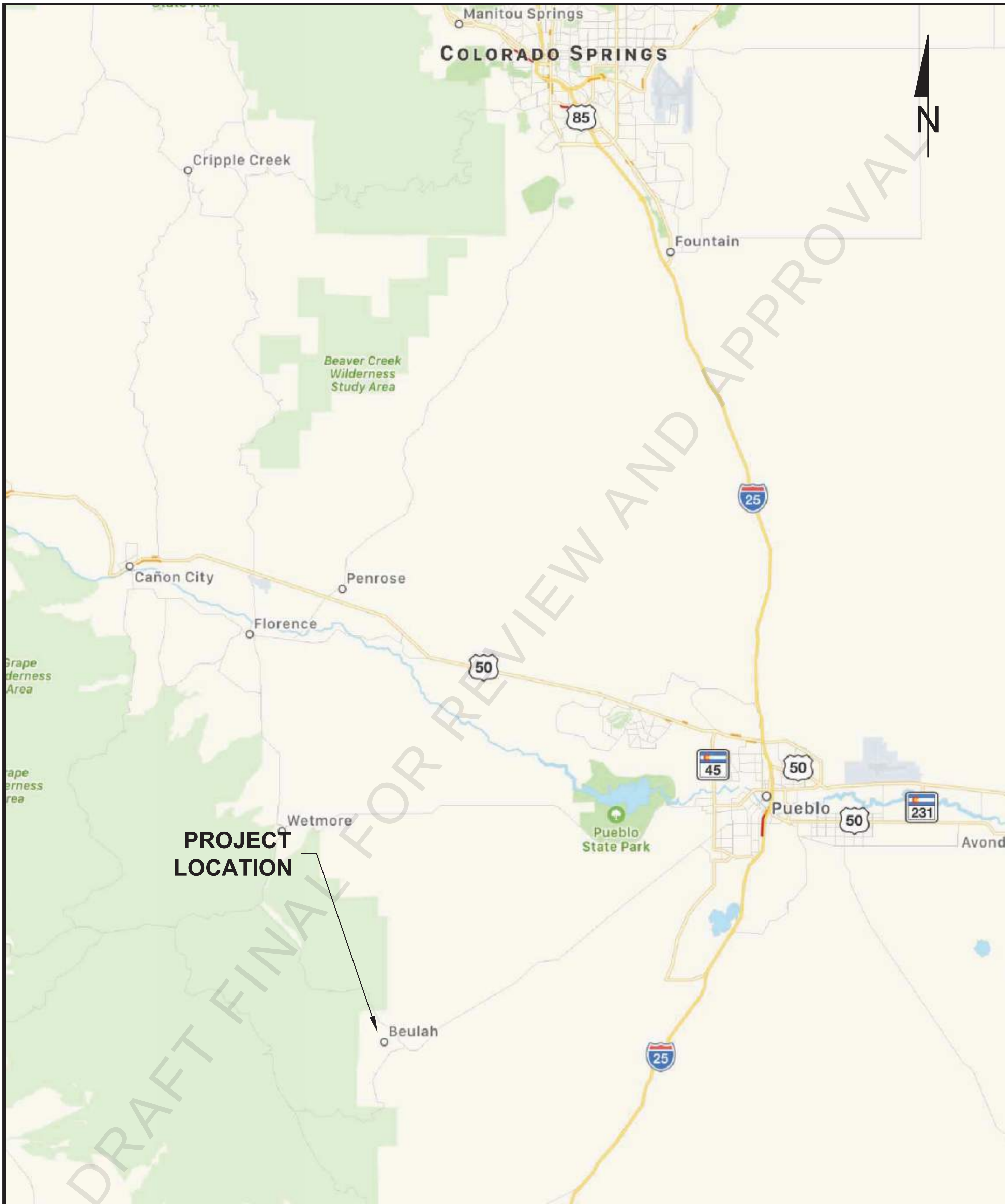
FIGURES



WATER SYSTEM IMPROVEMENTS PROJECT

APPENDIX A – REPORT FIGURES

- **Figure 1 - Location Map**
- **Figure 2 - BWWD & PDWD Service Areas**
- **Figure 3 - Existing BWWD & PDWD Water Systems**
- **Figure 4 - Existing BWWD Distribution System**
- **Figure 6 – Pine Drive Water District WTP and Floodplain Location**
- **Figure 7 – Project Overview Map19[1] - Alternative 1**
- **Figure 8 – Project Overview Map [1] – Alternative 2**
- **Figure 9 – Proposed Existing Finished Water Pipe Replacements**
- **Figure 10 – Wetlands Inventory Overview**



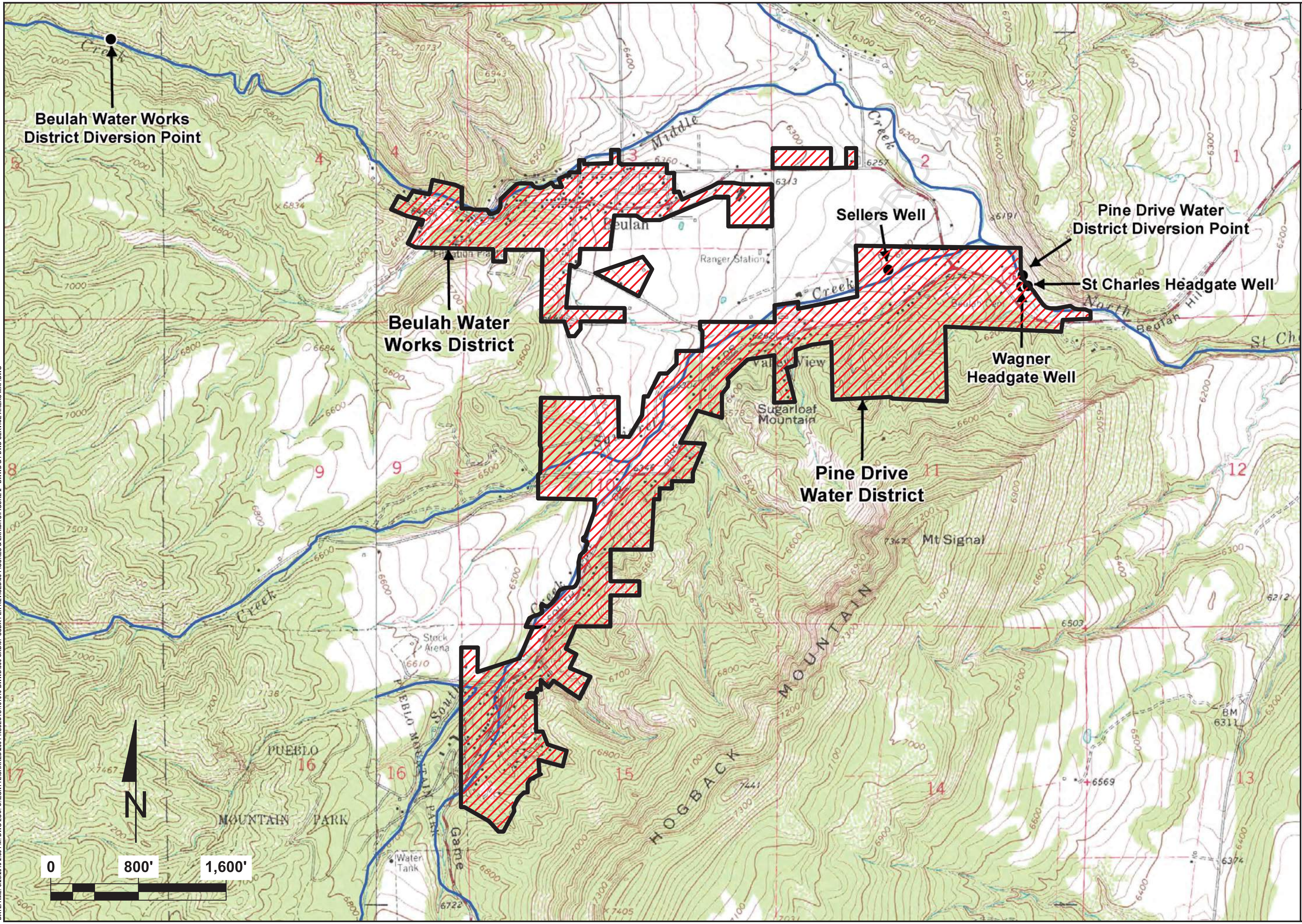
LOCATION MAP

BEULAH WATER WORKS DISTRICT
WATER SYSTEM IMPROVEMENTS PROJECT

FIGURE 1

PROVIDENCE INFRASTRUCTURE CONSULTANTS

DATE/TIME: 6/28/2019 12:45 PM: DWG LOC: C:\EGNYTE\SHARED\200 PROJECTS\151010-BWWD\900 CAD\07-USDA PER REVISED\06-FIGURES & EXHIBITS\FIGURE 1 - LOCATION MAP.DWG



PROVIDENCE INFRASTRUCTURE CONSULTANTS

FIGURE 2 - BWWD & PDWD SERVICE AREAS

BEULAH WATER WORKS DISTRICT
WATER SYSTEM IMPROVEMENTS PROJECT

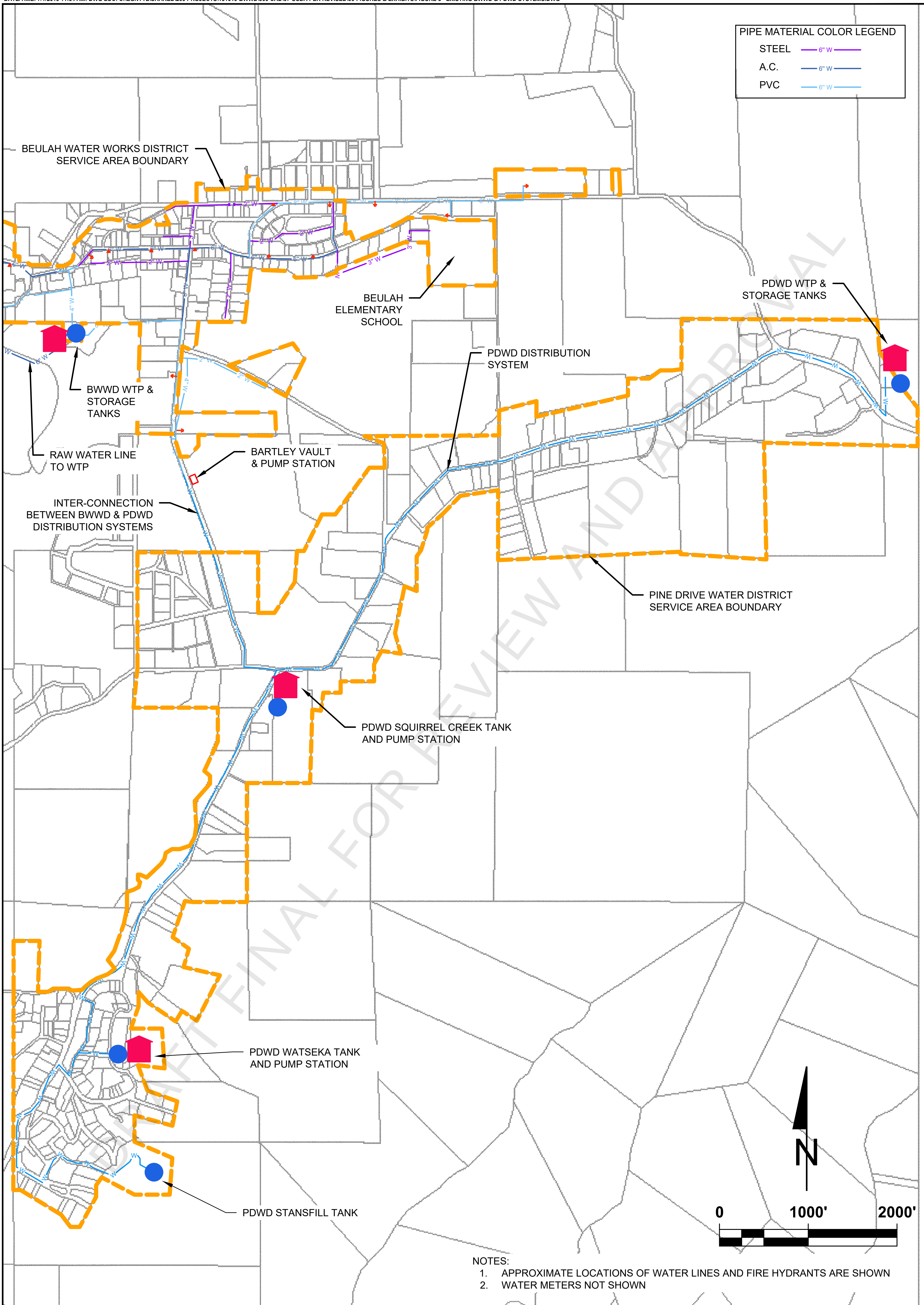
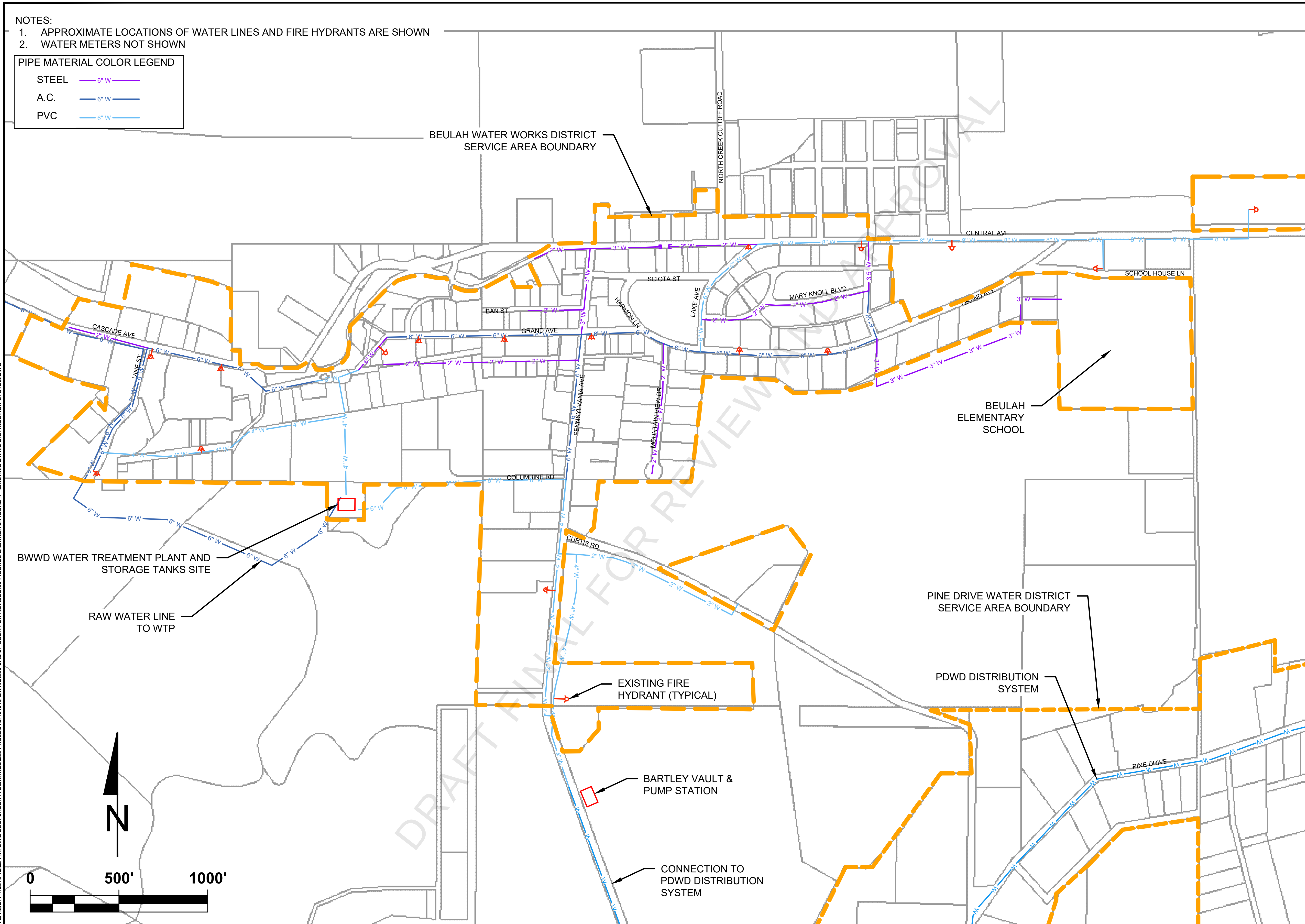


FIGURE 3 - EXISTING BWWD & PDWD WATER SYSTEMS

BEULAH WATER WORKS DISTRICT
WATER SYSTEM IMPROVEMENTS PROJECT

PROVIDENCE INFRASTRUCTURE CONSULTANTS

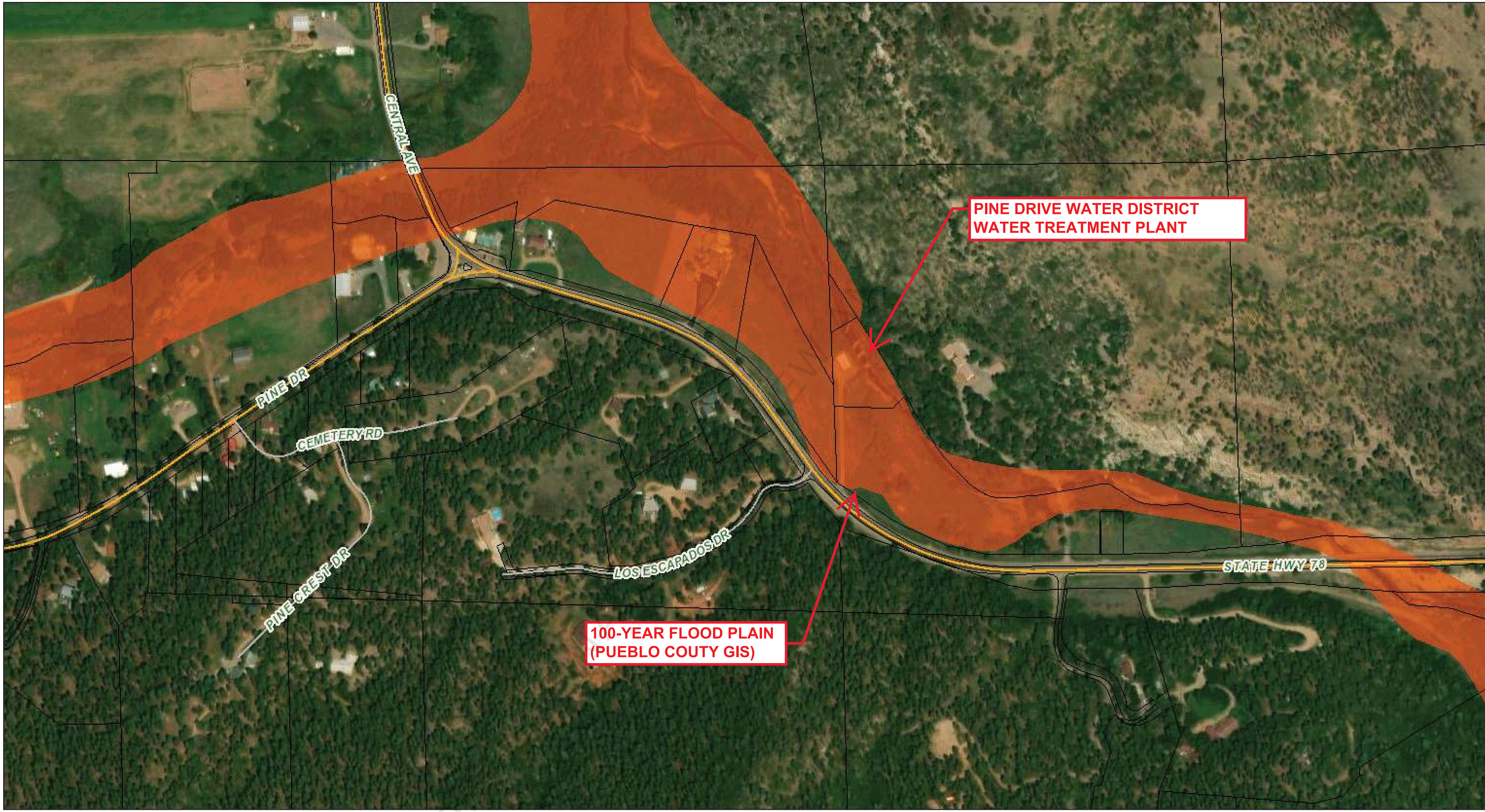


PROVIDENCE INFRASTRUCTURE CONSULTANTS

FIGURE4 - EXISTING BWWD WATER DISTRIBUTION SYSTEM

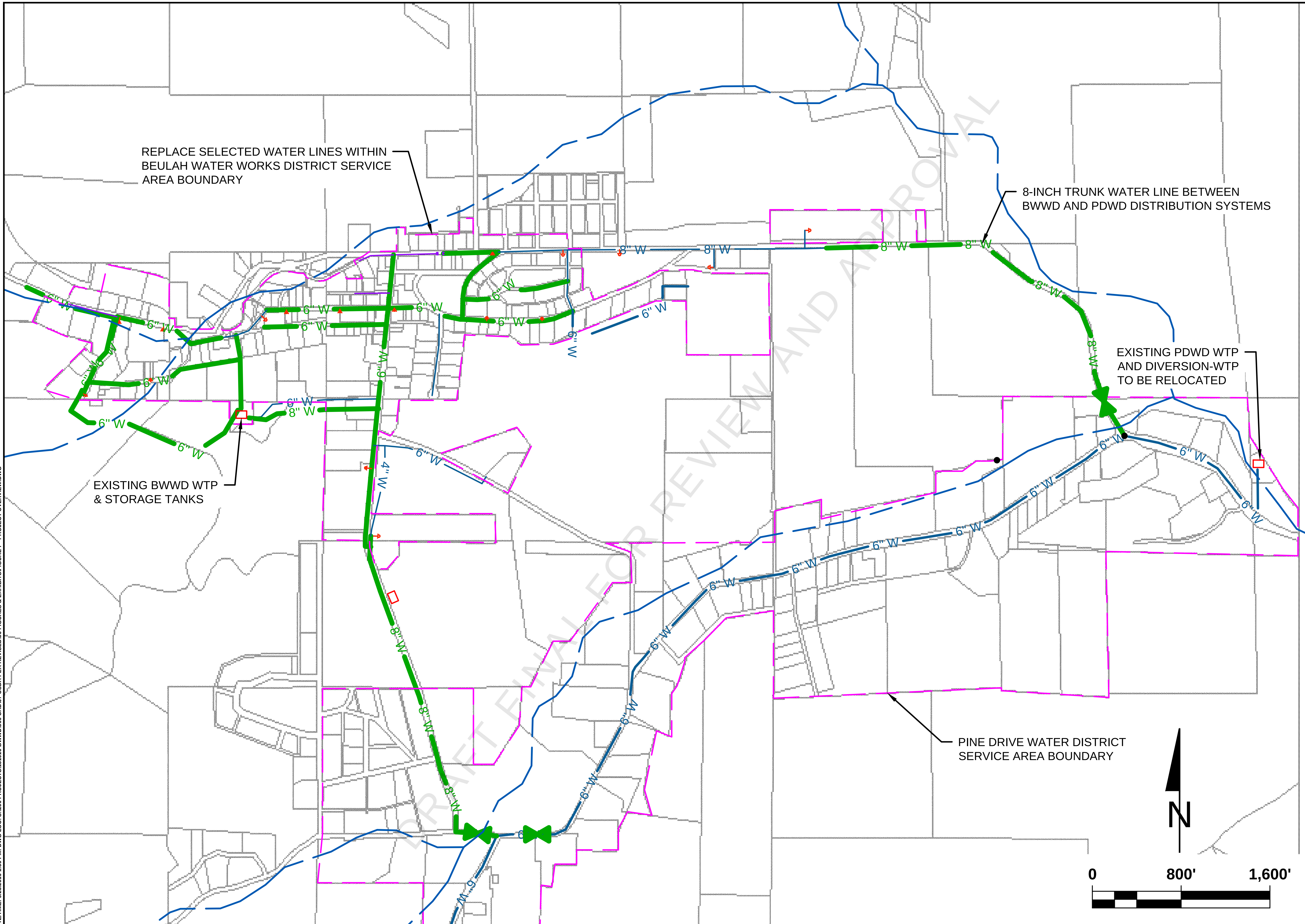
BEULAH WATER WORKS DISTRICT
WATER SYSTEM IMPROVEMENTS PROJECT

FIGURE 5 - Pine Drive Water District WTP and Floodplain Location



July 1, 2019

0 0.02 0.04 0.08 0.12 0.16 mi

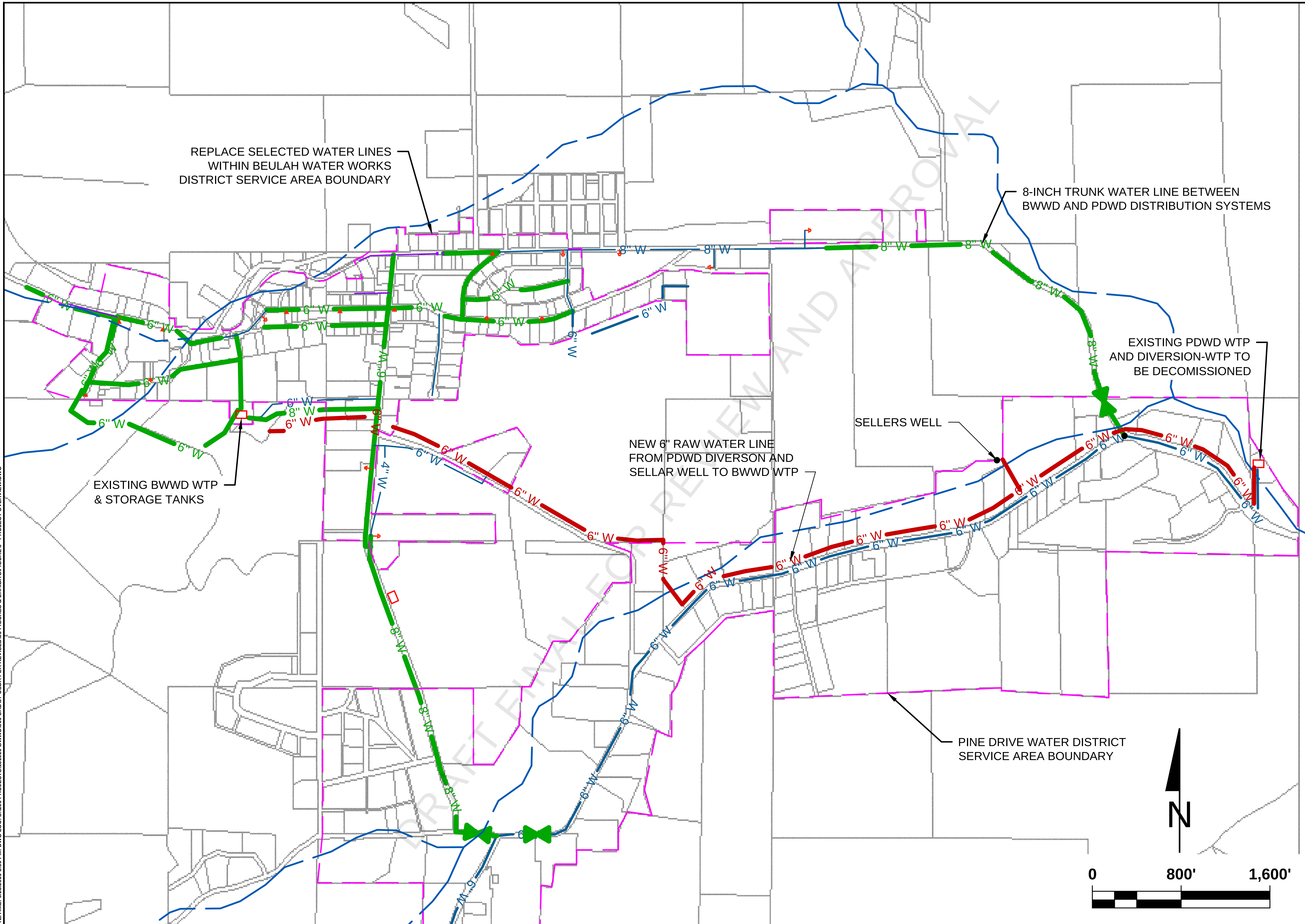


PROVIDENCE INFRASTRUCTURE CONSULTANTS

FIGURE 7 - PROJECT OVERVIEW MAP, ALTERNATIVE 1

BEULAH AND PINE DRIVE WATER WORKS DISTRICT
WATER SYSTEM IMPROVEMENTS PROJECT

DATE/TIME: 9/26/2019 1:59 PM: DWG LOC: S:\200 PROJECTS\151010-BWWD\900 CAD\07-USDA PER REVISED\06-FIGURES & EXHIBITS\FIGURE 7 - PROJECT OVERVIEW.DWG

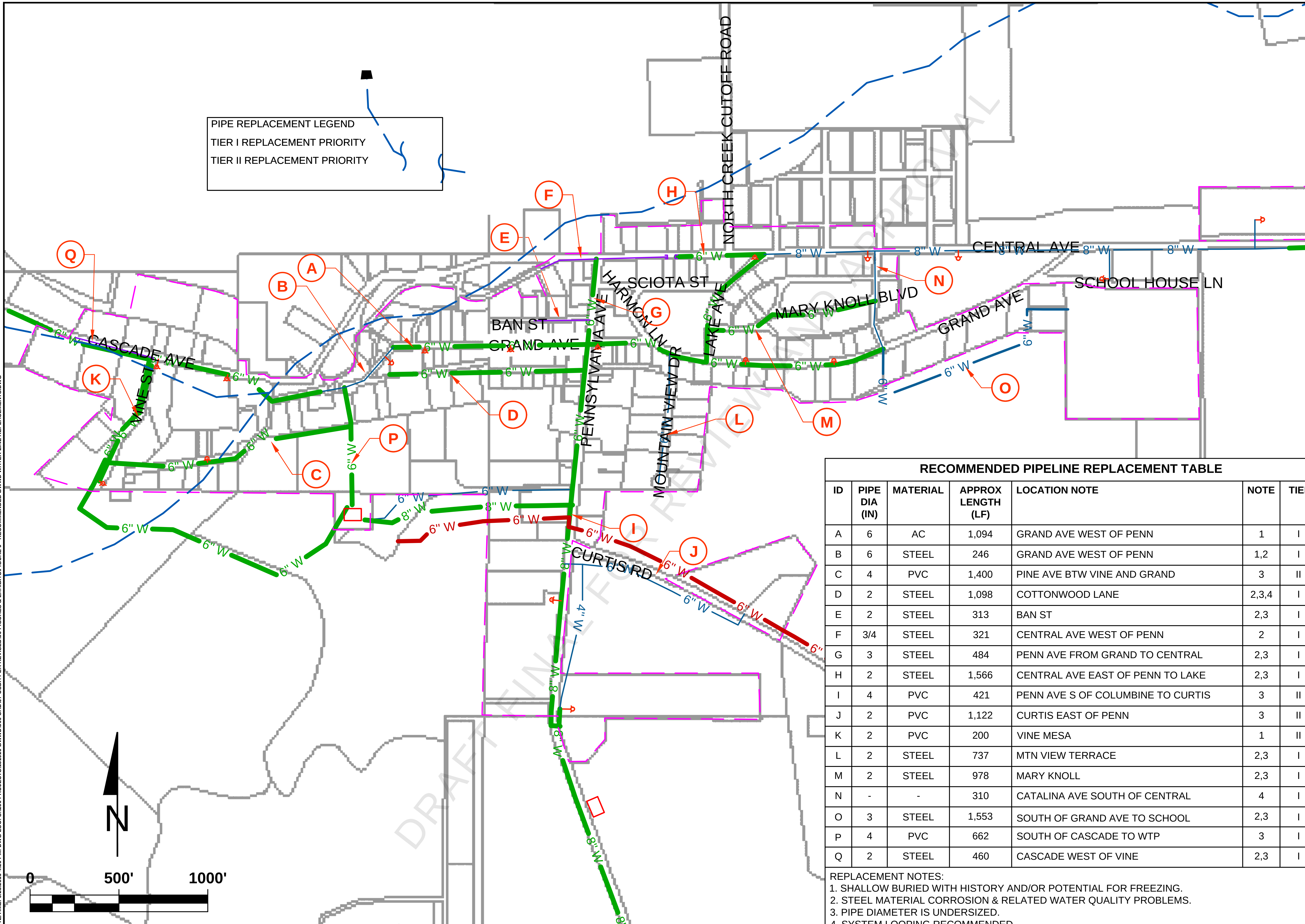


PROVIDENCE INFRASTRUCTURE CONSULTANTS

FIGURE 8 - PROJECT OVERVIEW MAP, ALTERNATIVE 2

BEULAH AND PINE DRIVE WATER WORKS DISTRICT WATER SYSTEM IMPROVEMENTS PROJECT

DATE/TIME: 9/26/2019 1:59 PM; DWG LOC: S:\200 PROJECTS\15010-BWWD\900 CAD\07-USDA PER REVISED\06-FIGURES & EXHIBITS\FIGURE 8 - PROJECT OVERVIEW.DWG



RECOMMENDED PIPELINE REPLACEMENT TABLE

ID	PIPE DIA (IN)	MATERIAL	APPROX LENGTH (LF)	LOCATION NOTE	NOTE	TIER
A	6	AC	1,094	GRAND AVE WEST OF PENN	1	I
B	6	STEEL	246	GRAND AVE WEST OF PENN	1,2	I
C	4	PVC	1,400	PINE AVE BTW VINE AND GRAND	3	II
D	2	STEEL	1,098	COTTONWOOD LANE	2,3,4	I
E	2	STEEL	313	BAN ST	2,3	I
F	3/4	STEEL	321	CENTRAL AVE WEST OF PENN	2	I
G	3	STEEL	484	PENN AVE FROM GRAND TO CENTRAL	2,3	I
H	2	STEEL	1,566	CENTRAL AVE EAST OF PENN TO LAKE	2,3	I
I	4	PVC	421	PENN AVE S OF COLUMBINE TO CURTIS	3	II
J	2	PVC	1,122	CURTIS EAST OF PENN	3	II
K	2	PVC	200	VINE MESA	1	II
L	2	STEEL	737	MTN VIEW TERRACE	2,3	I
M	2	STEEL	978	MARY KNOLL	2,3	I
N	-	-	310	CATALINA AVE SOUTH OF CENTRAL	4	I
O	3	STEEL	1,553	SOUTH OF GRAND AVE TO SCHOOL	2,3	I
P	4	PVC	662	SOUTH OF CASCADE TO WTP	3	I
Q	2	STEEL	460	CASCADE WEST OF VINE	2,3	I

REPLACEMENT NOTES:
1. SHALLOW BURIED WITH HISTORY AND/OR POTENTIAL FOR FREEZING.
2. STEEL MATERIAL CORROSION & RELATED WATER QUALITY PROBLEMS.
3. PIPE DIAMETER IS UNDERSIZED.
4. SYSTEM LOOPING RECOMMENDED

PROVIDENCE INFRASTRUCTURE CONSULTANTS

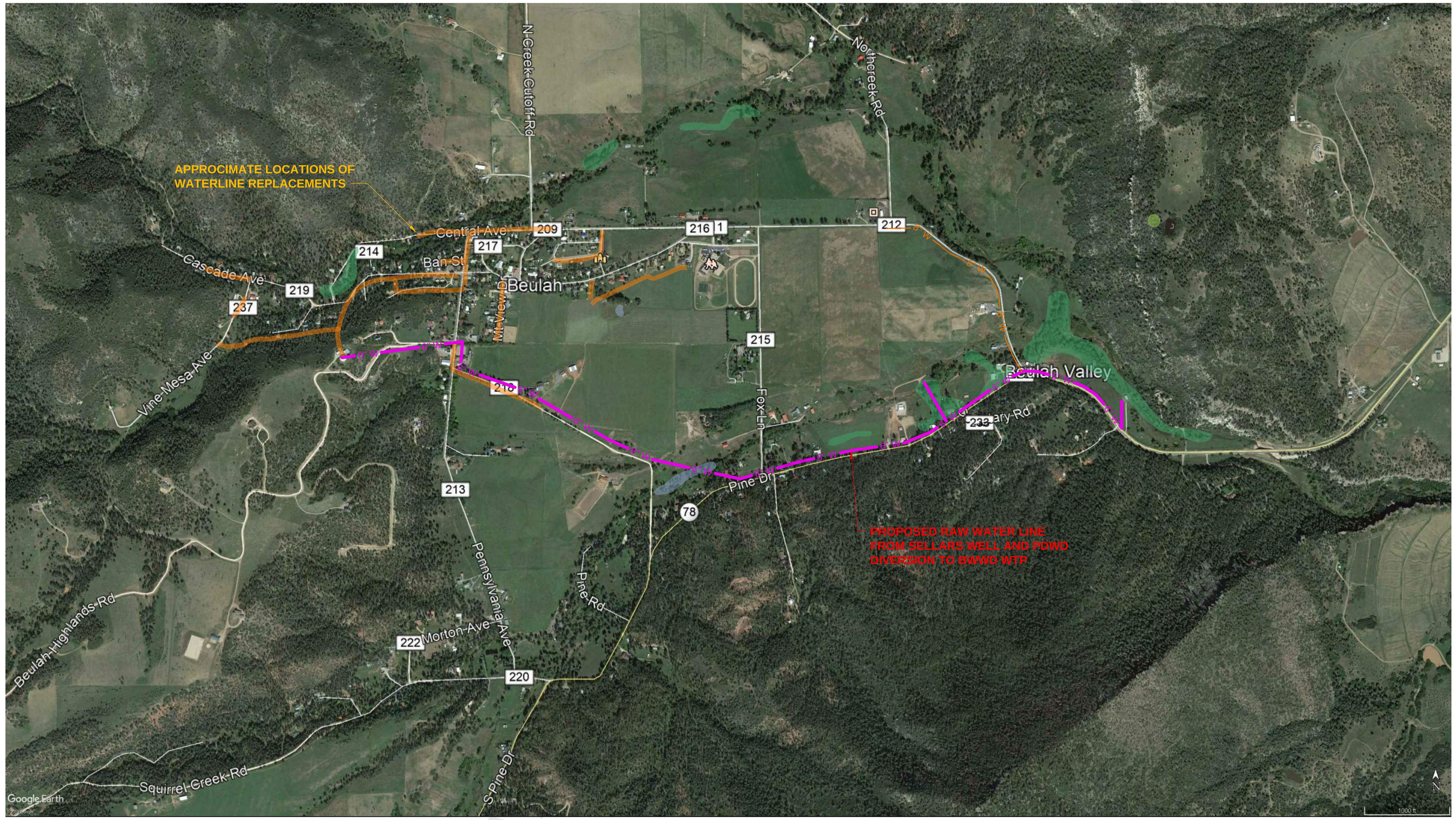
FIGURE 9 - BWWD WATER LINE REPLACEMENT LOCATIONS

BEULAH AND PINE DRIVE WATER WORKS DISTRICT
WATER SYSTEM IMPROVEMENTS PROJECT

DATE/TIME: 9/26/2019 4:20 PM; DWG LOC: S:\200 PROJECTS\15101-BWWD\900 CAD\07-USDA PER REVISED\06-FIGURES & EXHIBITS\FIGURE 9 - RECOMMENDED BWWD WATER LINE REPLACEMENTS.DWG

FIGURE 3 - PROPOESED CONSOLIDATION PLAN FOR BWWD & PDWD WATER SYSTEMS

BEULAH AND PINE DRIVE WATER WORKS DISTRICT
WATER SYSTEM IMPROVEMENTS PROJECT



USDA PRELIMINARY ENGINEERING REPORT

DRAFT FINAL

APPENDIX B

FINANCIAL INFO

WATER SYSTEM IMPROVEMENTS PROJECT

APPENDIX B – DISTRICT FINANCIAL INFORMATION

- **Notice of 2018 Rate Schedules – BWWD and PDWD**
- **Summary Financial Information - BWWD**
- **Summary of Financial Information - PDWD**

Begin forwarded message:

From: "catscat7" <catscat7@socolo.net>
Date: September 12, 2019 at 12:16:22 PM MDT
To: "Dave Stanford" <d.stanford@h2oconsultants.biz>
Subject: Re: Present Water Rates

Currently the base rate is $108.00 per month for 0 -1000 gallons, and $8.00 per each thousand after 1000 gallons.

November 30, 2017

Dear Customer,

Over this past year the Beulah Water Works District has been researching the sustainability of our water system. The aging system, first created in 1938 and with many modification and updates since, has been showing its wear with line leaks and breaks. We are currently losing 72% of the treated water we produce to these leaks in the system. This means that we are literally flushing money down the drain each day and must take action to combat this issue.

As a result of our findings, we are looking to replace some of the major lines in our system that have deteriorated beyond repair. The estimated cost for this project, based on a water engineers study and recommendation, is $ 2,600,000 to be paid over a 40-year loan. While this cost doesn't replace the entire system, it does replace many of our problem areas. With such a significant cost to upgrade the system the Board of Directors has proposed a rate increase as outlined below.

Tap Size	2018 Monthly Base Fee to include first 1000 gallons	Residential Water Rate	Commercial Water Rate
¾"-1 ½" Tap	$ 85.00	$ 10.00 per 1000 gallons beyond the first 1000 gallons	$ 15.00 per 1000 gallons beyond the first 1000 gallons
2" – 6" Tap	$ 200.00	$ 10.00 per 1000 gallons beyond the first 1000 gallons	$ 15.00 per 1000 gallons beyond the first 1000 gallons

**Non-Profit businesses will be treated as a Residential Water Rate **
Commercial as defined by the BWWD approved definition

Example:

Residential User: $85.00 monthly fee + used 2300 gallons of water (+20.00) total bill = $ 105.00

The District has not raised rates in many years and does not gain any income from property tax. Its sole income source is based from water/tap sales. The next Beulah Water Works District Meeting where these rates will be voted on by the Board will be on December 19, 2017 at 5:30pm at the Beulah Community Center. We encourage you to attend this meeting to ask any questions that you might have.

Trickling will still be allowed up to 1500 gallons a month during those allowed months. We understand that anytime costs are increased it is a concern, but we also understand that the cost of doing business is constantly increasing and we must continue to be able to provide safe and healthy drinking water to our valley.

Sincerely,

The Beulah Water Works District Board

Beulah Water Works District
2018 Profit & Loss

Income	
7000 Cell Tower	5,808.00
7100 Late Charges Fees	20.00
7400 Water Sales	232,189.22
7500 Grants	30,730.98
7600 Equipment Sales	1,360.00
Total Income	**270,108.20**
Expenses	
District Expenses & Supply	
8101.00 Repair & Maintenance	8.06
Total District Expenses & Supply	**8.06**
Administration	
8200 Plant Management	57,334.04
8201 Engineer	1,782.97
8203 Employee	37,472.00
8204 PERA	5,133.74
8205 Payroll Taxes	687.10
8206 Director Fees/Minutes	619.95
8207 Education	305.00
Total Administration	**103,334.80**
Insurance	
8300 Workers Compensation	2,362.00
8301 General Insurance	(432.02)
Total Insurance	**1,929.98**
Office Expenses	
8400 Office Supplies	2,574.08
8401 Post Office Box	96.70
8402 Postage	1,711.31
8403 Telephone	3,476.56
Total Office Expenses	**7,858.65**
Professional Expenses	
8000 Accounting	3,894.00
8001 Auditing	245.55
8002 Bank Fees	556.48
8003 Dues & Membership	5,307.14
8004 Legal	7,055.49
8005 Billing	293.13
Total Professional Expenses	**17,351.79**
Transmission & Distribution	
8500 Equipment	489.54
8501 License and Fees	1,290.52
8502 Repairs & Maintenance	65,569.72
8503 Supplies	1,155.75

8507.00 PER Grant	18,891.18
8507.01 PEP Grant (Bartley)	33,269.06
8507.02PNA Grant	12,099.16
Utilities	6,652.24
Total Transmission & Distribution	**139,417.17**
Water Treatment	
8600 Plant Repairs & Maintenace	29,877.47
8601 Chemicals	16,413.40
8602 Data Security	1,558.37
8604 Lab Testing	9,997.19
8605 Supplies	2,035.81
8606 Truck Maintenance	1,790.21
Total Water Treatment	**61,672.45**
8507.03 Merger Account	18,814.94
8900 3% DOLA Emergency Reserve	0.00
Total Expenses	**350,387.84**
Net Income	**(80,279.64)**

Beulah Water District
Balance Sheet
December 31, 2018

ASSETS

Current Assets		
Pueblo Bank and Trust Checking	$ 56,161.68	
Total Current Assets		56,161.68
Total Assets		$ 56,161.68

LIABILITIES AND CAPITAL

Current Liabilities		
Payroll Payable	$ 1,048.05	
PERA Payable	1,877.32	
Total Current Liabilities		2,925.37
Capital		
Retained Earnings	133,515.95	
Net Income	(80,279.64)	
Total Capital		53,236.31
Total Liabilities & Capital		$ 56,161.68

Beulah Water Works District
Profit and Loss

	August 2019	July 2019	June 2019	May 2019	April 2019	March 2019	February 2019	January 2019
Income								
7000 Cell Tower	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7400 Water Sales	15,914.55	17,096.20	19,370.00	15,582.00	17,122.00	22,845.00	24,076.00	32,162.70
7600 Equipment Sales	0.00	0.00	0.00	0.00	0.00	569.00	0.00	0.00
Billable Expense Income	0.00	3,030.03	0.00	0.00	0.00	0.00	0.00	0.00
Total Income	**$ 15,914.55**	**$ 20,126.23**	**$ 19,370.00**	**$ 15,582.00**	**$ 17,122.00**	**$ 23,414.00**	**$ 24,076.00**	**$ 32,162.70**
Gross Profit	**$ 15,914.55**	**$ 20,126.23**	**$ 19,370.00**	**$ 15,582.00**	**$ 17,122.00**	**$ 23,414.00**	**$ 24,076.00**	**$ 32,162.70**
Expenses								
Administration								
8200 Plant Management	3,663.90	2,509.50	4,787.00	0.00	7,480.00	0.00	6,676.00	9,089.40
8201 Engineer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8203 Employee	3,985.00	4,790.00	4,074.00	4,441.00	4,113.00	4,257.00	5,668.00	3,086.00
8204 PERA	545.95	656.23	557.00	523.00	562.00	583.00	777.00	422.74
8205 Payroll Taxes	69.74	83.83	67.00	75.00	72.00	75.00	99.00	55.48
8206 Director Fees/Minutes	100.00	50.00	0.00	0.00	0.00	0.00	205.00	0.00
8207 Education	50.00	188.26	630.00	90.00	114.00	0.00	585.00	0.00
Total Administration	**$ 8,414.59**	**$ 8,277.82**	**$ 10,115.00**	**$ 5,129.00**	**$ 12,341.00**	**$ 4,915.00**	**$ 14,010.00**	**$ 12,653.62**
Insurance								
8300 Workers Compensation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,075.00
8301 General Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5,191.47
Total Insurance	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 6,266.47**
District Expansion								
8507.03 District Project - PM	464.70	350.53	225.00	0.00	103.00	384.00	10,110.00	2,566.54
8507.04 District Expansion - Other	278.25	6,459.57	2,279.00	330.00	1,910.00	0.00	0.00	0.00
Total District Expansion	**$ 742.95**	**$ 6,810.10**	**$ 2,504.00**	**$ 330.00**	**$ 2,013.00**	**$ 384.00**	**$ 10,110.00**	**$ 2,566.54**
Office Expenses								
8400 Office Supplies	112.67	12.99	174.00	62.00	172.00	30.00	34.00	341.35
8401 Post Office Box	0.00	0.00	0.00	76.00	0.00	0.00	0.00	0.00
8402 Postage	0.00	0.00	175.00	0.00	0.00	110.00	0.00	0.00
8403 Telephone	246.49	208.95	317.00	435.00	281.00	704.00	264.00	310.86
Total Office Expenses	**$ 359.16**	**$ 221.94**	**$ 666.00**	**$ 573.00**	**$ 453.00**	**$ 844.00**	**$ 298.00**	**$ 652.21**
Professional Expenses								
8000 Accounting	0.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
8001 Auditing	0.00	0.00	0.00	0.00	0.00	1,200.00	0.00	0.00
8002 Bank Fees	-0.05	-0.05	20.00	0.00	60.00	20.00	20.00	39.90
8003 Dues & Membership	0.00	0.00	0.00	0.00	0.00	0.00	0.00	895.89
8004 Legal	0.00	14.84	0.00	0.00	0.00	0.00	0.00	260.16
8005 Billing	487.24	652.24	86.00	986.00	1,396.00	537.00	537.00	536.59

	August 2019	July 2019	June 2019	May 2019	April 2019	March 2019	February 2019	January 2019
8006 Customer Refunds	92.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Professional Expenses	**$ 579.20**	**$ 817.03**	**$ 256.00**	**$ 1,136.00**	**$ 1,606.00**	**$ 1,907.00**	**$ 707.00**	**$ 1,882.54**
Transmission & Distribution								
8500 Equipment	0.00	0.00	0.00	0.00	0.00	0.00	172.00	0.00
8501 License and Fees	100.00	0.00	0.00	-345.00	0.00	0.00	0.00	0.00
8502 Repairs & Maintenance	257.59	4.26	212.00	0.00	6,375.00	0.00	0.00	14,168.68
8503 Supplies	0.00	0.00	35.00	509.00	188.00	0.00	0.00	0.00
Total Transmission & Distribution	**$ 357.59**	**$ 4.26**	**$ 247.00**	**$ 164.00**	**$ 6,563.00**	**$ 0.00**	**$ 172.00**	**$ 14,168.68**
Unapplied Payroll Expenses	900.56	2,352.82	0.00	0.00	0.00	0.00	0.00	0.00
Water Treatment								
8600 Plant Repairs & Maintenace	528.73	126.59	0.00	305.00	190.00	1,574.00	150.00	1,292.17
8601 Chemicals	0.00	4,225.40	0.00	4,635.00	1,520.00	0.00	0.00	0.00
8602 Data Security	1,557.08	0.00	130.00	130.00	130.00	130.00	156.00	129.84
8603 Access Maintenance	190.00	98.69	0.00	0.00	0.00	0.00	0.00	0.00
8604 Lab Testing	1,244.00	923.84	1,590.00	387.00	417.00	596.00	2,467.00	366.88
8605 Supplies	170.01	156.08	161.00	390.00	1,068.00	37.00	141.00	189.06
8606 Truck Maintenance	161.04	101.95	0.00	0.00	1,035.00	0.00	0.00	0.00
8607 Utilities - Electric	286.40	332.44	307.00	308.00	323.00	766.00	0.00	396.25
8607 Utilities - Propane	0.00	0.00	0.00	161.00	300.00	428.00	395.00	393.99
8609 Utilities - Dumpster	25.00	25.00	25.00	35.00	50.00	50.00	50.00	50.00
Total Water Treatment	**$ 4,162.26**	**$ 5,989.99**	**$ 2,213.00**	**$ 6,351.00**	**$ 5,033.00**	**$ 3,581.00**	**$ 3,359.00**	**$ 2,818.19**
8700 Capital Improvement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8800 Contingency Line	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8900 3% DOLA Emergency Reserve	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Expenses	**$ 15,516.31**	**$ 24,473.96**	**$ 16,001.00**	**$ 13,683.00**	**$ 28,009.00**	**$ 11,631.00**	**$ 28,656.00**	**$ 41,008.25**
Net Operating Income	**$ 398.24**	**-$ 4,347.73**	**$ 3,369.00**	**$ 1,899.00**	**-$ 10,887.00**	**$ 11,783.00**	**-$ 4,580.00**	**-$ 8,845.55**
Net Income	**$ 398.24**	**-$ 4,347.73**	**$ 3,369.00**	**$ 1,899.00**	**-$ 10,887.00**	**$ 11,783.00**	**-$ 4,580.00**	**-$ 8,845.55**
Ending Bank Balance	$50,085.16	$44,578.91	$49,965.90	$46,077.32	$48,464.46	$55,381.37	$43,021.22	$46,968.28

10:37 AM
08/08/19
Accrual Basis

Pine Drive Water District
Profit & Loss
January through December 2018

	Jan - Dec 18
Income	
4 · Revenues	
40 · User Fees & Property Taxes	
400 · Metered Water Sales	173,301.00
410 · General Property Tax	36,957.40
411 · Equitable Monthly Payment	720.00
Total 40 · User Fees & Property Taxes	210,978.40
45 · Other Income	
450 · Interest Income	1,003.08
460 · Miscellaneous Income	1,186.46
465 · Grant Revenue	10,500.00
470 · Deliq/Reconnect Fees	855.00
Total 45 · Other Income	13,544.54
Total 4 · Revenues	224,522.94
Total Income	224,522.94
Cost of Goods Sold	
5 · Total Expenses	
50 · Cost of Water Sold	
500 · Water Treatment Salaries	19,060.71
510 · Routine Wages	
510.1 · Routine Wages	10,429.00
510.2 · Emergency Wages	0.00
510 · Routine Wages - Other	0.00
Total 510 · Routine Wages	10,429.00
512 · Water transfer expense	32,226.01
515 · Chemicals	7,034.72
520 · Equipment Maint & Repairs	
520.1 · Equipment Purchase	0.00
520.3 · Infrastructure Upgrades	0.00
520 · Equipment Maint & Repairs - Other	27,979.33
Total 520 · Equipment Maint & Repairs	27,979.33
525 · Miscellaneous	3,277.80
526 · A License Oversee	46,286.40
527 · Water Professional Fees	15,952.73
530 · Operating Supplies	878.08
535 · Pumping Utilities	9,577.92
540 · Water Testing	6,277.96
Total 50 · Cost of Water Sold	178,980.66
Total 5 · Total Expenses	178,980.66
Total COGS	178,980.66
Gross Profit	45,542.28
Expense	
Payroll Expenses	0.00
55 · Administration	
550 · Amort-Bond Issue Exp	137.92
555 · A/Depreciation	46,308.22
560 · Directors Fees	2,100.00
567 · CWR&PA Interest	3,353.19
570 · Insurance	6,292.00
575 · Miscellaneous Exp	999.18
580 · Office Expenses	4,369.96
590 · Payroll Taxes	4,586.49
595 · Professional Fees	29,947.17
Total 55 · Administration	98,094.13
Total Expense	98,094.13

	Jan - Dec 18
Net Income	-52,551.85

PINE DRIVE WATER DISTRICT
COMPARATIVE BUDGET STATEMENT
FOR THE TWELVE MONTHS ENDED
DECEMBER 31, 2018

	ANNUAL BUDGET	BUDGET Y-T-D	ACTUAL Y-T-D	BUDGET DECEMBER	ACTUAL DECEMBER
WATER SALES	165,000.00	165,000.00	173,301.00	13,750.00	19,218.00
PROPERTY TAXES	36,500.00	36,500.00	36,957.40	3,041.67	613.36
EQUIT. MONTH. PAY	720.00	720.00	720.00	60.00	60.00
INTEREST	970.00	970.00	1,003.08	80.83	14.06
MISCELLANEOUS	1,250.00	1,250.00	1,186.46	104.17	.00
GRANT RECEIPTS	10,000.00	10,000.00	10,500.00	833.33	.00
DELINQ CHGS	765.00	765.00	855.00	63.75	105.00
FROM SAVINGS*---	22,000.00	22,000.00	29,600.00	1,833.33	13,600.00
TOTAL REVENUES	215,205.00	237,205.00	224,522.94	19,767.08	33,610.42
* NOT ADDED IN TOTALS			254,122.94		
WTR TRTMNT SALARY	28,000.00	28,000.00	19,060.71	2,333.33	545.00
ROUTINE WAGES	2,100.00	2,100.00	10,429.00	175.00	1,680.00
EMERGENCY OVERTIM	.00	.00	.00	.00	.00
BWWD WATER TRANSF	46,000.00	46,000.00	32,226.01	3,833.33	7,698.00
CHEMICALS	8,500.00	8,500.00	7,034.72	708.33	(8,450.80)
EQP.MNT & REPAIR	32,000.00	32,000.00	27,979.33	2,666.67	.00
INFRASTUR.UPGRADE	6,000.00	6,000.00	[5,568.01]	500.00	.00
MISCELLANEOUS	5,400.00	5,400.00	3,277.80	450.00	141.61
OUTSIDE LABOR	.00	.00	.00	.00	.00
B LICENSE OVERSEE	51,000.00	51,000.00	46,286.40	4,250.00	2,229.90
WATER PROF.FEES	.00	.00	15,952.73	.00	14,748.73
OPER SUPPLIES	700.00	700.00	878.08	58.33	.00
UTILITIES	10,000.00	10,000.00	9,577.92	833.33	548.27
WATER TESTING	6,000.00	6,000.00	6,277.96	500.00	308.35
EQUIP. PURCHASE	3,000.00	3,000.00	[1,791.34]	250.00	(42,260.51)
COST OF WATER	198,700.00	198,700.00	178,980.66	16,558.33	(22,811.45)
COST WATER +EQ.PURCH.			186,340.01		
AMORTIZATION	.00	.00	137.92	.00	137.92
DEPRECIATION	.00	.00	46,308.22	.00	.00
DIRECTORS' FEES	2,200.00	2,200.00	2,100.00	183.33	140.00
CWR&PA LOAN INT	3,431.00	3,431.00	3,353.19	285.92	266.45
INSURANCE	6,292.00	6,292.00	6,292.00	524.33	524.33
MISCELLANEOUS	1,000.00	1,000.00	999.18	83.33	268.29
OFFICE EXPENSES	6,000.00	6,000.00	4,369.96	500.00	287.93
OFFICE SALARY	.00	.00	.00	.00	.00
PAYROLL TAXES	5,120.00	5,120.00	4,586.49	426.67	280.45
PROFESSIONAL FEES	33,680.00	33,680.00	29,947.17	2,806.67	4,804.50
COMPUTER/TRAINING	.00	.00	.00	.00	.00
ELECTION	.00	.00	.00	.00	.00
ADMINISTRATION	57,723.00	57,723.00	98,094.13	4,810.25	6,571.95
ADMIN. COST+DEPRE					6,709.87
CW&PA PRINCIPAL	11,686.00				
TOTAL EXPENSES	268,109.00	256,423.00	284,434.14	21,368.58	(16,239.50)
NET INCOME	(52,904.00)	(19,218.00)	(52,551.85)	(1,601.50)	49,849.92

PINE DRIVE WATER DISTRICT
COMPARATIVE BUDGET STATEMENT
FOR THE TWELVE MONTHS ENDED
DECEMBER 31, 2018

AFTER DEPRECIATION

	ANNUAL BUDGET	BUDGET Y-T-D	ACTUAL Y-T-D	BUDGET DECEMBER	ACTUAL DECEMBER
WATER SALES	165,000.00	165,000.00	173,301.00	13,750.00	19,218.00
PROPERTY TAXES	36,500.00	36,500.00	36,957.40	3,041.67	613.36
EQUIT. MONTH. PAY	720.00	720.00	720.00	60.00	60.00
INTEREST	970.00	970.00	1,003.08	80.83	14.06
MISCELLANEOUS	1,250.00	1,250.00	1,186.46	104.17	.00
GRANT RECEIPTS	10,000.00	10,000.00	10,500.00	833.33	.00
DELINQ CHGS	765.00	765.00	855.00	63.75	105.00
FROM SAVINGS*---	22,000.00	22,000.00	29,600.00	1,833.33	13,600.00
TOTAL REVENUES	215,205.00	237,205.00	224,522.94	19,767.08	33,610.42
* NOT ADDED IN TOTALS			254,122.94		
WTR TRTMNT SALARY	28,000.00	28,000.00	19,060.71	2,333.33	545.00
ROUTINE WAGES	2,100.00	2,100.00	10,429.00	175.00	1,680.00
EMERGENCY OVERTIM	.00	.00	.00	.00	.00
BWWD WATER TRANSF	46,000.00	46,000.00	32,226.01	3,833.33	7,698.00
CHEMICALS	8,500.00	8,500.00	7,034.72	708.33	(8,450.80)
EQP MNT & REPAIR	32,000.00	32,000.00	27,979.33	2,666.67	.00
INFRASTUR.UPGRADE	6,000.00	6,000.00	[5,568.01]	500.00	.00
MISCELLANEOUS	5,400.00	5,400.00	3,277.80	450.00	141.61
OUTSIDE LABOR	.00	.00	.00	.00	.00
B LICENSE OVERSEE	51,000.00	51,000.00	46,286.40	4,250.00	2,229.90
WATER PROF.FEES	.00	.00	15,952.73	.00	14,748.73
OPER SUPPLIES	700.00	700.00	878.08	58.33	.00
UTILITIES	10,000.00	10,000.00	9,577.92	833.33	548.27
WATER TESTING	6,000.00	6,000.00	6,277.96	500.00	308.35
EQUIP. PURCHASE	3,000.00	3,000.00	[1,791.34]	250.00	(42,260.51)
COST OF WATER	198,700.00	198,700.00	178,980.66	16,558.33	(22,811.45)
COST WATER +EQ.PURCH.			186,340.01		
AMORTIZATION	.00	.00	137.92	.00	137.92
DEPRECIATION	.00	.00	46,308.22	.00	.00
DIRECTORS' FEES	2,200.00	2,200.00	2,100.00	183.33	140.00
CWR&PA LOAN INT	3,431.00	3,431.00	3,353.19	285.92	266.45
INSURANCE	6,292.00	6,292.00	6,292.00	524.33	524.33
MISCELLANEOUS	1,000.00	1,000.00	999.18	83.33	268.29
OFFICE EXPENSES	6,000.00	6,000.00	4,369.96	500.00	287.93
OFFICE SALARY	.00	.00	.00	.00	.00
PAYROLL TAXES	5,120.00	5,120.00	4,586.49	426.67	280.45
PROFESSIONAL FEES	33,680.00	33,680.00	29,947.17	2,806.67	4,804.50
COMPUTER/TRAINING	.00	.00	.00	.00	.00
ELECTION	.00	.00	.00	.00	.00
ADMINISTRATION	57,723.00	57,723.00	98,094.13	4,810.25	6,571.95
ADMIN. COST+DEPRE					6,709.87
CW&PA PRINCIPAL	11,686.00				
TOTAL EXPENSES	268,109.00	256,423.00	284,434.14	21,368.58	(16,239.50)
NET INCOME	(52,904.00)	(19,218.00)	(52,551.85)	(1,601.50)	49,849.92

USDA PRELIMINARY ENGINEERING REPORT

DRAFT FINAL

APPENDIX C

OTHER REPORTS

WATER SYSTEM IMPROVEMENTS PROJECT

APPENDIX C – OTHER RELATED REPORTS

- **Operator's Leak Report – January 6, 2018**
- **Water Treatment Facility Capacity Evaluation – February 26, 2018**
- **Groundwater Potable Water Supply Evaluation for the Beulah Valley – November 19, 2018**
- **Sellers Well Pumping Test – February 24, 2019**
- **Augmentation Plan Alternatives Analysis – June 24, 2019**

H2O
CONSULTANTS LTD

P.O. Box 1905
Woodland Park, CO 80866-1905
(719) 687-2386 Office
(719) 687-1426 Fax

January 6, 2018
Beulah Water Works District
P.O. Box 1922
Woodland Park, CO 80866-1922
Re: Operator's Leak Location Report

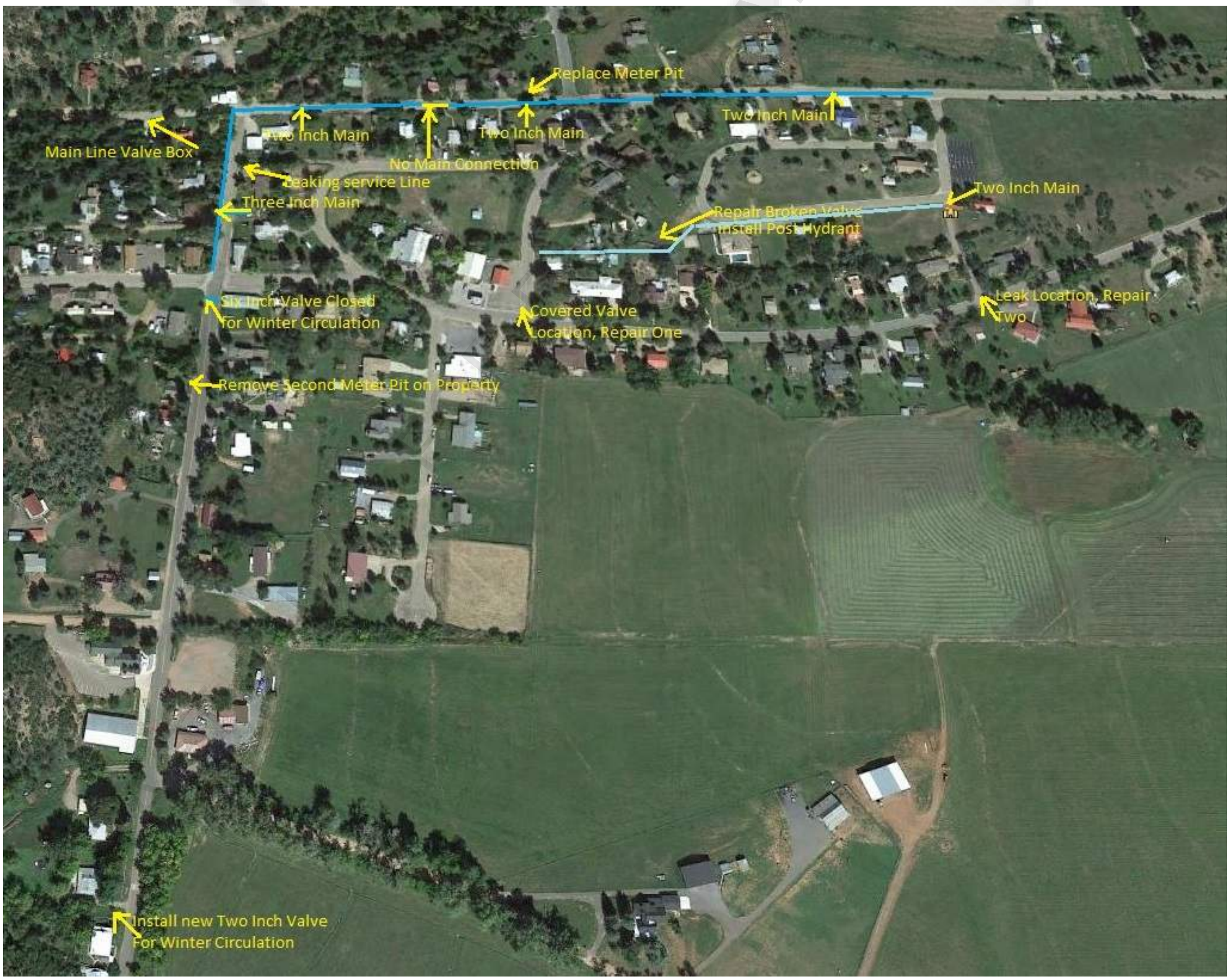
Dear Board Members:

This report summarizes our efforts at locating water leaks in the distribution system over the last two weeks. The picture below shows notes that Michael and I have made regarding the water mains we have found.

First, we have closed the six-inch valve in Pennsylvania at Grand Avenue. This will force all the water used east of Pennsylvania Avenue to flow through Pine Avenue, Vine Mesa, Cascade Avenue, and Grand Avenue reducing the chances of frozen water mains west of Pennsylvania Avenue.

This valve closure will require that Michael be contacted to open this valve in the event of a fire anywhere within the district to assure proper fire flows.

The second item of note is that there are two 2" water mains in Central Avenue, one coming east from Pennsylvania



Avenue, and one that comes west from Lake Street. The two mains do not connect in Central Avenue. The ends of the mains are separated by three feet or so, but they do not connect to each other. (Go Figure, this one baffles me)

LEAK LOCATIONS:

We have found a water leak at the intersection of Catalina Avenue and Grand Avenue. There are three valve boxes at this intersection, they all have water in the valve boxes. The valves in this intersection control the water flow in the three-inch water main that services the school, water flow to the fire hydrant on Catalina and Mary's Knoll, and a two-inch main servicing one house on Grand Avenue.

Because this intersection is paved we are contacting Parker Excavation for their advice on what permits will have to be obtained for the water main repair work to proceed and a schedule from them for the main repair.

It should be noted that this repair will require the water to be shut off to the school. The school will have to be notified of the repair date so that they can make the appropriate notifications.

Because of the large area that will be shut off to effect repairs at this intersection it is incumbent that the main line valves in Lake Avenue at Grand Avenue be found and made operational. Making sure these valves are operational will be the first job for Parker excavation. On Monday, Mike will be working to locate the three valves in this intersection that are noted on the system mapping. He will mark their locations and Parker Excavation will have to get the valve boxes to the surface of the roadway so that they are permanently available to operate.

The district mapping notes that the water main materials at the Catalina Avenue and Grand Avenue intersection are asbestos concrete, and galvanized steel. Finding the exact point of the leak and repairing it could be very time consuming and costly because of the asphalt covering the leak at this location.

The second leak that we found appears to be in a service line in the alley going east between Pennsylvania Avenue and Harmon Drive. The shut off box for the service line in the alley is full of ice which means there is a leak at or very near this point. This leak is large enough that Mike was able to hear it through an adjoining meter pit service line. The meter pit for the property is at the property line in the alley and is covered in old wire fencing frozen to the ground. Locating this meter pit will require some artful excavation and removal of years of trash wire fencing laying on top of the meter pit.

PRIORITY DISTRIBUTION SYSTEM MAINTENANCE:

We have noted several priority maintenance items that need to be addressed in the distribution system.

1. The main line valve box in Central Avenue west of Pennsylvania Avenue needs to be replaced so that this section of water main can be shut down and drained for the winter as this water main freezes each year.
2. A new two-inch water main line valve needs to be installed at the end of the four-inch water main servicing the fire hydrant on Pennsylvania Avenue south of the intersection of Curtis Road. This will allow the fire hydrant to have full four-inch fire flow through the winter. The homes south of this location will provide the circulation needed to keep the two-inch water main in Pennsylvania Avenue from freezing.
3. The two-inch main line valve between Lake Avenue and Mary's Knoll is broken in the closed position. This valve needs to be replaced and a post hydrant w/two-inch isolation valve installed to replace the two-inch blow off piping now at this location.
4. There are two meter pits on the property where the new home has been built on Pennsylvania Avenue just south of Grand Avenue. The unused meter pit should be removed and the service line to it plugged so there is no confusion in the future regarding an additional water tap on this property.
5. Michael has found a meter pit on Central Avenue that has its lid off-set and is filled with dirt. This meter pit should be replaced so that the water meter and service line within the meter pit does not freeze and burst.

The five items on this list will be addressed as soon as the two water leaks have been repaired. Further delay of these maintenance items will cause problems within the distribution system going forward. The board can affirm the expenditure of the funds needed for the leak repairs and five maintenance items at their next regular meeting.

Many of the water service lines providing water to the water users in Beulah are ¾ inch galvanized pipe. These galvanized pipes are coming to the end of their useful service life (they are beginning to leak). Once the listed repairs and maintenance items are addressed/replaced/repaired Michael will need to test each water service line for leaks by listening to each service line at the meter pit. This should be done at least annually until the existing galvanized water service lines are all replaced.

I believe that covers my main leak/repairs report, if you have any questions please let me know.

Sincerely,

David Stanford
President
H20 Consultants, LTD
(719) 205-0201

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BEULAH WATER WORKS DISTRICT
WATER TREATMENT PLANT CAPACITY EVALUATION

FEBRUARY 26, 2018

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1 EXECUTIVE SUMMARY

There are several potential future scenarios whereby the Beulah Water Works District (BWWD) Water Treatment Plant (WTP) would need to provide potable water to the service area of the Pine Drive Water District (PDWD). These scenarios range from a catastrophic flood destroying the PDWD WTP to a temporal water quality or water treatment challenge for the PDWD to the potential for the two districts to consolidate. This report compares the potential combined water demands to the current BWWD WTP production capacity. The recommended maximum daily production for the BWWD WTP is approximately 67,000 gpd which is based on the WTP being 'online' approximately 16 hours per day.

The BWWD water distribution system currently loses approximately two (2) gallons for every three (3) gallons of water treated. The average leakage rate for the BWWD system in the second half of 2017 was about 31,000 gallons per day. This leakage rate has increased in recent years and should be remedied if the BWWD WTP is to have capacity to provided drinking water to PDWD.

The annual average day flow (AADF) demands for the BWWD and PDWD systems are approximately 14,700 and 10,600 gallons per day respectively. The combined total AADF for both Districts is approximately 25,000 gpd. This number represents "water sold" or metered and does not include water lost to leakage or used for filter backwash.

Water usage data indicates that the maximum month average demand (MMAD) is approximately 2 times greater than the AADF. If the water use patterns remain the same for both Districts, it is expected that the required future production rate for the WTP would need to be approximately 69,000 gpd. This slightly exceeds the recommended maximum capacity of the WTP. However for maximum days, the WTP would operate just less than 17 hours per day. Given the substantial treated water storage capacity at the WTP, this is acceptable on rare occasions of maximum demand.

The total treated water storage at the WTP provides approximately 11 days of MMAD use for both Districts. This is enough storage volume for expected and unexpected maintenance events. It is not enough storage for long term drought protection[1].

The existing capacity of the BWWD WTP is sufficient for providing water service to both Districts provided water demands do not appreciably increase. However, the WTP will continue to need ongoing capital investments to maintain, repair and replace existing equipment as needed.

2 EXISTING WATER TREATMENT PLANT OVERVIEW

The BWWD operates a water treatment plant (WTP) that was originally constructed in the 1960's. The WTP utilizes a conventional "package plant" filter system with flocculation, sedimentation and filtration processes. Disinfection with liquid calcium hypochlorite ($Ca(ClO)_2$) follows the filtration process. $Ca(ClO)_2$ is added to the filtered water ahead of the two onsite storage tanks which provide chlorine contact time[2]. The initial construction of the WTP included a 130,000-gallon clearwell[3]. A 125,000 gallon above grade steel storage tank was added to the system in 1993 and a 500,000 above grade steel storage tank was added in 2003. The water source is surface water taken from Middle Creek approximately 2 miles to the northwest. A process flow diagram is shown in Figure 1.

[1] *Water storage for long term drought protection is beyond the scope of this report.*
[2] *CDPHE approved use of the 125,000-gallon and 500,000-gallon storage tanks for chlorine contact via letter dated December 22, 2016.*
[3] *Maximum clearwell volume = 130,000 gallons, Minimum Operating Volume = 95,000 gallons @ 8' operating depth*

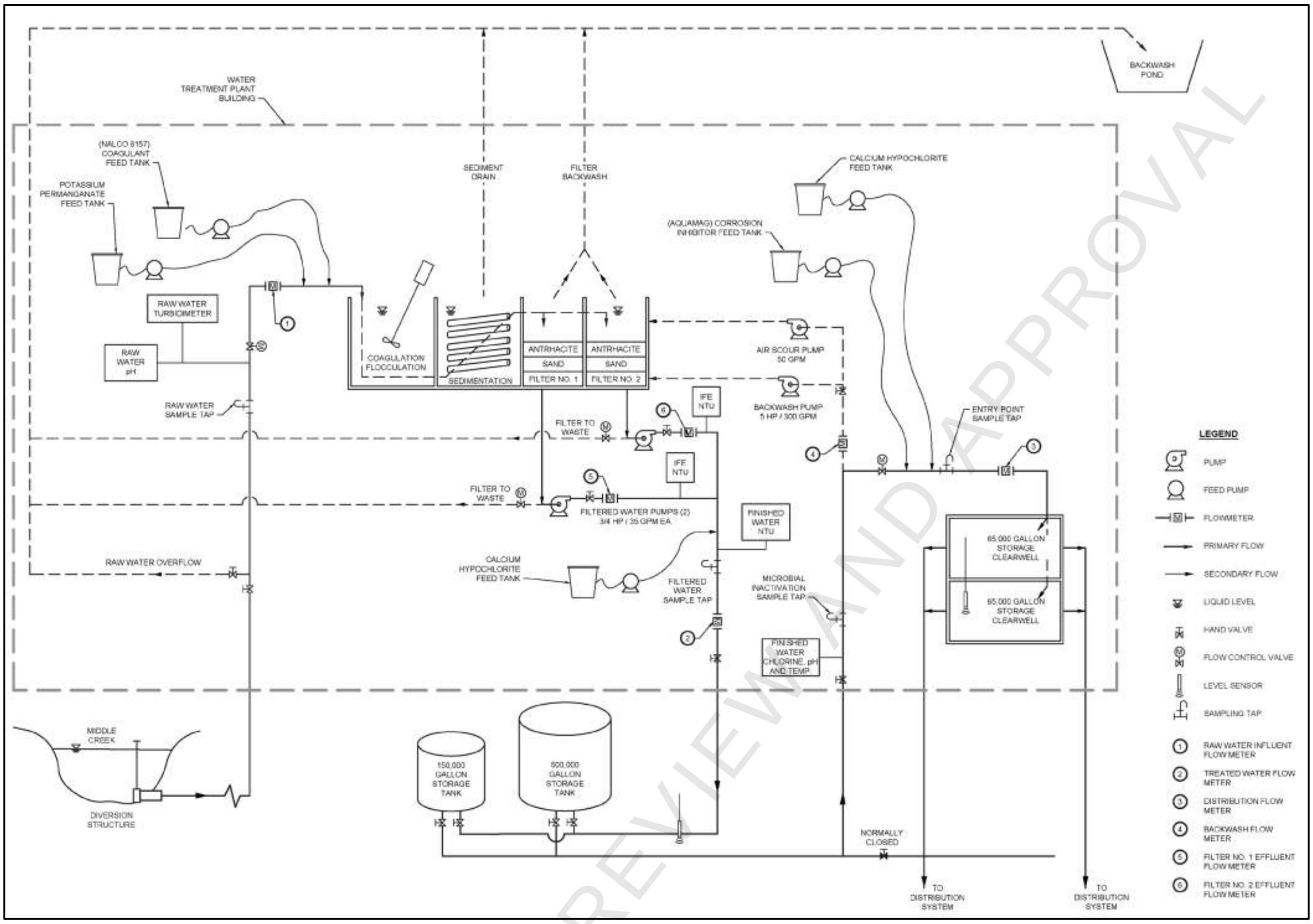


Figure 1 – Process Flow Diagram[4]

The WTP is operated part time and has an operating capacity of approximately 70 gallons per minute[5] (gpm). It is run on automatic controls based on the water level in the storage tanks. The WTP currently operates 4-8 hours per day. The daily production typically ranges from 10,000 gallons per day (gpd) to 60,000 gpd, with an average of approximately 28,000 GPD[6]. The recommended normal maximum daily production of the WTP is approximately 67,000 gpd[7]. With the two at-grade storage tanks and the clearwell, the maximum water storage capacity is approximately 755,000 gallons[8]. This equates to about 27 days of water storage capacity, if the tanks are kept full. However, concerns with disinfection byproduct (DBP) formation may prevent BWWD from normally operating with completely full tanks unless demand increases and water age decreases.

[4] *A larger version of this figure is included in Appendix A.*
[5] *Per CDPHE Draft Record of Approved Waterworks (RAW) dated June 8, 2016.*
[6] *Based on WTP production records from October 2013 through December 2017 – this accounts for substantial leakage in the system*
[7] *70 gpm x 16 hours per day x 60 min per hour = 67,200 gpd; allow 8 hr/day for backwash, sediment drain, and refill.*
[8] *Max Storage Volume = 500,000 + 125,000 + 130,000 = 755,000 gallons*

3 EXISTING WATER USERS AND DEMANDS – BEULAH WATER WORKS DISTRICT

There are 145 residential water taps serving primarily detached, single-family residences. There are 15 "commercial" taps; of which there are five (5) "non-profit" users. This yields a total of 160 water taps within the BWWD service area. It is understood that a significant portion of the current residences are seasonally occupied but water demands and use patterns for the District are stable with little foreseeable potential for increases.

3.1 Treated Water Production Records

The District provided treated water production records for the past four (4) years which are summarized in Table 1. Please note that the data presented below is for water that flowed from the WTP into the Distribution System. Review of WTP records for the same time interval indicates the WTP uses, on average, about 3,300 gallons per day for backwash water. This is water that was first treated and then pumped backward through the filters to remove debris and other filtered matter.

Table 1 – Beulah Water Works District Treated Water Records

Month	Year			
	2017	**2016**	**2015**	**2014**
January	777,332	622,692	600,220	995,321
February	630,467	541,019	495,061	1,027,650
March	852,270	644,889	508,673	728,961
April	923,014	565,826	573,128	492,383
May	1,135,377	631,983	635,170	561,663
June	1,087,368	732,497	568,520	609,051
July	1,120,305	792,405	885,170	535,677
August	1,732,636	900,492	660,235	618,431
September	1,372,521	892,694	715,785	552,390
October	1,407,057	827,458	621,005	582,788
November	1,313,241	758,250	554,518	578,457
December	1,220,285	944,982	624,233	560,450
Annual Total	13,573,890	8,857,203	7,443,733	7,845,236
Max Month Total	1,732,636	944,982	885,170	1,027,650
Max Month Avg Day	57,755	31,499	29,506	34,255
Annual Average Day Demand	37,189	24,266	20,394	21,494

This monthly flow data can also be represented graphically as shown in Figure 2.

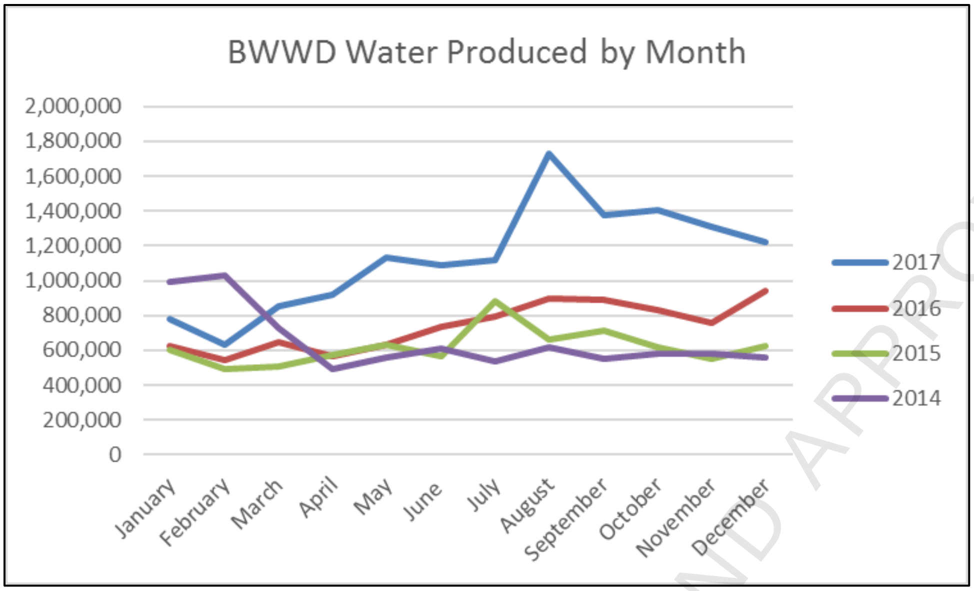


Figure 2 – Beulah Water Works District Water Treated

It can be seen from the data presented above, the average water produced from 2014 to 2016 was about 8,000,000 gallons per year. In 2017, the WTP produced approximately 13,500,000 gallons. This represents an approximate increase of 69 percent in 2017. The District has not seen growth in users during this time frame. Therefore, the increase in treated water production is likely attributable to an increase in water loss in the system.

3.2 Comparison of Water Produced and Water Sold

The District provided "water sold" records from June through December 2017 which is compared to the water produced for the same period in Table 2. The data indicates that the District system is losing approximately two (2) gallons of water for every three (3) gallons produced. This "loss" can occur through either unmetered water usage or leakage in the system. The loss rate equates to approximately 21 gallons per minute (gpm).

Table 2 – Comparison of Water Sold and Water Produced for Beulah Water Works District

Parameter	Value	Unit	Notes
No. of Active Taps	160	ea	Per Records from Dave Stanford
Start Date of Records provided by BWWD	6/1/2017		
End Date of Records provided by BWWD	12/20/2017		
Total Days of Water Use Records	202	days	
Total Water "Sold"	2,961,882	gallons	Total June - December 2017
Average Daily Flow "Sold"	14,663	gpd	= Total Sold / No of Days
AADF of Water Sold, per Tap	92	gpd	= AADF / No of Taps
Total Water Produced during same period	9,253,413	gallons	Total June - December 2017
AADF of Water Treated, Total	45,809	gpd	Average of June-December 2017
AADF of Water Treated, per Tap	286	gpd	= AADF / No of Taps
Average Daily Water Lost	31,146	gpd	=Daily Water Treated - Daily Water Sold
Ratio of Water Lost to Water Produced	2.12	-	= Water Lost / Water Sold
Average Daily Water "leak rate"	21.6	gpm	=Daily Water Loss / 1440 min per day

4 FUTURE WATER USERS AND DEMANDS – PINE DRIVE WATER DISTRICT

In the future, the Beulah Water Works District may be asked to provide drinking water to the adjacent Pine Drive Water District (PDWD). There are several scenarios whereby this may occur either through voluntary consolidation, temporary emergency (i.e., failure of PDWD WTP) or permanent emergency (i.e., complete loss of PDWD due to catastrophic flood event). Therefore, an understanding of the potable water use demands of the PDWD is needed.

4.1 Treated Water Production Records

The District provided treated water production records for the past three (3) years as summarized in Table 3. This monthly flow data can also be represented graphically as shown in Figure 3. Please note, the data presented below is for water that was pumped from the WTP into the Distribution System.

Table 3 – Pine Drive Water District Water Treated Records

Month	Year		
	2017	**2016**	**2015**
January	378,000	315,000	
February	294,000	369,000	304,000
March	381,000	276,000	347,000
April	336,000	261,000	286,000
May	404,000	468,000	312,000
June	475,000	508,000	396,000
July	462,000	598,000	454,000
August	374,000	533,000	399,000
September	338,000	439,000	464,000
October	278,000	415,000	325,000
November	341,000	480,000	337,000
December	274,000	466,000	368,000
Annual Total	4,337,017	5,130,016	3,994,015
Max Month Total	475,000	598,000	464,000
Max Month Avg Day	15,833	19,933	15,467
Annual Average Day Demand	11,882	14,055	10,943

An approximate average of 4,500,000 gallons of water per years was produced from 2015 to 2017. This corresponds to an average of 12,600 gallons per day.

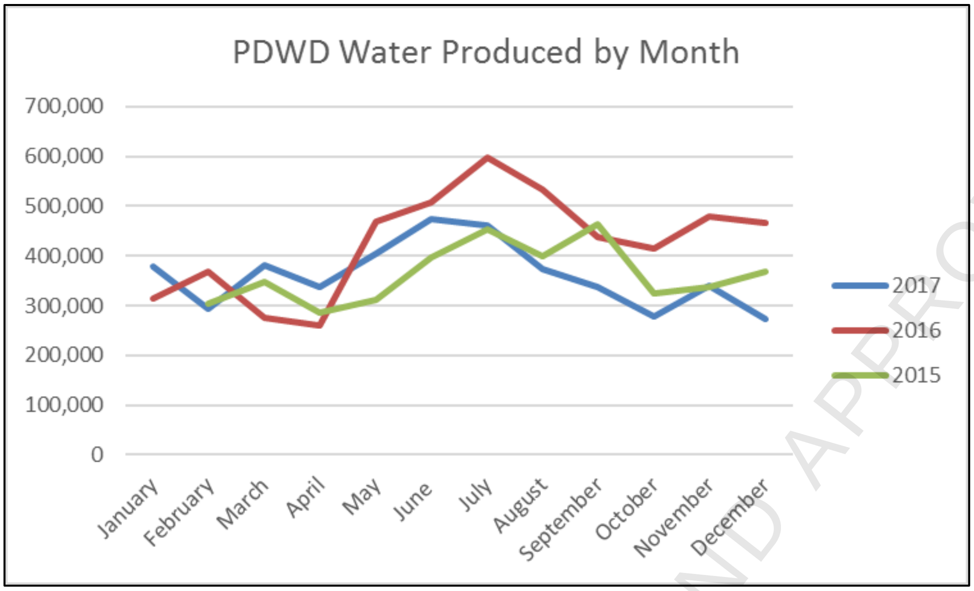


Figure 3 – Pine Drive Water District Water Treated

4.2 Comparison of Water Produced and Water Sold

The District provided "water sold" records from 2012 through 2017 which are summarized in Table 4 and Figure 4 below. This data is compared to the water production rates as shown in Table 5. The data indicates that the District system is losing approximately 0.2 gallons of water for every gallon produced. This "loss" can occur through either unmetered water usage or leakage in the system. The loss rate equates to approximately 1.4 gallons per minute (gpm).

Table 4 – Pine Drive Water District Water Sold Records

Month	Year					
	2017	**2016**	**2015**	**2014**		
January	301,800	311,590	455,030	287,270	310,380	333,790
February	287,970	276,720	379,370	369,400	396,490	253,660
March	254,490	244,200	292,670	225,330	208,450	229,330
April	268,700	255,590	263,380	247,540	236,660	267,920
May	264,330	290,950	246,250	294,700	236,480	303,440
June	343,210	362,340	318,370	454,540	421,260	612,110
July	435,360	505,240	367,020	493,290	472,490	535,890
August	290,300	467,500	395,160	317,540	300,340	554,990
September	321,130	373,630	380,720	396,120	547,000	495,670
October	267,750	345,110	314,590	301,100	259,670	315,060
November	237,310	361,440	260,160	277,260	247,830	272,650
December	234,820	386,260	260,250	260,190	268,180	338,300
Annual Total	3,509,187	4,182,586	3,934,985	3,926,294	3,907,243	4,514,822
Max Month Total	435,360	505,240	455,030	493,290	547,000	612,110
Max Month Avg Day	14,512	16,841	15,168	16,443	18,233	20,404
Annual Avg Day Demand	9,614	11,459	10,781	10,757	10,705	12,369

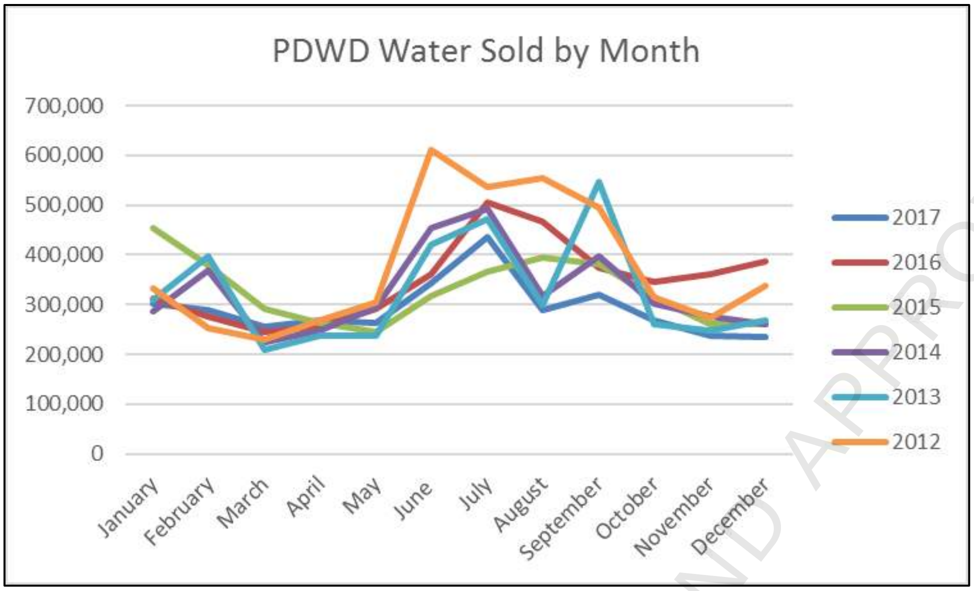


Figure 4 – Pine Drive Water District Water Sold per Month

Table 5 – Comparison of Water Sold and Water Produced for Pine Drive Water District

Parameter	Value	Unit	Notes
No. of Active Taps	161	ea	Per Records from Catherine Halcombe
Total Water "Sold"	11,626,758	gallons	Total 2015-2017
Average Daily Flow "Sold"	10,618	gpd	= Total Sold / No of Days
AADF of Water Sold, per Tap	66	gpd	= AADF / No of Taps
Total Water Produced during same period	13,461,048	gallons	Total 2015 - 2017
AADF of Water Treated, Total	12,651	gpd	Average 2015 - 2017
AADF of Water Treated, per Tap	79	gpd	= AADF / No of Taps
Average Daily Water Lost	2,033	gpd	=Daily Water Treated - Daily Water Sold
Ratio of Water Lost to Water Produced	0.19	-	= Water Lost / Water Sold
Average Daily Water "leak rate"	1.4	gpm	=Daily Water Loss / 1440 min per day

5 WATER LEAKAGE DISCUSSION

All water systems will have minor leaks and unaccounted for water. According to the Water Research Foundation, the national median real water loss rate, per service connection, for small water utilities is 31.6 gallons per day[9]. A comparison of this national median value to the data reported by BWWD and PDWD is shown in Table 6.

Table 6 – Comparison of Expected and Reported Water Losses

Parameter	Value	Unit	Notes
BWWD Median Water Loss, expected	5,056	gpd	=No. Taps x Median Loss Value
Reported Water Losses for BWWD	31,146	gpd	June - December 2017 data
BWWD Exceedance Factor	6.2X	-	=Reported Loss / Median Expected Loss
PDWD Median Water Loss, expected	5,088	gpd	=No. Taps x Median Loss Value
Reported Water Losses for PDWD	2,033	gpd	June - December 2017 data
PWWD Exceedance Factor	0.4X	-	=Reported Loss / Median Expected Loss

[9] *WRF Report 4372b "Water Audits in the United States: A Review of Water Losses and Data Validity", 2015*

This illustrates the magnitude of the water leaks plaguing the Beulah Water Works District system. The data shows the leakage rates have been increasing in recent years. As of the end of 2017, BWWD was leaking twice as much water as it was metering as used/sold which is approximately 6 times more than the national median for small systems. This level of leakage creates a substantial additional demand on the WTP. By way of comparison, data for the Pine Drive Water District indicates that only 0.2 gallons of water is lost for every gallon metered as used/sold which equates to a value approximately 40% of the national median.

6 POTENTIAL FOR SERVICE TO PINE DRIVE WATER DISTRICT

Using the data presented in the sections above, a future total combined water treatment capacity is estimated at 69,000 gallons per day for the maximum month average day. This calculation of this prediction is summarized in Table 7. It is imperative to note that this estimation is based on two (2) important assumptions:

A. The combined leakage rate for the two Districts should be equal to the national median rate of 31.6 gallons per service connection per day. This will require a substantial effort by BWWD to find and fix leaks within their system.

B. The per tap water demands remain the same as discussed above and little to no increase in water demand in the two Districts is realized.

Table 7 – Estimate of Future BWWD WTP Demand for both Districts

Parameter	Value	Unit	Notes
No. of Active Taps for PDWD	161	ea	Per Catherine Halcombe records
AADF per tap for Water Sold, PDWD	66	gpd	Per calcs
PDWD AADF Requirement	10,626	gpd	= No. Taps x AADF per tap
No. of Active Taps for BWWD	160	ea	Per District report
AADF per tap for Water Sold, BWWD	92	gpd	Per calcs
BWWD AADF Requirement	14,720	gpd	= No. Taps x AADF per tap
Total AADF for "sold" water (BWWD + PDWD)	25,346	gpd	=AADF for BWWD + AADF for PDWD
Peaking Factor for Max Day	2.0	-	per review of PDWD records
Total MMAD Demand for "Sold" Water	50,692	gpd	=Total AADF x Peaking Factor
Median Leakage (Real Loss) Per Tap	31.6	gpd	Figure 5.3 WRF 4372b, 2015
Target (Median) Leakage Volume, per day	10,144	gpd	=Leakage % x AADF Sold Water
Total Water Produced Requirement	68,836	gpd	=MMAD + Leakage
Backwash Water Requirement, avg per day	8,000	gpd	= assume 2X current rate at BWWD
Total Water Treatment Production Required	68,836	gpd	=Total Water Production + Backwash

In order to produce 69,000 gpd, the WTP would need to run 16.4 hours per day at 70 gpm.

7 CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis presented above, the following conclusions and recommendations are offered:

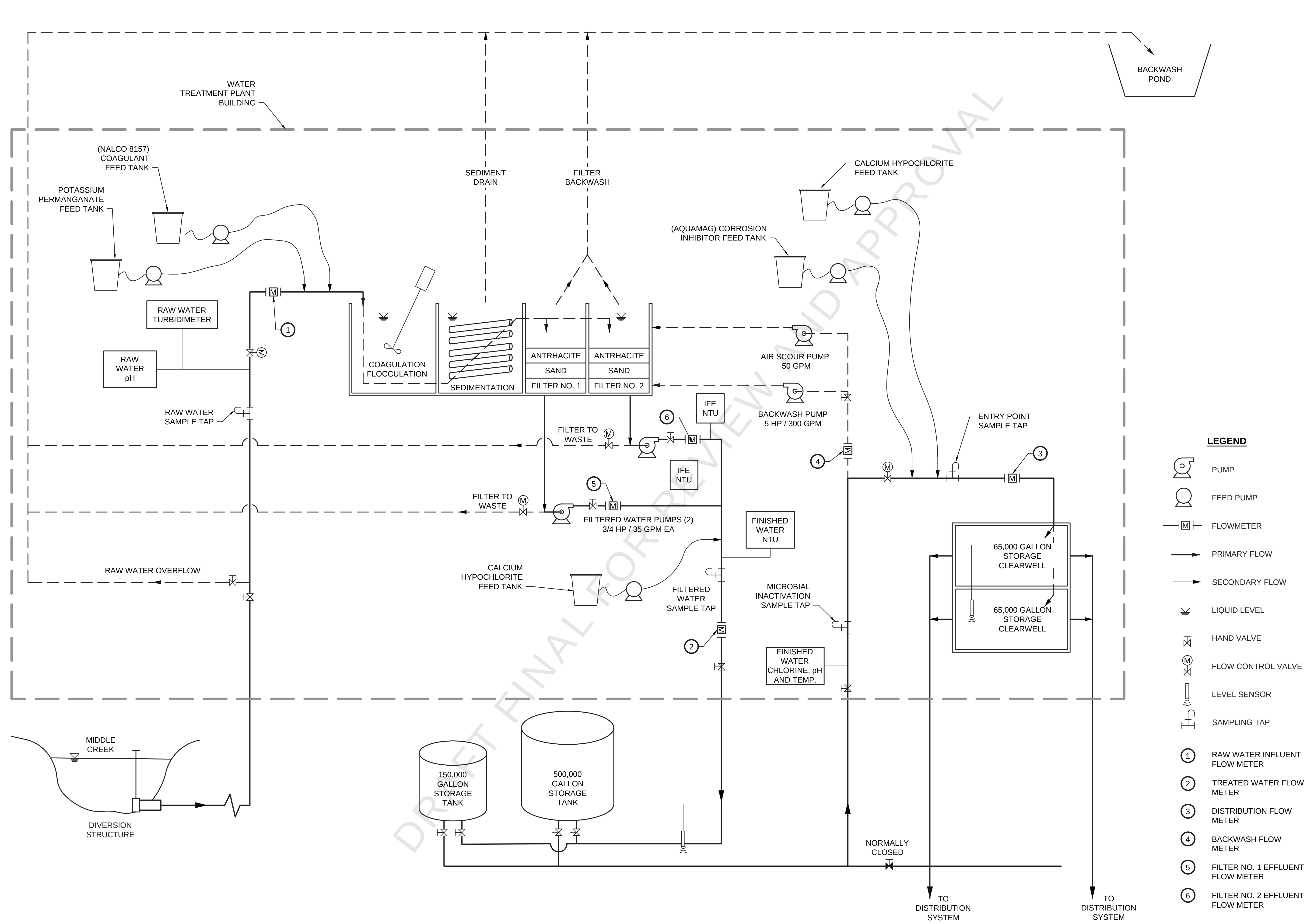
1. Beulah Water Works District must continue to identify and repair significant water leaks in their system.

2. The capacity of the treatment processes and facilities at the BWWD do not need to be expanded to provide water service to the two Districts provided that water leaks are addressed and system water demands do not substantially increase. However, ongoing capital investments are required to operate and maintain the existing facilities.

3. Potential future WTP modifications required by future regulatory changes are beyond the scope of this report.

4. The combined treated water storage volume at the BWWD WTP is 755,000 gallons which provides approximately 11 days of max month demand for the combined Districts. This is more than adequate for maximum day demands but will not provide the same level of drought protection that is currently enjoyed. Due to the health and regulatory concerns surrounding disinfection by products (DBPs), future water storage considerations should focus on raw water storage rather than treated water storage.

APPENDIX A – FIGURES



PROVIDENCE INFRASTRUCTURE CONSULTANTS

FIGURE 1 - PROCESS FLOW DIAGRAM

BEULAH WATER WORKS DISTRICT
WATER TREATMENT PLANT CAPACITY EVALUATION

DWG: C:\Egnyte\Shared\200 Projects\151010-BWWD\900 CAD\04-WTP Eval\06-EXHIBITS\Process Flow Diagrams\Figure 1 - Process Flow Diagram.dwg USER: arice
DATE: Jan 12, 2018 11:50am XREFS: G-BWWD-11X17-BDR P-BWWD-PFD IMAGES:

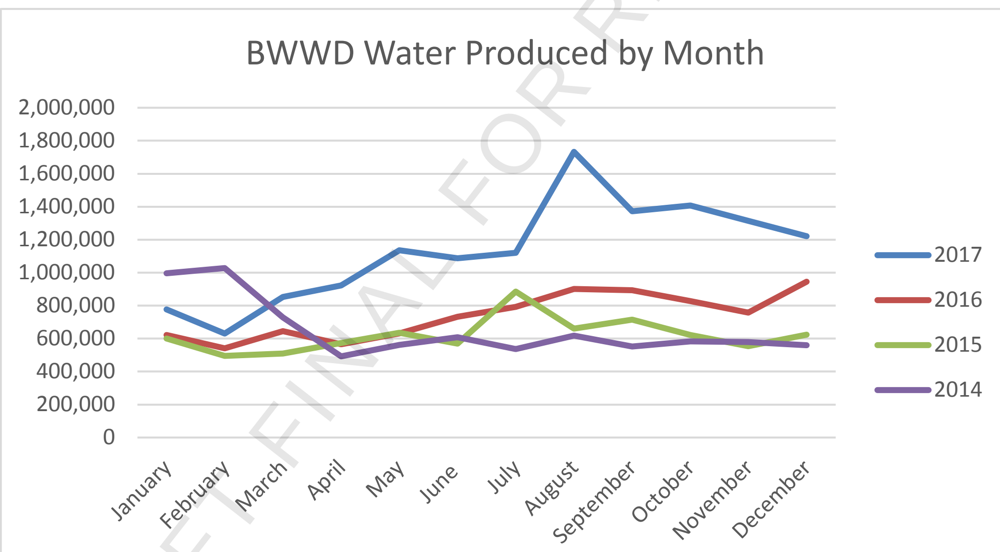
APPENDIX B - CALCULATIONS

PROJECT	Beulah Water Works District
DATE	1/18/2018
SUBJECT	Water Treated Records - By Year
CALC	ARR

C:\Egnyte\Shared\200 Projects\151010-BWWD\400 TECHNICAL DESIGN\433-Design Calcs\04-WTP Eval\[BWWD Water Records and Calcs 2012 02 14.xlsx]Comparison & Leakage

note: Cells in BLACK are "inputs" and cells in RED are calculated

Month	2017	2016	2015	2014			
January	777,332	622,692	600,220	995,321			
February	630,467	541,019	495,061	1,027,650			
March	852,270	644,889	508,673	728,961			
April	923,014	565,826	573,128	492,383			
May	1,135,377	631,983	635,170	561,663			
June	1,087,368	732,497	568,520	609,051			
July	1,120,305	792,405	885,170	535,677			
August	1,732,636	900,492	660,235	618,431			
September	1,372,521	892,694	715,785	552,390			
October	1,407,057	827,458	621,005	582,788			
November	1,313,241	758,250	554,518	578,457			
December	1,220,285	944,982	624,233	560,450			
TOTALS	13,573,890	8,857,203	7,443,733	7,845,236	Total:	29,874,826	gpyr
Max Month	1,732,636	944,982	885,170	1,027,650			
MMAD	57,755	31,499	29,506	34,255			
AADF	37,189	24,266	20,394	21,494		28,078	gpd
MM PF	1.55	1.30	1.45	1.59			



Average of 2014-2016 8,048,724 gal/yr

PROJECT Beulah Water Works District
DATE 1/18/2018
SUBJECT Water Sold Records
CALC ARR

C:\Egnyte\Shared\200 Projects\151010-BWWD\400 TECHNICAL DESIGN\433-Design Calcs\04-WTP Eval\[BWWD Water Records and Calcs 2012 02 14.xlsx]Comparison & Leakage

note: Cells in BLACK are "inputs" and cells in RED are calculated

Parameter	Value	Unit	Notes
Start Date of Records provided by BWWD	6/1/2017		
End Date of Records provided by BWWD	12/20/2017		
Total Days of Water Use Records	202	days	
Total Water "Sold"	2,961,882	gallons	
Average Daily Flow "Sold"	14,663	gpd	

PROJECT	Beulah Water Works District
DATE	2/14/2018
SUBJECT	Comparison of Produced and Leaked Water
CALC	ARR

C:\Egnyte\Shared\200 Projects\151010-BWWD\400 TECHNICAL DESIGN\433-Design Calcs\04-WTP Eval\[BWWD Water Records and Calcs 2012 02 14.xlsx]Comparison & Leakage

note: Cells in BLACK are "inputs" and cells in RED are calculated

Parameter	Value	Unit	Notes
No. of Active Taps	160	ea	Per Records from Dave Stanford
AADF of Water Sold, total	14,663	gpd	Average of 6/1/2017 to 12/20/2017
AADF of Water Sold, per Tap	92	gpd	= AADF / No of Taps
Total Water Produced during same period	9,253,413	gallons	Total June - December 2017
AADF of Water Produced, Total	45,809	gpd	Average of June-December 2017
AADF of Water Produced, per Tap	286	gpd	= AADF / No of Taps
Average Daily Water Lost	31,146	gpd	=Daily Water Treated - Daily Water Sold
Ratio of Water Lost to Water Produced	2.12	-	= Water Lost / Water Sold
Average Daily Water "leak rate"	21.6	gpm	=Daily Water Loss / 1440 min per day
Avg Water Loss per Tap	195	gpd/tap	=Water Loss / Taps
Median Real Loss Per Svc Connection	31.6	gpd	Figure 5.3 WRF 4372b, 2015
Ratio of Avg Water Loss to Median Water Loss	6.2	-	=AVG LOSS / National Median

PROJECT Beulah Water Works District
DATE 2/14/2018
SUBJECT Estimate of WTP Capacity Required
CALC ARR

C:\Egnyte\Shared\200 Projects\151010-BWWD\400 TECHNICAL DESIGN\433-Design Calcs\04-WTP Eval\[BWWD WTP Capacity Worksheet 2018 02 14.xlsx]BWWD WTP Future Capacity Need

note: Cells in BLACK are "inputs" and cells in RED are calculated

Parameter	Value	Unit	Notes
No. of Active Taps for PDWD	161	ea	Per Catherine Halcombe records
AADF per tap for Water Sold, PDWD	66	gpd	Per calcs
PDWD AADF Requirement	10,626	gpd	= No. Taps x AADF per tap
No. of Active Taps for BWWD	160	ea	Per Dave Stanford records
AADF per tap for Water Sold, BWWD	92	gpd	Per calcs
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Total AADF for "sold" water (BWWD + PDWD)	25,346	gpd	=AADF for BWWD + AADF for PDWD
Peaking Factor for Max Day	2.0	-	per review of PDWD records
Total MMAD Demand for "Sold" Water	50,692	gpd	=Total AADF x Peaking Factor
Median Leakage (Real Loss) Per Tap	31.6	gpd	Figure 5.3 WRF 4372b, 2015
Target (Median) Leakage Volume, per day	10,144	gpd	=Leakage % x AADF Sold Water
Total Water Produced Requirement	60,836	gpd	=MMAD + Leakage
Backwash Water Requirement, avg per day	8,000	gpd	= assume 2X current rate at BWWD
Total Water Treatment Production Required	68,836	gpd	=Total Water Production + Backwash
WTP approved production rate	70	gpm	
Hours Per Day online	16.39	hpd	=Required Productoin / Capacity
total WTP Treated Water Storage	755,000	gallons	=500,000+125,000+130,000
MMAD storage	10.97		

PROJECT Beulah Water Works District
DATE 2/14/2018
SUBJECT Comparison of Leakage Rates & National Median Leakage Rate
CALC ARR

C:\Egnyte\Shared\200 Projects\151010-BWWD\400 TECHNICAL DESIGN\433-Design Calcs\04-WTP Eval\[BWWD WTP Capacity Worksheet 2018 02 14.xlsx]BWWD WTP Future Capacity Need

note: Cells in BLACK are "inputs" and cells in RED are calculated

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Median Real Loss Per Svc Connection	31.6	gpd	Figure 5.3 WRF 4372b, 2015
No. of Active Taps for BWWD	160	ea	Per Dave Stanford records
Median Water Loss, expected	5,056	gpd	=No. Taps x Median Loss Value
Reported Water Losses	31,146	gpd	June - December 2017 data
Water Loss below or above National Median	ABOVE	-	
Exceedence Factor	6.2	-	=AVG LOSS / National Median
No. of Active Taps for PDWD	161	ea	Per Catherine Halcombe records
Median Water Loss, expected	5,088	gpd	=No. Taps x Median Loss Value
Reported Water Losses	2,033	gpd	June - December 2017 data
Water Loss below or above National Median	BELOW	-	
Exceedence Factor	0.4	-	=AVG LOSS / National Median

PROJECT Pine Drive Water District
DATE 1/18/2018
SUBJECT Water Treated Records - By Year
CALC ARR

C:\Egnyte\Shared\200 Projects\151010-BWWD\400 TECHNICAL DESIGN\433-Design Calcs\04-WTP Eval\[PDWD Water Records and Calcs 2018 02 14.xlsx]Water Usage & Taps

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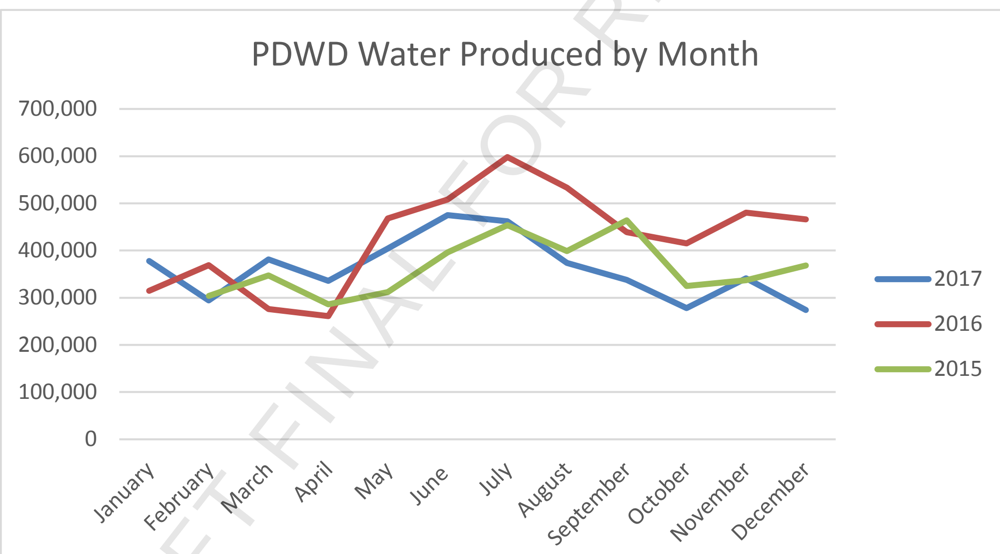
March	381,000	276,000	347,000		
April	336,000	261,000	286,000		
May	404,000	468,000	312,000		
June	475,000	508,000	396,000		
July	462,000	598,000	454,000		
August	374,000	533,000	399,000		
September	338,000	439,000	464,000		
October	278,000	415,000	325,000		
November	341,000	480,000	337,000		
December	274,000	466,000	368,000		
TOTALS	4,337,017	5,130,016	3,994,015	Total: 13,461,048	gal/3 yrs
Max Month	475,000	598,000	464,000		
MMAD	15,833	19,933	15,467		
AADF	11,882	14,055	10,943	12,651	gpd
MM PF	1.33	1.42	1.41		

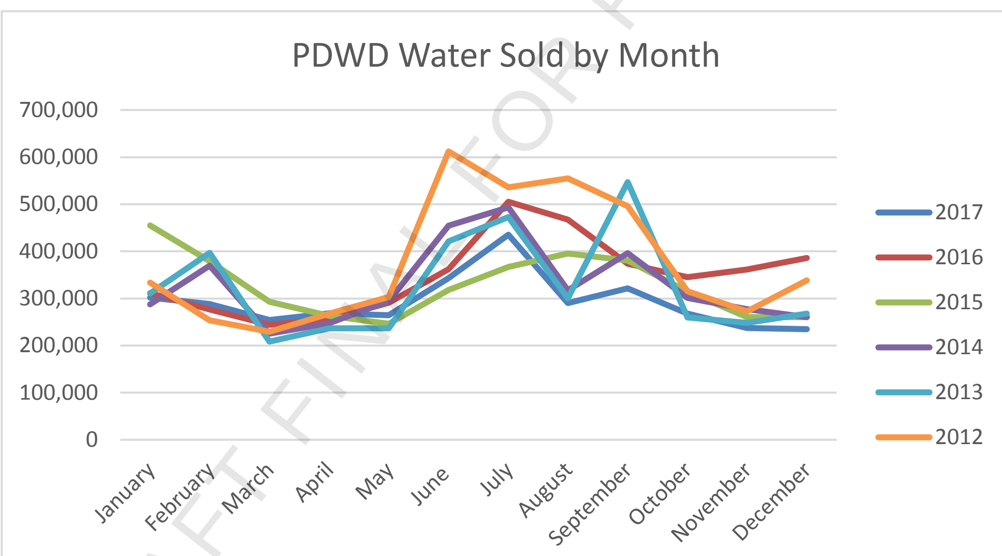


PROJECT Pine Drive Water District
DATE 1/18/2018
SUBJECT Water Sold Records - By Year
CALC ARR

C:\Egnyte\Shared\200 Projects\151010-BWWD\400 TECHNICAL DESIGN\433-Design Calcs\04-WTP Eval\[PDWD Water Records and Calcs 2018 02 14.xlsx]Water Usage & Taps

note: Cells in BLACK are "inputs" and cells in RED are calculated

Month	2017	2016	2015	2014	2013	2012	
January	301,800	311,590	455,030	287,270	310,380	333,790	
February	287,970	276,720	379,370	369,400	396,490	253,660	
March	254,490	244,200	292,670	225,330	208,450	229,330	
April	268,700	255,590	263,380	247,540	236,660	267,920	
May	264,330	290,950	246,250	294,700	236,480	303,440	
June	343,210	362,340	318,370	454,540	421,260	612,110	
July	435,360	505,240	367,020	493,290	472,490	535,890	
August	290,300	467,500	395,160	317,540	300,340	554,990	
September	321,130	373,630	380,720	396,120	547,000	495,670	
October	267,750	345,110	314,590	301,100	259,670	315,060	
November	237,310	361,440	260,160	277,260	247,830	272,650	
December	234,820	386,260	260,250	260,190	268,180	338,300	
TOTALS	3,509,187	4,182,586	3,934,985	3,926,294	3,907,243	4,514,822	Total: 23,975,117
Max Month	435,360	505,240	455,030	493,290	547,000	612,110	
MMAD	14,512	16,841	15,168	16,443	18,233	20,404	
AADF	9,614	11,459	10,781	10,757	10,705	12,369	10,948
MM PF	1.51	1.47	1.41	1.53	1.70	1.65	



PROJECT Pine Drive Water District
DATE 1/18/2018
SUBJECT Compare Water Treated to Water Sold
CALC ARR

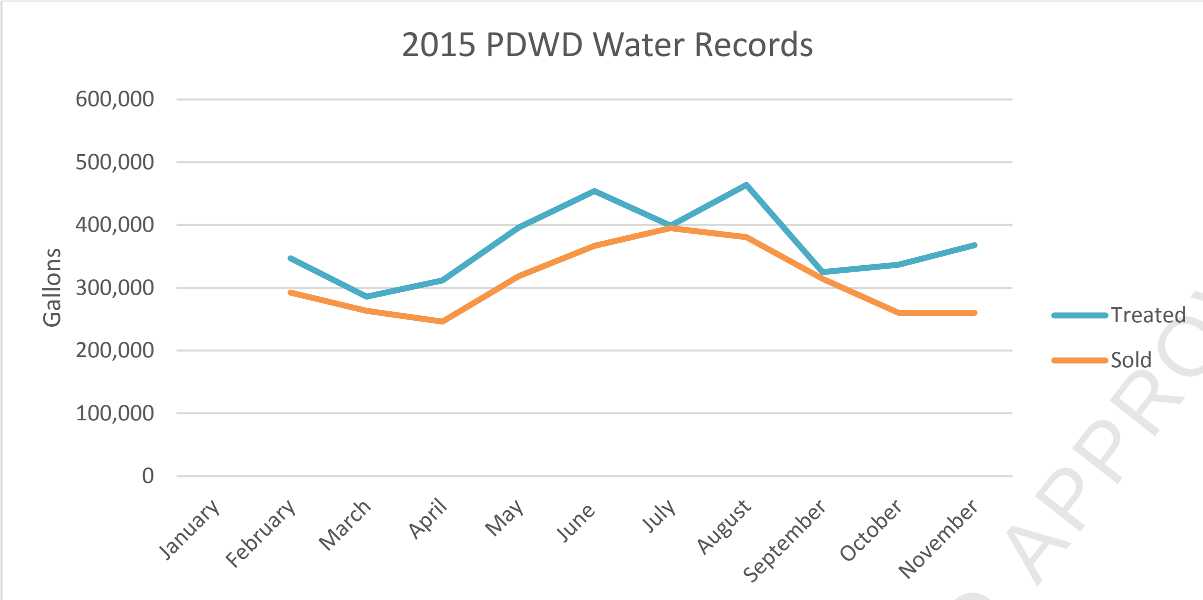
C:\Egnyte\Shared\200 Projects\151010-BWWD\400 TECHNICAL DESIGN\433-Design Calcs\04-WTP Eval\[PDWD Water Records and Calcs 2018 02 14.xlsx]Water Usage & Taps

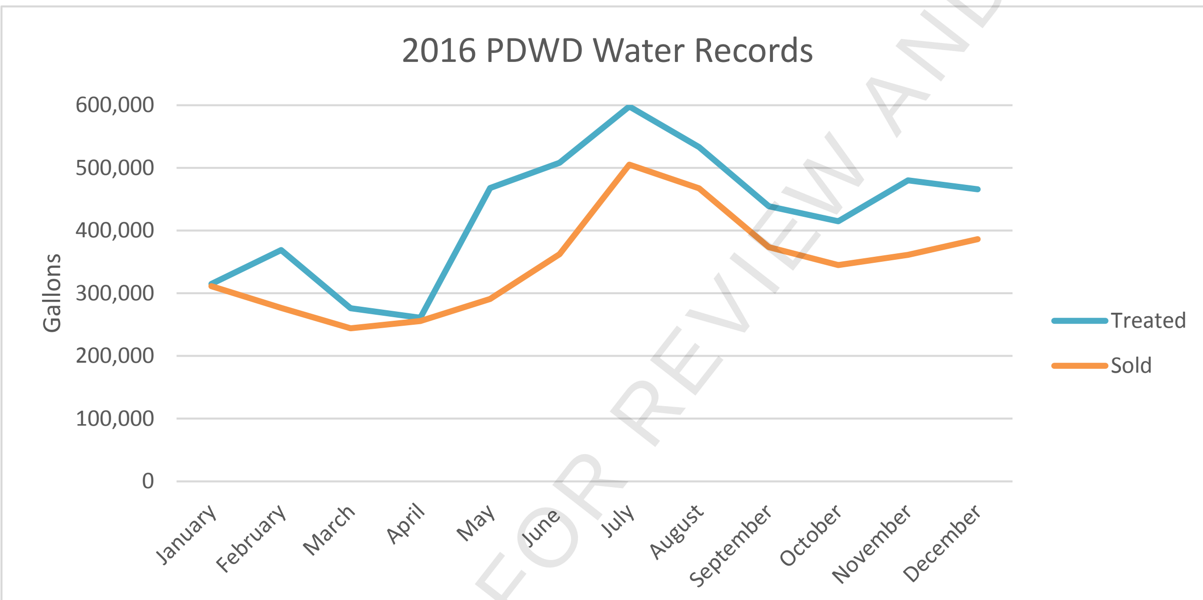
note: Cells in BLACK are "inputs" and cells in RED are calculated

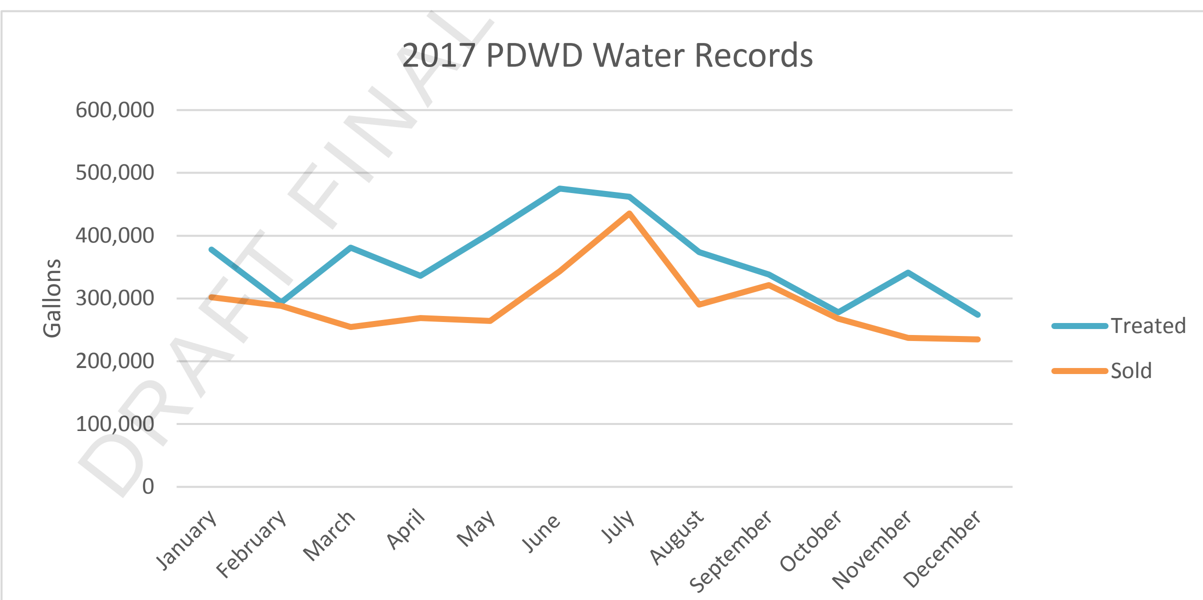
		2017			2016			2015	
Month	Treated	Sold	Difference	Treated	Sold		Treated	Sold	Difference
January	378,000	301,800	76,200	315,000	311,590	3,410			
February	294,000	287,970	6,030	369,000	276,720	92,280			
March	381,000	254,490	126,510	276,000	244,200	31,800	347,000	292,670	54,330
April	336,000	268,700	67,300	261,000	255,590	5,410	286,000	263,380	22,620
May	404,000	264,330	139,670	468,000	290,950	177,050	312,000	246,250	65,750
June	475,000	343,210	131,790	508,000	362,340	145,660	396,000	318,370	77,630
July	462,000	435,360	26,640	598,000	505,240	92,760	454,000	367,020	86,980
August	374,000	290,300	83,700	533,000	467,500	65,500	399,000	395,160	3,840
September	338,000	321,130	16,870	439,000	373,630	65,370	464,000	380,720	83,280
October	278,000	267,750	10,250	415,000	345,110	69,890	325,000	314,590	10,410
November	341,000	237,310	103,690	480,000	361,440	118,560	337,000	260,160	76,840
December	274,000	234,820	39,180	466,000	386,260	79,740	368,000	260,250	107,750

		2017			2016			2015	
Statistics	Treated	Sold	Difference	Treated	Sold		Treated	Sold	Difference
TOTALS	4,335,000	3,507,170	827,830	5,128,000	4,180,570	947,430	3,688,000	3,098,570	589,430
Max Month	475,000	435,360	139,670	598,000	505,240	177,050	464,000	395,160	107,750
MMAD	15,833	14,512	4,656	19,933	16,841	5,902	15,467	13,172	3,592
AADF	11,877	9,609	2,268	14,049	11,454	2,596	10,104	8,489	1,615

Total Three (3) Year Statistics		
Total Water Treated	13,151,000	
Max Month Treated	598,000	July 2016
MMAD Treated	19,933	
AADF Treated	12,893	
Total Water Sold	10,786,310	
Max Month Sold	505,240	July 2016
MMAD Sold	16,841	
AADF Sold	10,575	


2015 PDWD Water Records
600,000
500,000
400,000
300,000
200,000
100,000
0
Gallons
January
February
March
April
May
June
July
August
September
October
November
Treated
Sold


2016 PDWD Water Records
600,000
500,000
400,000
300,000
200,000
100,000
0
Gallons
January
February
March
April
May
June
July
August
September
October
November
December
Treated
Sold


2017 PDWD Water Records
600,000
500,000
400,000
300,000
200,000
100,000
0
Gallons
January
February
March
April
May
June
July
August
September
October
November
December
Treated
Sold

PROJECT Pine Drive Water District
DATE 2/14/2018
SUBJECT Comparison of Produced and Leaked Water
CALC ARR

C:\Egnyte\Shared\200 Projects\151010-BWWD\400 TECHNICAL DESIGN\433-Design Calcs\04-WTP Eval\[PDWD Water Records and Calcs 2018 02 14.xlsx]Water Usage & Taps

note: Cells in BLACK are "inputs" and cells in RED are calculated

Parameter	Value	Unit	Notes
No. of Active Taps	161	ea	Per Catherine Halcombe
AADF of Water Sold, total	10,618	gpd	Average of 2015 to 2017
AADF of Water Sold, per Tap	66	gpd	= AADF / No of Taps
Total Water Produced during same period	13,461,048	gallons	Total 2015 - 2017
AADF of Water Produced, Total	12,651	gpd	Average 2015 - 2017
AADF of Water Produced, per Tap	79	gpd	= AADF / No of Taps
Average Daily Water Lost	2,033	gpd	=Daily Water Treated - Daily Water Sold
Ratio of Water Lost to Water Produced	0.19	-	= Water Lost / Water Sold
Average Daily Water "leak rate"	1.4	gpm	=Daily Water Loss / 1440 min per day
MMAD of Water Sold	20,404	gpd	June of 2012
Ratio of MMAD to AADF	1.9	-	=MMAD/AADF
MMAD per Tap	127	gpd/tap	=MMAD / No. Taps
Avg Water Loss per Tap	13	gpd/tap	=Water Loss / Taps
Median Real Loss Per Svc Connection	31.6	gpd	Figure 5.3 WRF 4372b, 2015
Ratio of Avg Water Loss to Median Water Loss	0.4	-	=AVG LOSS / National Median

Groundwater Potable Water Supply Evaluation for the Beulah Valley

TO:	Bryan Ware/Beulah Water Works District Gary Kyte/Pine Drive Water District
COPIES:	Andrew Rice/Infrastructure Consultants Dave Stanford, H2O Consultants LTD
FROM:	Courtney Hemenway
DATE:	November 19, 2018
RESPOND BY:	

Hemenway Groundwater Engineering (HGE) was contracted by the Beulah Water Works District (BWWD) to provide an evaluation of potential groundwater sources for potable supplies for the Beulah Valley. Drought conditions and surface water flows with heavy sediment loading from upgradient drainage areas with forest fire damage have significantly curtailed the existing sources of potable water supplies to the Beulah Valley. In response to these conditions, Andrew Rice, of Providence Infrastructures Consultants (PIC), provided the Beulah Valley water districts with an outline of seven possible tasks to study, evaluate, and develop new groundwater sources of potable supply. This Technical Memorandum (TM) addresses the first two tasks: 1) Preliminary Groundwater Resources Evaluation, and 2) Soil Boring Management and Inspection Services.

Task 1 - Preliminary Groundwater Resources Evaluation

HGE initially reviewed the service areas for BWWD and Pine Drive Water District (PDWD) and existing potable water diversion and treatment points for each district to evaluate current system constraints to any new sources of groundwater supplies. Current system configurations indicated that new sources of groundwater supplies could be located at many locations within the service areas of the two districts. HGE also met with representatives from both water districts to review historical information regarding wells located with the Beulah Valley. HGE examined available studies from the United States Geological Survey (USGS), Colorado Geologic Survey (CGS), and other identified sources to review hydrogeolgic and groundwater quality data within the Beulah Valley. In addition, HGE contacted Bill Tyner and Bethany Arnold of the Division of Water Resources, Division 2 office in Pueblo, Colorado to obtain well permit and groundwater hydrology information. Bethany provided a very comprehensive study within the Beulah Valley that included maps of permitted wells with a summary table illustrating decreed uses, pumping rates, annual appropriation volumes, and other pertinent information. In addition, the information included a rating for each of the wells identified for the potential to meet the water supply need for the Beulah Valley. The map and summary table are attached.

Following the initial review, two potential groundwater sources were identified for additional investigation. The first source considered was groundwater from bedrock aquifers underlying the Beulah Valley. The second source was shallow alluvial aquifers that are situated along existing and historical river channels.

Regarding bedrock aquifers underlying the Beulah Valley, one existing bedrock well located adjacent to the PDWD Bartley pump station and water transmission pipeline was identified as a potential well that could be acquired for use by the two districts. The well was identified as the Rice Well and was permitted for municipal uses and was flowing under artesian pressure. However, water quality concerns based on local information and published data suggested there would be potential water quality concerns with the use of the Rice well. As part of the groundwater resources evaluation, on August 9, 2018 Dave Stanford collected a water sample from the well for laboratory analyses for a variety of constituents recommended by Andrew Rice based on Colorado Department of Public Health and Environment (CDPHE) drinking water criteria. The results from the water quality sample from the Rice well were summarized by Andrew Rice and are attached. The sample results indicated a uranium level of 0.18 milligrams per liter (mg/l), which greatly exceeded the primary drinking water maximum contaminant level (MCL) of 0.03 mg/l. Due to the high uranium level and the potential high costs to treat the water to meet drinking water standards, the bedrock aquifers underlying the Beulah Valley were downgraded as a potential economic source of potable water to the two districts.

Following the reporting of sample results from the Rice well, the preliminary groundwater resources evaluation focused on the shallow aquifers as a potential source of potable water. HGE met with Andrew Rice and Dave Stanford in Beulah on September 4, 2018 to inspect potential sites to conduct soil borings and to review potential wells to collect water quality samples for investigating the shallow alluvial aquifers in the Beulah Valley. HGE, Dave, and Andrew traveled around the Beulah Valley identifying possible locations for wells to be tested and areas where soil boring could be drilled to assess the lithology of the shallow alluvial aquifers systems. Based on the site inspections, information provided in the Division 2 data and mapping, and personal communication by Dave Stanford and district staff, the Sellers shallow alluvial well (permit 4679-F-R) was identified as the highest-ranked well for potential use by the two districts. The ranking was based on measured flow rates from the Sellers well of 175 gallons per minute (gpm) from Division 2 records and also because the well was permitted for municipal uses. During the site inspection, Dick Sellers was contacted and arrangements were made for Dave Stanford to collect a water quality sample from his well. In addition, Mr. Sellers indicated areas around his well that HGE could conduct soil borings to define the alluvial conditions at that site under Task 2 of the study.

As with the Rice well, sampling was conducted in the Sellers well to verify the water quality from the shallow alluvial aquifer at that location. Dave Stanford collected the sample on September 11, 2018 and submitted it to SGS laboratory in Wheat Ridge, Colorado. The results from the water quality sample from the Sellers well were summarized by Andrew Rice and are attached. The sample results showed that no drinking water parameter analyzed exceeded a regulatory drinking water MCL.

Task 2 – Soil Boring Management and Inspection Services

Results from the Task 1 Preliminary Groundwater Resources Evaluation directed the field investigations under Task 2. Based on the sample results from the Rice well, no additional field work was warranted at this time with respect to bedrock aquifers as a potential groundwater resource for the Beulah Valley. Regarding shallow aquifers, based on known geology, well permit conditions, water quality, and proximity to district facilities and active rivers/creeks, two locations were selected for further investigation by soil borings. The first soil investigation was focused around the existing Sellers well. The second site was located near the existing PDWD water treatment plant (WTP). The location of the two soil investigations are shown in Figures 1 and 2.

The soil borings at each location were drilled by Drilling Engineers of Fort Collins, Colorado. The original drilling program included the use of a 4.25-inch Hollow Stem Auger (HSA) with split-spoon sampling for the collection of soil samples and to determine the depth to bedrock at each location. However, the drilling program was modified at several of the soil boring locations due to the lithology containing significant large sized rocks and cobbles. At locations where the HSA could not penetrate the soil profile due to the cobbles, the drilling continued with 4-inch Solid Stem Augers (SSA). At borings where the SSA was used, when possible, the lithology was logged using the drill cuttings coming up the bore hole during the drilling process. Lithologic logs were recorded for each of the soil borings where the split-spoon sampling was completed or where representative soil samples could be logged from the auger cuttings.

For the Sellers site, soil borings were completed north of Squirrel Creek and upgradient to the existing Sellers well (see Figure 1). Four soil borings were drilled at the site (STH-1 through STH-4) on October 29, 2018. Test hole STH-1 was completed to a depth of 12 feet before the HSA could not be advanced due to the presence of large cobbles. Drilling continued approximately 15 feet to the northwest of STH-1 at test hole STH-2. Test hole STH-2 was completed to a depth of only 9 feet before the HSA could not be advanced due to the presence of large cobbles. Following the problems of drilling through the cobbles with the HSA, test hole STH-3 was drilled approximately 15 feet north of STH-2 using an SSA. However, drilling could only be completed to a depth 17 feet with an SSA before the auger locked on a large cobble and snapped off the auger. Bedrock was not encountered before the drilling was terminated in STH-3. Also, a lithologic log could not be completed for STH-3 due to very few drill cuttings coming up the auger that could be logged. Drilling continued on the north side of the access road to the existing Sellers well. The ground north of the access road was very soft with saturated materials. Test Hole STH-4 was drilled using the HSA and split-spoon sampler and completed to a depth of 13 feet where bedrock was encountered. The bedrock was a red claystone/siltstone. The soils encountered in test hole STH-4 were very different from the three other test holes drilled at the Sellers site. No large cobbles were encountered at test hole STH-4 and the soils consisted primarily of fine-grained sand with silts and some small pebbles.

A test hole was attempted at a location approximately 20 to 25 feet northeast of test hole STH-4. However, the ground became increasingly more soft and saturated as the rig moved to the north. The drill rig eventually became stuck with no test hole being drilled north of test hole STH-4. An excavator digging a trench across the Sellers property was used to pull the rig back to the south onto the access road.

Following the drilling at each of the Sellers test holes, the bore holes were allowed to remain open until a water level was measured in each hole. The water level in test holes STH-1, STH-2, and STH-4 were 12, 9, and 13 feet bgs (bgs), respectively. No water level was obtained from STH-3 due to the bore hole collapsing prior to a water level being measured. The relative ground surface difference between the four test holes completed on the Sellers property was less than one to two feet.

At the conclusion of the soil boring and due to the difficulty of drilling through the cobbles at the site, Dick Sellers, at HGE's request, allowed the excavator being used to install the trench on the property to dig two test pits adjacent to the test hole boring sites. The test pits allowed for the visual logging of the entire soil profile down to a depth of approximately 14 feet. The first test pit was located just east of the line of test holes (STH-1 through STH-3) south of the well access road (see Figure 1). The test pit at this location showed the fine sands with silts and clays to a depth of approximately 6 feet bgs. From 6 feet to the final depth of 14 feet, the pit exposed fully-saturated sands and gravels with large cobbles and rocks up to over 3 feet in diameter. Bedrock was not encountered in the test pit. Water level in the pit was measured at a depth of approximately 6 to 7 feet before the pit was backfilled.

A second test pit was excavated north of the well access road and approximately 25 feet northeast of test hole STH-4. The soils at the second test pit were significantly different from those logged at test hole STH-4, which consisted of fine-grained materials. The second test pit showed the same soils as logged in the first test pit. Fine sand with silts and clays were logged to a depth of approximately 6 to 7 feet bgs. From 7 feet to the final depth of 14 feet, the pit exposed fully-saturated sands and gravels with large cobbles. Bedrock was not encountered in the second test pit. The second test pit showed that the alluvial channel was incised along a path between the second test pit and test hole STH-4.

Lithologic logs of test holes STH-1, STH-2, and STH-4 are attached. In addition, photos of the two test pits are also attached.

The second set of test holes was completed near the existing PDWD WTP site adjacent to Highway 78 and are shown in Figure 2. The drilling of test holes PTH-1 through PTH-4 was completed on October 30, 2018 by Drilling Engineers. The test holes were located in the easement along the access road to the WTP. The line of test holes were designed to identify any deep alluvial channels that may exist across the narrow valley that exists at that location. The existing horizontal wells at the WTP along the north side of the valley at that location extend approximately 10 to 14 feet bgs before encountering bedrock. Based on the surface topography and geology, it was anticipated that a deep alluvial channel may exist somewhere in the narrow section of the valley that provided drainage for the large subsurface watershed upgradient to the WTP site.

Drilling at the WTP site was initiated at the furthest southern possible site along the access road easement area. Test hole PTH-1 is located immediately north of Highway 78 (see Figure 2). PTH-1 was drilled using the HSA and sampled using the split spoon sampler. However, drilling below a depth of 2 feet encountered cobbles and rocks that prohibited the use of the split spoon sampler. Therefore, the lithology was logged using the cuttings from the HSA to a depth of 23 feet where bedrock was possibly encountered. To verify the bedrock depth, the drill rig was moved approximately four feet to the north and test hole PTH-1A was drilled using the SSA. At a depth of 23 feet the SSA was removed and the split spoon sampler was used to collect a small sample of the bedrock. The bedrock was a grey fine-grained sandstone.

Following the drilling of test holes PTH-1 and 1A, the drill rig moved approximately 50 feet north along the west side of the access road to drill test hole PTH-2. Due to the drilling conditions, HGE directed Drilling Engineers to drill the remaining test holes using the SSA and confirm the bedrock using the split-spoon sampler when possible. Test hole PTH-1 was drilled to a depth of 23 feet where bedrock was encountered. A split-spoon sample confirmed the bedrock (grey sandstone) at a depth of 23 feet. The lithology at PTH-2 showed fewer large cobbles and rocks then what was logged at test holes PTH-1 and 1A.

Test hole PTH-3 was located approximately 56 feet north of test hole PTH-2 along the west side of the WTP access road (see Figure 2). Lithology at this site was very similar to test hole PTH-2. Bedrock was encountered at a depth of 29 feet bgs. Drilling continued until a depth of 34 feet to confirm the continuity of the bedrock. A split-spoon sample at a depth of 34 feet in the open bore hole confirmed that the bedrock encountered at a depth of 29 feet bgs was continuous to 34 feet bgs. The bedrock was fine-grained grey sandstone.

Following the drilling of test hole PTH-3, the drill rig moved as far to the north as possible based on constraints due to the allowable drilling easement and overhead power lines. Test hole PTH-4 was located approximately 69 feet north of PTH-3 (see Figure 2). Lithology at this site was very similar to test holes PTH-2 and PTH-3 consisting of fine-grained sand with silts, clays, and gravels, and cobbles in the first 15 feet. Bedrock was encountered at a depth of 23 feet bgs and confirmed with a split-spoon sample. The bedrock was fine-grained grey sandstone.

Following the drilling of all four test holes, water levels were measured in each bore hole. The bore holes were allowed to remain open until a water level was measured in each hole. The water levels in test holes PTH-1A, PTH-2, PTH-3, and PTH-4 were 16, 17, 13, and 14.5 feet bgs, respectively. The relative ground surface difference between the four test holes completed on the PDWD property was less than one to two feet. Lithologic logs of test holes PTH-1, PTH-2, PTH-3, and PTH-4 are attached.

Conclusions and Recommendations

Based on the review of available information, site inspections, and the soil boring program, the following conclusions can be made:

1. The bedrock aquifers in the Beulah Valley would provide a possible source of water. However, the presence of radionuclides would require specialized treatment and would produce materials that would be problematic for disposal.

2. Information provided by the Division of Water Resources, Division 2 office in Pueblo, Colorado pointed to several wells that potentially could provide water to the

two water districts. HGE, Dave Stanford, and Andrew Rice conducted a site visit to the wells listed as “first choice” wells in the Division 2 summary. The site inspection determined that the Sellers well offered the best opportunity for further investigation due to the existing permitted uses (municipal), geologic conditions, and willingness by Dick Sellers to work with the districts. Soil borings and open pit excavations confirmed that the Sellers site would provide alluvial aquifer conditions that could yield high volumes of high-quality water for the Beulah Valley.

3. Soil borings were drilled across the narrow eastern end of the Beulah Valley adjacent to the PDWD WTP site to investigate possible alluvial aquifer conditions that would provide high-yield alluvial well opportunities. The drilling at this site did not indicate favorable conditions that would allow for the development of alluvial groundwater supplies. The lithology at the soil borings showed alluvial materials to depths ranging from 23 to 29 feet bgs. However, the alluvial materials were significantly less favorable than those found at the Sellers site. The alluvial materials at the PDWD WTP site contained a much higher percentage of fine silts and clays that would reduce the yield from alluvial wells as compared to those identified at the Sellers site. In addition, new well permit(s) would need to be issued for any wells at the WTP site that may involve complicated water rights issues and a long permitting process.

As a result of the data reviews and soil investigations, HGE recommends the following:

1. Based on the results from the bedrock aquifer water sample from the Rice well and published information on the bedrock aquifers in the area, development of the bedrock aquifers as a potential water supply source should only be explored if the alluvial aquifer sources are determined to be not viable.

2. Development of the alluvial wells at the PDWD WTP site does not appear to be optimal based on the soil boring investigation and possible permitting issues. New well permits would need to be issued for any wells at the WTP site, and that may involve complicated water rights issues and a long permitting process. However, if development of the Sellers well site cannot be completed, additional studies and review of permitting issues would need to be conducted at the PDWD WTP site to develop the alluvial groundwater.

3. The primary focus of developing a new groundwater supply source should be focused at the Sellers well site. The results from the soil boring program, water quality sampling, and existing permit conditions that allow for municipal uses, are all favorable for development of the alluvial groundwater at the Sellers site. HGE recommends two potential pathways for developing the alluvial groundwater at the Sellers site. However, both pathways require negotiations with Mr. Sellers on the use of his well and associated permit. The negotiations will involve both economic and legal discussions to address issues. Water rights and well permit issues would need to be addressed and clarified between the Sellers and the two water districts and the State Engineer’s Office (SEO). In addition, easement for pipelines and distribution of power costs will need to be worked out as the groundwater development program

proceeds. Assuming that the economic and legal issues can negotiated, the following two paths may be taken to develop the alluvial groundwater at the Sellers site.

The first and recommended alternative would be to test and verify production capabilities of the existing Sellers well. Testing would provide the actual pumping capacity of the existing well structure and is estimated to be completed for $30,000 or less. If the yield from the existing structure is sufficient to meet all parties' (Sellers and the two districts) water supply needs, the wellhead can be modified to meet current CDPHE wellhead requirements. If the water from the well is determined to be groundwater under the direct influence of surface water, there will be certain additional water treatment requirements for use of the water in a potable water supply system. Based on the location of the well with respect to Squirrel Creek and the lithology, the groundwater would be expected to be under the direct influence of surface water. Additionally, it would be expected that any new vertical or horizontal well completed in the immediate area of the existing Sellers well would also be classified as under the direct influence of surface water. CDPHE currently classifies any new horizontal well as under the influence unless additional testing proves otherwise.

Assuming that the groundwater would require the additional treatment (supplemental filtration), the wellhead would require minimal modification prior to incorporation into the Beulah Valley potable water supply system. In addition to any well head modifications, only a new pump or pumps (to provide separate water supply to the Sellers property) and controls would need to be installed at the well. The cost for these wellhead modifications and new equipment is estimated to be less than $50,000.

The second recommended pathway forward would be selected if the existing Sellers well does not produce the required rate or volume required to meet the Sellers' and two water districts' needs. If the well needs to be replaced to meet the water supply needs, HGE recommends the installation of a horizontal well. Due to the shallow nature of the alluvial deposits at the site, a horizontal well would provide a much higher yield than a normal vertical well. Also, due to the large rocks and cobbles, drilling a large-diameter vertical well would be very challenging and potentially very costly. One-Pass Trenching technologies would provide the best alternative for construction of a horizontal well at the site considering the depth and composition of the alluvial materials with large rocks and cobbles and shallow (less than 6 feet) groundwater level. Based on experience with similar conditions, the horizontal well would be estimated to produce 500 gpm or more. However, permitting and water rights issues would need to addressed between a new well and the existing Sellers well permit and water rights conditions.

Cost estimates for designing, constructing, testing, and equipping a new horizontal well would be impacted by the difficulty of constructing the well in alluvium that exists at the site. The large rocks and cobbles would require specialized equipment, which would impact the cost of constructing the well. However, based on estimates from a horizontal well contractor, the costs to construct and test the well would range from $200,000 to $300,000. Additional costs would be incurred for the design and installation of a pump, electrical controls, piping, metering, valving, and other equipment required for a new well site.

Attachments

Figures

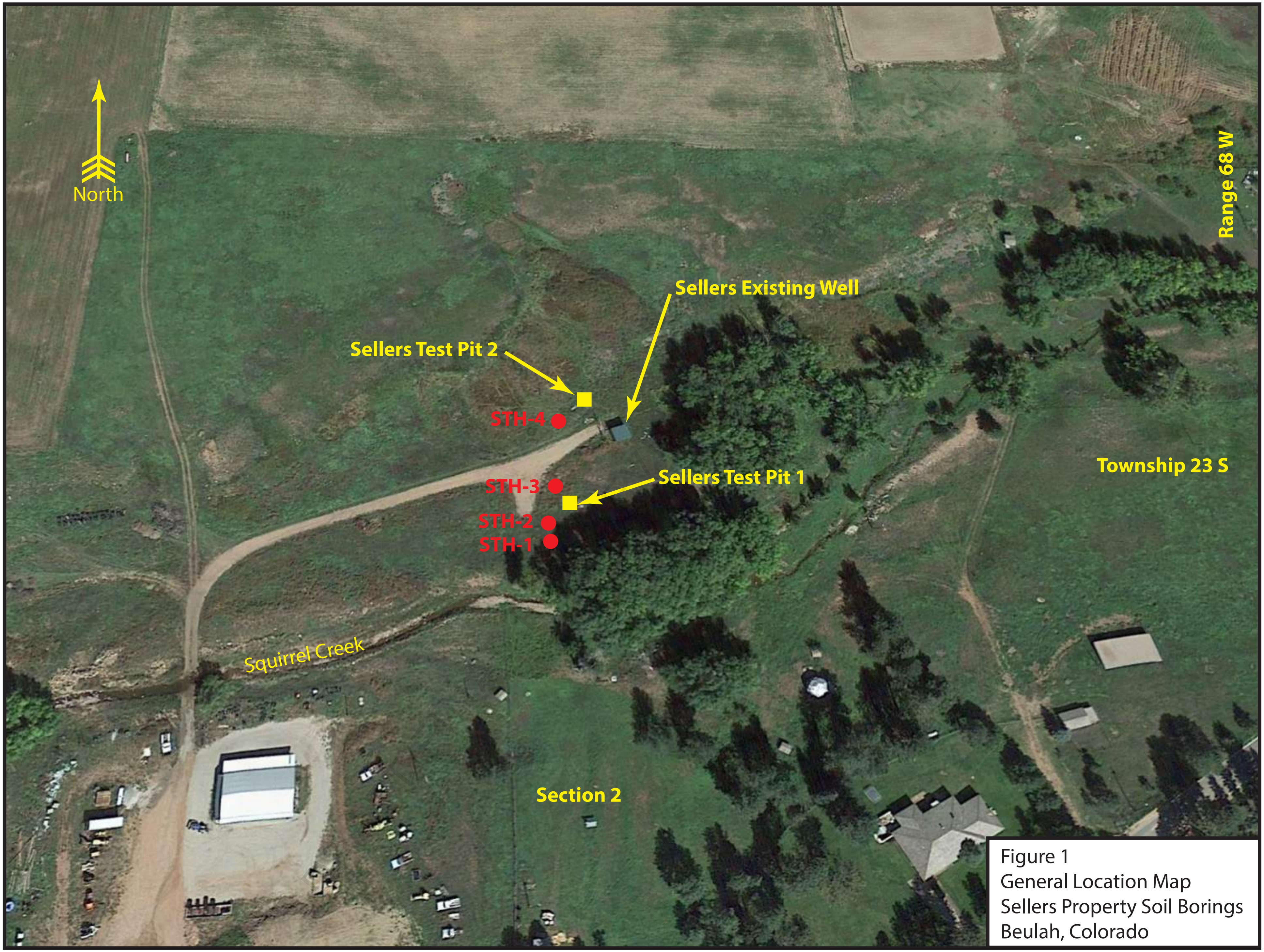


Figure 1
General Location Map
Sellers Property Soil Borings
Beulah, Colorado

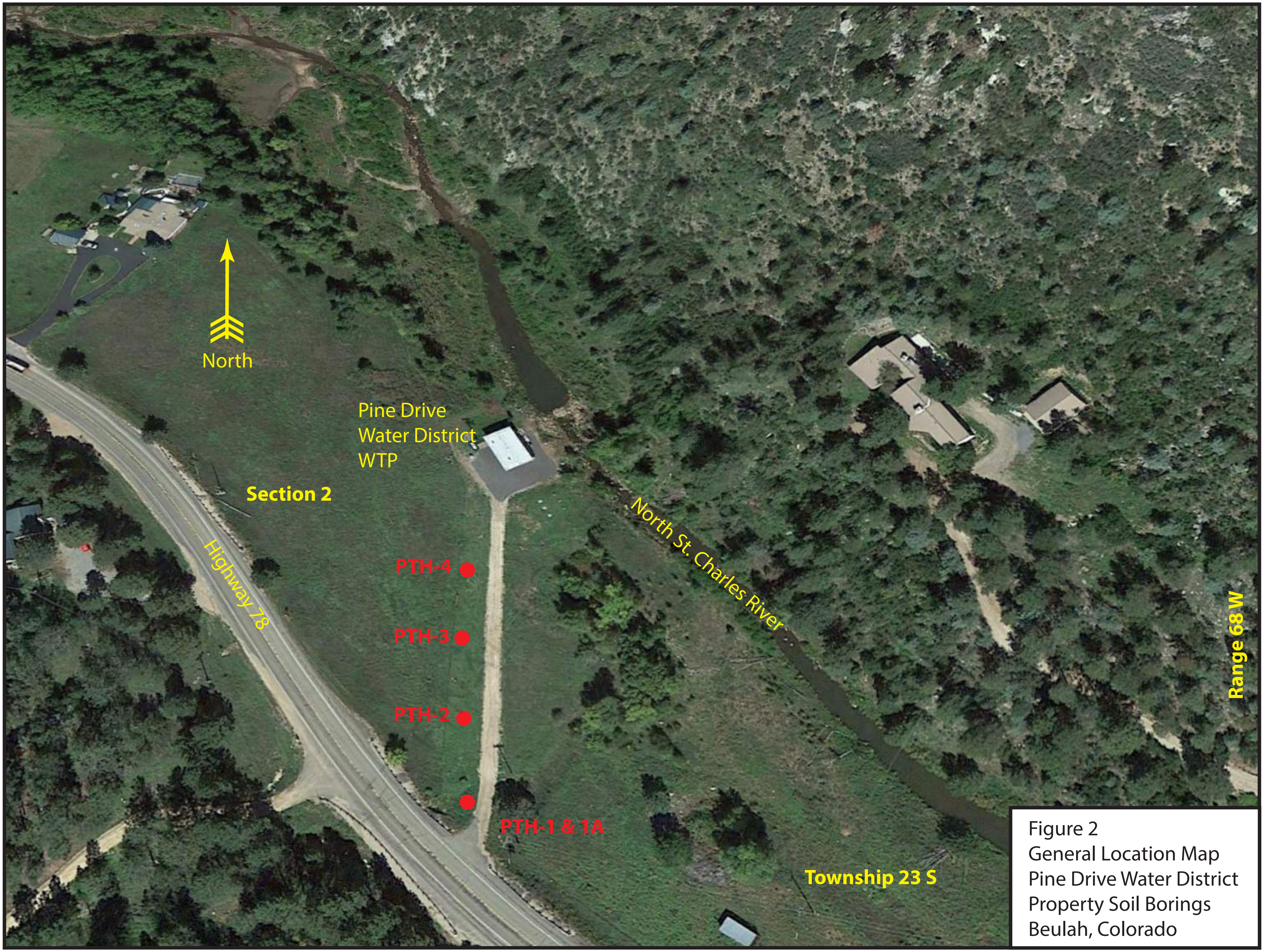
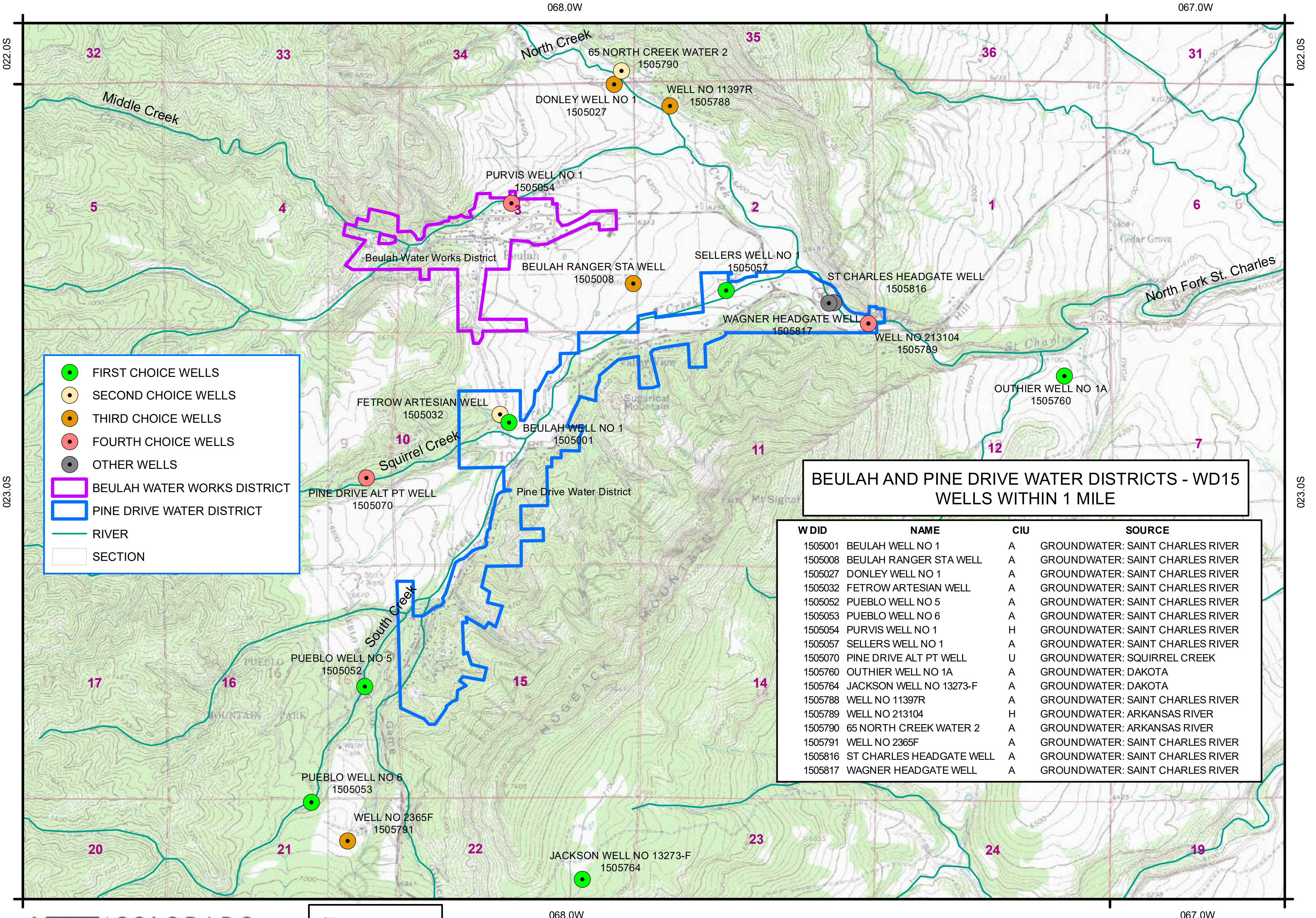


Figure 2
General Location Map
Pine Drive Water District
Property Soil Borings
Beulah, Colorado

Division of Water Resources Information

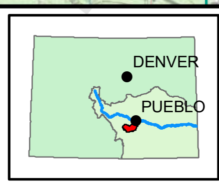
BEULAH AND PINE DRIVE WATER DISTRICTS - WD15
WELLS WITHIN 1 MILE



W DID	NAME	CIU	SOURCE
1505001	BEULAH WELL NO 1	A	GROUNDWATER: SAINT CHARLES RIVER
1505008	BEULAH RANGER STA WELL	A	GROUNDWATER: SAINT CHARLES RIVER
1505027	DONLEY WELL NO 1	A	GROUNDWATER: SAINT CHARLES RIVER
1505032	FETROW ARTESIAN WELL	A	GROUNDWATER: SAINT CHARLES RIVER
1505052	PUEBLO WELL NO 5	A	GROUNDWATER: SAINT CHARLES RIVER
1505053	PUEBLO WELL NO 6	A	GROUNDWATER: SAINT CHARLES RIVER
1505054	PURVIS WELL NO 1	H	GROUNDWATER: SAINT CHARLES RIVER
1505057	SELLERS WELL NO 1	A	GROUNDWATER: SAINT CHARLES RIVER
1505070	PINE DRIVE ALT PT WELL	U	GROUNDWATER: SQUIRREL CREEK
1505760	OUTHIER WELL NO 1A	A	GROUNDWATER: DAKOTA
1505764	JACKSON WELL NO 13273-F	A	GROUNDWATER: DAKOTA
1505788	WELL NO 11397R	A	GROUNDWATER: SAINT CHARLES RIVER
1505789	WELL NO 213104	H	GROUNDWATER: ARKANSAS RIVER
1505790	65 NORTH CREEK WATER 2	A	GROUNDWATER: ARKANSAS RIVER
1505791	WELL NO 2365F	A	GROUNDWATER: SAINT CHARLES RIVER
1505816	ST CHARLES HEADGATE WELL	A	GROUNDWATER: SAINT CHARLES RIVER
1505817	WAGNER HEADGATE WELL	A	GROUNDWATER: SAINT CHARLES RIVER

COLORADO
Division of Water Resources
Department of Natural Resources

Date: 8/2/2018



LOCATION OF WATER DISTRICT 15
ST CHARLES RIVER BASIN
TRIBUTARY TO ARKANSAS RIVER
WATER DIVISION 2, PUEBLO
STATE OF COLORADO

0 0.5 1 1.5 2
Miles

1:33,000

PROJECTION: NAD83 UTM ZONE 13N
BASE: USGS TOP 1:24K

WDID	PermitNO	Case No	Description of Permitted Uses	Decreed Uses	Comments	Actions for Water District	Well Depth	Diversion Record Comments	Decreed Rate (gpm)	Permitted Rate (gpm)	Last Measurement Test Rate (gpm)	Decreed Annual Limits (AF)	Permitted Annaul Limits (AF)
1505057	4679-F-R	W2684	irrigation and domestic	irrigation, domestic, municipal	AGUA member	May qualify for Rule 14 plan; if not, would need to file a court case and SWSP	14	Has contemporary diversions since 1999; water class coding indicates municipal use	140	40	175	--	--
1505760	14316-F-R	W0003, 99CW0168	irrigation and municipal	Irrigation, municipal, augmentation	Used to augment Rancho San Carlos Ponds 2, 3 and 5 (1503554, 1503555, 1503556)	File an Court Case and SWSP to cover augmentation of use beyond the place of use in the original decree	162	Has contemporary diversions since 2006; water class coding indicates augmentaion use	200	200	--	323	323
1505764	13273-F	W0010, 83CW0096	municipal	Irrigation and municipal	Place of use is 320 acres in Section 22, Township 23S; Non-tributary	Re-permit for use outside 320 acres described in decree and file a court case	200	No contemporary diversion records; no reporting available	100	100	--	162	500
1505001	29-WCB	--	Municipal	--	Form 7 filed in 2014; already within the Pinedrive Water District Boundaries	Install a pump and a TFM, certify TFM, and file for court case and SWSP	745	Diversion Records only go back to 2014 because a Form 7 was filed that year	--	--	--	--	--
1505052	--	W3382	--	Municipal	alluvial; Form 7 Filed in 1999	Install a pump and TFM, certify TFM, and file an court case	10	No water diverted since 1999	103	--	--	--	--
1505053	--	W3382	--	Municipal	alluvial; Form 7 filed since 1995	File a court case and SWSP	55	No water diverted since 1999	14.9	--	26	--	--
1505790	--	--	--	--	Pre-1965 well; no need for permit or decree; AGUA member; not limited to any flowrate or volume by decree or permit; being used for domestic purposes right now	File an court and re-permit pursuant to temporary SWSP after approval	--	Has contemporary diversions since 2007	--	--	13.97	--	--
1505032	21535-F	W1734	irrigation, domestic, livestock, municipal	Irrigation and domestic	deep well	Re-permit for municipal use and file a court case to expand the use and make a decreed plan for augmentation	365	Has contemporary diversions since 1999; all diversion records under either domestic or irrigation	135	135	17.57	96	20
1505008	21489-F	W0789	Irrigation & Domestic in School	Irrigation & Domestic in School		File an court case and SWSP and re-permit	74	Has contemporary diversions since 1999	10	10	2.3	--	--
1505027	6607-R	W1145	Irrigation & Domestic	Irrigation, domestic, livestock	Form 7 filed in 2011	File an court case and SWSP and re-permit	20	No water diverted since 2008	48 for irrigation 6 for domestic 6 for livestock	60	45.07	--	--
1505788	11397-R	--	municipal	--	used for 4 year-round homes and 2 seasonal homes; AGUA member	Re-permit for municipal use and file an swsp; would not qualify for Rule 14 because it expands the Pre-1985 uses	25	Has contemporary diversions since 2007	--	20	15.44	--	--
1505791	2365-F	--	Domestic, Commercial, Irrigation	--	Form 7 filed in 1997	Install a pump and a TFM, certify TFM, and file for cout case and SWSP and re-permit pursuant to SWSP	457	No water diverted since 2007	--	25	--	--	--
1505054	247620	W2577	domestic	irrigation and domestic	62 gpm irr (abandoned) and 50 gpm for domestic	File an SWSP and a court case to change the uses, re-permit as part of the process.	18	No contemporary diversion records because non-exempt uses have been abandoned	50	15	--	--	--
1505070	--	W4121	--	APOD for Squirrel Creek Ditch for	0.1 cfs of Squirrel Creek Ditch for Pine Drive Waterworks System for domestic in house use; cancelled in 1979 because a dilligence case was not filed	--	--	--	45	--	--	--	--
1505789	219153	--	domestic	--	Downgraded to exempt status in 1998	File a court case and SWSP and re-permit for municipal use	24	No contemporary diversion records	--	15	--	--	--
1505816	60070-F	03CW0014	irrigation, manufacturing, sanitary, domestic purposes	0.1 cfs of a 0.9 cfs right to St. Charles Flood Ditch; for use inside Pine Drive Water District	I believe this is one of the galleries that have dried up due to low stream flows	--	--	--	--	--	--	--	--
1505817	60071-F	03CW0014	irrigation, manufacturing, sanitary, domestic purposes	0.1 cfs of a 0.9 cfs right to St. Charles Flood Ditch; for use inside Pine Drive Water District	I believe this is one of the galleries that have dried up due to low stream flows	--	--	--	--	--	--	--	--

Water Quality Summaries
Rice and Sellers Wells

BEULAH WATER WORKS DISTRICT

Rice Well Water Quality - sampled 8/9/2018

Parameter	Unit	Measured Value	MCL
Antimony	mg/L	BDL	0.006
Arsenic	mg/L	0.0015	0.01
Barium	mg/L	0.022	2
Cadmium	mg/L	BDL	0.005
Chromium	mg/L	BDL	0.1
Carbon Dioxide	mg/L	337	n/a
Gross Alpha	pCi/L	180	n/a
Mercury	mg/L	BDL	0.002
Nickel	mg/L	BDL	n/a
Radium 226	pCi/L	0.3	n/a
Radium 228	pCi/L	0.9	n/a
Radium, Total (226 + 228)	pCi/L	1.2	5
Selenium	mg/L	0.00099	0.05
Sodium	mg/L	564	n/a
Total Dissolved Solids	mg/L	1580	n/a
Uranium	mg/L	0.18	0.03

BEULAH WAER WORKS DISTRICT

Sellers Well Water Quality - sampled 9/11

Parameter	Unit	Measured Value	MCL
Alkalinity, Total	mg/L as CaCO3	330	n/a
Antimony	mg/L	BDL	0.006
Arsenic	mg/L	BDL	0.01
Barium	mg/L	0.14	2
Beryllium	mg/L	BDL	0.004
Cadmium	mg/L	BDL	0.005
Chromium	mg/L	BDL	0.1
Cyanide	mg/L as free Cyanide	BDL	0.2
Fluoride	mg/L	0.74	4
Gross Alpha	pCi/L	9.8	n/a
Gross Alpha less Uranium & Radon	pCi/L	NOT REPORTED	15
Mercury	mg/L	BDL	0.002
Nickel	mg/L	0.0026	n/a
Nitrate	mg/L	0.14	10 (as Nitrogen)
Nitrite	mg/L	BDL	1 (as Nitrogen)
Nitrite+Nitrate (Total)	mg/L	0.14	10 (as Nitrogen)
Radium 226	pCi/L	0.3	n/a
Radium 228	pCi/L	1	n/a
Radium, Total (226 + 228)	pCi/L	1.3	5
Selenium	mg/L	0.00062	0.05
Sodium	mg/L	70.4	n/a
Thallium	mg/L	BDL	0.002
Total Dissolved Solids	mg/L	386	n/a
Total Organic Carbon	mg/L	2.2	n/a
Uranium	mg/L	0.0089	0.03

Soil Boring Logs and Test Pit Photographs

Hemenway Groundwater Engineering, Inc.

Well/Bore Log

Project No. CO-0009-17

Well/Bore Name: STH-1 **Permit No.:** NA **Date:** 10-29-18

Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway

Location: SE **1/4 of the** SW **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH

Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger

Aquifer: Alluvium **Static Water Level (Date):** 6 ft. (October 29, 2018) **Total Depth:** 12 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
1		Alluvium	Moderate	Clay with silt, moist	None	Brown	Samples from auger cuttings
2		Alluvium	Moderate	Clay with silt, moist	None	Brown	Samples from auger cuttings
3		Alluvium	Moderate	Clay with silt, moist	None	Brown	Samples from split-spoon sampler
4		Alluvium	Moderate	Clay with silt, moist	None	Brown	Samples from split-spoon sampler
5		Alluvium	Moderate	Clay with silt, moist	None	Brown	Samples from split-spoon sampler
6		Alluvium	Poor	Fine to medium sand, gravel, pebbles, saturated	None	White to pink	Samples from split-spoon sampler
7		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Samples from split-spoon sampler
8		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Samples from split-spoon sampler
9		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Samples from split-spoon sampler
10		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Samples from split-spoon sampler
11		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Samples from split-spoon sampler
12		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Rig refusal due to large cobbles
13				**Total Depth = 12 feet**			
14							
15							

Hemenway Groundwater Engineering, Inc.

Well/Bore Log

Project No. CO-0009-17

Well/Bore Name: STH-2 **Permit No.:** NA **Date:** 10-29-18

Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway

Location: SE **1/4 of the** SW **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH

Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger

Aquifer: Alluvium **Static Water Level (Date):** 6 ft. (October 29, 2018) **Total Depth:** 9 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
1		Alluvium	Moderate	Clay with silt, moist	None	Brown	Samples from auger cuttings
2		Alluvium	Moderate	Clay with silt, moist	None	Brown	Samples from auger cuttings
3		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Samples from split-spoon sampler
4		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Samples from split-spoon sampler
5		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Samples from split-spoon sampler
6		Alluvium	Moderate	Silt with fine sand	None	Brown	Samples from split-spoon sampler
7		Alluvium	Poor	Medium to coarse sand, pebbles	None	Brown to red	Samples from split-spoon sampler
8		Alluvium	Poor	Medium to coarse sand, pebbles	None	White to pink	Samples from split-spoon sampler
9		Alluvium	Poor	Fine to coarse sand, pebbles, cobbles, saturated	None	White to pink	Samples from split-spoon sampler
10				**Total Depth = 9 feet**			Rig refusal at 9 ft.
11							
12							
13							
14							
15							

Hemenway Groundwater Engineering, Inc.	**Well/Bore Log**	**Page** 1 **of** 1 **Project No.** CO-0009-17

Well/Bore Name: STH-4 **Permit No.:** NA **Date:** 10-29-18
Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway
Location: SE **1/4 of the** SW **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH
Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger
Aquifer: Alluvium **Static Water Level (Date):** 6.4 ft. (October 29, 2018) **Total Depth:** 13 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
1		Alluvium	Moderate	Clay with silt, moist	None	Brown	Samples from auger cuttings
2		Alluvium	Moderate	Clay with silt, moist	None	Brown	Samples from auger cuttings
3		Alluvium	Poor	Clay with silt and fine sand, moist	None	Dark Brown	Samples from split-spoon sampler
4		Alluvium	Poor	Clay with silt and fine sand, moist	None	Dark Brown	Samples from split-spoon sampler
5		Alluvium	Poor	Clay with silt and fine sand, moist	None	Dark Brown	Samples from split-spoon sampler
6		Alluvium	Poor	Clay with silt and fine sand, moist	None	Dark Brown	Samples from split-spoon sampler
7		Alluvium	Poor	Clay with silt and fine sand, moist	None	Dark Brown	Samples from split-spoon sampler
8		Alluvium	Poor	Fine sand, silt, pebbles, saturated	None	Brown to red	Samples from split-spoon sampler
9		Alluvium	Poor	Fine sand, silt, pebbles, saturated	None	Brown to red	Samples from split-spoon sampler
10		Alluvium	Well	Fine sand, saturated	None	Brown to red	Samples from split-spoon sampler
11		Alluvium	Well	Fine sand, satuarted	None	Dark Brown	Samples from split-spoon sampler
12		Alluvium	Well	Fine sand, saturated	None	Dark Brown	Samples from split-spoon sampler
13		Alluvium	Well	Fine sand, saturated	None	Dark Brown	Samples from split-spoon sampler
14		Claystone/Siltstone	Well	Claystone/siltstone	Poor	Red	Samples from split-spoon sampler
15				**Toatl Depth = 13 ft.**			

Hemenway Groundwater Engineering, Inc.	**Well/Bore Log**	**Page** 1 **of** 2 **Project No.** CO-0009-17

Well/Bore Name: PTH-1 & PTH-1A **Permit No.:** NA **Date:** 10-30-18
Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway
Location: SE **1/4 of the** SE **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH
Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger
Aquifer: Alluvium **Static Water Level (Date):** 16 ft. (October 30, 2018) **Total Depth:** 23 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
1		Alluvium	Moderate	Clay with silt, dry	None	Brown	Samples from auger cuttings
2		Alluvium	Moderate	Clay with silt, dry	None	Brown	Samples from auger cuttings
3		Alluvium	Poor	Clay with silt, some pebbles, dry	None	Dark brown	Samples from split-spoon sampler
4		Alluvium	Poor	Clay with silt, some pebbles, dry	None	Dark brown	Samples from split-spoon sampler
5		Alluvium	Poor	Silt with fine sand, gravel, dry	None	Dark brown	Samples from split-spoon sampler
6		Alluvium	Poor	Silt with fine sand, gravel, dry	None	Dark brown	Samples from split-spoon sampler
7		Alluvium	Moderate	Silt with fine sand, dry	None	Dark brown	Samples from split-spoon sampler
8		Alluvium	Moderate	Silt with fine sand, dry	None	Dark brown	Samples from split-spoon sampler
9		Alluvium	Moderate	Silt with fine sand, dry to slightly moist	None	Dark brown	Samples from split-spoon sampler
10		Alluvium	Moderate	Silt with fine sand, dry to slightly moist	None	Dark brown	Samples from split-spoon sampler
11		Alluvium	Moderate	Fine to medium sand, pebbles, dry to slightly moist	None	White to pink	Samples from split-spoon sampler
12		Alluvium	Moderate	Fine to medium sand, pebbles, dry to slightly moist	None	White to pink	Samples from split-spoon sampler
13		Alluvium	Poor	Fine to medium sand, gravel, pebbles, cobbles, dry to slightly moist	None	White to pink	Sample from auger cuttings due to coarse material
14		Alluviium	Poor	Fine to medium sand, gravel, pebbles, cobbles, dry to slightly moist	None	White to pink	Samples from auger cuttings due to coarse materials
15		Alluvium	Poor	Fine to medium sand, gravel, pebbles, cobbles, dry to slightly moist	None	White to pink	PTH-1 terminated: Sample from 4-inch auger at PTH-1A

Hemenway Groundwater Engineering, Inc.

Well/Bore Log

Project No. CO-0009-17

Well/Bore Name: PTH-1 & PTH-1A **Permit No.:** NA **Date:** 10-30-18
Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway
Location: SE **1/4 of the** SE **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH
Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger
Aquifer: Alluvium **Static Water Level (Date):** 16 ft. (October 30, 2018) **Total Depth:** 23 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
16		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, dry to slightly moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
17		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
18		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, moist to saturated	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
19		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, saturated	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
20		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, saturated	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
21		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, saturated	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
22		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, saturated	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
23		Alluvium	Well	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, saturated	None	dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
24		Sandstone	Well	Bedrock at 23 ft.; Sandstone	Poor	Grey	Samples from split-spoon sampler
25				**Total Depth (PTH-1A) = 23 ft.**			
26							
27							
28							
29							
30							

Hemenway Groundwater Engineering, Inc.

Well/Bore Log

Project No. CO-0009-17

Well/Bore Name: PTH-2 **Permit No.:** NA **Date:** 10-30-18
Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway
Location: SE **1/4 of the** SE **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH
Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger
Aquifer: Alluvium **Static Water Level (Date):** 16 ft. (October 30, 2018) **Total Depth:** 23 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
1		Alluvium	Moderate	Clay with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
2		Alluvium	Moderate	Clay with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
3		Alluvium	Poor	Fine sand with silt, dry	None	Red to brown	Samples from 4-inch solid stem auger cuttings
4		Alluvium	Poor	Fine sand with silt, dry	None	Dark brown	Samples from 4-inch solid stem auger cuttings
5		Alluvium	Poor	Fine sand with silt, dry	None	Dark brown	Samples from 4-inch solid stem auger cuttings
6		Alluvium	Poor	Fine sand with silt, dry	None	Dark brown	Samples from 4-inch solid stem auger cuttings
7		Alluvium	Moderate	Fine sand with silt, dry	None	Dark brown	Samples from 4-inch solid stem auger cuttings
8		Alluvium	Moderate	Fine sand with silt, dry	None	Dark brown	Samples from 4-inch solid stem auger cuttings
9		Alluvium	Moderate	Fine sand with silt, dry	None	Dark brown	Samples from 4-inch solid stem auger cuttings
10		Alluvium	Moderate	Fine sand with silt, dry	None	Dark brown	Samples from 4-inch solid stem auger cuttings
11		Alluvium	Moderate	Fine to medium sand, pebbles, dry to slightly moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
12		Alluvium	Moderate	Fine to medium sand, pebbles, dry to slightly moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
13		Alluvium	Poor	Fine to medium sand, gravel, pebbles, cobbles, dry to slightly moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
14		Alluviium	Poor	Fine to medium sand, gravel, pebbles, cobbles, dry to slightly moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
15		Alluvium	Poor	Fine to medium sand, gravel, pebbles, cobbles, dry to slightly moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings

Hemenway Groundwater Engineering, Inc.	**Well/Bore Log**	**Page** 2 **of** 2 **Project No.** CO-0009-17

Well/Bore Name: PTH-2 **Permit No.:** NA **Date:** 10-30-18
Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway
Location: SE **1/4 of the** SE **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH
Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger
Aquifer: Alluvium **Static Water Level (Date):** 17 ft. (October 30, 2018) **Total Depth:** 23 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
16		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, dry to slightly moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
17		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, dry to slightly moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
18		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, dry to slightly moist	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
19		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, saturated	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
20		Alluvium	Poor	Fine sand, with silt	None	Brown	Samples from 4-inch solid stem auger cuttings
21		Alluvium	Poor	Fine sand, with silt	None	Brown	Samples from 4-inch solid stem auger cuttings
22		Alluvium	Poor	Fine sand, with silt	None	Brown	Samples from 4-inch solid stem auger cuttings
23		Alluvium	Well	Fine sand, with silt	None	Brown	Samples from 4-inch solid stem auger cuttings
24		Sandstone	Well	Bedrock at 23 ft.; Sandstone	Poor	Grey	Samples from split-spoon sampler
25				**Total Depth = 23 ft.**			
26							
27							
28							
29							
30							

Hemenway Groundwater Engineering, Inc.

Well/Bore Log

Project No. CO-0009-17

Well/Bore Name: PTH-3 **Permit No.:** NA **Date:** 10-30-18
Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway
Location: SE **1/4 of the** SE **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH
Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger
Aquifer: Alluvium **Static Water Level (Date):** 13 ft. (October 30, 2018) **Total Depth:** 34 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
1		Alluvium	Moderate	Clay with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
2		Alluvium	Moderate	Clay with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
3		Alluvium	Poor	Fine sand with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
4		Alluvium	Poor	Fine sand with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
5		Alluvium	Poor	Fine sand with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
6		Alluvium	Poor	Fine sand with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
7		Alluvium	Moderate	Fine sand with silt, gravel, pebbles, dry	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
8		Alluvium	Moderate	Fine sand with silt, gravel, pebbles, dry	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
9		Alluvium	Moderate	Fine sand with silt, gravel, pebbles, dry	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
10		Alluvium	Moderate	Fine sand with silt, gravel, pebbles, dry	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
11		Alluvium	Moderate	Fine sand with silt, gravel, pebbles, dry	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
12		Alluvium	Moderate	Fine sand with silt, gravel, pebbles, dry	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
13		Alluvium	Poor	Fine sand with silt, gravel, pebbles, cobbles, dry	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
14		Alluviium	Poor	Fine sand with silt, gravel, pebbles, cobbles, dry	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings
15		Alluvium	Poor	Fine sand with silt, gravel, pebbles, cobbles, dry	None	Dark brown with white quartz	Samples from 4-inch solid stem auger cuttings

Hemenway Groundwater Engineering, Inc.

Well/Bore Log

Project No. CO-0009-17

Well/Bore Name: PTH-3 **Permit No.:** NA **Date:** 10-30-18
Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway
Location: SE **1/4 of the** SE **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH
Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger
Aquifer: Alluvium **Static Water Level (Date):** 13 ft. (October 30, 2018) **Total Depth:** 34 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
16		Alluvium	Poor	Fine sand, slightly moist	None	Brown	Samples from 4-inch solid stem auger cuttings
17		Alluvium	Poor	Fine to medium sand, silt, clays, limestone chips, gravel, pebbles, cobbles, moist	None	Brown with iron stains	Samples from 4-inch solid stem auger cuttings
18		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, cobbles, moist to wet	None	Brown with iron stains	Samples from 4-inch solid stem auger cuttings
19		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Light tan	Samples from 4-inch solid stem auger cuttings
20		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
21		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
22		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
23		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
24		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
25		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
26		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
27		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
28		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
29		Alluvium	Poor	Fine to medium sand, silt, clays, gravel, pebbles, intermittent cobbles, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
30		Sandstone	Well	Fine grained sandstone	Poor	Grey	Samples from 4-inch solid stem auger cuttings

Hemenway Groundwater Engineering, Inc.

Well/Bore Log

Project No. CO-0009-17

Well/Bore Name: PTH-3 **Permit No.:** NA **Date:** 10-30-18

Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway

Location: SE **1/4 of the** SE **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH

Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger

Aquifer: Alluvium **Static Water Level (Date):** 13 ft. (October 30, 2018) **Total Depth:** 34 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
31		Sandstone	Well	Fine grained sandstone	Poor	Grey	Samples from 4-inch solid stem auger cuttings
32		Sandstone	Well	Fine grained sandstone	Poor	Grey	Samples from 4-inch solid stem auger cuttings
33		Sandstone	Well	Fine grained sandstone	Poor	Grey	Samples from 4-inch solid stem auger cuttings
34		Sandstone	Well	Fine grained sandstone	Poor	Grey	Samples from split-spoon sampler
35				**Total Depth = 34 ft**.			
36							
37							
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40							
41							
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45							

Hemenway Groundwater Engineering, Inc.

Well/Bore Log

Project No. CO-0009-17

Well/Bore Name: PTH-4 **Permit No.:** NA **Date:** 10-30-18
Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway
Location: SE **1/4 of the** SE **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH
Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger
Aquifer: Alluvium **Static Water Level (Date):** 14.5 ft. (October 30, 2018) **Total Depth:** 23 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
1		Alluvium	Moderate	Clay with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
2		Alluvium	Moderate	Clay with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
3		Alluvium	Poor	Fine sand with silt, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
4		Alluvium	Poor	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
5		Alluvium	Poor	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
6		Alluvium	Poor	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
7		Alluvium	Moderate	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
8		Alluvium	Moderate	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
9		Alluvium	Moderate	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
10		Alluvium	Moderate	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
11		Alluvium	Moderate	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
12		Alluvium	Moderate	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
13		Alluvium	Poor	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
14		Alluviium	Poor	Fine sand with silt, intermittent pebbles/cobbles, dry	None	Brown	Samples from 4-inch solid stem auger cuttings
15		Alluvium	Poor	Fine sand with silt, clays, gravel, pebbles, cobbles, dmoist	None	Brown	Samples from 4-inch solid stem auger cuttings

Hemenway Groundwater Engineering, Inc.

Well/Bore Log

Project No. CO-0009-17

Well/Bore Name: PTH-4 **Permit No.:** NA **Date:** 10-30-18

Owner: Beulah and Pine Drive Water Districts **Logger:** Courtney Hemenway

Location: SE **1/4 of the** SE **1/4 of Section** 2 **Township** 23 S **Range** 68 W **P.M.** 6TH

Driller: Drilling Engineers/Fort Collins **Drilling Method/Equipment:** Continuous Flight Hollow Stem Auger

Aquifer: Alluvium **Static Water Level (Date):** 14.5 ft. (October 30, 2018) **Total Depth:** 23 ft.

Depth Below Surface (FT)	Lithology	Soil Name	Sorting	Soil Description	Cementation	Color	Comments
16		Alluvium	Poor	Fine sand with silt, clays, moist	None	Brown	Samples from 4-inch solid stem auger cuttings
17		Alluvium	Poor	Fine sand with silt, clays, moist	None	Brown with iron stains	Samples from 4-inch solid stem auger cuttings
18		Alluvium	Poor	Fine sand with silt, clays, moist	None	Brown with iron stains	Samples from 4-inch solid stem auger cuttings
19		Alluvium	Poor	Fine sand with silt, clays, fine sand, gravels, saturated	None	Light tan	Samples from 4-inch solid stem auger cuttings
20		Alluvium	Poor	Fine sand with silt, clays, fine sand, gravels, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
21		Alluvium	Poor	Fine sand with silt, clays, fine sand, gravels, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
22		Alluvium	Poor	Fine sand with silt, clays, fine sand, gravels, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
23		Alluvium	Poor	Fine sand with silt, clays, fine sand, gravels, saturated	None	Brown to light brown	Samples from 4-inch solid stem auger cuttings
24		Sandstone	Well	Fine grained sandstone	Poor	Grey	Samples from split-spoon sampler
25				**Total Depth = 23 ft.**			
26							
27							
28							
29							
30							

Groundwater Potable Water Supply Evaluation for the Beulah Valley – Sellers Well Pumping Test

TO: Bill Wheeler/Beulah Water Works District
Gary Kyte/Pine Drive Water District

COPIES: Andrew Rice/Infrastructure Consultants
Dave Stanford, H2O Consultants LTD

FROM: Courtney Hemenway

DATE: February 24, 2019

RESPOND BY:

Hemenway Groundwater Engineering (HGE) was initially contracted by the Beulah Water Works District (BWWD) to provide an evaluation of potential groundwater sources for potable supplies for the Beulah Valley. HGE conducted a site visit to evaluate the current conditions in the Beulah Valley and reviewed groundwater and well information compiled by the Division of Water Resources Pueblo office. Following the initial site and data review, HGE conducted a field investigation involving soil borings near the existing Pine Drive Water District water treatment plant (WTP) and adjacent to Dick Sellers' existing alluvial well. The preliminary potable water supply evaluation indicated that the testing of the Sellers Well would be the most cost-effective path forward in determining an alternate water supply for the BWWD. The pumping test would be beneficial in determining the capacity of the existing well and evaluating the hydraulic characteristics of the alluvial aquifer at that site.

Task 1 - Pumping Test at the Sellers Well

Prior to the proposed testing of the Sellers Well, HGE met with Dick Sellers and Dave Stanford at the well site to discuss the equipment required to test the well and how the test would be conducted. Two existing pumps were installed in the well prior to HGE conducting the pumping tests. One pump is used to fill water tanker trucks and the other provides water to an office building owned by Dick Sellers. The Sellers Well is a hand-dug well with a four-foot-diameter steel casing to an original depth of 14 feet. The location of the Sellers Well is shown in Figure 1. Pictures of the well prior to the testing are shown in Figure 2.

HGE contracted Hydro Resources Rocky Mountain (Hydro) of Fort Lupton, Colorado to provide the necessary pumping equipment and staff to conduct a continuous 72-hour pumping test. HGE contracted with Hydro to install a temporary pump in the Sellers Well without removing the existing two pumps. Copies of Certificates of Insurance from Hydro and HGE were provided to Dick Sellers prior to any work at the site. On January 28, 2019, Hydro installed a five-horsepower Gundfos pump with shroud in the Sellers Well with the intake at a depth of 12 feet. A separate pump control panel was installed to control Hydro's pump during the test with power supplied by the existing electrical service at the site. In addition, a 30 pounds per square inch (psi) pressure transducer was installed in the well with a Dynotek data logging unit to record water levels throughout the pumping tests. The pressure transducer was set at a depth of 13.8 feet below the top of the well casing (TOC). Three-inch-diameter discharge steel piping was used to discharge the pumped water from the well. A three-inch magnetic flow meter, control valve, water sample port, and Rossum sand content tester were placed in the steel discharge piping. Flexible temporary hoses were used to discharge the flow from the well approximately 100 feet to the south towards South Creek.

Prior to the initiation of the pumping test, Bill Wheeler, president of the BWWD, offered to use his well as a monitoring well during the pumping test in the Sellers Well. The well is located approximately 300 feet to the southwest of the Sellers Well on the south side of South Creek and is used to supply water to a single residential house (see Figure 1). Pumping for residential uses was not curtailed during the Sellers Well pumping test. HGE installed a temporary two-inch diameter PVC drawdown tube in the Wheeler Well with a 50-psi transducer set at a depth of 10 feet. Water levels were recorded in the Wheeler Well with a Dynotek data logger throughout the pumping and recovery periods of the 72-hour test. A picture of the Wheeler Well is shown in Figure 2.

Throughout the pumping test, field water quality measurements of water temperature, pH, conductivity, and specific conductivity were recorded for the pump discharge water. In addition, water samples from South Creek were collected and measured for the same parameters at random intervals throughout the pumping test. No field water quality measurements were made from the Wheeler Well.

The pumping was to be started on January 28, 2019 after the equipment was installed. However, an electrical fuse in Hydro's control panel was not working and no replacement fuse was available until the morning of January 30th. After replacing the fuse, the 72-hour pumping test was started at 9:30 a.m. on January 30th and continued without interruption until 9:30 a.m. on February 1, 2019.

Pumping was initially conducted at a rate of 150 gallons per minute (gpm). However, the drawdown in the well indicated that the well could not sustain that rate for the entire 72 hours without the pumping water level reaching the intake of the pump. After 10 minutes the pumping rate was reduced to 125 gpm. After monitoring the water level in the well and the discharge rate, the pumping rate was reduced again at 6:30 p.m., after 480 minutes of pumping, to a rate of 100 gpm due to air being drawn into the intake. The water level at which the air was being drawn into the discharge was at a depth of 9.55 feet below TOC. Pumping continued at a rate of 100 gpm until 12:30 a.m. on January 30th when the pumping water level reached a depth of 9.51 feet below TOC. The pumping rate was reduced to 90 gpm and continued at that rate until 6:12 a.m on January 31st. Again, the pumping water level dropped to the level with air being drawn into the pump intake. The rate was reduced to 80 gpm an continued at that rate until the end of the test on February 1st at 9:30 a.m. Water levels were recorded continuously throughout the pumping and recovery portions of the test and are graphically presented in Figures 3 and 4. Recovery water levels were recorded for three days (4,655 minutes) after the 72-hour constant-rate test was concluded. The maximum depth to water was 9.56 feet below TOC at a pumping rate of 100 gpm. The total volume of water pumped over the entire 72-hour test was 393,323 gallons, which calculates to an average pumping rate of 91 gpm over the entire pumping test. All water level measurements recorded during the pumping and recovery portions of the 72-hour test from both the Sellers and Wheeler Wells are presented in Appendix A. Figures 3 and 4 graphically illustrate the water level data collected in the Sellers and Wheeler Wells during the 72-hour pumping test and recovery period.

The maximum drawdown in the Wheeler Well was 0.29 feet. The water level trends in the Wheeler Well appear to be more in response to pumping for in-house uses from the Wheeler Well than in response to pumping in the Sellers Well. If the Sellers Well pumping was significantly influencing or impacting the Wheeler Well, there would have been a constant water level decline throughout the test. In addition, there were no wide fluctuations in the flow or water level in South Creek during the test that would have influenced the well water level as the majority of the river water surface was frozen during the pumping test. At the end of the 72-hour pumping test, the water level in the Wheeler Well was only 0.08 feet below the water level at the start of the test.

Recovery water levels were recorded in the Sellers Well and the Wheeler Well after the pump was turned off following 72 hours of pumping. Water levels were measured from the time the pumping stopped through 4,655 minutes of recovery. The recovery water level data is plotted as residual drawdown (s') versus the ratio of t/t' (Figure 4). Residual drawdown is the difference between the original static water level and the depth to water at any time during the recovery period. The value of t/t' represents the ratio of time from the start of the pumping test (t) to the time since the pumping stopped (t'). From Figure 4, the straight-line extrapolation of the residual drawdown (s') approaches zero before the ratio of t/t' reaches a unity value of one. This indicates that a positive boundary was encountered during the 72-hour test, which was not unexpected with South Creek located adjacent to the Sellers Well. Typically, the interception of recharge boundaries during pumping results in the residual drawdown equaling zero significantly before the ratio of t/t' reaches a value of one. Conversely, if the residual drawdown does not reach zero before t/t' approaches a value of one, the test would indicate that a negative or impermeable boundary has been encountered or the formation "pinches out" or diminishes laterally away from the well. From Figure 4, there is a variation in the recovery water levels centered around a ratio of t/t' of 2 to 3. The variation may be a result of increase infiltration of water from South Creek, as warm weather during the recovery period removed much of the ice on the creek and thawed the surficial alluvial materials along the creek. In addition, the recovery water level data from the Wheeler Well appears to show impacts from pumping in the well during the recovery period as well as similar responses due to increased creek infiltration during the snowmelt and alluvial materials thawing from frozen conditions.

The value of transmissivity was calculated from the pumping water level using the Jacob straight-line method. Transmissivity is the rate at which water is transmitted through a unit width of the aquifer under a unit hydraulic gradient. Transmissivity is calculated using the following equation:

$$T = \frac{264Q}{\Delta s}$$

where:

T = transmissivity in gallons per day per foot (gpd/ft)

Q = pumping rate in gallons per minute (gpm)

Δs = slope of the time drawdown graph expressed as the change in drawdown between any two times on the log scale whose ratio is 10 (one log cycle)

The Jacob method is based on constant-rate pumping. Since the pumping rate was reduced several times during the test, a single transmissivity rate could not be derived from the data. However, the water level data for the final three pumping rates (100, 90, and 80 gpm) produced relatively uniform rates of decline (Figure 3), which were used to calculate transmissivity values for each pumping rate. Transmissivity values calculated from the water level data from three pumping rates were 24,275.86 gpd/ft, or 3,245.44 feet squared per day (ft^2/day) at 100 gpm, 23,760.00 gpd/ft, or 3,176.47 ft^2/day at 90 gpm, and 25,480.77 gpd/ft, or 3,406.52 ft^2/day at 80 gpm. The average transmissivity value from all three pumping rates was 24,505.54.86 gpd/ft, or 3,276.14 ft^2/day. The transmissivity value obtained from the recovery data from the 72-hour test (Figure 4) was 20,890.43 gpd/ft, or 2,792.84 ft^2/day. The transmissivity value obtained from the recovery data is generally more representative of the true aquifer hydraulic characteristics because the response in the well is not influenced by variations in the pumping.

Typically, observation well water level data can be used to assess the storage coefficient and well efficiency. However, due to minimal and irregular water level data obtained from the Wheeler Well, these values could not be calculated. However, the observation well data does indicate that pumping in the Sellers Well has negligible impact on the Wheeler Well. It appears that the infiltration of water from South Creek into the alluvium mitigates pumping water impacts from pumping across the creek.

In addition to the water level data, field measurements of temperature, specific conductivity, and pH were recorded throughout the variable-rate test and three 72-hour constant-rate pumping tests. The field water quality measurements were collected to identify any major water quality changes during the tests and for use in future evaluations of water from the well being identified as groundwater under the influence of surface water (GWUDI). Prior to measurement of the pH, the field meter was calibrated using a three-point calibration. Sand content readings from the discharge water were collected to determine whether or not the well produces significant sand during pumping. The field water quality measurement data are included in Appendix B.

No major shifts in the water quality, sand content, or appearance of the water were noted in the field water quality measurements during any of the tests. Sand content measurements showed very little to no sand content throughout the entire 72-hour test. The only measurable sand content (2.64 parts per million) occurred within the first 10 minutes of the test. No other sand was measured in the discharge water throughout the remainder of the test. The specific conductance of the pumped water averaged approximately 482 μmhos throughout the duration of the completed 72-hour test with the minimum and maximum values of 455 μmhos and 502 μmhos, respectively. The pH and temperature also remained stable throughout the completed 72-hour test. The pH averaged approximately 7.35 and the temperature averaged approximately 49°F.

Field water quality measurements recorded for water collected from South Creek also remained stable throughout the 72-hour test. The specific conductance of the creek water averaged approximately 332 μmhos throughout the duration of the completed 72-hour test with the minimum and maximum values of 211 μmhos and 357 μmhos, respectively. The pH averaged approximately 7.71 and ranged from 7.4 to 7.99. The creek water temperature averaged approximately 40.3°F with the minimum and maximum values of 34.3°F and 43.7°F, respectively.

In addition, the field water quality samples did not indicate any degassing occurring in the discharge water throughout the 72-hour test. Degassing of carbon dioxide occurs in some wells as the water is pumped from the well and the water pressure is reduced, causing the carbon dioxide to degas or bubble from the water. The degassing of the water may create problems in the transmission pipelines from the well. Also, no odors were detected in the discharge water throughout the 72 hours of pumping.

Conclusions and Recommendations

Based on the testing that was conducted in the Sellers Well, the following conclusions can be made:

1. The Sellers Well was drilled in 1963 and was completed with 48-inch diameter steel casing to a depth of 14 feet. The well has been in use since its completion and has a current measured depth in the well of approximately 12 feet. The well is permitted for municipal uses and has existing augmentation rights with the Arkansas Groundwater Users' Association (AGUA).

2. The pumping test in the Sellers Well showed that the well is capable of sustaining a pumping rate of 90 gpm for a minimum of 72 hours at a time of low flows in the surface water systems (winter time) and after extended droughts in the drainage area supplying the alluvial aquifer system.

3. The alluvial aquifer hydraulic characteristics that best fit for matching the pumping test data were a transmissivity value of 35,000 gpd/ft and a storage coefficient of 0.35. Using these alluvial aquifer parameters and maximum allowable drawdown in the well to 9.6 feet below the top of casing, it is estimated that the Sellers Well could be pumped continuously at a rate of 80 gpm for 10 days and at a rate of 70 gpm for over 30 days.

4. An optimal site for developing potable groundwater supplies would be at the Sellers' property based on the information obtained from the previous groundwater potable water supply and soil boring program and the Sellers Well pumping test.

As a result of the data reviews and soil investigations, HGE recommends the following:

1. Begin negotiations with Dick Sellers for developing and utilizing the alluvial groundwater at his property for potable water supplies for the Beulah Water Works District and Pine Drive Water District. There are currently two pumps installed in the well to pump water for county water trucks and to supply a small office building. Water rights and use agreements will need to be completed prior to any further development of the groundwater at the Sellers property for the two districts.

2. Once the legal agreements have been completed, the direction on proceeding with the development of the alluvial groundwater may take the following paths:

    a. Utilize the existing Sellers Well
    b. Drill and complete a new vertical well
    c. Complete a horizontal trenched well.

The following describes each of the recommended alternatives:

<u>Utilize the Existing Sellers Well:</u>

This option would be the most expedient and least costly option for developing the alluvial groundwater at the Sellers site. Since the groundwater would most likely be designated as groundwater under the influence of surface water (GWUDI), the well would be providing "raw" water that would require more than simple disinfection for the treatment of the water prior to incorporation into the potable supplies for the two districts. Limited filtration may be required with the final treatment requirements determined by the Colorado Department of Public Health and Environment (CDPHE). However, if the water is determined as GWUDI, minimal modifications would need to be made to the well and the wellhead prior to incorporating the well into the water supply system and treatment facilities.

In addition, depending on water rights and State Engineer's Office (SEO) permit conditions, as demonstrated during the pumping tests, three pumps could be installed in the well to meet district and the Sellers' needs. However, optimally it would be recommended to install one pump in the well to meet the water supply requirements of all parties involved.

The pumping tests indicated that a pumping rate of 91 gpm could be sustained for 72 hours of continuous pumping. Additionally, the pumping test results indicated that pumping rates of 70 and 80 gpm could be sustained for greater pumping durations. Any of these pumping rates and pumping durations would meet current and projected water demands for each of the districts as detailed in the report from Providence Infrastructure Consultants Report entitled "*Beulah Water Works District Water Treatment Plant Capacity Evaluation*" dated February 26, 2018. However, the pumping rates and pumping durations may be increased if the well is rehabilitated prior to the installation of the permanent pumping equipment. Rehabilitation would involve using a vacuum truck to pump out the sediments from the base of the well that have accumulated over 50 years of pumping in the well. This may increase the efficiency of the well and possibly increase the depth of the well back to the original completed depth of 14 feet, which would allow for additional drawdown in the well during pumping.

Costs for developing this option would require limited well rehabilitation, new pumping equipment, controls and discharge piping, and minimal modifications to the well and wellhead. This option would be the least-costly path forward for developing the alluvial aquifer at the Sellers site. A cost for developing this option may range from $30,000 to $75,000. **Additional information from the final negotiations with the Sellers and final water system design criteria will need to be evaluated prior to finalizing any projected costs for this or any of the other development options**.

Drill a New Vertical Well:

This option would provide a new well to develop the alluvial groundwater supplies at the Sellers site. This would eliminate the concerns of utilizing a 56-year-old well for meeting the district's water supply demands. However, based on the soil boring and test pit work completed at the site, drilling a vertical well in the alluvial materials at the site may be challenging due to the presence of large cobbles and rocks. The drilling equipment used in the soil boring investigation (hollow-stem auger) was unable to determine the full depth of the alluvial materials at the site. HGE has utilized cable-tool drilling equipment in similar alluvial systems with the successful completion of vertical water supply wells.

In addition, a new vertical well may be able to be drilled to a greater depth than the existing Sellers Well, which would provide additional drawdown in the well and increase the production from the aquifer. However, a new well would be completed with a much smaller diameter (10 to 16 inches), which would limit the well to be able to accommodate only a single pump. This may limit the flexibility of the existing well to accommodate up to three pumps for the individual needs of the districts and the Sellers.

Costs for developing this option would require the drilling, installation, development, and testing of a new vertical well. As with the first option, new pumping equipment, controls, and discharge piping would need to be provided. This option would be the second most-costly path forward for developing the alluvial aquifer at the Sellers site. A cost for developing this option may range from $75,000 to $150,000.

Install a New Horizontal Well:

Under this alternative, a new horizontal well would be constructed at the Sellers site. This option would require a construction easement of approximately 100 to 200 feet in the area of the existing Sellers Well. After construction of the well, only a new wellhead and cleanout would be exposed at the surface. The area above the horizontal piping would be restored for normal activities at the site.

Installing a trenched horizontal well would provide the highest production capacity for development of the alluvial water at the Sellers site. HGE's experience with horizontal wells indicates that the pumping rates would be two to fives times the rate of vertical wells completed in the same alluvial materials. Therefore, it would be estimated that completion of a horizontal well would provide pumping rates from 150 to over 500 gpm, which would greatly exceed current and projected water demands for the two districts and the Sellers.

As with the installation of a new vertical well, the installation of a horizontal trenched well would also be difficult due to the size of the cobble and rocks in the alluvium. However, HGE contacted Dewind One-Pass Trenching and forwarded the geologic information obtained during the preliminary groundwater investigation. Dewind indicated that they would be able to construct a horizontal well in the materials found at the site, but would require a larger machine to complete the installation. Cost for completing the horizontal well was estimated at $200,000 to $300,000. As with the other two options, additional costs would be incurred for the design and installation of a pump, electrical controls, piping, metering, valving, and other equipment required for a new well site.

Figures

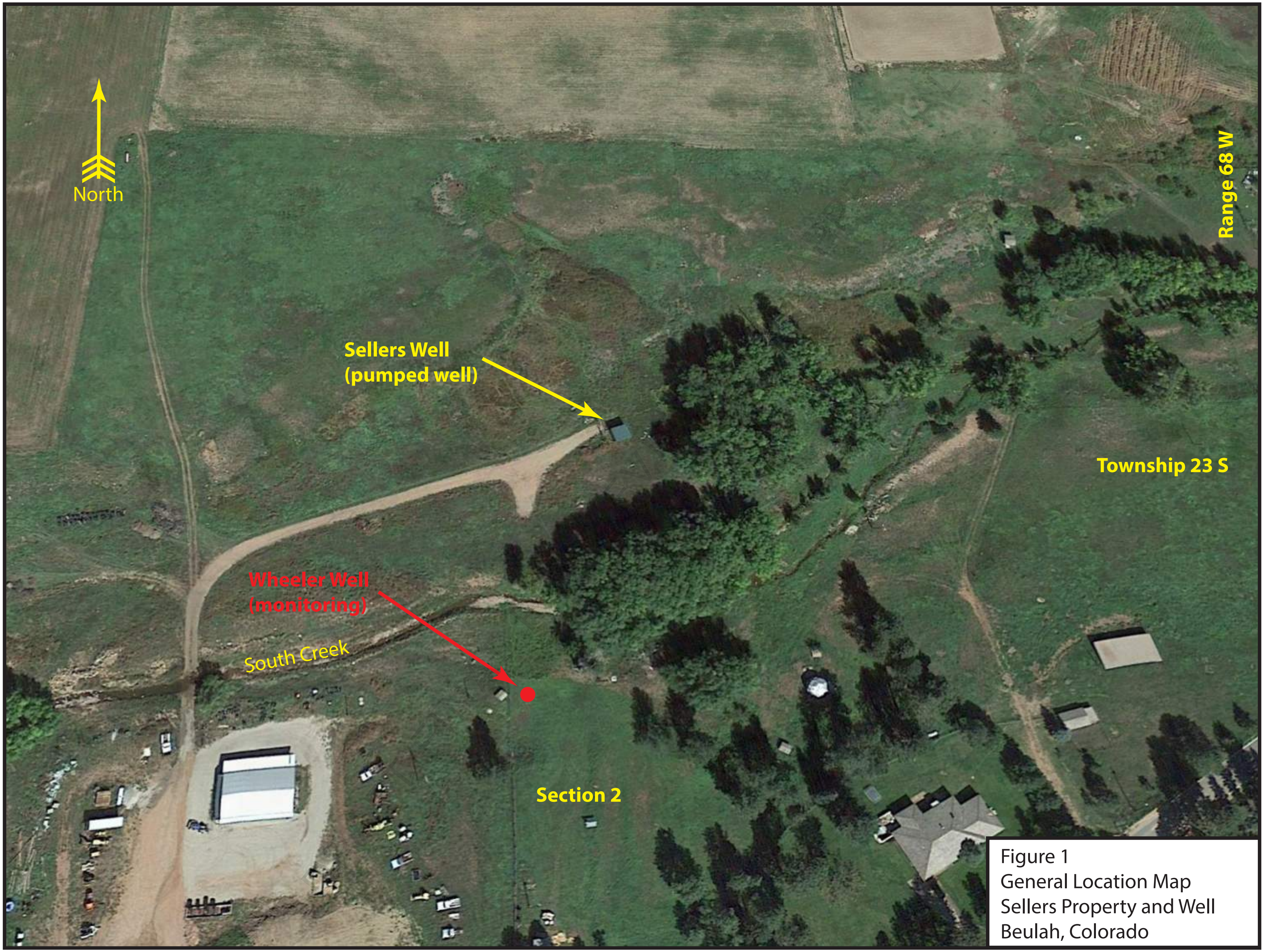

Figure 1
General Location Map
Sellers Property and Well
Beulah, Colorado

Figure 2a – Sellers Well

Figure 2b. - Sellers Well

Figure 2c – Wheeler Well

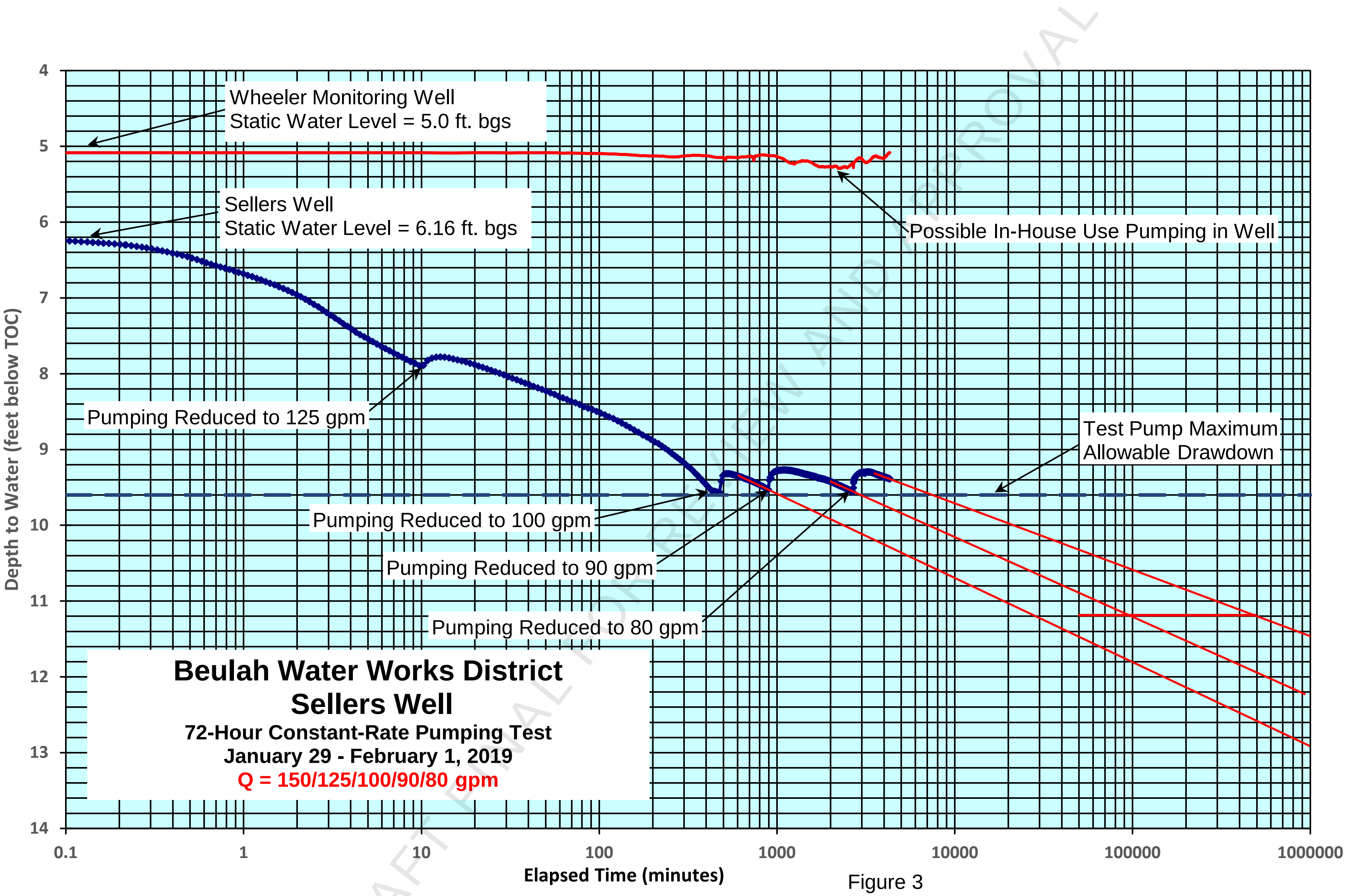

Figure 3
Sellers Well
Constant-Rate Pumping Test Jan. 30 - Feb. 1, 2019
72-Hour Pumping Rates at 150/125/100/90/90 gpm
Beulah Water Works District

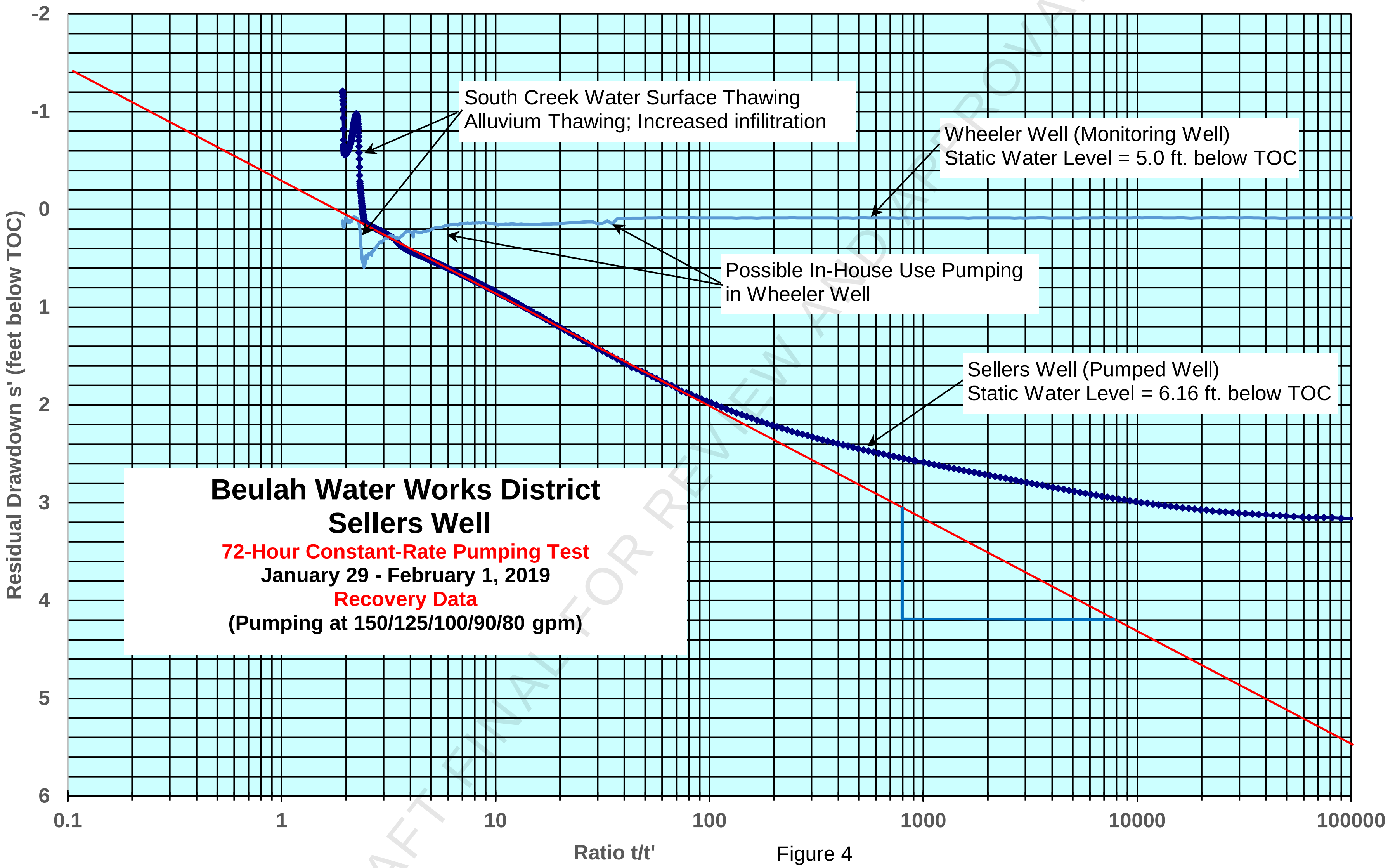

Figure 4
Sellers Well
72-Hour Constant-Rate Pumping Test Jan. 29 - Feb. 1, 2019
Recovery Water Level Data
Beulah Water Works District

Appendix A

Pumping Test Water Level Data

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
	Static Water Level = 6.16 ft.	
0.001	6.16	0.00
0.002	6.16	0.00
0.005	6.17	0.01
0.008	6.17	0.01
0.010	6.17	0.01
0.013	6.18	0.02
0.017	6.18	0.02
0.020	6.19	0.03
0.023	6.19	0.03
0.025	6.19	0.03
0.028	6.19	0.03
0.032	6.20	0.04
0.035	6.20	0.04
0.038	6.20	0.04
0.042	6.20	0.04
0.047	6.21	0.05
0.050	6.21	0.05
0.055	6.22	0.06
0.060	6.22	0.06
0.065	6.22	0.06
0.070	6.23	0.07
0.077	6.23	0.07
0.083	6.23	0.07
0.090	6.24	0.08
0.097	6.24	0.08
0.105	6.25	0.09
0.113	6.25	0.09
0.122	6.26	0.10
0.132	6.26	0.10
0.142	6.27	0.11
0.152	6.27	0.11
0.163	6.28	0.12
0.175	6.28	0.12
0.188	6.29	0.13
0.202	6.30	0.14
0.215	6.30	0.14
0.218	6.30	0.14
0.233	6.31	0.15
0.250	6.32	0.16
0.268	6.33	0.17
0.285	6.34	0.18
0.305	6.35	0.19
0.327	6.37	0.21
0.348	6.38	0.22
0.372	6.39	0.23
0.397	6.41	0.25
0.423	6.42	0.26
0.452	6.44	0.28
0.482	6.45	0.29
0.513	6.47	0.31
0.547	6.49	0.33
0.582	6.52	0.36

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
0.618	6.54	0.38
0.657	6.56	0.40
0.697	6.57	0.41
0.740	6.59	0.43
0.785	6.61	0.45
0.833	6.63	0.47
0.885	6.64	0.48
0.938	6.66	0.50
0.995	6.68	0.52
1.055	6.70	0.54
1.118	6.72	0.56
1.185	6.74	0.58
1.255	6.76	0.60
1.330	6.78	0.62
1.408	6.81	0.65
1.492	6.83	0.67
1.580	6.85	0.69
1.673	6.88	0.72
1.772	6.90	0.74
1.875	6.93	0.77
1.985	6.96	0.80
2.100	6.99	0.83
2.222	7.02	0.86
2.350	7.05	0.89
2.487	7.08	0.92
2.630	7.12	0.96
2.782	7.16	1.00
2.933	7.19	1.03
3.100	7.23	1.07
3.267	7.27	1.11
3.450	7.30	1.14
3.633	7.34	1.18
3.833	7.37	1.21
4.050	7.41	1.25
4.283	7.45	1.29
4.517	7.48	1.32
4.767	7.51	1.35
5.033	7.55	1.39
5.317	7.58	1.42
5.617	7.61	1.45
5.933	7.64	1.48
6.267	7.67	1.51
6.617	7.70	1.54
6.983	7.73	1.57
7.383	7.76	1.60
7.800	7.78	1.62
8.233	7.81	1.65
8.700	7.84	1.68
9.200	7.86	1.70
9.717	7.89	1.73
10.267	7.89	1.73
10.850	7.83	1.67
11.467	7.80	1.64

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
12.117	7.78	1.62
12.800	7.78	1.62
13.517	7.78	1.62
14.283	7.79	1.63
15.083	7.80	1.64
15.933	7.82	1.66
16.833	7.83	1.67
17.783	7.84	1.68
18.783	7.86	1.70
19.850	7.88	1.72
20.967	7.90	1.74
22.150	7.92	1.76
23.400	7.94	1.78
24.717	7.95	1.79
26.100	7.98	1.82
27.567	8.00	1.84
29.117	8.02	1.86
30.750	8.04	1.88
32.483	8.06	1.90
34.317	8.08	1.92
36.250	8.10	1.94
38.283	8.12	1.96
40.433	8.14	1.98
42.700	8.17	2.01
45.100	8.19	2.03
47.633	8.21	2.05
50.300	8.23	2.07
53.117	8.25	2.09
56.083	8.27	2.11
59.217	8.30	2.14
62.533	8.32	2.16
66.033	8.34	2.18
69.733	8.36	2.20
73.633	8.38	2.22
77.750	8.41	2.25
82.100	8.43	2.27
86.683	8.46	2.30
91.533	8.47	2.31
96.650	8.50	2.34
102.050	8.52	2.36
107.750	8.54	2.38
113.767	8.57	2.41
120.117	8.59	2.43
126.817	8.62	2.46
133.900	8.65	2.49
141.367	8.68	2.52
149.250	8.71	2.55
157.567	8.74	2.58
166.350	8.77	2.61
175.633	8.81	2.65
185.433	8.83	2.67
195.433	8.87	2.71
205.433	8.90	2.74

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
215.433	8.92	2.76
225.433	8.96	2.80
235.433	8.99	2.83
245.433	9.02	2.86
255.433	9.05	2.89
265.433	9.08	2.92
275.433	9.11	2.95
285.433	9.14	2.98
295.433	9.16	3.00
305.433	9.19	3.03
315.433	9.22	3.06
325.433	9.25	3.09
335.433	9.28	3.12
345.433	9.31	3.15
355.433	9.34	3.18
365.433	9.37	3.21
375.433	9.40	3.24
385.433	9.43	3.27
395.433	9.45	3.29
405.433	9.48	3.32
415.433	9.51	3.35
425.433	9.54	3.38
435.433	9.55	3.39
445.433	9.55	3.39
455.433	9.56	3.40
465.433	9.56	3.40
475.433	9.56	3.40
485.433	9.42	3.26
495.433	9.35	3.19
505.433	9.33	3.17
515.433	9.32	3.16
525.433	9.32	3.16
535.433	9.32	3.16
545.433	9.32	3.16
555.433	9.33	3.17
565.433	9.33	3.17
575.433	9.33	3.17
585.433	9.34	3.18
595.433	9.35	3.19
605.433	9.35	3.19
615.433	9.36	3.20
625.433	9.36	3.20
635.433	9.37	3.21
645.433	9.37	3.21
655.433	9.38	3.22
665.433	9.39	3.23
675.433	9.39	3.23
685.433	9.40	3.24
695.433	9.40	3.24
705.433	9.41	3.25
715.433	9.41	3.25
725.433	9.42	3.26
735.433	9.43	3.27

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
745.433	9.43	3.27
755.433	9.44	3.28
765.433	9.45	3.29
775.433	9.45	3.29
785.433	9.46	3.30
795.433	9.46	3.30
805.433	9.47	3.31
815.433	9.48	3.32
825.433	9.48	3.32
835.433	9.49	3.33
845.433	9.50	3.34
855.433	9.50	3.34
865.433	9.51	3.35
875.433	9.52	3.36
885.433	9.52	3.36
895.433	9.53	3.37
905.433	9.40	3.24
915.433	9.37	3.21
925.433	9.38	3.22
935.433	9.33	3.17
945.433	9.31	3.15
955.433	9.30	3.14
965.433	9.30	3.14
975.433	9.29	3.13
985.433	9.29	3.13
995.433	9.28	3.12
1005.433	9.28	3.12
1015.433	9.28	3.12
1025.433	9.27	3.11
1035.433	9.27	3.11
1045.433	9.27	3.11
1055.433	9.27	3.11
1065.433	9.27	3.11
1075.433	9.27	3.11
1085.433	9.27	3.11
1095.433	9.27	3.11
1105.433	9.27	3.11
1115.433	9.27	3.11
1125.433	9.27	3.11
1135.433	9.27	3.11
1145.433	9.27	3.11
1155.433	9.27	3.11
1165.433	9.27	3.11
1175.433	9.28	3.12
1185.433	9.28	3.12
1195.433	9.28	3.12
1205.433	9.28	3.12
1215.433	9.28	3.12
1225.433	9.28	3.12
1235.433	9.28	3.12
1245.433	9.29	3.13
1255.433	9.29	3.13
1265.433	9.29	3.13

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
1275.433	9.29	3.13
1285.433	9.29	3.13
1295.433	9.29	3.13
1305.433	9.29	3.13
1315.433	9.30	3.14
1325.433	9.30	3.14
1335.433	9.30	3.14
1345.433	9.30	3.14
1355.433	9.31	3.15
1365.433	9.31	3.15
1375.433	9.31	3.15
1385.433	9.31	3.15
1395.433	9.32	3.16
1405.433	9.32	3.16
1415.433	9.32	3.16
1425.433	9.32	3.16
1435.433	9.32	3.16
1445.433	9.33	3.17
1455.433	9.33	3.17
1465.433	9.33	3.17
1475.433	9.33	3.17
1485.433	9.33	3.17
1495.433	9.33	3.17
1505.433	9.34	3.18
1515.433	9.34	3.18
1525.433	9.34	3.18
1535.433	9.34	3.18
1545.433	9.34	3.18
1555.433	9.34	3.18
1565.433	9.35	3.19
1575.433	9.35	3.19
1585.433	9.35	3.19
1595.433	9.35	3.19
1605.433	9.35	3.19
1615.433	9.35	3.19
1625.433	9.36	3.20
1635.433	9.36	3.20
1645.433	9.36	3.20
1655.433	9.36	3.20
1665.433	9.36	3.20
1675.433	9.36	3.20
1685.433	9.37	3.21
1695.433	9.38	3.22
1705.433	9.37	3.21
1715.433	9.37	3.21
1725.433	9.38	3.22
1735.433	9.38	3.22
1745.433	9.38	3.22
1755.433	9.38	3.22
1765.433	9.38	3.22
1775.433	9.38	3.22
1785.433	9.38	3.22
1795.433	9.39	3.23

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
1805.433	9.39	3.23
1815.433	9.39	3.23
1825.433	9.39	3.23
1835.433	9.39	3.23
1845.433	9.39	3.23
1855.433	9.39	3.23
1865.433	9.40	3.24
1875.433	9.40	3.24
1885.433	9.40	3.24
1895.433	9.40	3.24
1905.433	9.40	3.24
1915.433	9.40	3.24
1925.433	9.41	3.25
1935.433	9.41	3.25
1945.433	9.41	3.25
1955.433	9.41	3.25
1965.433	9.41	3.25
1975.433	9.42	3.26
1985.433	9.42	3.26
1995.433	9.42	3.26
2005.433	9.42	3.26
2015.433	9.43	3.27
2025.433	9.43	3.27
2035.433	9.43	3.27
2045.433	9.43	3.27
2055.433	9.43	3.27
2065.433	9.44	3.28
2075.433	9.44	3.28
2085.433	9.44	3.28
2095.433	9.44	3.28
2105.433	9.44	3.28
2115.433	9.45	3.29
2125.433	9.45	3.29
2135.433	9.45	3.29
2145.433	9.45	3.29
2155.433	9.45	3.29
2165.433	9.46	3.30
2175.433	9.46	3.30
2185.433	9.46	3.30
2195.433	9.46	3.30
2205.433	9.47	3.31
2215.433	9.47	3.31
2225.433	9.47	3.31
2235.433	9.47	3.31
2245.433	9.47	3.31
2255.433	9.48	3.32
2265.433	9.48	3.32
2275.433	9.48	3.32
2285.433	9.48	3.32
2295.433	9.48	3.32
2305.433	9.48	3.32
2315.433	9.49	3.33
2325.433	9.49	3.33

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
2335.433	9.49	3.33
2345.433	9.50	3.34
2355.433	9.50	3.34
2365.433	9.50	3.34
2375.433	9.50	3.34
2385.433	9.50	3.34
2395.433	9.50	3.34
2405.433	9.51	3.35
2415.433	9.51	3.35
2425.433	9.51	3.35
2435.433	9.51	3.35
2445.433	9.51	3.35
2455.433	9.52	3.36
2465.433	9.52	3.36
2475.433	9.52	3.36
2485.433	9.52	3.36
2495.433	9.52	3.36
2505.433	9.53	3.37
2515.433	9.53	3.37
2525.433	9.53	3.37
2535.433	9.53	3.37
2545.433	9.53	3.37
2555.433	9.54	3.38
2565.433	9.54	3.38
2575.433	9.54	3.38
2585.433	9.54	3.38
2595.433	9.54	3.38
2605.433	9.55	3.39
2615.433	9.55	3.39
2625.433	9.55	3.39
2635.433	9.55	3.39
2645.433	9.55	3.39
2655.433	9.55	3.39
2665.433	9.56	3.40
2675.433	9.56	3.40
2685.433	9.50	3.34
2695.433	9.44	3.28
2705.433	9.42	3.26
2715.433	9.40	3.24
2725.433	9.39	3.23
2735.433	9.38	3.22
2745.433	9.37	3.21
2755.433	9.36	3.20
2765.433	9.36	3.20
2775.433	9.35	3.19
2785.433	9.35	3.19
2795.433	9.34	3.18
2805.433	9.34	3.18
2815.433	9.34	3.18
2825.433	9.33	3.17
2835.433	9.33	3.17
2845.433	9.33	3.17
2855.433	9.32	3.16

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
2865.433	9.32	3.16
2875.433	9.32	3.16
2885.433	9.32	3.16
2895.433	9.31	3.15
2905.433	9.31	3.15
2915.433	9.31	3.15
2925.433	9.31	3.15
2935.433	9.31	3.15
2945.433	9.31	3.15
2955.433	9.31	3.15
2965.433	9.31	3.15
2975.433	9.30	3.14
2985.433	9.30	3.14
2995.433	9.30	3.14
3005.433	9.30	3.14
3015.433	9.30	3.14
3025.433	9.30	3.14
3035.433	9.30	3.14
3045.433	9.30	3.14
3055.433	9.31	3.15
3065.433	9.30	3.14
3075.433	9.30	3.14
3085.433	9.30	3.14
3095.433	9.30	3.14
3105.433	9.30	3.14
3115.433	9.30	3.14
3125.433	9.31	3.15
3135.433	9.30	3.14
3145.433	9.30	3.14
3155.433	9.30	3.14
3165.433	9.30	3.14
3175.433	9.30	3.14
3185.433	9.30	3.14
3195.433	9.30	3.14
3205.433	9.30	3.14
3215.433	9.30	3.14
3225.433	9.30	3.14
3235.433	9.30	3.14
3245.433	9.30	3.14
3255.433	9.30	3.14
3265.433	9.30	3.14
3275.433	9.30	3.14
3285.433	9.30	3.14
3295.433	9.29	3.13
3305.433	9.30	3.14
3315.433	9.30	3.14
3325.433	9.30	3.14
3335.433	9.30	3.14
3345.433	9.30	3.14
3355.433	9.30	3.14
3365.433	9.30	3.14
3375.433	9.30	3.14
3385.433	9.30	3.14

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
3395.433	9.30	3.14
3405.433	9.30	3.14
3415.433	9.30	3.14
3425.433	9.30	3.14
3435.433	9.30	3.14
3445.433	9.31	3.15
3455.433	9.31	3.15
3465.433	9.31	3.15
3475.433	9.31	3.15
3485.433	9.31	3.15
3495.433	9.31	3.15
3505.433	9.31	3.15
3515.433	9.32	3.16
3525.433	9.32	3.16
3535.433	9.32	3.16
3545.433	9.32	3.16
3555.433	9.32	3.16
3565.433	9.32	3.16
3575.433	9.32	3.16
3585.433	9.32	3.16
3595.433	9.32	3.16
3605.433	9.33	3.17
3615.433	9.33	3.17
3625.433	9.33	3.17
3635.433	9.33	3.17
3645.433	9.33	3.17
3655.433	9.33	3.17
3665.433	9.33	3.17
3675.433	9.33	3.17
3685.433	9.33	3.17
3695.433	9.33	3.17
3705.433	9.33	3.17
3715.433	9.33	3.17
3725.433	9.33	3.17
3735.433	9.34	3.18
3745.433	9.34	3.18
3755.433	9.34	3.18
3765.433	9.34	3.18
3775.433	9.34	3.18
3785.433	9.34	3.18
3795.433	9.34	3.18
3805.433	9.34	3.18
3815.433	9.34	3.18
3825.433	9.35	3.19
3835.433	9.35	3.19
3845.433	9.35	3.19
3855.433	9.35	3.19
3865.433	9.35	3.19
3875.433	9.35	3.19
3885.433	9.35	3.19
3895.433	9.35	3.19
3905.433	9.35	3.19
3915.433	9.36	3.20

Beulah Water Works District		
Sellers Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
3925.433	9.36	3.20
3935.433	9.35	3.19
3945.433	9.36	3.20
3955.433	9.36	3.20
3965.433	9.36	3.20
3975.433	9.36	3.20
3985.433	9.36	3.20
3995.433	9.36	3.20
4005.433	9.36	3.20
4015.433	9.36	3.20
4025.433	9.36	3.20
4035.433	9.36	3.20
4045.433	9.37	3.21
4055.433	9.37	3.21
4065.433	9.37	3.21
4075.433	9.37	3.21
4085.433	9.37	3.21
4095.433	9.37	3.21
4105.433	9.37	3.21
4115.433	9.37	3.21
4125.433	9.37	3.21
4135.433	9.37	3.21
4145.433	9.37	3.21
4155.433	9.37	3.21
4165.433	9.37	3.21
4175.433	9.37	3.21
4185.433	9.37	3.21
4195.433	9.38	3.22
4205.433	9.38	3.22
4215.433	9.38	3.22
4225.433	9.38	3.22
4235.433	9.38	3.22
4245.433	9.38	3.22
4255.433	9.38	3.22
4265.433	9.38	3.22
4275.433	9.38	3.22
4285.433	9.38	3.22
4295.433	9.39	3.23
4305.433	9.38	3.22
4315.433	9.39	3.23

Beulah Water Works District		
Wheeler Monitoring Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
	Static Water Level = 5.0 ft.	
0.001	5.09	0.09
1.916	5.09	0.09
3.950	5.09	0.09
6.100	5.09	0.09
8.366	5.09	0.09
10.750	5.09	0.09
13.266	5.09	0.09
15.933	5.09	0.09
18.750	5.09	0.09
21.716	5.09	0.09
24.850	5.09	0.09
28.166	5.09	0.09
31.666	5.09	0.09
35.350	5.09	0.09
39.250	5.09	0.09
43.366	5.09	0.09
47.700	5.09	0.09
52.283	5.09	0.09
57.116	5.09	0.09
62.216	5.09	0.09
67.600	5.09	0.09
73.283	5.09	0.09
79.283	5.09	0.09
85.616	5.09	0.09
92.316	5.09	0.09
99.383	5.09	0.09
106.833	5.10	0.10
114.700	5.10	0.10
123.016	5.10	0.10
131.783	5.11	0.11
141.050	5.11	0.11
150.833	5.11	0.11
160.833	5.12	0.12
170.833	5.12	0.12
180.833	5.12	0.12
190.833	5.13	0.13
200.833	5.13	0.13
210.833	5.13	0.13
220.833	5.13	0.13
230.833	5.13	0.13
240.833	5.14	0.14
250.833	5.14	0.14
260.833	5.14	0.14
270.833	5.14	0.14
280.833	5.14	0.14
290.833	5.13	0.13
300.833	5.13	0.13
310.833	5.12	0.12
320.833	5.12	0.12
330.833	5.12	0.12
340.833	5.12	0.12
350.833	5.12	0.12

Beulah Water Works District		
Wheeler Monitoring Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
360.833	5.12	0.12
370.833	5.12	0.12
380.833	5.12	0.12
390.833	5.12	0.12
400.833	5.12	0.12
410.833	5.13	0.13
420.833	5.13	0.13
430.833	5.14	0.14
440.833	5.14	0.14
450.833	5.15	0.15
460.833	5.15	0.15
470.833	5.15	0.15
480.833	5.15	0.15
490.833	5.15	0.15
500.833	5.14	0.14
510.833	5.18	0.18
520.833	5.14	0.14
530.833	5.14	0.14
540.833	5.14	0.14
550.833	5.14	0.14
560.833	5.15	0.15
570.833	5.15	0.15
580.833	5.15	0.15
590.833	5.15	0.15
600.833	5.15	0.15
610.833	5.15	0.15
620.833	5.14	0.14
630.833	5.14	0.14
640.833	5.14	0.14
650.833	5.14	0.14
660.833	5.14	0.14
670.833	5.14	0.14
680.833	5.13	0.13
690.833	5.13	0.13
700.833	5.13	0.13
710.833	5.13	0.13
720.833	5.14	0.14
730.833	5.13	0.13
740.833	5.19	0.19
750.833	5.13	0.13
760.833	5.12	0.12
770.833	5.13	0.13
780.833	5.12	0.12
790.833	5.12	0.12
800.833	5.12	0.12
810.833	5.11	0.11
820.833	5.11	0.11
830.833	5.11	0.11
840.833	5.11	0.11
850.833	5.11	0.11
860.833	5.12	0.12
870.833	5.12	0.12
880.833	5.12	0.12

Beulah Water Works District		
Wheeler Monitoring Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
890.833	5.12	0.12
900.833	5.12	0.12
910.833	5.12	0.12
920.833	5.12	0.12
930.833	5.12	0.12
940.833	5.12	0.12
950.833	5.12	0.12
960.833	5.12	0.12
970.833	5.12	0.12
980.833	5.13	0.13
990.833	5.13	0.13
1000.833	5.13	0.13
1010.833	5.14	0.14
1020.833	5.15	0.15
1030.833	5.15	0.15
1040.833	5.15	0.15
1050.833	5.15	0.15
1060.833	5.16	0.16
1070.833	5.16	0.16
1080.833	5.16	0.16
1090.833	5.17	0.17
1100.833	5.18	0.18
1110.833	5.18	0.18
1120.833	5.18	0.18
1130.833	5.19	0.19
1140.833	5.20	0.20
1150.833	5.20	0.20
1160.833	5.21	0.21
1170.833	5.21	0.21
1180.833	5.22	0.22
1190.833	5.22	0.22
1200.833	5.22	0.22
1210.833	5.22	0.22
1220.833	5.22	0.22
1230.833	5.22	0.22
1240.833	5.23	0.23
1250.833	5.23	0.23
1260.833	5.23	0.23
1270.833	5.22	0.22
1280.833	5.21	0.21
1290.833	5.21	0.21
1300.833	5.21	0.21
1310.833	5.21	0.21
1320.833	5.20	0.20
1330.833	5.20	0.20
1340.833	5.20	0.20
1350.833	5.20	0.20
1360.833	5.20	0.20
1370.833	5.19	0.19
1380.833	5.19	0.19
1390.833	5.19	0.19
1400.833	5.19	0.19
1410.833	5.19	0.19

Beulah Water Works District		
Wheeler Monitoring Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
1420.833	5.20	0.20
1430.833	5.19	0.19
1440.833	5.19	0.19
1450.833	5.20	0.20
1460.833	5.20	0.20
1470.833	5.19	0.19
1480.833	5.19	0.19
1490.833	5.19	0.19
1500.833	5.20	0.20
1510.833	5.20	0.20
1520.833	5.20	0.20
1530.833	5.20	0.20
1540.833	5.21	0.21
1550.833	5.21	0.21
1560.833	5.21	0.21
1570.833	5.21	0.21
1580.833	5.22	0.22
1590.833	5.22	0.22
1600.833	5.22	0.22
1610.833	5.23	0.23
1620.833	5.24	0.24
1630.833	5.24	0.24
1640.833	5.25	0.25
1650.833	5.25	0.25
1660.833	5.25	0.25
1670.833	5.25	0.25
1680.833	5.26	0.26
1690.833	5.26	0.26
1700.833	5.26	0.26
1710.833	5.26	0.26
1720.833	5.27	0.27
1730.833	5.27	0.27
1740.833	5.27	0.27
1750.833	5.27	0.27
1760.833	5.27	0.27
1770.833	5.27	0.27
1780.833	5.27	0.27
1790.833	5.26	0.26
1800.833	5.27	0.27
1810.833	5.27	0.27
1820.833	5.27	0.27
1830.833	5.27	0.27
1840.833	5.27	0.27
1850.833	5.27	0.27
1860.833	5.27	0.27
1870.833	5.27	0.27
1880.833	5.27	0.27
1890.833	5.27	0.27
1900.833	5.27	0.27
1910.833	5.27	0.27
1920.833	5.27	0.27
1930.833	5.27	0.27
1940.833	5.26	0.26

Beulah Water Works District		
Wheeler Monitoring Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
1950.833	5.27	0.27
1960.833	5.27	0.27
1970.833	5.27	0.27
1980.833	5.27	0.27
1990.833	5.27	0.27
2000.833	5.27	0.27
2010.833	5.27	0.27
2020.833	5.27	0.27
2030.833	5.28	0.28
2040.833	5.27	0.27
2050.833	5.27	0.27
2060.833	5.27	0.27
2070.833	5.27	0.27
2080.833	5.26	0.26
2090.833	5.26	0.26
2100.833	5.26	0.26
2110.833	5.27	0.27
2120.833	5.26	0.26
2130.833	5.26	0.26
2140.833	5.26	0.26
2150.833	5.26	0.26
2160.833	5.26	0.26
2170.833	5.26	0.26
2180.833	5.27	0.27
2190.833	5.28	0.28
2200.833	5.28	0.28
2210.833	5.29	0.29
2220.833	5.29	0.29
2230.833	5.29	0.29
2240.833	5.29	0.29
2250.833	5.29	0.29
2260.833	5.28	0.28
2270.833	5.29	0.29
2280.833	5.29	0.29
2290.833	5.29	0.29
2300.833	5.29	0.29
2310.833	5.28	0.28
2320.833	5.28	0.28
2330.833	5.28	0.28
2340.833	5.28	0.28
2350.833	5.27	0.27
2360.833	5.28	0.28
2370.833	5.28	0.28
2380.833	5.27	0.27
2390.833	5.27	0.27
2400.833	5.27	0.27
2410.833	5.26	0.26
2420.833	5.27	0.27
2430.833	5.27	0.27
2440.833	5.27	0.27
2450.833	5.28	0.28
2460.833	5.28	0.28
2470.833	5.28	0.28

Beulah Water Works District		
Wheeler Monitoring Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
2480.833	5.28	0.28
2490.833	5.28	0.28
2500.833	5.27	0.27
2510.833	5.27	0.27
2520.833	5.27	0.27
2530.833	5.27	0.27
2540.833	5.26	0.26
2550.833	5.26	0.26
2560.833	5.26	0.26
2570.833	5.25	0.25
2580.833	5.25	0.25
2590.833	5.24	0.24
2600.833	5.24	0.24
2610.833	5.24	0.24
2620.833	5.24	0.24
2630.833	5.23	0.23
2640.833	5.23	0.23
2650.833	5.23	0.23
2660.833	5.23	0.23
2670.833	5.23	0.23
2680.833	5.22	0.22
2690.833	5.28	0.28
2700.833	5.22	0.22
2710.833	5.21	0.21
2720.833	5.21	0.21
2730.833	5.21	0.21
2740.833	5.20	0.20
2750.833	5.20	0.20
2760.833	5.20	0.20
2770.833	5.19	0.19
2780.833	5.19	0.19
2790.833	5.18	0.18
2800.833	5.18	0.18
2810.833	5.18	0.18
2820.833	5.17	0.17
2830.833	5.17	0.17
2840.833	5.17	0.17
2850.833	5.16	0.16
2860.833	5.16	0.16
2870.833	5.16	0.16
2880.833	5.15	0.15
2890.833	5.15	0.15
2900.833	5.15	0.15
2910.833	5.15	0.15
2920.833	5.15	0.15
2930.833	5.15	0.15
2940.833	5.15	0.15
2950.833	5.15	0.15
2960.833	5.15	0.15
2970.833	5.16	0.16
2980.833	5.16	0.16
2990.833	5.17	0.17
3000.833	5.17	0.17

Beulah Water Works District		
Wheeler Monitoring Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
3010.833	5.17	0.17
3020.833	5.17	0.17
3030.833	5.17	0.17
3040.833	5.18	0.18
3050.833	5.19	0.19
3060.833	5.19	0.19
3070.833	5.19	0.19
3080.833	5.20	0.20
3090.833	5.20	0.20
3100.833	5.20	0.20
3110.833	5.20	0.20
3120.833	5.21	0.21
3130.833	5.21	0.21
3140.833	5.21	0.21
3150.833	5.21	0.21
3160.833	5.21	0.21
3170.833	5.21	0.21
3180.833	5.22	0.22
3190.833	5.21	0.21
3200.833	5.21	0.21
3210.833	5.21	0.21
3220.833	5.21	0.21
3230.833	5.21	0.21
3240.833	5.20	0.20
3250.833	5.20	0.20
3260.833	5.20	0.20
3270.833	5.20	0.20
3280.833	5.20	0.20
3290.833	5.20	0.20
3300.833	5.20	0.20
3310.833	5.19	0.19
3320.833	5.19	0.19
3330.833	5.19	0.19
3340.833	5.19	0.19
3350.833	5.18	0.18
3360.833	5.18	0.18
3370.833	5.17	0.17
3380.833	5.17	0.17
3390.833	5.17	0.17
3400.833	5.17	0.17
3410.833	5.16	0.16
3420.833	5.15	0.15
3430.833	5.15	0.15
3440.833	5.15	0.15
3450.833	5.15	0.15
3460.833	5.14	0.14
3470.833	5.14	0.14
3480.833	5.14	0.14
3490.833	5.14	0.14
3500.833	5.13	0.13
3510.833	5.13	0.13
3520.833	5.14	0.14
3530.833	5.13	0.13

Beulah Water Works District		
Wheeler Monitoring Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
3540.833	5.14	0.14
3550.833	5.13	0.13
3560.833	5.13	0.13
3570.833	5.13	0.13
3580.833	5.13	0.13
3590.833	5.13	0.13
3600.833	5.13	0.13
3610.833	5.13	0.13
3620.833	5.13	0.13
3630.833	5.13	0.13
3640.833	5.13	0.13
3650.833	5.13	0.13
3660.833	5.13	0.13
3670.833	5.14	0.14
3680.833	5.14	0.14
3690.833	5.14	0.14
3700.833	5.14	0.14
3710.833	5.14	0.14
3720.833	5.14	0.14
3730.833	5.15	0.15
3740.833	5.14	0.14
3750.833	5.15	0.15
3760.833	5.15	0.15
3770.833	5.15	0.15
3780.833	5.15	0.15
3790.833	5.15	0.15
3800.833	5.15	0.15
3810.833	5.15	0.15
3820.833	5.15	0.15
3830.833	5.15	0.15
3840.833	5.15	0.15
3850.833	5.15	0.15
3860.833	5.15	0.15
3870.833	5.15	0.15
3880.833	5.15	0.15
3890.833	5.15	0.15
3900.833	5.15	0.15
3910.833	5.15	0.15
3920.833	5.15	0.15
3930.833	5.16	0.16
3940.833	5.16	0.16
3950.833	5.15	0.15
3960.833	5.16	0.16
3970.833	5.15	0.15
3980.833	5.16	0.16
3990.833	5.15	0.15
4000.833	5.15	0.15
4010.833	5.15	0.15
4020.833	5.15	0.15
4030.833	5.15	0.15
4040.833	5.15	0.15
4050.833	5.15	0.15
4060.833	5.14	0.14

Beulah Water Works District		
Wheeler Monitoring Well		
72-Hour Pumping Test		
January 29 - February 1, 2019		
Q = 150/125/100/90/80 gpm		
	Sellers Well	Sellers Well
Elapsed Time	Depth to Water	Drawdown
(minutes)	(feet bgs)	(feet bgs)
4070.833	5.14	0.14
4080.833	5.14	0.14
4090.833	5.13	0.13
4100.833	5.13	0.13
4110.833	5.13	0.13
4120.833	5.13	0.13
4130.833	5.12	0.12
4140.833	5.12	0.12
4150.833	5.12	0.12
4160.833	5.11	0.11
4170.833	5.11	0.11
4180.833	5.11	0.11
4190.833	5.11	0.11
4200.833	5.10	0.10
4210.833	5.10	0.10
4220.833	5.09	0.09
4230.833	5.09	0.09
4240.833	5.09	0.09
4250.833	5.09	0.09
4260.833	5.09	0.09
4270.833	5.09	0.09
4280.833	5.08	0.08
4290.833	5.09	0.09
4300.833	5.09	0.09
4310.833	5.08	0.08

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
			Static Water Level = 6.16 ft.		Static Water Level = 5.0 ft.	
4320.001	0.001	4320001.0	9.35	3.19	5.09	0.09
4320.005	0.005	864001.0	9.35	3.19	5.09	0.09
4320.010	0.010	432001.0	9.34	3.18	5.09	0.09
4320.015	0.015	288001.0	9.34	3.18	5.09	0.09
4320.020	0.020	216001.0	9.34	3.18	5.09	0.09
4320.025	0.025	172801.0	9.34	3.18	5.09	0.09
4320.030	0.030	144001.0	9.34	3.18	5.09	0.09
4320.035	0.035	123429.6	9.34	3.18	5.09	0.09
4320.042	0.042	102858.1	9.33	3.17	5.09	0.09
4320.047	0.047	91915.9	9.33	3.17	5.09	0.09
4320.052	0.052	83077.9	9.33	3.17	5.09	0.09
4320.057	0.057	75790.5	9.33	3.17	5.09	0.09
4320.062	0.062	69678.4	9.33	3.17	5.09	0.09
4320.067	0.067	64478.6	9.33	3.17	5.09	0.09
4320.072	0.072	60001.0	9.32	3.16	5.09	0.09
4320.077	0.077	56104.9	9.32	3.16	5.09	0.09
4320.083	0.083	52049.2	9.32	3.16	5.09	0.09
4320.088	0.088	49091.9	9.31	3.15	5.09	0.09
4320.093	0.093	46452.6	9.31	3.15	5.09	0.09
4320.098	0.098	44082.6	9.31	3.15	5.09	0.09
4320.103	0.103	41942.7	9.31	3.15	5.09	0.09
4320.110	0.110	39273.7	9.30	3.14	5.09	0.09
4320.117	0.117	36924.1	9.30	3.14	5.09	0.09
4320.123	0.123	35123.0	9.30	3.14	5.09	0.09
4320.132	0.132	32728.3	9.29	3.13	5.08	0.08
4320.140	0.140	30858.1	9.29	3.13	5.09	0.09
4320.148	0.148	29190.2	9.28	3.12	5.09	0.09
4320.158	0.158	27342.8	9.28	3.12	5.08	0.08
4320.168	0.168	25715.3	9.28	3.12	5.09	0.09
4320.178	0.178	24270.7	9.27	3.11	5.09	0.09
4320.190	0.190	22737.8	9.27	3.11	5.08	0.08
4320.202	0.202	21387.1	9.26	3.10	5.09	0.09
4320.215	0.215	20094.0	9.26	3.10	5.09	0.09
4320.228	0.228	18948.4	9.25	3.09	5.09	0.09
4320.242	0.242	17852.2	9.24	3.08	5.09	0.09
4320.257	0.257	16810.3	9.24	3.08	5.09	0.09
4320.272	0.272	15883.4	9.23	3.07	5.08	0.08
4320.288	0.288	15001.0	9.22	3.06	5.09	0.09
4320.307	0.307	14072.7	9.22	3.06	5.09	0.09

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
4320.325	0.325	13293.3	9.21	3.05	5.09	0.09
4320.345	0.345	12522.7	9.20	3.04	5.08	0.08
4320.367	0.367	11772.1	9.20	3.04	5.08	0.08
4320.388	0.388	11135.0	9.19	3.03	5.08	0.08
4320.410	0.410	10537.6	9.18	3.02	5.09	0.09
4320.435	0.435	9932.0	9.17	3.01	5.08	0.08
4320.462	0.462	9351.6	9.16	3.00	5.09	0.09
4320.490	0.490	8817.3	9.16	3.00	5.09	0.09
4320.520	0.520	8308.7	9.15	2.99	5.09	0.09
4320.552	0.552	7827.1	9.14	2.98	5.09	0.09
4320.585	0.585	7385.6	9.13	2.97	5.09	0.09
4320.620	0.620	6968.7	9.12	2.96	5.08	0.08
4320.657	0.657	6576.3	9.11	2.95	5.09	0.09
4320.695	0.695	6216.8	9.10	2.94	5.09	0.09
4320.735	0.735	5878.6	9.09	2.93	5.09	0.09
4320.778	0.778	5553.7	9.08	2.92	5.09	0.09
4320.823	0.823	5250.1	9.07	2.91	5.09	0.09
4320.872	0.872	4955.1	9.06	2.90	5.09	0.09
4320.922	0.922	4686.5	9.05	2.89	5.09	0.09
4320.975	0.975	4431.8	9.04	2.88	5.09	0.09
4321.032	1.032	4187.0	9.03	2.87	5.09	0.09
4321.092	1.092	3957.0	9.02	2.86	5.09	0.09
4321.155	1.155	3741.3	9.01	2.85	5.09	0.09
4321.222	1.222	3536.2	9.00	2.84	5.08	0.08
4321.292	1.292	3344.7	8.99	2.83	5.09	0.09
4321.367	1.367	3161.2	8.98	2.82	5.09	0.09
4321.445	1.445	2990.6	8.97	2.81	5.09	0.09
4321.528	1.528	2828.2	8.96	2.80	5.09	0.09
4321.617	1.617	2672.6	8.95	2.79	5.09	0.09
4321.710	1.710	2527.3	8.94	2.78	5.09	0.09
4321.808	1.808	2390.4	8.93	2.77	5.09	0.09
4321.912	1.912	2260.4	8.92	2.76	5.09	0.09
4322.022	2.022	2137.5	8.91	2.75	5.09	0.09
4322.137	2.137	2022.5	8.90	2.74	5.09	0.09
4322.258	2.258	1914.2	8.89	2.73	5.09	0.09
4322.387	2.387	1810.8	8.88	2.72	5.09	0.09
4322.522	2.522	1713.9	8.87	2.71	5.09	0.09
4322.665	2.665	1622.0	8.86	2.70	5.09	0.09
4322.817	2.817	1534.5	8.85	2.69	5.09	0.09
4322.967	2.967	1457.0	8.84	2.68	5.09	0.09

Beulah Water Works District

Sellers and Wheeler Wells

72-Hour Pumping Test

January 29 - February 1, 2019

Recovery Data

Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
4323.133	3.133	1379.9	8.83	2.67	5.09	0.09
4323.300	3.300	1310.1	8.82	2.66	5.09	0.09
4323.483	3.483	1241.3	8.81	2.65	5.09	0.09
4323.667	3.667	1179.1	8.80	2.64	5.09	0.09
4323.867	3.867	1118.1	8.79	2.63	5.09	0.09
4324.083	4.083	1059.0	8.78	2.62	5.09	0.09
4324.317	4.317	1001.7	8.77	2.61	5.09	0.09
4324.550	4.550	950.5	8.76	2.60	5.09	0.09
4324.800	4.800	901.0	8.75	2.59	5.09	0.09
4325.067	5.067	853.6	8.73	2.57	5.09	0.09
4325.350	5.350	808.5	8.73	2.57	5.09	0.09
4325.650	5.650	765.6	8.72	2.56	5.09	0.09
4325.967	5.967	725.0	8.71	2.55	5.09	0.09
4326.300	6.300	686.7	8.70	2.54	5.09	0.09
4326.650	6.650	650.6	8.69	2.53	5.09	0.09
4327.017	7.017	616.6	8.68	2.52	5.09	0.09
4327.417	7.417	583.4	8.66	2.50	5.09	0.09
4327.833	7.833	552.5	8.65	2.49	5.09	0.09
4328.267	8.267	523.6	8.64	2.48	5.08	0.08
4328.733	8.733	495.7	8.63	2.47	5.09	0.09
4329.233	9.233	468.9	8.62	2.46	5.09	0.09
4329.750	9.750	444.1	8.61	2.45	5.09	0.09
4330.300	10.300	420.4	8.59	2.43	5.09	0.09
4330.883	10.883	397.9	8.58	2.42	5.09	0.09
4331.500	11.500	376.7	8.57	2.41	5.09	0.09
4332.150	12.150	356.6	8.56	2.40	5.09	0.09
4332.833	12.833	337.6	8.54	2.38	5.09	0.09
4333.550	13.550	319.8	8.53	2.37	5.09	0.09
4334.317	14.317	302.7	8.52	2.36	5.09	0.09
4335.117	15.117	286.8	8.50	2.34	5.09	0.09
4335.967	15.967	271.6	8.49	2.33	5.09	0.09
4336.867	16.867	257.1	8.47	2.31	5.09	0.09
4337.817	17.817	243.5	8.46	2.30	5.08	0.08
4338.817	18.817	230.6	8.45	2.29	5.09	0.09
4339.867	19.867	218.4	8.43	2.27	5.09	0.09
4340.983	20.983	206.9	8.42	2.26	5.09	0.09
4342.167	22.167	195.9	8.40	2.24	5.09	0.09
4343.417	23.417	185.5	8.38	2.22	5.09	0.09
4344.733	24.733	175.7	8.37	2.21	5.09	0.09
4346.117	26.117	166.4	8.35	2.19	5.09	0.09

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
4347.583	27.583	157.6	8.33	2.17	5.09	0.09
4349.133	29.133	149.3	8.31	2.15	5.09	0.09
4350.767	30.767	141.4	8.30	2.14	5.09	0.09
4352.500	32.500	133.9	8.28	2.12	5.09	0.09
4354.317	34.317	126.9	8.26	2.10	5.09	0.09
4356.233	36.233	120.2	8.24	2.08	5.09	0.09
4358.267	38.267	113.9	8.22	2.06	5.09	0.09
4360.417	40.417	107.9	8.20	2.04	5.09	0.09
4362.683	42.683	102.2	8.18	2.02	5.09	0.09
4365.067	45.067	96.9	8.16	2.00	5.09	0.09
4367.583	47.583	91.8	8.14	1.98	5.09	0.09
4370.250	50.250	87.0	8.12	1.96	5.09	0.09
4373.067	53.067	82.4	8.10	1.94	5.08	0.08
4376.033	56.033	78.1	8.08	1.92	5.09	0.09
4379.167	59.167	74.0	8.05	1.89	5.08	0.08
4382.483	62.483	70.1	8.03	1.87	5.09	0.09
4385.983	65.983	66.5	8.02	1.86	5.09	0.09
4389.667	69.667	63.0	7.99	1.83	5.09	0.09
4393.567	73.567	59.7	7.96	1.80	5.08	0.08
4397.683	77.683	56.6	7.94	1.78	5.09	0.09
4402.017	82.017	53.7	7.91	1.75	5.09	0.09
4406.600	86.600	50.9	7.89	1.73	5.09	0.09
4411.433	91.433	48.2	7.87	1.71	5.09	0.09
4416.533	96.533	45.8	7.84	1.68	5.09	0.09
4421.917	101.917	43.4	7.82	1.66	5.09	0.09
4427.600	107.600	41.1	7.79	1.63	5.09	0.09
4433.600	113.600	39.0	7.78	1.62	5.09	0.09
4439.933	119.933	37.0	7.74	1.58	5.10	0.10
4446.633	126.633	35.1	7.71	1.55	5.15	0.15
4453.700	133.700	33.3	7.69	1.53	5.12	0.12
4461.150	141.150	31.6	7.66	1.50	5.14	0.14
4469.017	149.017	30.0	7.63	1.47	5.15	0.15
4477.333	157.333	28.5	7.61	1.45	5.13	0.13
4486.100	166.100	27.0	7.58	1.42	5.13	0.13
4495.367	175.367	25.6	7.55	1.39	5.13	0.13
4505.150	185.150	24.3	7.53	1.37	5.13	0.13
4515.150	195.150	23.1	7.50	1.34	5.13	0.13
4525.150	205.150	22.1	7.47	1.31	5.14	0.14
4535.150	215.150	21.1	7.44	1.28	5.14	0.14
4545.150	225.150	20.2	7.42	1.26	5.15	0.15

Beulah Water Works District

Sellers and Wheeler Wells

72-Hour Pumping Test

January 29 - February 1, 2019

Recovery Data

Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
4555.150	235.150	19.4	7.39	1.23	5.15	0.15
4565.150	245.150	18.6	7.37	1.21	5.15	0.15
4575.150	255.150	17.9	7.35	1.19	5.15	0.15
4585.150	265.150	17.3	7.33	1.17	5.15	0.15
4595.150	275.150	16.7	7.31	1.15	5.15	0.15
4605.150	285.150	16.1	7.29	1.13	5.15	0.15
4615.150	295.150	15.6	7.27	1.11	5.15	0.15
4625.150	305.150	15.2	7.25	1.09	5.15	0.15
4635.150	315.150	14.7	7.23	1.07	5.15	0.15
4645.150	325.150	14.3	7.22	1.06	5.15	0.15
4655.150	335.150	13.9	7.20	1.04	5.15	0.15
4665.150	345.150	13.5	7.18	1.02	5.15	0.15
4675.150	355.150	13.2	7.17	1.01	5.15	0.15
4685.150	365.150	12.8	7.16	1.00	5.15	0.15
4695.150	375.150	12.5	7.14	0.98	5.15	0.15
4705.150	385.150	12.2	7.13	0.97	5.15	0.15
4715.150	395.150	11.9	7.11	0.95	5.15	0.15
4725.150	405.150	11.7	7.10	0.94	5.15	0.15
4735.150	415.150	11.4	7.09	0.93	5.15	0.15
4745.150	425.150	11.2	7.08	0.92	5.15	0.15
4755.150	435.150	10.9	7.07	0.91	5.15	0.15
4765.150	445.150	10.7	7.06	0.90	5.15	0.15
4775.150	455.150	10.5	7.04	0.88	5.15	0.15
4785.150	465.150	10.3	7.03	0.87	5.16	0.16
4795.150	475.150	10.1	7.03	0.87	5.15	0.15
4805.150	485.150	9.9	7.02	0.86	5.15	0.15
4815.150	495.150	9.7	7.01	0.85	5.15	0.15
4825.150	505.150	9.6	7.00	0.84	5.15	0.15
4835.150	515.150	9.4	6.99	0.83	5.14	0.14
4845.150	525.150	9.2	6.98	0.82	5.14	0.14
4855.150	535.150	9.1	6.97	0.81	5.14	0.14
4865.150	545.150	8.9	6.96	0.80	5.14	0.14
4875.150	555.150	8.8	6.96	0.80	5.14	0.14
4885.150	565.150	8.6	6.95	0.79	5.14	0.14
4895.150	575.150	8.5	6.94	0.78	5.14	0.14
4905.150	585.150	8.4	6.93	0.77	5.14	0.14
4915.150	595.150	8.3	6.92	0.76	5.14	0.14
4925.150	605.150	8.1	6.92	0.76	5.14	0.14
4935.150	615.150	8.0	6.91	0.75	5.14	0.14
4945.150	625.150	7.9	6.90	0.74	5.14	0.14

Beulah Water Works District Sellers and Wheeler Wells 72-Hour Pumping Test January 29 - February 1, 2019 Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
4955.150	635.150	7.8	6.90	0.74	5.14	0.14
4965.150	645.150	7.7	6.89	0.73	5.14	0.14
4975.150	655.150	7.6	6.88	0.72	5.14	0.14
4985.150	665.150	7.5	6.88	0.72	5.14	0.14
4995.150	675.150	7.4	6.87	0.71	5.14	0.14
5005.150	685.150	7.3	6.86	0.70	5.14	0.14
5015.150	695.150	7.2	6.86	0.70	5.14	0.14
5025.150	705.150	7.1	6.85	0.69	5.15	0.15
5035.150	715.150	7.0	6.85	0.69	5.15	0.15
5045.150	725.150	7.0	6.84	0.68	5.15	0.15
5055.150	735.150	6.9	6.84	0.68	5.15	0.15
5065.150	745.150	6.8	6.83	0.67	5.15	0.15
5075.150	755.150	6.7	6.82	0.66	5.15	0.15
5085.150	765.150	6.6	6.82	0.66	5.16	0.16
5095.150	775.150	6.6	6.81	0.65	5.15	0.15
5105.150	785.150	6.5	6.81	0.65	5.15	0.15
5115.150	795.150	6.4	6.80	0.64	5.15	0.15
5125.150	805.150	6.4	6.80	0.64	5.15	0.15
5135.150	815.150	6.3	6.79	0.63	5.15	0.15
5145.150	825.150	6.2	6.79	0.63	5.16	0.16
5155.150	835.150	6.2	6.78	0.62	5.15	0.15
5165.150	845.150	6.1	6.78	0.62	5.16	0.16
5175.150	855.150	6.1	6.78	0.62	5.16	0.16
5185.150	865.150	6.0	6.77	0.61	5.16	0.16
5195.150	875.150	5.9	6.77	0.61	5.16	0.16
5205.150	885.150	5.9	6.76	0.60	5.17	0.17
5215.150	895.150	5.8	6.76	0.60	5.17	0.17
5225.150	905.150	5.8	6.75	0.59	5.17	0.17
5235.150	915.150	5.7	6.75	0.59	5.17	0.17
5245.150	925.150	5.7	6.74	0.58	5.18	0.18
5255.150	935.150	5.6	6.74	0.58	5.18	0.18
5265.150	945.150	5.6	6.74	0.58	5.18	0.18
5275.150	955.150	5.5	6.73	0.57	5.18	0.18
5285.150	965.150	5.5	6.73	0.57	5.18	0.18
5295.150	975.150	5.4	6.73	0.57	5.18	0.18
5305.150	985.150	5.4	6.72	0.56	5.18	0.18
5315.150	995.150	5.3	6.72	0.56	5.18	0.18
5325.150	1005.150	5.3	6.71	0.55	5.18	0.18
5335.150	1015.150	5.3	6.71	0.55	5.18	0.18
5345.150	1025.150	5.2	6.71	0.55	5.19	0.19

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
5355.150	1035.150	5.2	6.70	0.54	5.19	0.19
5365.150	1045.150	5.1	6.70	0.54	5.19	0.19
5375.150	1055.150	5.1	6.70	0.54	5.20	0.20
5385.150	1065.150	5.1	6.69	0.53	5.20	0.20
5395.150	1075.150	5.0	6.69	0.53	5.20	0.20
5405.150	1085.150	5.0	6.69	0.53	5.21	0.21
5415.150	1095.150	4.9	6.68	0.52	5.21	0.21
5425.150	1105.150	4.9	6.68	0.52	5.22	0.22
5435.150	1115.150	4.9	6.68	0.52	5.22	0.22
5445.150	1125.150	4.8	6.67	0.51	5.22	0.22
5455.150	1135.150	4.8	6.67	0.51	5.22	0.22
5465.150	1145.150	4.8	6.67	0.51	5.22	0.22
5475.150	1155.150	4.7	6.67	0.51	5.22	0.22
5485.150	1165.150	4.7	6.66	0.50	5.23	0.23
5495.150	1175.150	4.7	6.66	0.50	5.22	0.22
5505.150	1185.150	4.6	6.66	0.50	5.23	0.23
5515.150	1195.150	4.6	6.65	0.49	5.23	0.23
5525.150	1205.150	4.6	6.65	0.49	5.23	0.23
5535.150	1215.150	4.6	6.65	0.49	5.23	0.23
5545.150	1225.150	4.5	6.65	0.49	5.24	0.24
5555.150	1235.150	4.5	6.64	0.48	5.24	0.24
5565.150	1245.150	4.5	6.64	0.48	5.23	0.23
5575.150	1255.150	4.4	6.64	0.48	5.24	0.24
5585.150	1265.150	4.4	6.64	0.48	5.24	0.24
5595.150	1275.150	4.4	6.63	0.47	5.23	0.23
5605.150	1285.150	4.4	6.63	0.47	5.23	0.23
5615.150	1295.150	4.3	6.63	0.47	5.23	0.23
5625.150	1305.150	4.3	6.63	0.47	5.23	0.23
5635.150	1315.150	4.3	6.62	0.46	5.23	0.23
5645.150	1325.150	4.3	6.62	0.46	5.23	0.23
5655.150	1335.150	4.2	6.62	0.46	5.23	0.23
5665.150	1345.150	4.2	6.62	0.46	5.23	0.23
5675.150	1355.150	4.2	6.61	0.45	5.23	0.23
5685.150	1365.150	4.2	6.61	0.45	5.22	0.22
5695.150	1375.150	4.1	6.61	0.45	5.23	0.23
5705.150	1385.150	4.1	6.61	0.45	5.28	0.28
5715.150	1395.150	4.1	6.61	0.45	5.27	0.27
5725.150	1405.150	4.1	6.60	0.44	5.26	0.26
5735.150	1415.150	4.1	6.60	0.44	5.24	0.24
5745.150	1425.150	4.0	6.60	0.44	5.23	0.23

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
5755.150	1435.150	4.0	6.60	0.44	5.23	0.23
5765.150	1445.150	4.0	6.59	0.43	5.23	0.23
5775.150	1455.150	4.0	6.59	0.43	5.23	0.23
5785.150	1465.150	3.9	6.59	0.43	5.23	0.23
5795.150	1475.150	3.9	6.59	0.43	5.22	0.22
5805.150	1485.150	3.9	6.58	0.42	5.23	0.23
5815.150	1495.150	3.9	6.58	0.42	5.22	0.22
5825.150	1505.150	3.9	6.58	0.42	5.22	0.22
5835.150	1515.150	3.9	6.58	0.42	5.23	0.23
5845.150	1525.150	3.8	6.57	0.41	5.23	0.23
5855.150	1535.150	3.8	6.57	0.41	5.23	0.23
5865.150	1545.150	3.8	6.57	0.41	5.23	0.23
5875.150	1555.150	3.8	6.57	0.41	5.23	0.23
5885.150	1565.150	3.8	6.56	0.40	5.24	0.24
5895.150	1575.150	3.7	6.56	0.40	5.25	0.25
5905.150	1585.150	3.7	6.56	0.40	5.25	0.25
5915.150	1595.150	3.7	6.56	0.40	5.25	0.25
5925.150	1605.150	3.7	6.55	0.39	5.26	0.26
5935.150	1615.150	3.7	6.55	0.39	5.26	0.26
5945.150	1625.150	3.7	6.55	0.39	5.27	0.27
5955.150	1635.150	3.6	6.54	0.38	5.27	0.27
5965.150	1645.150	3.6	6.54	0.38	5.27	0.27
5975.150	1655.150	3.6	6.54	0.38	5.28	0.28
5985.150	1665.150	3.6	6.54	0.38	5.28	0.28
5995.150	1675.150	3.6	6.53	0.37	5.28	0.28
6005.150	1685.150	3.6	6.53	0.37	5.29	0.29
6015.150	1695.150	3.5	6.53	0.37	5.29	0.29
6025.150	1705.150	3.5	6.52	0.36	5.29	0.29
6035.150	1715.150	3.5	6.52	0.36	5.29	0.29
6045.150	1725.150	3.5	6.51	0.35	5.29	0.29
6055.150	1735.150	3.5	6.51	0.35	5.29	0.29
6065.150	1745.150	3.5	6.51	0.35	5.29	0.29
6075.150	1755.150	3.5	6.50	0.34	5.29	0.29
6085.150	1765.150	3.4	6.50	0.34	5.29	0.29
6095.150	1775.150	3.4	6.49	0.33	5.29	0.29
6105.150	1785.150	3.4	6.49	0.33	5.29	0.29
6115.150	1795.150	3.4	6.48	0.32	5.28	0.28
6125.150	1805.150	3.4	6.48	0.32	5.28	0.28
6135.150	1815.150	3.4	6.47	0.31	5.28	0.28
6145.150	1825.150	3.4	6.47	0.31	5.28	0.28

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
6155.150	1835.150	3.4	6.47	0.31	5.28	0.28
6165.150	1845.150	3.3	6.46	0.30	5.28	0.28
6175.150	1855.150	3.3	6.46	0.30	5.28	0.28
6185.150	1865.150	3.3	6.45	0.29	5.28	0.28
6195.150	1875.150	3.3	6.45	0.29	5.27	0.27
6205.150	1885.150	3.3	6.45	0.29	5.27	0.27
6215.150	1895.150	3.3	6.45	0.29	5.27	0.27
6225.150	1905.150	3.3	6.45	0.29	5.27	0.27
6235.150	1915.150	3.3	6.44	0.28	5.28	0.28
6245.150	1925.150	3.2	6.44	0.28	5.27	0.27
6255.150	1935.150	3.2	6.44	0.28	5.27	0.27
6265.150	1945.150	3.2	6.44	0.28	5.27	0.27
6275.150	1955.150	3.2	6.44	0.28	5.27	0.27
6285.150	1965.150	3.2	6.43	0.27	5.27	0.27
6295.150	1975.150	3.2	6.43	0.27	5.27	0.27
6305.150	1985.150	3.2	6.43	0.27	5.28	0.28
6315.150	1995.150	3.2	6.43	0.27	5.28	0.28
6325.150	2005.150	3.2	6.43	0.27	5.28	0.28
6335.150	2015.150	3.1	6.42	0.26	5.28	0.28
6345.150	2025.150	3.1	6.42	0.26	5.29	0.29
6355.150	2035.150	3.1	6.42	0.26	5.29	0.29
6365.150	2045.150	3.1	6.42	0.26	5.28	0.28
6375.150	2055.150	3.1	6.42	0.26	5.29	0.29
6385.150	2065.150	3.1	6.42	0.26	5.29	0.29
6395.150	2075.150	3.1	6.41	0.25	5.29	0.29
6405.150	2085.150	3.1	6.41	0.25	5.29	0.29
6415.150	2095.150	3.1	6.41	0.25	5.30	0.30
6425.150	2105.150	3.1	6.41	0.25	5.30	0.30
6435.150	2115.150	3.0	6.41	0.25	5.30	0.30
6445.150	2125.150	3.0	6.41	0.25	5.30	0.30
6455.150	2135.150	3.0	6.41	0.25	5.30	0.30
6465.150	2145.150	3.0	6.40	0.24	5.30	0.30
6475.150	2155.150	3.0	6.40	0.24	5.31	0.31
6485.150	2165.150	3.0	6.40	0.24	5.31	0.31
6495.150	2175.150	3.0	6.40	0.24	5.32	0.32
6505.150	2185.150	3.0	6.40	0.24	5.32	0.32
6515.150	2195.150	3.0	6.39	0.23	5.32	0.32
6525.150	2205.150	3.0	6.39	0.23	5.32	0.32
6535.150	2215.150	3.0	6.39	0.23	5.32	0.32
6545.150	2225.150	2.9	6.39	0.23	5.33	0.33

Beulah Water Works District

Sellers and Wheeler Wells

72-Hour Pumping Test

January 29 - February 1, 2019

Recovery Data

Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
6555.150	2235.150	2.9	6.39	0.23	5.34	0.34
6565.150	2245.150	2.9	6.39	0.23	5.34	0.34
6575.150	2255.150	2.9	6.38	0.22	5.33	0.33
6585.150	2265.150	2.9	6.38	0.22	5.33	0.33
6595.150	2275.150	2.9	6.38	0.22	5.34	0.34
6605.150	2285.150	2.9	6.38	0.22	5.33	0.33
6615.150	2295.150	2.9	6.38	0.22	5.34	0.34
6625.150	2305.150	2.9	6.38	0.22	5.34	0.34
6635.150	2315.150	2.9	6.38	0.22	5.34	0.34
6645.150	2325.150	2.9	6.38	0.22	5.34	0.34
6655.150	2335.150	2.8	6.38	0.22	5.35	0.35
6665.150	2345.150	2.8	6.38	0.22	5.35	0.35
6675.150	2355.150	2.8	6.37	0.21	5.36	0.36
6685.150	2365.150	2.8	6.37	0.21	5.36	0.36
6695.150	2375.150	2.8	6.37	0.21	5.36	0.36
6705.150	2385.150	2.8	6.37	0.21	5.36	0.36
6715.150	2395.150	2.8	6.37	0.21	5.37	0.37
6725.150	2405.150	2.8	6.37	0.21	5.37	0.37
6735.150	2415.150	2.8	6.37	0.21	5.37	0.37
6745.150	2425.150	2.8	6.37	0.21	5.38	0.38
6755.150	2435.150	2.8	6.36	0.20	5.39	0.39
6765.150	2445.150	2.8	6.36	0.20	5.39	0.39
6775.150	2455.150	2.8	6.36	0.20	5.39	0.39
6785.150	2465.150	2.8	6.36	0.20	5.39	0.39
6795.150	2475.150	2.7	6.36	0.20	5.39	0.39
6805.150	2485.150	2.7	6.36	0.20	5.40	0.40
6815.150	2495.150	2.7	6.35	0.19	5.40	0.40
6825.150	2505.150	2.7	6.35	0.19	5.41	0.41
6835.150	2515.150	2.7	6.35	0.19	5.40	0.40
6845.150	2525.150	2.7	6.35	0.19	5.41	0.41
6855.150	2535.150	2.7	6.35	0.19	5.42	0.42
6865.150	2545.150	2.7	6.35	0.19	5.42	0.42
6875.150	2555.150	2.7	6.35	0.19	5.42	0.42
6885.150	2565.150	2.7	6.35	0.19	5.42	0.42
6895.150	2575.150	2.7	6.35	0.19	5.42	0.42
6905.150	2585.150	2.7	6.35	0.19	5.43	0.43
6915.150	2595.150	2.7	6.34	0.18	5.43	0.43
6925.150	2605.150	2.7	6.34	0.18	5.43	0.43
6935.150	2615.150	2.7	6.34	0.18	5.43	0.43
6945.150	2625.150	2.6	6.34	0.18	5.43	0.43

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
6955.150	2635.150	2.6	6.34	0.18	5.47	0.47
6965.150	2645.150	2.6	6.34	0.18	5.46	0.46
6975.150	2655.150	2.6	6.34	0.18	5.45	0.45
6985.150	2665.150	2.6	6.33	0.17	5.44	0.44
6995.150	2675.150	2.6	6.34	0.18	5.44	0.44
7005.150	2685.150	2.6	6.34	0.18	5.45	0.45
7015.150	2695.150	2.6	6.33	0.17	5.45	0.45
7025.150	2705.150	2.6	6.33	0.17	5.45	0.45
7035.150	2715.150	2.6	6.33	0.17	5.45	0.45
7045.150	2725.150	2.6	6.33	0.17	5.46	0.46
7055.150	2735.150	2.6	6.33	0.17	5.45	0.45
7065.150	2745.150	2.6	6.33	0.17	5.45	0.45
7075.150	2755.150	2.6	6.33	0.17	5.46	0.46
7085.150	2765.150	2.6	6.33	0.17	5.46	0.46
7095.150	2775.150	2.6	6.32	0.16	5.46	0.46
7105.150	2785.150	2.6	6.32	0.16	5.46	0.46
7115.150	2795.150	2.5	6.32	0.16	5.47	0.47
7125.150	2805.150	2.5	6.32	0.16	5.45	0.45
7135.150	2815.150	2.5	6.32	0.16	5.47	0.47
7145.150	2825.150	2.5	6.32	0.16	5.48	0.48
7155.150	2835.150	2.5	6.32	0.16	5.48	0.48
7165.150	2845.150	2.5	6.32	0.16	5.50	0.50
7175.150	2855.150	2.5	6.32	0.16	5.50	0.50
7185.150	2865.150	2.5	6.31	0.15	5.49	0.49
7195.150	2875.150	2.5	6.31	0.15	5.49	0.49
7205.150	2885.150	2.5	6.31	0.15	5.50	0.50
7215.150	2895.150	2.5	6.31	0.15	5.48	0.48
7225.150	2905.150	2.5	6.31	0.15	5.49	0.49
7235.150	2915.150	2.5	6.31	0.15	5.47	0.47
7245.150	2925.150	2.5	6.31	0.15	5.48	0.48
7255.150	2935.150	2.5	6.31	0.15	5.48	0.48
7265.150	2945.150	2.5	6.31	0.15	5.50	0.50
7275.150	2955.150	2.5	6.31	0.15	5.51	0.51
7285.150	2965.150	2.5	6.30	0.14	5.53	0.53
7295.150	2975.150	2.5	6.30	0.14	5.56	0.56
7305.150	2985.150	2.4	6.30	0.14	5.57	0.57
7315.150	2995.150	2.4	6.29	0.13	5.56	0.56
7325.150	3005.150	2.4	6.29	0.13	5.57	0.57
7335.150	3015.150	2.4	6.29	0.13	5.57	0.57
7345.150	3025.150	2.4	6.28	0.12	5.57	0.57

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
7355.150	3035.150	2.4	6.28	0.12	5.59	0.59
7365.150	3045.150	2.4	6.27	0.11	5.58	0.58
7375.150	3055.150	2.4	6.26	0.10	5.55	0.55
7385.150	3065.150	2.4	6.25	0.09	5.54	0.54
7395.150	3075.150	2.4	6.24	0.08	5.53	0.53
7405.150	3085.150	2.4	6.23	0.07	5.54	0.54
7415.150	3095.150	2.4	6.22	0.06	5.53	0.53
7425.150	3105.150	2.4	6.21	0.05	5.54	0.54
7435.150	3115.150	2.4	6.20	0.04	5.53	0.53
7445.150	3125.150	2.4	6.18	0.02	5.52	0.52
7455.150	3135.150	2.4	6.16	0.00	5.51	0.51
7465.150	3145.150	2.4	6.15	-0.01	5.49	0.49
7475.150	3155.150	2.4	6.13	-0.03	5.46	0.46
7485.150	3165.150	2.4	6.12	-0.04	5.44	0.44
7495.150	3175.150	2.4	6.10	-0.06	5.43	0.43
7505.150	3185.150	2.4	6.08	-0.08	5.41	0.41
7515.150	3195.150	2.4	6.07	-0.09	5.40	0.40
7525.150	3205.150	2.3	6.04	-0.12	5.38	0.38
7535.150	3215.150	2.3	6.02	-0.14	5.37	0.37
7545.150	3225.150	2.3	6.00	-0.16	5.33	0.33
7555.150	3235.150	2.3	5.98	-0.18	5.30	0.30
7565.150	3245.150	2.3	5.97	-0.19	5.27	0.27
7575.150	3255.150	2.3	5.95	-0.21	5.24	0.24
7585.150	3265.150	2.3	5.93	-0.23	5.22	0.22
7595.150	3275.150	2.3	5.92	-0.24	5.20	0.20
7605.150	3285.150	2.3	5.90	-0.26	5.18	0.18
7615.150	3295.150	2.3	5.87	-0.29	5.17	0.17
7625.150	3305.150	2.3	5.81	-0.35	5.16	0.16
7635.150	3315.150	2.3	5.72	-0.44	5.15	0.15
7645.150	3325.150	2.3	5.65	-0.51	5.14	0.14
7655.150	3335.150	2.3	5.58	-0.58	5.14	0.14
7665.150	3345.150	2.3	5.52	-0.64	5.13	0.13
7675.150	3355.150	2.3	5.46	-0.70	5.12	0.12
7685.150	3365.150	2.3	5.42	-0.74	5.12	0.12
7695.150	3375.150	2.3	5.37	-0.79	5.11	0.11
7705.150	3385.150	2.3	5.34	-0.82	5.11	0.11
7715.150	3395.150	2.3	5.31	-0.85	5.11	0.11
7725.150	3405.150	2.3	5.29	-0.87	5.11	0.11
7735.150	3415.150	2.3	5.26	-0.90	5.11	0.11
7745.150	3425.150	2.3	5.24	-0.92	5.11	0.11

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
7755.150	3435.150	2.3	5.23	-0.93	5.10	0.10
7765.150	3445.150	2.3	5.21	-0.95	5.10	0.10
7775.150	3455.150	2.3	5.20	-0.96	5.09	0.09
7785.150	3465.150	2.2	5.20	-0.96	5.09	0.09
7795.150	3475.150	2.2	5.19	-0.97	5.09	0.09
7805.150	3485.150	2.2	5.19	-0.97	5.09	0.09
7815.150	3495.150	2.2	5.18	-0.98	5.10	0.10
7825.150	3505.150	2.2	5.18	-0.98	5.10	0.10
7835.150	3515.150	2.2	5.18	-0.98	5.09	0.09
7845.150	3525.150	2.2	5.18	-0.98	5.09	0.09
7855.150	3535.150	2.2	5.19	-0.97	5.09	0.09
7865.150	3545.150	2.2	5.19	-0.97	5.09	0.09
7875.150	3555.150	2.2	5.19	-0.97	5.08	0.08
7885.150	3565.150	2.2	5.20	-0.96	5.09	0.09
7895.150	3575.150	2.2	5.20	-0.96	5.08	0.08
7905.150	3585.150	2.2	5.21	-0.95	5.08	0.08
7915.150	3595.150	2.2	5.21	-0.95	5.08	0.08
7925.150	3605.150	2.2	5.22	-0.94	5.08	0.08
7935.150	3615.150	2.2	5.23	-0.93	5.08	0.08
7945.150	3625.150	2.2	5.23	-0.93	5.08	0.08
7955.150	3635.150	2.2	5.24	-0.92	5.08	0.08
7965.150	3645.150	2.2	5.25	-0.91	5.08	0.08
7975.150	3655.150	2.2	5.25	-0.91	5.08	0.08
7985.150	3665.150	2.2	5.26	-0.90	5.08	0.08
7995.150	3675.150	2.2	5.27	-0.89	5.08	0.08
8005.150	3685.150	2.2	5.28	-0.88	5.08	0.08
8015.150	3695.150	2.2	5.29	-0.87	5.08	0.08
8025.150	3705.150	2.2	5.29	-0.87	5.08	0.08
8035.150	3715.150	2.2	5.31	-0.85	5.09	0.09
8045.150	3725.150	2.2	5.32	-0.84	5.09	0.09
8055.150	3735.150	2.2	5.33	-0.83	5.09	0.09
8065.150	3745.150	2.2	5.34	-0.82	5.09	0.09
8075.150	3755.150	2.2	5.34	-0.82	5.09	0.09
8085.150	3765.150	2.1	5.36	-0.80	5.10	0.10
8095.150	3775.150	2.1	5.36	-0.80	5.10	0.10
8105.150	3785.150	2.1	5.37	-0.79	5.10	0.10
8115.150	3795.150	2.1	5.38	-0.78	5.10	0.10
8125.150	3805.150	2.1	5.39	-0.77	5.11	0.11
8135.150	3815.150	2.1	5.40	-0.76	5.11	0.11
8145.150	3825.150	2.1	5.40	-0.76	5.11	0.11

Beulah Water Works District						
Sellers and Wheeler Wells						
72-Hour Pumping Test						
January 29 - February 1, 2019						
Recovery Data						
Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
8155.150	3835.150	2.1	5.41	-0.75	5.12	0.12
8165.150	3845.150	2.1	5.42	-0.74	5.12	0.12
8175.150	3855.150	2.1	5.42	-0.74	5.12	0.12
8185.150	3865.150	2.1	5.43	-0.73	5.12	0.12
8195.150	3875.150	2.1	5.44	-0.72	5.11	0.11
8205.150	3885.150	2.1	5.44	-0.72	5.11	0.11
8215.150	3895.150	2.1	5.45	-0.71	5.11	0.11
8225.150	3905.150	2.1	5.46	-0.70	5.11	0.11
8235.150	3915.150	2.1	5.46	-0.70	5.12	0.12
8245.150	3925.150	2.1	5.47	-0.69	5.11	0.11
8255.150	3935.150	2.1	5.47	-0.69	5.11	0.11
8265.150	3945.150	2.1	5.48	-0.68	5.12	0.12
8275.150	3955.150	2.1	5.48	-0.68	5.12	0.12
8285.150	3965.150	2.1	5.49	-0.67	5.11	0.11
8295.150	3975.150	2.1	5.49	-0.67	5.12	0.12
8305.150	3985.150	2.1	5.50	-0.66	5.12	0.12
8315.150	3995.150	2.1	5.50	-0.66	5.13	0.13
8325.150	4005.150	2.1	5.50	-0.66	5.13	0.13
8335.150	4015.150	2.1	5.51	-0.65	5.13	0.13
8345.150	4025.150	2.1	5.51	-0.65	5.13	0.13
8355.150	4035.150	2.1	5.51	-0.65	5.14	0.14
8365.150	4045.150	2.1	5.52	-0.64	5.13	0.13
8375.150	4055.150	2.1	5.52	-0.64	5.12	0.12
8385.150	4065.150	2.1	5.52	-0.64	5.12	0.12
8395.150	4075.150	2.1	5.53	-0.63	5.12	0.12
8405.150	4085.150	2.1	5.53	-0.63	5.11	0.11
8415.150	4095.150	2.1	5.54	-0.62	5.12	0.12
8425.150	4105.150	2.1	5.54	-0.62	5.12	0.12
8435.150	4115.150	2.0	5.54	-0.62	5.12	0.12
8445.150	4125.150	2.0	5.54	-0.62	5.13	0.13
8455.150	4135.150	2.0	5.54	-0.62	5.13	0.13
8465.150	4145.150	2.0	5.55	-0.61	5.12	0.12
8475.150	4155.150	2.0	5.55	-0.61	5.12	0.12
8485.150	4165.150	2.0	5.55	-0.61	5.11	0.11
8495.150	4175.150	2.0	5.56	-0.60	5.11	0.11
8505.150	4185.150	2.0	5.56	-0.60	5.11	0.11
8515.150	4195.150	2.0	5.56	-0.60	5.10	0.10
8525.150	4205.150	2.0	5.57	-0.59	5.10	0.10
8535.150	4215.150	2.0	5.57	-0.59	5.10	0.10
8545.150	4225.150	2.0	5.57	-0.59	5.10	0.10

Beulah Water Works District

Sellers and Wheeler Wells

72-Hour Pumping Test

January 29 - February 1, 2019

Recovery Data

Time Since Pump Started t (minutes)	Time Since Pump Stopped t' (minutes)	t/t'	Sellers Well Depth to Water (feet from TOC)	Sellers Well Residual Drawdown s' (feet from TOC)	Wheeler Well Depth to Water (feet from TOC)	Wheeler Well Residual Drawdown s' (feet from TOC)
8555.150	4235.150	2.0	5.58	-0.58	5.10	0.10
8565.150	4245.150	2.0	5.58	-0.58	5.09	0.09
8575.150	4255.150	2.0	5.58	-0.58	5.09	0.09
8585.150	4265.150	2.0	5.58	-0.58	5.10	0.10
8595.150	4275.150	2.0	5.58	-0.58	5.09	0.09
8605.150	4285.150	2.0	5.58	-0.58	5.09	0.09
8615.150	4295.150	2.0	5.59	-0.57	5.09	0.09
8625.150	4305.150	2.0	5.59	-0.57	5.09	0.09
8635.150	4315.150	2.0	5.59	-0.57	5.08	0.08
8645.150	4325.150	2.0	5.59	-0.57	5.09	0.09
8655.150	4335.150	2.0	5.60	-0.56	5.09	0.09
8665.150	4345.150	2.0	5.60	-0.56	5.09	0.09
8675.150	4355.150	2.0	5.60	-0.56	5.09	0.09
8685.150	4365.150	2.0	5.60	-0.56	5.09	0.09
8695.150	4375.150	2.0	5.60	-0.56	5.10	0.10
8705.150	4385.150	2.0	5.60	-0.56	5.10	0.10
8715.150	4395.150	2.0	5.60	-0.56	5.11	0.11
8725.150	4405.150	2.0	5.60	-0.56	5.12	0.12
8735.150	4415.150	2.0	5.60	-0.56	5.12	0.12
8745.150	4425.150	2.0	5.60	-0.56	5.13	0.13
8755.150	4435.150	2.0	5.60	-0.56	5.13	0.13
8765.150	4445.150	2.0	5.60	-0.56	5.14	0.14
8775.150	4455.150	2.0	5.60	-0.56	5.15	0.15
8785.150	4465.150	2.0	5.60	-0.56	5.16	0.16
8795.150	4475.150	2.0	5.60	-0.56	5.16	0.16
8805.150	4485.150	2.0	5.59	-0.57	5.17	0.17
8815.150	4495.150	2.0	5.59	-0.57	5.17	0.17
8825.150	4505.150	2.0	5.59	-0.57	5.18	0.18
8835.150	4515.150	2.0	5.58	-0.58	5.18	0.18
8845.150	4525.150	2.0	5.58	-0.58	5.18	0.18
8855.150	4535.150	2.0	5.57	-0.59	5.18	0.18
8865.150	4545.150	2.0	5.56	-0.60	5.18	0.18
8875.150	4555.150	1.9	5.55	-0.61	5.18	0.18
8885.150	4565.150	1.9	5.54	-0.62	5.18	0.18
8895.150	4575.150	1.9	5.52	-0.64	5.17	0.17
8905.150	4585.150	1.9	5.50	-0.66	5.18	0.18
8915.150	4595.150	1.9	5.45	-0.71	5.18	0.18
8925.150	4605.150	1.9	5.34	-0.82	5.17	0.17
8935.150	4615.150	1.9	5.23	-0.93	5.16	0.16
8945.150	4625.150	1.9	5.14	-1.02	5.15	0.15

Beulah Water Works District							
Sellers and Wheeler Wells							
72-Hour Pumping Test							
January 29 - February 1, 2019							
Recovery Data							
Time Since Pump Started	Time Since Pump Stopped		Sellers Well	Sellers Well	Wheeler Well	Wheeler Well
t	t'		Depth to Water	Residual Drawdown s'	Depth to Water	Residual Drawdown s'
(minutes)	(minutes)	t/t'	(feet from TOC)	(feet from TOC)	(feet from TOC)	(feet from TOC)
8955.150	4635.150	1.9	5.08	-1.08	5.14	0.14
8965.150	4645.150	1.9	5.04	-1.12	5.13	0.13
8975.150	4655.150	1.9	5.00	-1.16	5.13	0.13
8985.150	4665.150	1.9	4.98	-1.18	5.12	0.12

Appendix B

Field Water Quality Results

Beulah Water Works District

Sellers Well

72-Hour Constant-Rate Test Field Water Quality

January 29 - February 1, 2019

Q = 150 to 80 gpm

Date	Time	Flow Meter (gallons)	Cumulative Volume Pumped (gallons)	pH Meter Temperature (F)	pH (Meter)	Conductance (umhos)	Specific Conductance (umhos)	Thermometer Temperature (F)	pH (Litmus)	Pumping Rate Over Period (gpm)	Pumping Rate Instantaneous (gpm)	Comments
29-Jan-19	9:30	266									0	Start Test at 9:30 at Q = 150 gpm
	9:40	1808	1542	NA	NA	NA	NA	NA	NA	NA	125	Flow reduced to Q = 125 gpm
	9:55	3684	3418	43.1	7.19	287.2	457.8	43	7.0	125	125	Water Clear, No Odor
	10:10	5630	5364	42.2	7.42	286.5	455.0	42	7.0	130	125	Water Clear, No Odor
	10:25	7475	7209	45.5	7.37	259.8	460.0	43	7.0	123	125	Water Clear, No Odor
	11:00	11897	11631	45.5	7.46	310.3	468.0	45	7.0	126	125	Water Clear, No Odor
	12:00	19437	19171	48.8	7.38	344.9	488.0	48	7.0	126	125	Water Clear, No Odor
	13:00	26919	26653	50.3	7.33	346.6	480.0	50	7.0	125	125	Water Clear, No Odor
	14:00	34390	34124	50.6	7.42	333.6	466.0	47	7.0	125	125	Water Clear, No Odor
	15:00	41819	41553	50.2	7.41	342.6	483.0	47	7.0	124	125	Water Clear, No Odor
	16:30	52986	52720	50.3	7.42	346.3	483.0	47	7.0	124	125	Water Clear, No Odor
	17:33	NA	NA	49.3	7.43	349.7	491.0	48	7.0	NA	100	Flow reduced to Q = 100 gpm
	18:30	66427	66161	48.4	7.56	340.5	484.0	47	7.0	NA	100	Water Clear, No Odor
	19:30	72536	72270	47.8	7.51	331.7	477.0	47	7.0	102	100	Water Clear, No Odor
	20:30	78650	78384	47.4	7.53	332.8	478.0	47	7.0	102	100	Water Clear, No Odor
	23:30	97308	97042	47.5	7.51	341.3	495.0	47	7.0	104	100	Water Clear, No Odor
30-Jan-19	0:30	103017	102751	47.4	7.51	335.3	480.0	47	7.0	95	90	Flow reduced to Q = 90 gpm
	1:30	108405	108139	46.1	7.47	330.3	493.0	46	7.0	90	90	Water Clear, No Odor
	2:00	113770	113504	47.6	7.35	335.8	485.0	47	7.0	89	90	Water Clear, No Odor
	4:34	124836	124570	53.8	7.32	356.2	476.0	45	7.0	89	90	Water Clear, No Odor
	5:30	129829	129563	52.4	7.31	368.3	490.0	44	7.0	83	90	Water Clear, No Odor
	6:30	135176	134910	50.8	7.33	348.1	477.0	44	7.0	89	90	Water Clear, No Odor
	7:30	140522	140256	52.3	7.32	355.5	481.0	45	7.0	89	90	Water Clear, No Odor
	8:30	145868	145602	49.0	7.36	347.0	484.0	44	7.0	89	90	Water Clear, No Odor
	9:30	151216	150950	51.2	7.33	360.6	496.0	44	7.0	89	90	Water Clear, No Odor
	10:30	156559	156293	47.8	7.34	349.3	502.0	47	7.0	89	90	Water Clear, No Odor
	11:30	161910	161644	51.0	7.31	361.9	497.0	45	7.0	89	90	Water Clear, No Odor
	12:30	167244	166978	50.7	7.33	347.0	474.0	45	7.0	89	90	Water Clear, No Odor
	14:30	177884	177618	48.3	7.31	334.2	478.0	45	7.0	89	90	Water Clear, No Odor
	15:30	183218	182952	50.2	7.32	345.9	484.0	44	7.0	89	90	Water Clear, No Odor
	16:30	188552	188286	49.2	7.33	399.6	496.0	45	7.0	89	90	Water Clear, No Odor
	17:30	193886	193620	48.9	7.33	335.5	477.0	45	7.0	89	90	Water Clear, No Odor
	18:30	199221	198955	48.6	7.33	337.9	482.0	45	7.0	89	90	Water Clear, No Odor
	19:30	204556	204290	48.7	7.37	344.5	483.0	45	7.0	89	90	Water Clear, No Odor
	20:30	209900	209634	49.0	7.37	342.7	486.0	45	7.0	89	90	Water Clear, No Odor
	21:30	215239	214973	48.2	7.33	343.0	497.0	45	7.0	89	90	Water Clear, No Odor
	22:30	220580	220314	47.8	7.35	344.3	484.0	47	7.0	89	90	Water Clear, No Odor
	23:30	225919	225653	46.4	7.35	343.8	482.0	46	7.0	89	90	Water Clear, No Odor
31-Jan-19	0:30	231209	230943	46.3	7.33	344.5	481.0	45	7.0	88	90	Water Clear, No Odor
	1:30	236499	236233	46.6	7.41	343.2	483.0	45	7.0	88	90	Water Clear, No Odor
	2:30	241939	241673	45.9	7.35	344.3	488.0	45	7.0	91	90	Water Clear, No Odor
	3:30	247242	246976	45.8	7.33	342.4	487.0	45	7.0	88	90	Water Clear, No Odor

Beulah Water Works District												
Sellers Well												
72-Hour Constant-Rate Test Field Water Quality												
January 29 - February 1, 2019												
Q = 150 to 80 gpm												
Date	Time	Flow Meter (gallons)	Cumulative Volume Pumped (gallons)	pH Meter Temperature (F)	pH (Meter)	Conductance (umhos)	Specific Conductance (umhos)	Thermometer Temperature (F)	pH (Litmus)	Pumping Rate Over Period (gpm)	Pumping Rate Instantaneous (gpm)	Comments
	4:30	252607	252341	49.6	7.42	351.7	492.0	45	7.0	89	90	Water Clear, No Odor
	5:30	257938	257672	50.9	7.36	354.4	485.0	45	7.0	89	90	Water Clear, No Odor
	6:30	263138	262872	49.5	7.32	349.6	480.0	45	7.0	87	90	Flow reduced to Q = 80 gpm at 6:12
	7:30	267970	267704	46.1	7.30	312.3	466.0	43	7.0	81	80	Water Clear, No Odor
	8:30	272805	272539	47.8	7.31	330.8	477.0	44	7.0	81	80	Water Clear, No Odor
	9:30	277632	277366	49.3	7.32	347.7	488.0	44	7.0	80	80	Water Clear, No Odor
	10:30	282459	282193	49.4	7.32	338.3	467.0	44	7.0	80	80	Water Clear, No Odor
	11:30	287287	287021	50..1	7.31	348.7	482.0	45	7.0	80	80	Water Clear, No Odor
	12:30	292112	291846	50.1	7.31	348.9	486.0	45	7.0	80	80	Water Clear, No Odor
	13:30	296943	296677	48.6	7.48	327.4	468.0	45	7.0	81	80	Water Clear, No Odor
	14:30	301765	301499	51.2	7.34	328.6	480.0	44	7.0	80	80	Water Clear, No Odor
	16:30	311421	311155	54.9	7.30	371.6	484.0	44	7.0	80	80	Water Clear, No Odor
	17:30	316248	315982	50.4	7.30	352.8	478.0	44	7.0	80	80	Water Clear, No Odor
	18:30	321076	320810	49.7	7.31	349.9	490.0	44	7.0	80	80	Water Clear, No Odor
	19:30	325909	325643	50.6	7.31	354.1	486.0	44	7.0	81	80	Water Clear, No Odor
	20:30	330742	330476	50.0	7.30	343.3	480.0	44	7.0	81	80	Water Clear, No Odor
	21:30	335382	335116	50.2	7.30	342.6	481.0	44	7.0	77	80	Water Clear, No Odor
	22:30	340319	340053	50.1	7.31	344.3	483.0	44	7.0	82	80	Water Clear, No Odor
	23:30	345155	344889	50.0	7.33	346.1	487.0	44	7.0	81	80	Water Clear, No Odor
1-Feb-19	0:30	349997	349731	50.2	7.31	347.2	485.0	44	7.0	81	80	Water Clear, No Odor
	1:30	354895	354629	50.0	7.31	344.6	481.0	44	7.0	82	80	Water Clear, No Odor
	2:30	359749	359483	50.4	7.33	345.7	484.0	44	7.0	81	80	Water Clear, No Odor
	3:30	364589	364323	50.2	7.33	344.6	481.0	44	7.0	81	80	Water Clear, No Odor
	4:30	369422	369156	50.1	7.30	344.5	480.0	45	7.0	81	80	Water Clear, No Odor
	5:30	374258	373992	49.6	7.30	345.3	479.0	44	7.0	81	80	Water Clear, No Odor
	6:30	379092	378826	50.3	7.31	345.1	480.0	44	7.0	81	80	Water Clear, No Odor
	7:45	385130	384864	50.5	7.30	345.9	480.0	44	7.0	81	80	Water Clear, No Odor
	8:30	388756	388490	50.3	7.32	353.2	491.0	44	7.0	81	80	Water Clear, No Odor
	9:15	392379	392113	45.6	7.24	313.4	465.0	44	7.0	81	80	Water Clear, No Odor
	9:30	393589	393323								0	Test stopped
			Minimum Values =	42.2	7.2	259.8	455.0	42.0				
			Average Values =	49.0	7.35	341.56	481.66	45.00				
			Maximum Values	54.9	7.6	399.6	502.0	50.0				

Beulah Water Works District

Sellers Well

72-Hour Constant-Rate Test Field Sand Content

January 29 - February 1, 2019

Q = 150 to 80 gpm

Date	Start Time	End Time	Flow Meter (gallons)	Length of Sample Collection (minutes)	Total Sand Sample Collection (milliliters)	Sand Content (ppm)	Pumping Rate (gpm)	Comments
29-Jan-19	9:30	9:30	266					Start 72-Hour Test at 09:30 at Q=150 gpm
		9:40	1808	10	0.05	2.64	125	
	9:45	9:55	3684	10	0.00	0.00	125	
	10:00	10:10	5630	10	0.00	0.00	125	
	10:15	10:25	7475	10	0.00	0.00	125	
	10:30	11:00	11897	30	0.00	0.00	125	
		12:00	19432	90	0.00	0.00	125	
		13:00	26919	150	0.00	0.00	125	
		14:00	34390	210	0.00	0.00	125	
		15:00	41819	270	0.00	0.00	125	
		16:30	52986	360	0.00	0.00	125	
		19:30	72536	540	0.00	0.00	100	Flow reduced to Q = 100 gpm at 17:30
	19:30	20:30	78650	60	0.00	0.00	100	
30-Jan-19		4:30	124836	540	0.00	0.00	90	Flow reduced to Q = 90 gpm at 0:30
		5:30	129829	600	0.00	0.00	90	
		6:30	135176	660	0.00	0.00	90	
		7:30	140522	720	0.00	0.00	90	
		8:30	145868	780	0.00	0.00	90	
		9:30	151216	840	0.00	0.00	90	
		10:30	156559	900	0.00	0.00	90	
		11:30	161910	960	0.00	0.00	90	
		12:30	167244	1020	0.00	0.00	90	
		13:30	172547	1080	0.00	0.00	90	
		14:30	177884	1140	0.00	0.00	90	
		15:30	183218	1200	0.00	0.00	90	
		16:30	188552	1260	0.00	0.00	90	
		17:30	193886	1320	0.00	0.00	90	
		18:30	199221	1380	0.00	0.00	90	
		19:30	204556	1440	0.00	0.00	90	

Beulah Water Works District								
Sellers Well								
72-Hour Constant-Rate Test Field Sand Content								
January 29 - February 1, 2019								
Q = 150 to 80 gpm								
Date	Start Time	End Time	Flow Meter (gallons)	Length of Sample Collection (minutes)	Total Sand Sample Collection (milliliters)	Sand Content (ppm)	Pumping Rate (gpm)	Comments
		20:30	209900	1500	0.00	0.00	90	
		21:30	215239	1560	0.00	0.00	90	
		22:30	220580	1620	0.00	0.00	90	
31-Jan-19		23:30	225919	1680	0.00	0.00	90	
		0:30	231209	1740	0.00	0.00	90	
		1:30	236499	1800	0.00	0.00	90	
		2:30	241939	1860	0.00	0.00	90	
		3:30	247242	1920	0.00	0.00	90	
		4:30	252607	1980	0.00	0.00	90	
		5:30	257938	2040	0.00	0.00	90	
		6:30	263138	2100	0.00	0.00	80	Flow reduced to Q = 80 gpm at 6:12
		7:30	267970	2160	0.00	0.00	80	
		8:30	272805	2220	0.00	0.00	80	
		9:30	277632	2280	0.00	0.00	80	
		10:30	282459	2340	0.00	0.00	80	
		11:30	287287	2400	0.00	0.00	80	
		12:30	282112	2460	0.00	0.00	80	
		13:30	296943	2520	0.00	0.00	80	
		14:30	301765	2580	0.00	0.00	80	
		15:30	306594	2640	0.00	0.00	80	
		16:30	311421	2700	0.00	0.00	80	
		17:30	316248	2760	0.00	0.00	80	
		18:30	321076	2820	0.00	0.00	80	
		19:30	325909	2880	0.00	0.00	80	
		20:30	330742	2940	0.00	0.00	80	
1-Feb-19		5:30	374258	3480	0.00	0.00	80	
		6:30	379092	3540	0.00	0.00	80	
		7:45	385130	3615	0.00	0.00	80	
		8:30	388756	3660	0.00	0.00	80	

Beulah Water Works District								
Sellers Well								
72-Hour Constant-Rate Test Field Sand Content								
January 29 - February 1, 2019								
Q = 150 to 80 gpm								
Date	Start Time	End Time	Flow Meter (gallons)	Length of Sample Collection (minutes)	Total Sand Sample Collection (milliliters)	Sand Content (ppm)	Pumping Rate (gpm)	Comments
		9:15	392379	3705	0.00	0.00	80	
		9:30	393589				0	Test stopped

Beulah Water Works District

South Creek

72-Hour Constant-Rate Test Field Water Quality

January 29 - February 1, 2019

Q = 150 to 80 gpm

Date	Time	Flow Meter (gallons)	Cumulative Volume Pumped (gallons)	pH Meter Temperature (F)	pH (Meter)	Conductance (umhos)	Specific Conductance (umhos)	Thermometer Temperature (F)	pH (Litmus)	Pumping Rate Over Period (gpm)	Pumping Rate Instantaneous (gpm)	Comments
29-Jan-19	9:30	266									0	Start Test at 9:30 at Q = 150 gpm
	9:55	3684	3418	34.3	7.40	194.1	354.7	34	7.5	137	125	Water Clear, No Odor
	16:30	52986	52720	NA	NA	193.8	357.3	34	7.5	125	125	Water Clear, No Odor
30-Jan-19	7:40	141650	141384	42.1	7.63	217.3	345.7	34	7.5	97	90	Water Clear, No Odor
	12:30	167244	166978	43.7	7.70	226.4	352.3	34	7.0	88	90	Water Clear, No Odor
	16:30	188552	188286	39.6	7.81	135.4	211.1	34	7.0	89	90	Water Clear, No Odor
31-Jan-19	7:30	267970	267704	39.7	7.62	207.6	355.9	34	7.0	88	80	Water Clear, No Odor
	12:30	292112	291846	42.0	7.79	214.1	339.2	35	7.0	80	80	Water Clear, No Odor
	16:30	311421	311155	43.4	7.99	218.9	349.0	36	7.0	80	80	Water Clear, No Odor
1-Feb-19	9:30	393589	393323	37.9	7.73	190.3	324.7	34				Test stopped
			Minimum Values =	34.3	7.4	135.4	211.1	34.0				
			Average Values =	40.3	7.71	199.77	332.21	34.33				
			Maximum Values	43.7	8.0	226.4	357.3	36.0				

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June 24, 2019

M E M O R A N D U M

TO: Andrew R. Rice, P.E.

CC: Dave Stanford; Ryan Farr, Esq.

FROM: Daniel Gillham, P.E.

SUBJECT: Scope of Work and Cost Estimate for Work in Connection with Augmenting Future Well Depletions – Beulah Water Works District and Pine Drive Water District – Purchase Order No. 1

I have completed preliminary investigations of historical municipal water use and depletions by the Beulah Water Works District and the Pine Drive Water District (the Districts) under their surface water rights, and future depletions to be augmented by the Districts if they transition to a groundwater (alluvial well) source of water. This memorandum describes briefly the Districts' historical diversions of surface water, my analysis of those records, historical depletions of surface water, and future depletions if the same historical water demands are diverted from an alluvial well. It also identifies and describes several options for augmentation of the future well depletions and the approximate costs of each. All costs listed below are in 2019 dollars.

HISTORICAL WATER DEMANDS AND DEPLETIONS

The Pine Drive Water District (Pine Drive) diverts its Eureka Ditch water right (0.1 cfs, 1861 priority) through infiltration galleries and wells at its treatment plant located next to the North St. Charles River near the mouth of the Beulah Valley. The Beulah Water Works District (Beulah) diverts its Fisher Ditch water right (0.7 cfs, 1864 priority) from Middle Creek upstream of the town of Beulah. See **Figure 1**. Both water rights are relatively senior in priority. The most senior call on record is same priority as the Eureka Ditch and occurred only once. This same call is the only call on record senior to Beulah's Fisher Ditch. **Table 1** displays the recorded calls in the St. Charles River and Middle Creek. The main limitations on diversions of these water rights have been due to physical supply and water quality. **Table 2** shows the 2006-2018[1] average and maximum combined diversions for the Districts. These data are compiled from the individual diversion records for each District, obtained from the Districts and from the Colorado Decision Support System (CDSS). The diversion records represent water pumped in to the Districts' treatment plants[2].

[1] Records prior to 2006 are either missing, or not reliable or representative (based on communications with Dave Stanford and Andrew Rice, and engineering judgment).

[2] System losses are somewhat higher in the Districts' service areas (particularly in Beulah) than is generally expected for small community water systems (A. Rice, personal communication). The analysis herein uses total diversions because 1) the ultimate fate of system losses has not

Indoor diversions are the total diversions in the non-irrigation season months (November-March). During the irrigation season months (April-October), indoor use is the average monthly non-irrigation season use. Outdoor irrigation use is calculated as the total demand minus indoor use during the irrigation season months[3].

Historical consumptive use in **Table 3** is calculated as 10 percent of indoor use and 85 percent of outdoor use (i.e., the uses in **Table 2** x 10% or 85%). These are generally accepted, conservative factors for indoor use treated by non-evaporative individual septic systems and for outdoor irrigation, respectively.

The historical groundwater return flows (i.e., the remaining 90 percent of indoor use and the remaining 15 percent of outdoor use) are lagged back to the stream system using the Glover method (a commonly used and accepted method for calculating lagged effects of pumping or recharge on stream systems). The aquifer widths are shown in **Figure 2**, being the average distances to the stream system from the centroid of the Districts' service areas. The aquifer hydraulic parameters are based on communication with and reporting from C. Hemenway and on engineering judgement[4]. The historical stream depletion is calculated as the historical diversion minus historical return flow. **Table 4** shows the historical lagged return flow, and **Table 5** shows the historical depletions for the average and maximum-use years. Depletions are the difference between water diverted and water returned to the stream system (**Table 4** minus **Table 2**)[i]. The Districts historically depleted 9.9 acre-feet per year on average, and 18.6 acre-feet in the high-use year (2017). This is the amount of augmentation credit the Districts' water rights would generate if converted to augmentation use (Option Group 2 below).

FUTURE WELL DEPLETIONS

The Districts have identified the Sellers well[ii] (WDID No. 1505057) as the most promising source of water in the future. Courtney Hemenway reported on the aquifer productivity and parameters, recommending a transmissivity of 20,890 gpd/ft and a storage coefficient of 0.35 for the well. Future well depletions are modeled as the lagged pumping of the historical total combined water demands in **Table 2** from the Sellers well, using these aquifer parameters along with an alluvial aquifer boundary coincident with the top of the hill between Squirrel and Middle Creeks (**Figure 2**). **Table 6** displays the average and maximum total (gross) stream depletions from future pumping of the Sellers well for the Districts' use, and **Table 7** shows the net stream depletions after crediting the historical lagged return flows from **Table 4** (calculated as **Table 4** plus **Table 6**). Historical and future return flows will essentially be the same assuming minimal growth[5] and similar water use patterns in the future. Please see End Note (i) for definitions and information

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been investigated or assumed, and 2) to develop the worst-case volume of augmentation requirement.

[3] It is noted that the outdoor irrigation use appears to be very low, indicating few large lawns in the area. This was confirmed by D. Stanford (personal communication) and by my own site visit to the Districts' service areas on November 20, 2018.

[4] "Groundwater Potable Water Supply Evaluation for the Beulah Valley – Sellers Well Pumping Test". Courtney Hemenway, February 24, 2019. Transmissivity applied herein for the Districts' combined service area is half of the Sellers well (50% of 20,890 gpd/ft), and specific yield (S_y) = 0.35.

[5] The Districts' service areas are mostly built out, and the Districts do not plan to expand their service area boundaries (D. Stanford, personal communication).

on historical and future depletions, and End Note (ii) for more information on the Districts' and Mr. Sellers' future use of his well.

FUTURE WELL AUGMENTATION

The future well depletions by the Districts will be junior to all existing downstream water rights in the St. Charles River system, and therefore, they must be augmented (repaid). The principal downstream senior call in the St. Charles River system is the St. Charles Flood Ditch, owned by EVRAZ Rocky Mountain Steel (EVRAZ, formerly Colorado Fuel & Iron Co.). Senior calls would generally come from the main stem Arkansas River at other times, but the Districts must be able to augment their junior well depletions above the St. Charles Flood Ditch whenever the water rights are calling at that point. The Districts have two primary groups of options for well augmentation: 1) purchase augmentation water/credit for the full net well depletions, or 2) use the historical depletion of their surface water rights (i.e., the Eureka and Fisher Ditch water rights) as credit against future well depletions. Each group of options is described below.

Option Group 1 – Purchase Full Augmentation

The Districts must secure a source of augmentation water and/or join a well augmentation association to manage their water rights augment their out of priority depletions. This option *may* require Water Court action to adjudicate a "plan for augmentation" and/or enroll the Districts' use of the Sellers well into an existing plan for augmentation. I investigated several entities for the possibility of full augmentation (approximately 10 to 18 acre-feet per year as shown in **Table 7**):

- **Option 1a – Colorado Water Protective and Development Association (CWPDA):** CWPDA's plan for augmentation is limited to a total annual volume of augmentation by its Water Court decree. It is currently very near that cap and does not have the ability to augment the Districts' depletion under its plan for augmentation.
    - The only way CWPDA could augment the Districts' use of the Sellers well is if the Division Engineer determines that future use of the Sellers well by the Districts fits the Rule 14 criteria[6]. I think this is an unlikely outcome, and the cost of augmentation water would be high. Therefore, CWPDA is not being considered as an option for full augmentation for the Districts.
- **Option 1b – Pueblo Board of Water Works (PBWW):** PBWW leases water annually to numerous parties for augmentation or other uses. PBWW's augmentation water sources are predominantly on the main stem Arkansas River. PBWW has limited ability to divert water into the Minnequa Canal, owned by EVRAZ, in lieu of providing augmentation water at the St. Charles Flood Ditch headgate[7] (the Minnequa Canal conveys water to the same system as the St. Charles Flood Ditch—see **Figure 3**). EVRAZ would have to agree to this arrangement. However, PBWW cannot guarantee the amount of augmentation water needed by the Districts at that location, and does not appear to be a viable option for full augmentation.

[6] The State and Division Engineers may approve plans for augmentation, outside of the Water Court process, for pumping of wells for uses permitted or decreed prior to January 1, 1986.

[7] Alan Ward, Water Resources Division Manager, Pueblo Board of Water Works, Personal communication.

- **Option 1c – Arkansas Groundwater Users Association (AGUA):** AGUA has member wells in the St. Charles River system, including the Sellers well. However, it does not have unused additional water sources above the St. Charles Flood Ditch in the annual volumes needed by the Districts[8]. Therefore, AGUA does not presently appear to be a viable option for augmentation of the Districts' full well depletions.

- **Option 1d – Mountain View Water & Ditch Company (MVWDC):** I communicated with Steve Phelps, owner of the MVWDC. MVWDC owns 900 acre-feet of nontributary, bedrock aquifer water which it pumps into the St. Charles River system for augmentation credit for its shareholders. One share provides 0.1 acre-foot of augmentation water per year. The Districts could purchase MVWDC stock at $1,800 per share. After the initial purchase, MVWDC members pay annual assessments to cover power, maintenance, and administrative costs for the shares they have actually put to use (no assessments are levied against shares for which no pumping has occurred). In 2018, these fees worked out to approximately $54 per share ($54 per 0.1 ac-ft).

  The Districts' average annual depletions would require a minimum of 104 shares assuming 5 percent transit loss in the St. Charles River to the confluence of the North St. Charles River with the main stem St. Charles River (9.8 acre-feet ÷ 0.1 acre-foot per share ÷ (100% - 5%)). The initial cost would be about $187,000. In addition, this option would require a Water Court-decreed plan for augmentation to use the water source as augmentation for the well. I estimate that such a case could cost up to $40,000 for the engineering and legal fees. Annual assessments for the 104 shares would be approximately $5,600 (2019 dollars).

  *Additional note: There is currently enough un-allocated water in MVWDC's portfolio to fully augment the Districts' future maximum depletions (would require more shares, see **Table 7**). However, it is available on a "first come, first served" basis. If other parties purchase significant volumes of the unallocated water prior to the Districts, it may not be a viable/available source for full augmentation in the future.*

Option Group 2 – Use the Districts' Surface Water Rights as Augmentation Credit

The Districts' annual depletions in the future, using the Sellers well, will essentially be the same as their historical annual depletions, assuming negligible population growth or additional outdoor irrigation). Therefore, on an annual basis, the Districts' existing surface water rights would generate sufficient credit such that little, if any, additional augmentation water would need to be purchased. **Table 8** compares the historical annual depletions shown in **Table 5** and the future net well depletions in **Table 7**. The Districts would have to record well meter readings and measure water available to their surface water rights, and provide accounting forms to the Division Engineer and Water Commissioner, on a monthly basis. Advantages to this option are 1) financial—most likely lower initial costs and relatively low annual membership, maintenance, and engineering fees long-term; and 2) water supply security—the Districts will own the bulk of their augmentation water supplies, which originate from natural flows in the same vicinity as the well depletions (as opposed to being pumped from off-site). Risks are that the Districts could still face water use restrictions in dry months or years when Middle Creek is not flowing, unless the Districts purchase or lease additional augmentation water described below.

[8] Kevin Niles, General Manager, personal communication.

Option Group 2 would require Water Court action to change the use of the water rights (initially costing up to approximately $80,000 for engineering and legal services and approximately $60,000 for additional infrastructure for measurement and determination of augmentation credit, described below). Annual costs would be approximately $6,000 for infrastructure maintenance. After the Water Court decree is final, the Districts' would ongoing reporting responsibilities and potential annual fees for measurement, association membership, administration, and/or engineering. The Water Court decree would be set up for either a standalone plan for augmentation with possible backup augmentation supplies (Options 2b and 2d below), or would allow the Districts to use their water rights in an established plan for augmentation (Options 2a and 2c below).

Measurement Equipment

My understanding from my communications with the Division 2 Engineer and his staff is that measurement of Pine Drive's water right might require an in-stream structure such as a rock cross-vane weir in the vicinity of Pine Drive's existing water treatment plant[9]. Measurements at different flow rates would be made to establish a "rating curve". A rating curve is the relationship between water depth and flow at a given location. If this type of structure is ultimately deemed to be acceptable by Division 2, the design- and construction-related cost is estimated at $19,000. If a more traditional measurement or diversion structure is required, the cost could be $50,000 or more.

Measurement of Beulah's water right would require one of 1) measurement of Beulah's water right over the V-notch weir at the existing intake[10]; 2) diversion of Beulah's water right into the existing intake, measurement by a flow meter, and discharge to Middle Creek (aka, an augmentation station); 3) a cross-vane or similar structure on Middle Creek (could be near the confluence with North Creek); or 4) an augmentation station out of one of the ditches in the area[11].

Data logging equipment would be required at both points of measurement, and telemetry on at least the Pine Drive structure. Finally, the Districts would pay annual maintenance and measurement fees to the State. I obtained costs for similar structures from the Division 2 and State Engineers' Offices and from A. Rice. **Table 9** details my estimates of the infrastructure costs, including contingencies. For this memorandum, initial design and construction costs are estimated at $100,000 (assuming the "worst-case", traditional measurement structure for Pine Drive), and annual maintenance fees are estimated at $6,000.

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[9] The Districts would need to obtain a Nationwide permit through the Army Corps of Engineers. Such permit allows water providers such as the Districts to conduct work within stream channels exempt from the normal Section 404 permit requirements. **The process and cost of obtaining said permit are beyond the scope of this memorandum**.

[10] Measurement items (1) and (2): It is assumed that while Beulah's existing pipeline would be abandoned, the V-notch weir and/or pipeline intake could be utilized to measure the Fisher Ditch water right (over the weir) or divert and measure it through the pipeline intake and return the diversion to Middle Creek a short distance downstream.

[11] Beulah's Fisher Ditch water right could be diverted into the Pioneer Middle or Sease Ditches near Beulah's existing point of diversion, and a new turnout and flume established just below the diversion to measure Beulah's water right back into Middle Creek. This would require an agreement with the owner(s) of the ditch used, and the ditch would have to be able to divert Beulah's water right all year long. (This is not viewed as the best option, compared to Measurement Items (1) and (2).)

Baseline costs for these options are $180,000 initially ($80,000 engineering and legal plus $100,000 measurement infrastructure) and $6,000 annually for maintenance and measurement. Individual options below have varied annual costs, depending on estimates of membership fees and additional engineering support.

- **Option 2a – CWPDA:** As noted above, CWPDA is not presently judged to be a possibility for augmentation of the Districts' use of the Sellers well. IF we learn otherwise, **Table 10** contains pertinent details. Annual CWPDA membership is currently $315 per well. CWPDA would also charge the Districts additional fees annually for any depletions over the yield of the Districts' water rights; the only source in the upper St. Charles River system approved for use in CWPDA's Rule 14 Plan is MVWDC water. I estimate that this Option 2a would cost up to approximately $180,000 initially and $6,315 annually (2019 dollars), NOT including additional water purchased from MVWDC.

- **Option 2b – PBWW:** PBWW is open to entering in to a lease agreement with the Districts for Arkansas River main stem augmentation water[12]. The maximum lease term is typically 20 years. The minimum lease volume is 10 acre-feet per year, and the lease rate is $736.40 per acre-foot ($7,364 total, annually). The cost would be up to approximately $180,000 initially plus $7,000 annually for maintenance and engineering support ($6,000 maintenance + $1,000 engineering), besides the annual lease payments of $7,364. Given that 1) the lease volume is likely much greater than the Districts would need, 2) the Districts would likely need the augmentation water at the St. Charles Flood Ditch headgate rather than the Arkansas River, and 3) the annual cost is approximately double the other options in Group 2, PBWW does not appear to be the best option for the Districts.

- **Option 2c – AGUA:** AGUA has much greater ability to manage the Districts' well depletions if the Districts provide water rights for credit than for full augmentation[13]. AGUA and the Districts would enter into a long-term agreement whereby the Districts would lease their water rights to AGUA[14], and AGUA would augment the Districts out of its entire water rights portfolio (including the Districts' water rights). AGUA would include monthly accounting of the Districts' well depletion within its decreed plan for augmentation. The Districts' responsibilities would be 1) monthly reporting of well pumping, 2) annual membership fee of $600, and 3) annual payment of $325 per acre-foot for any depletion over and above the yield of the Districts' water rights (accounted for annually)[15]. For example, if the Districts' water rights yielded 10 acre-feet in a year, and the Districts' well depletions summed to 11 acre-feet, the Districts' financial obligation to AGUA would be $925 ($600 membership + $325/acre-foot x 1 acre-foot). I estimate that this Option 2c would cost up to $180,000 initially and $6,600 annually (2019 dollars), NOT including costs for additional depletions.

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[12] A. Ward, personal communication

[13] K. Niles, personal communication

[14] My understanding is that it would be the Districts' responsibility to change the use of their water rights in Water Court before AGUA would enter into an augmentation and lease agreement.

[15] This additional cost assumes that AGUA sources, NOT MVWDC shares, could be used for additional augmentation of the Districts' depletions.

- **Option 2d – MVWDC:** MVWDC stock is an option for additional water to cover any imbalances if the Districts choose to adjudicate their own standalone plan for augmentation, or if they need supplemental water along with CWPDA or AGUA. The initial cost would be $180,000 engineering, legal, and infrastructure, plus the amount of additional water the Districts desire to purchase ($1,800 per 0.1 acre-foot). Annual ongoing costs would be approximately $7,000 for maintenance and engineering support, plus approximately $54 per 0.1 acre-foot ($54 per share) of MVWDC stock utilized.

Table 9 displays all of the Options described above along with their key advantages and disadvantages and estimated costs.

CONCLUSION AND NEXT STEPS

As discussed above and demonstrated in **Table 10**, the Districts' best options from the perspective of legal water supply involve changing the use of their existing water rights from direct diversion for municipal uses to augmentation of their use of the Sellers well. The only option in Group 1 (options without a change of use of existing water rights) that guarantees augmentation water for the Districts in the time, place, and amounts they need it is MVWDC (Option 1d). This option would cost an approximate minimum of $224,000 initially, plus and ongoing annual fees comparable to Option Group 2. Unless the Districts purchase more water (e.g., 17.6 acre-feet for the maximum-use year, totaling about $375,000 initially and $10,000 annually[16]), water use restrictions may be necessary most years in the future.

Option Group 2, involving changing the use of the Districts' existing water rights, has the potential to provide the Districts much greater flexibility and buffer against fluctuating water supplies and demands. This is because the Districts' water rights originate in the same area of their future well depletions, so any small imbalance between their monthly or annual depletions and yield of their water rights can be augmented much more easily and cheaply either through an augmentation association (AGUA or CWPDA) or additional supplies (MVWDC or PBWW).

Funding Request Recommendation

I recommend that the Districts pursue Option Group 2. For all of the Options in Option Group 2, the Districts should plan on up-front engineering, legal, and construction-related fees to total approximately **$216,000** ($180,000 plus 20% contingency). Ongoing annual costs of augmentation will total **$6,600** to **$14,000**, inclusive of an allowance for minor depletions over and above the yield of the Districts' water rights.

Next Steps

The Districts should plan on the following next steps in the augmentation process:

1. In June, 2019, the Districts' water resources engineer should renew the temporary substitute water supply plan (SWSP) by which Division 2 allows the Districts' IGA for sharing and hauling water to operate (estimated to cost less than $1,500 for 2019 and 2020 renewals, including SWSP fees). As the funding and Water Court application processes will take many months to complete, the SWSP will need to be renewed annually until the Water Court application is filed. At that point, new SWSPs will be

[16] Initial MVWDC cost calculated by: (9.7 or 17.6) acre-feet ÷ 0.1 acre-feet per share at 5% transit loss (102 or 186 shares at $1,800 per share), plus $40,000 legal and engineering fees. Annual fees calculated by $54 per share x 186 shares.

necessary until completion of the Sellers well rehabilitation/pipelines to the Districts, AND the Water Court decree is signed. These future SWSP requests may cost more due to the additional engineering efforts that may be required.

2. The Districts will continue and complete their funding request package in order to secure funding for the entire water project, including the augmentation and change of water right topics described herein.

3. Designate a representative to communicate and negotiate with the entities described above regarding augmentation of the Sellers well. This can be started any time, but the best and most effective start time would be after funding is secured.

4. Determine the best (most effective, risk-free, and economically feasible initial- and long-term) option for augmentation, upon securing funding and negotiations described in Step 1. The Districts' water resources engineer and water counsel will complete this task, with assistance from District representatives and consultants. This is included in the cost estimate for legal and engineering fees.

5. Complete preliminary engineering report, file an application with the Water Court to a) change the use of the Districts' water rights from direct diversion for municipal uses to diversion for augmentation, replacement, storage, and municipal uses; b) augment the Districts' use of the Sellers well with the changed water rights; and c) use each District's water rights within the boundaries of the other District. The Districts' water resources engineer and water counsel will complete this task, with assistance from District representatives and consultants. This is included in the cost estimate for legal and engineering fees.

6. Negotiate a stipulated Water Court decree (18 months to 3 years after the application is filed). The Districts' water resources engineer and water counsel will complete this task, with assistance from District representatives and consultants. This is included in the cost estimate for legal and engineering fees.

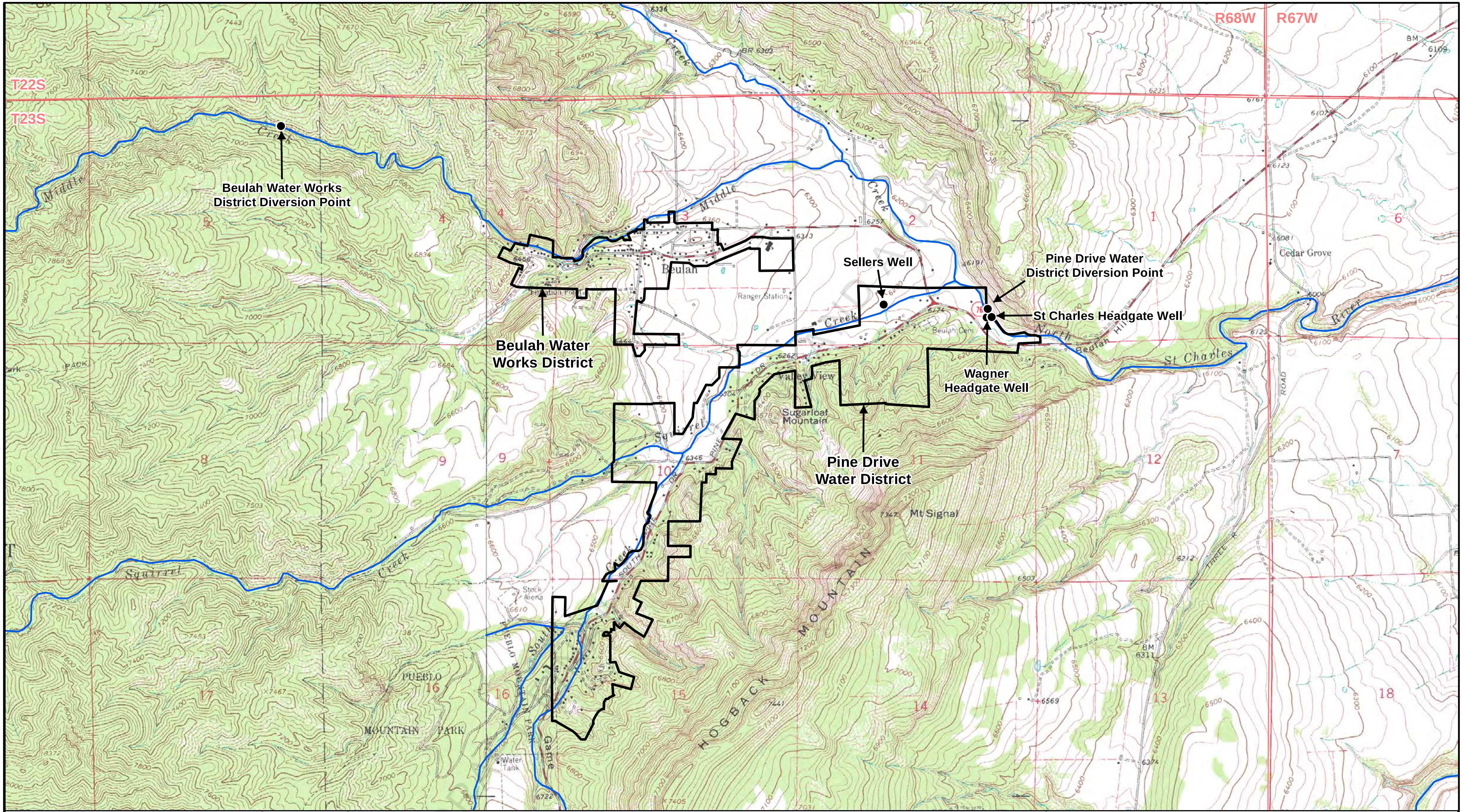
Steps 4 through 6 will be largely completed by the Districts' water resources engineer and water counsel, with assistance from District representatives and other consultants. They are included in the cost estimate for legal and engineering fees.

END NOTES

[i] DISCUSSION OF DEPLETIONS: Use of water results in consumption of a portion of the water used. The unconsumed portion returns to the stream system after running either over the surface of the land through gutters or storm drains, or percolating through the soil to the groundwater (e.g., lawn irrigation and septic systems). Surface runoff is generally modeled to return to the stream system in the same month of diversion, whereas groundwater returns take longer ("lag"). The depletions experienced by the stream system are the differences between the amount of water diverted and the portion that returns to the stream in a given month. The Districts' future diversions at the Sellers well will also have a lagged effect on the stream system, as opposed to the historical "direct" diversions from the streams. Future depletions will be determined by the difference between the lagged depletions from the well diversions and the lagged return flows after use of the water.

[ii] DISCUSSION REGARDING DICK SELLERS' USE OF WELL The overall concept of the Districts' future use of the Sellers well envisions reconstruction of the existing well casing and pumping equipment along with well site access, security, electrical and control improvements consistent with the Colorado Department of Public Health and Environment (CDPHE) requirements for a public water supply well. The Districts will cover all capital cost improvements to the well and will share operations expenses (i.e., electrical, maintenance, repairs) on a percentage basis equivalent to the annual amount of water each party uses.

The design, construction and operation of these improvements will not hinder or otherwise impact Mr. Sellers' use of water from the well. The infrastructure design will incorporate a means whereby Mr. Sellers can withdraw water from the well at any time at flowrates that are useable to him and with separate flow measurement and totalizing equipment. The Districts and Mr. Sellers envision that his future use of water from the well to continue largely unchanged from his current use and continue to be governed by his current augmentation agreement with AGUA. Nothing contained in this memorandum should be construed as changing, adding to, or limiting Mr. Sellers' use or augmentation obligation.



Helton & Williamsen, P.C.

Drawn by: ACO

File: Beulah_Pine_Dr_Fig1.mxd

Checked by:

Job No. P2001 | Date: 11/8/2018 | Rev. Date:

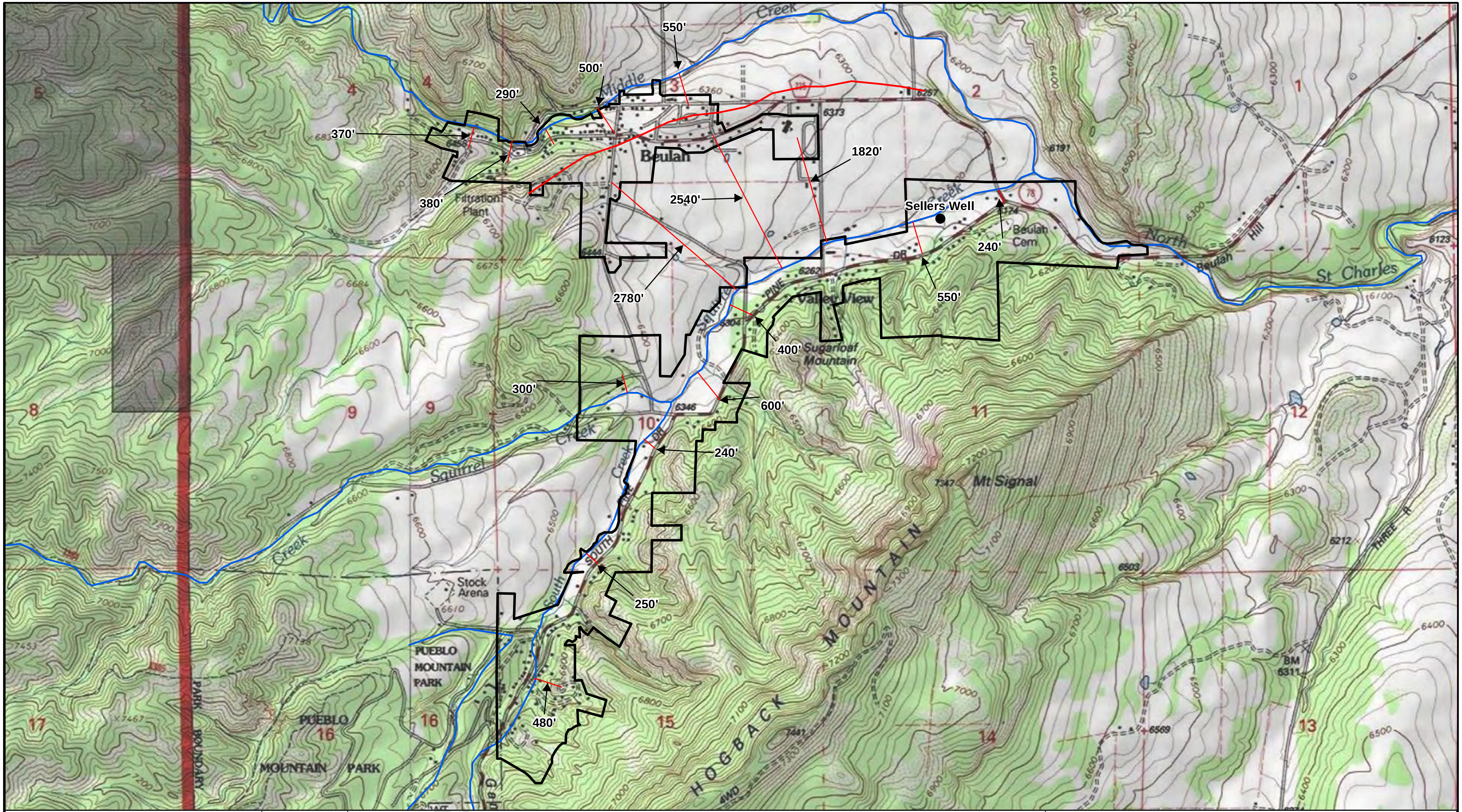
N

0 1,000 2,000 4,000 6,000

Scale in Feet

FIGURE 1

Pine Drive Water District,
Beulah Water Works District



Helton & Williamsen, P.C.		N
Drawn by: ACO		
File: Beulah_Pine_Dr_Distances.mxd		Checked by:
Job No. P2001	Date: 11/8/2018	Rev. Date: 6/21/2019

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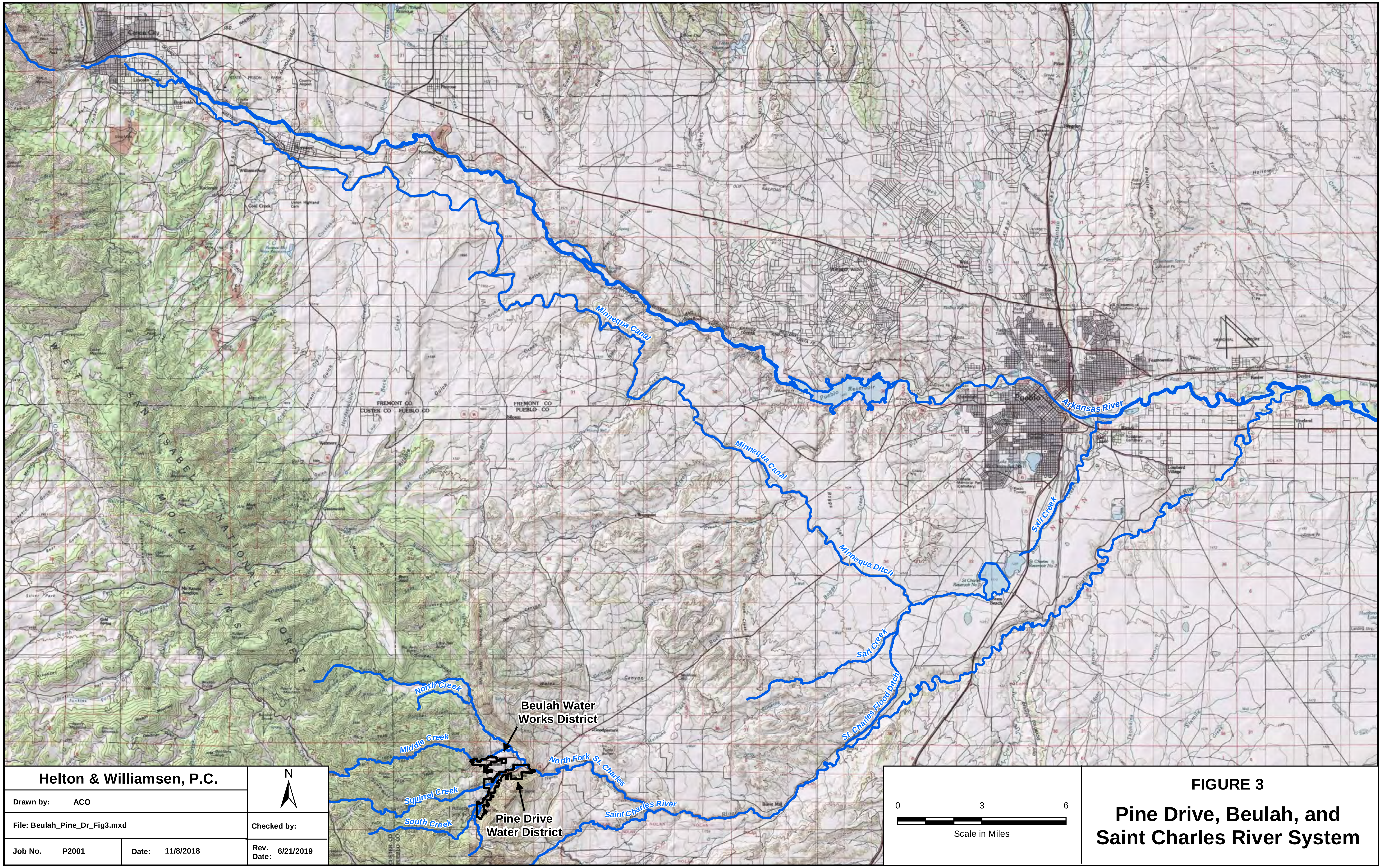
Scale in Feet

FIGURE 2

Extents of Alluvial Aquifer



Helton & Williamsen, P.C.	
Drawn by: ACO	
File: Beulah_Pine_Dr_Fig3.mxd	Checked by:
Job No. P2001 — Date: 11/8/2018	Rev. Date: 6/21/2019

FIGURE 3

Pine Drive, Beulah, and Saint Charles River System

Table 1
Priority Calls in the St. Charles River System

Calls on the St. Charles River (Potentially Affect Both Districts' Water Rights)

Water Year	Administration Scenario	Set Date	Release Date	Calling Structure Name	Priority Date of Call	Priority No	Affect Eureka Ditch (Pine Dr, 12/31/1861)?	Affect Fisher Ditch (Beulah 5/1/1864)?
2005	CALL	7/7/2005	10/31/2005	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
	CALL	7/11/2005	11/8/2005	MEXICAN DITCH	02/20/1867	34	NO	NO
2006	CALL	4/12/2006	4/13/2006	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
	CALL	4/13/2006	4/16/2006	BRYSON DITCH	10/31/1883	151	NO	NO
	CALL	4/16/2006	10/14/2006	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
	CALL	6/21/2006	6/23/2006	KELLER PUMP (ZOELLER)	12/31/1866	31	NO	NO
	CALL	6/23/2006	7/9/2006	BLUNT (CHAMBERS) PUMP	01/08/1867	33	NO	NO
	CALL	7/9/2006	10/9/2006	BROWN & MEXICAN ALT PT	12/31/1885	167	NO	NO
2007	CALL	7/2/2007	8/10/2007	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
2008	CALL	6/24/2008	9/30/2008	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
	CALL	9/30/2008	10/18/2008	BRYSON DITCH	10/31/1883	151	NO	NO
2009	CALL	10/18/2008	11/12/2008	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
	CALL	6/24/2009	10/14/2009	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
2010	CALL	7/1/2010	11/10/2010	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
2011	CALL	4/7/2011	6/6/2012	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
2012	CALL	6/6/2012	12/31/2012	DOTSON DITCH NO 1	05/01/1866	24	NO	NO
2013	CALL	6/5/2013	6/16/2013	DOTSON DITCH NO 1	05/01/1866	24	NO	NO
	CALL	6/16/2013	11/1/2013	ST CHARLES FLOOD DITCH	12/31/1861	6	NO. (Same Date)	YES
2014	CALL	4/3/2014	5/24/2014	EDSON DITCH	12/31/1867	37	NO	NO
	CALL	6/18/2014	7/15/2014	DOTSON DITCH NO 1	05/01/1868	45	NO	NO
	CALL	9/17/2014	10/15/2014	DOTSON DITCH NO 1	05/01/1868	45	NO	NO
2015	CALL	4/22/2015	4/24/2015	DOTSON DITCH NO 1	05/01/1868	45	NO	NO
	CALL	9/7/2015	10/6/2015	DOTSON DITCH NO 1	05/01/1866	24	NO	NO
	CALL	10/15/2015	11/3/2015	DOTSON DITCH NO 1	05/01/1866	24	NO	NO
2016	CALL	6/27/2016	11/8/2016	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
2017	CALL	3/8/2017	3/27/2017	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
2018	CALL	3/14/2018	9/4/2018	DOTSON DITCH NO 1	12/31/1881	138	NO	NO
	CALL	9/17/2018	10/15/2018	DOTSON DITCH NO 1	05/01/1868	45	NO	NO

Table 2
Summary of Historical Diversions
Combined Beulah Water Works District and Pine Drive Water District
(values in acre-feet)

(1)	Nov (2)	Dec (3)	Jan (4)	Feb (5)	Mar (6)	Apr (7)	May (8)	Jun (9)	Jul (10)	Aug (11)	Sep (12)	Oct (13)	Annual (14)	Nov-Apr (15)	May-Oct (16)
Average Year (2006-2018)															
Indoor	4.0	4.2	4.8	3.9	3.7	3.4	3.7	3.8	3.8	3.8	3.8	3.5	46.5	24.1	22.5
Outdoor	0.0	0.0	0.0	0.0	0.4	0.2	0.9	1.2	0.9	1.0	0.9	0.4	5.9	0.6	5.3
Total	4.0	4.2	4.8	3.9	4.0	3.6	4.6	5.0	4.7	4.8	4.7	3.9	52.5	24.7	27.8
High Year (2017)															
Indoor	4.8	5.1	4.2	3.5	4.0	3.7	3.9	4.1	3.8	3.5	3.3	3.6	47.3	25.3	22.0
Outdoor	0.0	0.0	0.0	0.0	0.7	0.5	1.9	2.0	1.2	4.1	2.2	2.1	14.7	1.2	13.5
Total	4.8	5.1	4.2	3.5	4.7	4.2	5.8	6.1	5.0	7.6	5.5	5.6	62.0	26.5	35.6

Table 3
Summary of Historical Consumptive Use[1]
Combined Beulah Water Works District and Pine Drive Water District
(values in acre-feet)

(1)	Nov (2)	Dec (3)	Jan (4)	Feb (5)	Mar (6)	Apr (7)	May (8)	Jun (9)	Jul (10)	Aug (11)	Sep (12)	Oct (13)	Annual (14)	Nov-Apr (15)	May-Oct (16)
Average Year (2007-2018)	0.4	0.4	0.5	0.4	0.7	0.5	1.1	1.4	1.2	1.2	1.2	0.7	9.7	2.9	6.8
High Year (2017)	0.5	0.5	0.4	0.3	1.0	0.8	2.0	2.1	1.4	3.8	2.2	2.1	17.2	3.5	13.7

[1]Table 2: Indoor x 10% + Outdoor x 85%.

Table 4

Summary of Historical Lagged Return Flow
Combined Beulah Water Works District and Pine Drive Water District
(values in acre-feet)

(1)	Nov (2)	Dec (3)	Jan (4)	Feb (5)	Mar (6)	Apr (7)	May (8)	Jun (9)	Jul (10)	Aug (11)	Sep (12)	Oct (13)	Annual (14)	Nov-Apr (15)	May-Oct (16)
Average Year (2007-2018)	3.4	3.6	4.0	3.4	3.6	3.5	3.5	3.6	3.6	3.5	3.4	3.4	42.5	21.5	21.1
High Year (2017)[1]	4.0	4.3	4.0	3.5	3.6	3.3	3.5	3.6	3.6	3.4	3.1	3.5	43.5	22.7	20.8

[1]2017 is not the maximum return flow year; rather, 2017 was the maximum <u>use</u> year.

Table 5

Summary of Historical Depletion (-)/Accretion (+)[2]
Combined Beulah Water Works District and Pine Drive Water District
(values in acre-feet)

(1)	Nov (2)	Dec (3)	Jan (4)	Feb (5)	Mar (6)	Apr (7)	May (8)	Jun (9)	Jul (10)	Aug (11)	Sep (12)	Oct (13)	Annual (14)	Nov-Apr (15)	May-Oct (16)
Average Year (2007-2018)	-0.6	-0.6	-0.9	-0.5	-0.4	-0.2	-1.1	-1.4	-1.1	-1.3	-1.3	-0.5	-9.9	-3.2	-6.7
High Year (2017)	-0.8	-0.9	-0.2	0.0	-1.1	-0.9	-2.2	-2.5	-1.4	-4.2	-2.3	-2.2	-18.6	-3.8	-14.8

[2]Table 4 minus Table 2

Table 6
Summary of Projected Future Total Well Depletions (Negative Effect on Stream)
Combined Beulah Water Works District and Pine Drive Water District Pumping of the Sellers Well
(values in acre-feet)

(1)	Nov (2)	Dec (3)	Jan (4)	Feb (5)	Mar (6)	Apr (7)	May (8)	Jun (9)	Jul (10)	Aug (11)	Sep (12)	Oct (13)	Annual (14)	Nov-Apr (15)	May-Oct (16)
Average Year[1] (2007-2018)	-4.0	-4.2	-4.6	-4.0	-4.1	-3.8	-4.4	-4.7	-4.7	-4.8	-4.6	-4.2	-52.2	-24.8	-27.4
High Year (2017)	-4.7	-5.0	-4.4	-3.7	-4.5	-4.3	-5.4	-5.7	-5.2	-6.8	-5.7	-5.6	-61.1	-26.7	-34.4

[1]Small differences to pumping totals are due to short study period and lagged return flow/depletion priming.

Table 7
Summary of Projected Future Net Depletion (-)/Accretion (+)[2]
Combined Beulah Water Works District and Pine Drive Water District Pumping of the Sellers Well
(values in acre-feet)

(1)	Nov (2)	Dec (3)	Jan (4)	Feb (5)	Mar (6)	Apr (7)	May (8)	Jun (9)	Jul (10)	Aug (11)	Sep (12)	Oct (13)	Annual (14)	Nov-Apr (15)	May-Oct (16)
Average Year (2007-2018)	-0.6	-0.6	-0.7	-0.5	-0.5	-0.3	-0.9	-1.1	-1.1	-1.2	-1.3	-0.8	-9.7	-3.3	-6.4
High Year (2017)	-0.7	-0.8	-0.5	-0.2	-0.9	-1.0	-1.8	-2.1	-1.6	-3.4	-2.6	-2.1	-17.6	-4.0	-13.6

[2]Table 4 plus Table 6

Table 8
Comparison of Historical Net Depletions of Surface Water Rights with Projected Future Net Depletions from Pumping of the Sellers Well (Net Effect AFTER Credit from Historical Net Depletion)[1]
Beulah Water Works District and Pine Drive Water District
(values in acre-feet)

(1)	Nov (2)	Dec (3)	Jan (4)	Feb (5)	Mar (6)	Apr (7)	May (8)	Jun (9)	Jul (10)	Aug (11)	Sep (12)	Oct (13)	Annual (14)	Nov-Apr (15)	May-Oct (16)
Average Year (2007-2018)	0.0	0.0	0.2	-0.1	-0.1	-0.1	0.2	0.3	0.0	0.1	0.1	-0.2	0.3	-0.1	0.4
Max Future Depletion[2]	-3.8	-0.3	-2.4	-1.0	-0.5	-0.5	-0.4	-0.2	-0.4	-0.8	-0.2	-0.6	-3.1	-5.4	-0.9

[1]Table 7 minus Table 5

[2]The Maximum Future Depletion shown in this table is compiled from the maximum monthly, annual, and seasonal depletions in the analysis, rather than the 2017 Water Year. (The maximum water use in that year results in greater return flows, which when lagged, results in an annual accretion, rather than depletion.)

Table 9
Approximate Costs for Measurement Structures
Beulah Water Works District and Pine Drive Water District

Item	Cost	Initial Cost	Annual Cost
Pine Drive's Eureka Ditch Water Right - Cross-Vane Weir in North St. Charles River			
Design and Construction[1]	$ 8,000	$ 8,000	
Data Collection Aparatus	$ 2,000	$ 2,000	
Data Collection Equipment	$ 7,500	$ 7,500	
Data Collection Installation	$ 1,500	$ 1,500	
Annual Maintenance	$ 1,000		$ 1,400
Measurement: monthly @ $300	$ 3,600		$ 3,600
Sub-Total		$ 19,000	$ 5,000
Beulah's Fisher Ditch Water Right - Augmentation Station from Ditch or Pipeline			
Design and Construction	$ 30,000	$ 30,000	
Data Collection Equipment	$ 6,000	$ 6,000	
Data Collection Installation	$ 1,500	$ 1,500	
Annual Maintenance	$ 1,000		$ 1,000
Sub-Total		$ 37,500	$ 1,000
TOTAL FOR BOTH STRUCTURES		**$ 56,500**	**$ 6,000**

Table 10
Comparison of Options for Future Water Supply and Augmentation
Beulah Water Works District and Pine Drive Water District

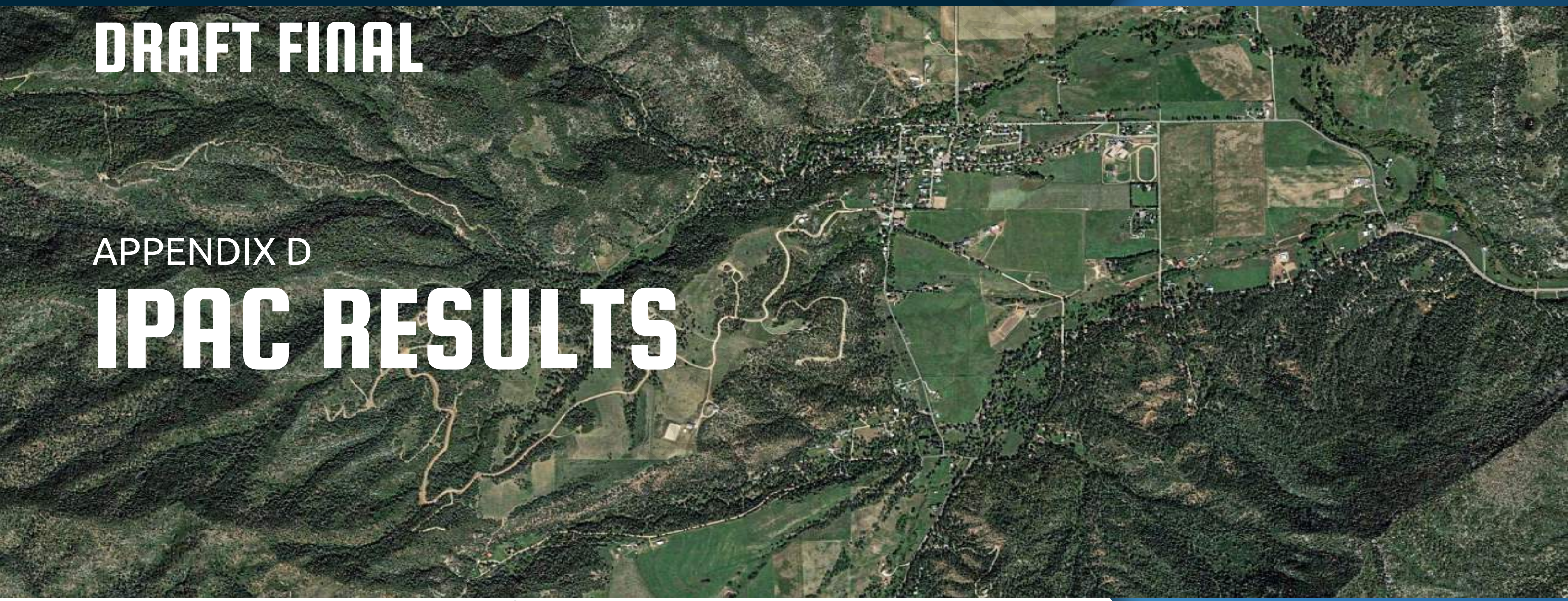
OPTION GROUP 1 - Full Augmentation of Well Pumping				
Option	**1a**	**1b**	**1c**	**1d**
Name	**CWPDA**	**PBWW**	**AGUA**	**MVWDC**
Comment	Membership in Association, **IF** pumping qualifies for Rule 14	Not enough water in St. Charles above CF&I	Not enough water in St. Charles above CF&I	upstream, fully consumable, on-demand
Cost Comments	$315 per year + Water Rate for additional depletions (e.g., MVWDC purchase--see 1d)	N/A-Not an option	N/A-Not an option	$1800 per 0.1 ac-ft share (initial), plus annual maintenance fees (estimated $54 per 0.1 ac-ft)
Approximate Cost	N/A ($189,000 + $315 CWPDA + annual MVWDC)			$187,000 to $335,000 initial + $5,600 to $10,000 annual
Additional Costs for Option Group 1	Need Water Court-decreed Plan for Augmentation: approximately $40,000 engineering & legal			
Final Cost Estimate	N/A-Assume not an option	N/A-Not an option	N/A-Not an option	at least $227,000 initial + $5,600 annual

Table 10
Comparison of Options for Future Water Supply and Augmentation
Beulah Water Works District and Pine Drive Water District

OPTION GROUP 2 - Change Use of Districts' Water Rights to Use as Augmentation Credit Against Well Depletions				
Option	**2a**	**2b**	**2c**	**2d**
Name	**CWPDA**	**Plan for Aug. w/ PBWW backup**	**AGUA**	**Plan for Aug. w/ MVWDC backup**
Comment	Membership in Association, **IF** pumping qualifies for Rule 14	Use credit from water rights. Lease minimum 10 ac-ft/year for occasional imbalances.	Could augment if Districts bring changed water right	Use credit from water rights, no association membership. Purchase water only for occasional imbalances or increases in desired water use.
Cost Comments	$315 per year + Water Rate for additional depletions (e.g., MVWDC purchase)	Lease @ $7364 plus any additional engineering support	Rates can increase by Board action	$1800 per 0.1 ac-ft share (initial), plus annual maintenance fees (estimated $54 per 0.1 ac-ft)
Approximate Cost		$1,000 annual engineering support plus lease payments	$600 + $325 per ac-ft depletion over water right credit annually	
Additional Costs for Option Group 2	Up to $80,000 engr & legal and approx. $100,000 infrastructure initially*, plus approx. $6,000 annual maintenance.			
Final Cost Estimate	Initial: $180,000 + $18,000 per ac-ft additional depletion (MVWD)	$180,000 initial	$180,000 initial	Initial: $180,000 initial + MVWD cost of water for additional depletion
	Annual: $6,315 measurement & membership + $54 per 0.1 ac-ft MVWD fees. (Assume not an option.)	Annual: $14,364 measurement, engineering, and lease payment (Assume not an option.)	Annual: $6,600 measurement & membership, + $325 per ac-ft additional depletion	Annual: $7,000 measurement & engineering support, plus MVWD fees.
***Final Cost Note:**	**Subtract $40,000 from all Group 2 initial infrastructure estimates in the event that a cross-vein weir may be used instead of a traditional diversion/measurement structure for Pine Drive's Eureka Ditch water right.**			

USDA PRELIMINARY ENGINEERING REPORT

DRAFT FINAL



APPENDIX D

IPAC RESULTS

WATER SYSTEM IMPROVEMENTS

PROJECT

APPENDIX D – U.S. FISH AND WILDLIFE IPAC RESULTS

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Pueblo County, Colorado

Local office

Colorado Ecological Services Field Office

(303) 236-4773
(303) 236-4005

MAILING ADDRESS
Denver Federal Center
P.O. Box 25486
Denver, CO 80225-0486

PHYSICAL ADDRESS
134 Union Boulevard, Suite 670
Lakewood, CO 80228-1807

http://www.fws.gov/coloradoES
http://www.fws.gov/platteriver

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Canada Lynx *Lynx canadensis* There is **final designated** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/3652	Threatened
North American Wolverine *Gulo gulo luscus* No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5123	Proposed Threatened

Birds

NAME	STATUS
Mexican Spotted Owl *Strix occidentalis lucida* There is **final designated** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8196	Threatened

Fishes

NAME	STATUS
Greenback Cutthroat Trout *Oncorhynchus clarki stomias* No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2775	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any activity that results in the take (to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) of migratory birds or eagles is prohibited unless authorized by the U.S. Fish and Wildlife Service[3]. There are no provisions for allowing the take of migratory birds that are unintentionally killed or injured. Any person or organization who plans or conducts activities that may result in the take of migratory birds is responsible for complying with the appropriate regulations and implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are USFWS Birds of Conservation Concern that might be affected by activities in this location. The list does not contain every bird you may find in this location, nor is it guaranteed that all of the birds on the list will be found on or near this location. To get a better idea of the specific locations where certain species have been reported and their level of occurrence, please refer to resources such as the E-bird data mapping tool (year-round bird sightings by birders and the general public) and Breeding Bird Survey (relative abundance maps for breeding birds). Although it is important to try to avoid and minimize impacts to all birds, special attention should be given to the birds on the list below. To get a list of all birds potentially present in your project area, visit the E-bird Explore Data Tool.

NAME	BREEDING SEASON
Black Swift Cypseloides niger https://ecos.fws.gov/ecp/species/8878	Breeds Jun 15 to Sep 10
Brewer's Sparrow Spizella breweri https://ecos.fws.gov/ecp/species/9291	Breeds May 15 to Aug 10
Burrowing Owl Athene cunicularia https://ecos.fws.gov/ecp/species/9737	Breeds Mar 15 to Aug 31
Golden Eagle Aquila chrysaetos https://ecos.fws.gov/ecp/species/1680	Breeds Apr 1 to Aug 31
Grace's Warbler Dendroica graciae	Breeds May 20 to Jul 20
Lesser Yellowlegs Tringa flavipes https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Lewis's Woodpecker Melanerpes lewis https://ecos.fws.gov/ecp/species/9408	Breeds Apr 20 to Sep 30
Long-billed Curlew Numenius americanus https://ecos.fws.gov/ecp/species/5511	Breeds Apr 1 to Jul 31
Long-eared Owl asio otus https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
Marbled Godwit Limosa fedoa https://ecos.fws.gov/ecp/species/9481	Breeds elsewhere
Mountain Plover Charadrius montanus https://ecos.fws.gov/ecp/species/3638	Breeds Apr 15 to Aug 15

Olive-sided Flycatcher Contopus cooperi — Breeds May 20 to Aug 31
https://ecos.fws.gov/ecp/species/3914

Pinyon Jay Gymnorhinus cyanocephalus — Breeds Feb 15 to Jul 15
https://ecos.fws.gov/ecp/species/9420

Rufous Hummingbird selasphorus rufus — Breeds elsewhere
https://ecos.fws.gov/ecp/species/8002

Veery Catharus fuscescens — Breeds May 15 to Jul 15

Virginia's Warbler Vermivora virginiae — Breeds May 1 to Jul 31
https://ecos.fws.gov/ecp/species/9441

Willow Flycatcher Empidonax traillii — Breeds May 20 to Aug 31
https://ecos.fws.gov/ecp/species/3482

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in your project's counties during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

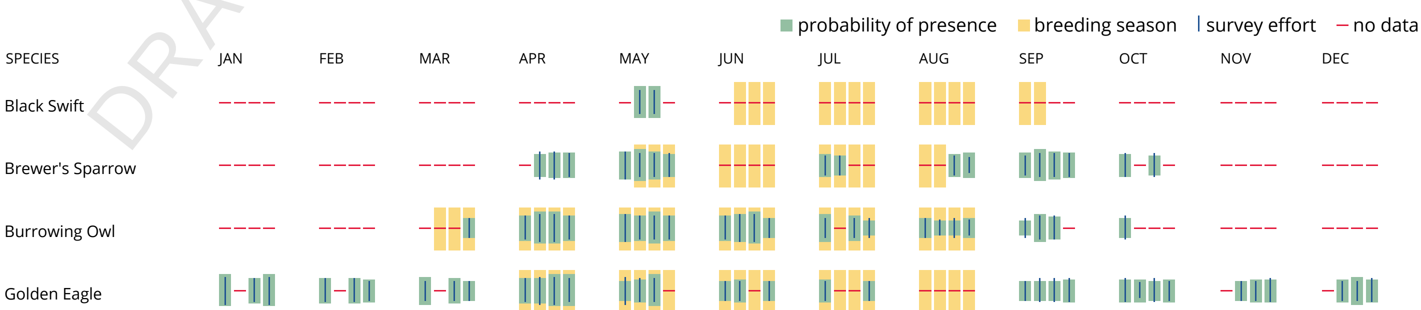
Breeding Season (■)
Yellow bars denote when the bird breeds in the Bird Conservation Region(s) in which your project lies. If there are no yellow bars shown for a bird, it does not breed in your project area.

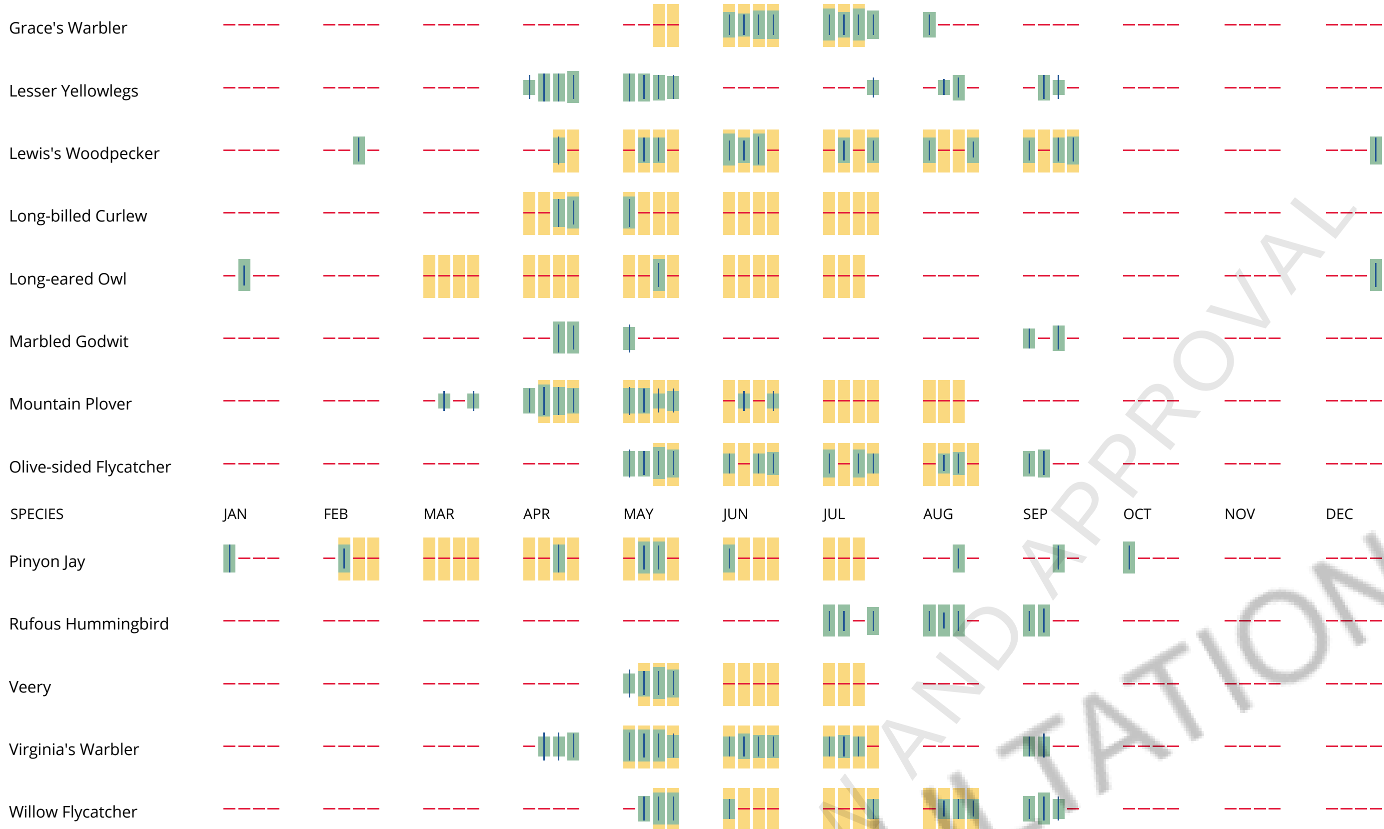
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the counties of your project area. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information.





Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Such measures are particularly important when birds are most likely to occur in the project area. To see when birds are most likely to occur in your project area, view the Probability of Presence Summary. Special attention should be made to look for nests and avoid nest destruction during the breeding season. The best information about when birds are breeding can be found in Birds of North America (BNA) Online under the "Breeding Phenology" section of each species profile. Note that accessing this information may require a subscription. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) that might be affected by activities in your project location. These birds are of priority concern because it has been determined that without additional conservation actions, they are likely to become candidates for listing under the Endangered Species Act (ESA).

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets. The AKN list represents all birds reported to be occurring at some level throughout the year in the counties in which your project lies. That list is then narrowed to only the Birds of Conservation Concern for your project area.

Again, the Migratory Bird Resource list only includes species of particular priority concern, and is not representative of all birds that may occur in your project area. Although it is important to try to avoid and minimize impacts to all birds, special attention should be made to avoid and minimize impacts to birds of priority concern. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird entry on your migratory bird species list indicates a breeding season, it is probable the bird breeds in your project's counties at some point within the time-frame specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

Facilities

Wildlife refuges

Any activity proposed on National Wildlife Refuge lands must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGES AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

This location overlaps the following wetlands:

FRESHWATER FORESTED/SHRUB WETLAND
PSSC

FRESHWATER POND
PUSC

A full description for each wetland code can be found at the National Wetlands Inventory website: https://ecos.fws.gov/ipac/wetlands/decoder

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

USDA PRELIMINARY ENGINEERING REPORT

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APPENDIX E

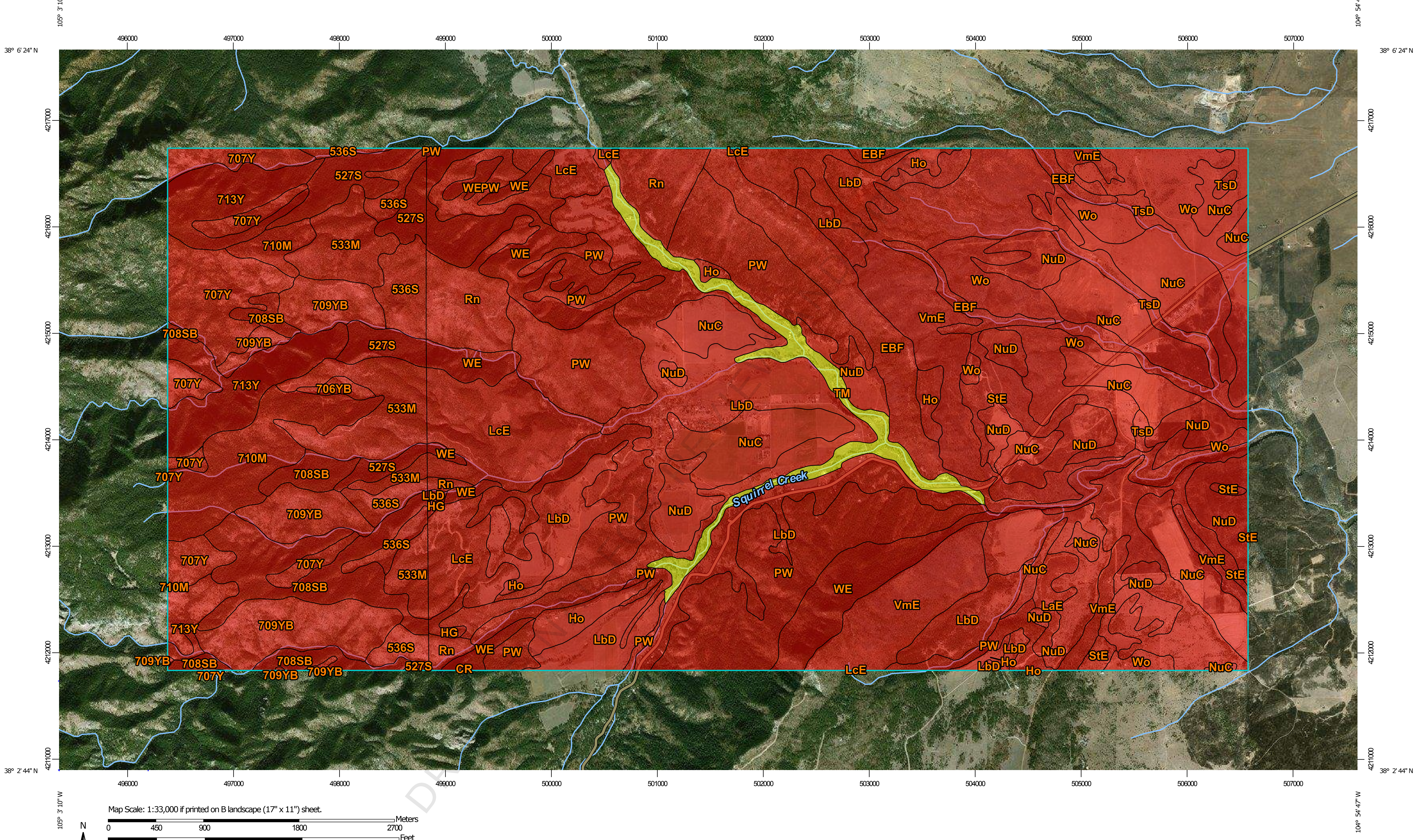
WEBSOIL SURVEY

WATER SYSTEM IMPROVEMENTS

PROJECT

APPENDIX E – WEBSOIL SURVEY RESULTS

Farmland Classification—Pueblo Area, Colorado, Parts of Pueblo and Custer Counties; and Wet Mountains and Spanish Peaks Area, Colorado, Parts of Custer, Fremont, Huerfano, Las Animas, and Pueblo Counties



Map Scale: 1:33,000 if printed on B landscape (17" x 11") sheet.

Meters: 0 450 900 1800 2700

Feet: 0 1500 3000 6000 9000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Soil Rating Lines

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Soil Rating Points

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Water Features

MAP INFORMATION

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Pueblo Area, Colorado, Parts of Pueblo and Custer Counties
Survey Area Data: Version 15, Sep 22, 2015

Soil Survey Area: Wet Mountains and Spanish Peaks Area, Colorado, Parts of Custer, Fremont, Huerfano, Las Animas, and Pueblo Counties
Survey Area Data: Version 5, Sep 24, 2014

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 8, 2010—Mar 9, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Farmland Classification

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CR	Cathedral family, moist-Rock outcrop complex, 40 to 150 percent slopes, rubbly	Not prime farmland	0.2	0.0%
EBF	Eutroboralfs, steep	Not prime farmland	492.3	4.0%
HG	Hechtman-Guffey families complex, 40 to 60 percent slopes, extremely bouldery	Not prime farmland	23.5	0.2%
Ho	Holderness silt loam, 3 to 9 percent slopes	Not prime farmland	202.2	1.6%
LaE	Laporte channery loam, 3 to 25 percent slopes	Not prime farmland	48.8	0.4%
LbD	Larkson loam, 6 to 12 percent slopes	Not prime farmland	1,398.6	11.3%
LcE	Larkson stony loam, 5 to 20 percent slope	Not prime farmland	523.6	4.2%
NuC	Nunn clay loam, 0 to 3 percent slopes	Not prime farmland	1,006.8	8.1%
NuD	Nunn clay loam, 3 to 9 percent slopes	Not prime farmland	769.7	6.2%
PW	Pinata-Wetmore association	Not prime farmland	1,549.1	12.5%
Rn	Ring family, 40 to 60 percent slopes, rubbly	Not prime farmland	338.7	2.7%
StE	Stroupe extremely stony loam, 9 to 25 percent slopes	Not prime farmland	384.2	3.1%
TM	Table Mountain association	Prime farmland if irrigated	235.1	1.9%
TsD	Travessilla sandy loam, 1 to 9 percent slopes	Not prime farmland	161.2	1.3%
VmE	Vamer-Rock outcrop complex, 5 to 25 percent slopes	Not prime farmland	1,035.8	8.4%
WE	Wetmore-Mortenson association	Not prime farmland	594.6	4.8%
Wo	Wormser silt loam	Not prime farmland	655.0	5.3%
Subtotals for Soil Survey Area			**9,419.3**	**76.0%**
Totals for Area of Interest			**12,396.5**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
527S	Wetmore-Mortenson association, 20 to 50 percent slopes	Not prime farmland	234.5	1.9%
533M	Larkson family, 5 to 40 percent slopes	Not prime farmland	414.5	3.3%
536S	Ring family, 40 to 60 percent slopes	Not prime farmland	244.2	2.0%
706YB	Cathedral family-Rock outcrop complex, 40 to 150 percent slopes	Not prime farmland	20.2	0.2%
707Y	Larkspur family-Rock outcrop complex, 40 to 150 percent slopes	Not prime farmland	422.1	3.4%
708SB	Hechtman, dry-Guffey families complex, 40 to 60 percent slopes	Not prime farmland	410.4	3.3%
709YB	Cathedral family, moist-Rock outcrop complex, 40 to 150 percent slopes	Not prime farmland	508.6	4.1%
710M	Hechtman, dry-Ashcroft, dry families complex, 5 to 25 percent slopes	Not prime farmland	330.0	2.7%
713Y	Hechtman family, dry-Rock outcrop complex, 40 to 150 percent slopes	Not prime farmland	392.5	3.2%
Subtotals for Soil Survey Area			**2,977.2**	**24.0%**
Totals for Area of Interest			**12,396.5**	**100.0%**

Description

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

Rating Options

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

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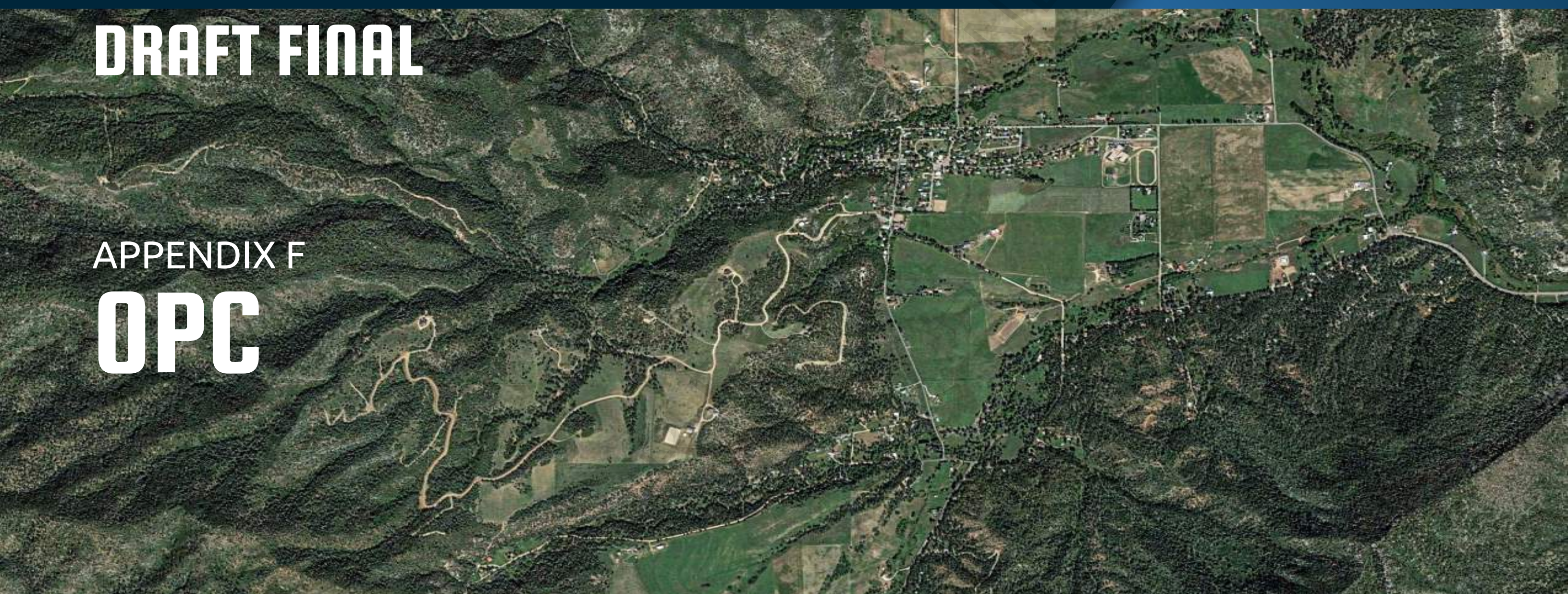
APPENDIX F

OPC



WATER SYSTEM IMPROVEMENTS PROJECT

APPENDIX F – OPINIONS OF PROBABLE COSTS BACK-UP

- **Table 4.5 – Sub-Alternatives Cost Comparison for Water Supply and Treatment Water Treatment**
- **Table 4 6 – Sub-Alternatives Cost Comparison for Current Distribution System Pipeline Replacement**
- **Table 5 1 – Water Supply and Treatment Life Cycle Cost Comparison**
- **Tables 6.2 to 6.6 – Total Project Summary Opinion of Probable Cost for Recommended Alternative**

PROJECT: Beulah Water Works District - Water System Improvements - Alt 2 - Tables 6.2 - 6.6
DATE 9/30/2019
SUBJECT: Opinion of Probable Cost - Project Summary
CALC: LEL/MMS

C:\MMS\Beulah\[2019 08 26 Revised OPC-MMS-DF-1.xlsx]Total Project Summary EOPC

Item	Description	Quantity	Unit	Unit Cost	Item Cost
1	Emergency Source Groundwater Well Subtotal	1	LS	$ 2,400,000	$ 2,400,000
2	Beulah Treated Water Distribution System Pipelines Subtotal	1	LS	$3,900,000	$ 3,900,000
3	Pine Drive Treated Distribution System Pipelines Subtotal	1	LS	$3,100,000	$ 3,100,000
4	Beulah Water Treatment Plant Rehabilitation Costs	1	LS	$ 4,600,000	$ 4,600,000
	Subtotal				$ 14,000,000
	ROUNDED CONSTRUCTION BUDGET				**$ 14,000,000**
	Legal Fees for District Consolodation and Water Rights	1.5%			$ 210,000
	New District Establishment and Election	0.5%			$ 70,000
	Bond Counsel Fees	0.5%			$ 70,000
	TOTAL BUDGET				$ 14,350,000
	ROUNDED TOTAL BUDGET				**$ 14,400,000**

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PROJECT: Beulah Water Works District - Water System Improvements Prelim Design - Alt 2
DATE 9/30/2019
SUBJECT: Opinion of Probable Cost - Treated Water Distribution Systems Portion of Project
CALC: LEL/MMS

Item	Description	Quantity	Unit	Unit Cost	Item Cost
	Total Tier I and II Beulah Distribution System Improvements				
1	TIER 1 6" WATERLINE REPLACEMENT	9,200	LF	$120	$1,104,000
2	TIER 1 Water service reconnections	90	EA	$5,000	$450,000
3	TIER 2 6"WATERLINE REPLACEMENT	3,200	LF	$120	$384,000
4	TIER 2 Water service reconnections	12	EA	$5,000	$60,000
5	Landscaping & Asphalt Repair Allowance	12	EA	$10,000	$120,000
6	Fire Hydrants	10	EA	$7,500	$75,000
	Sub-Total				**$2,193,000**
	Contractor Mobilization, Overhead & Profit (18%)	15%			$328,950
	Project Subtotal				$2,521,950
	Contingency (30%)	30%			$756,585
	Total Construction Budget				$3,278,535
	ROUNDED CONSTRUCTION BUDGET				**$3,300,000**
	Bond Counsel Fees	0.5%			$16,500
	Design Surveying & Geotechnical	3%			$99,000
	Engineering Design & Bidding	10%			$330,000
	Engineering Construction Phase Services & RPR	6%			$198,000
	TOTAL BUDGET				$3,943,500
	ROUNDED BUDGET BWWD DISTRIBUTION				**$3,900,000**

Item	Description	Quantity	Unit	Unit Cost	Item Cost
	Pine Drive Distribution System Improvements				
1	8" East Interconnecting Pipeline	3,800	LF	$120	$456,000
2	8" West Interconnecting Pipeline	5,700	LF	$120	$684,000
3	PRV Stations	3	EA	$50,000	$150,000
4	TIER 2 Water service reconnections	10	EA	$5,000	$50,000
5	Landscaping & Asphalt Repair Allowance	8	EA	$10,000	$80,000
6	Fire Hydrant Extensions	12	EA	$1,500	$18,000
7	Watseka Tank Access Hatch Improvements	3	EA	$ 6,000	$18,000
8	Stansfield Tank Access Hatch Improvements	4	EA	$ 6,000	$24,000
9	Stansfield Tank Site Access Road Improvements	750	LF	$ 120	$90,000
10	Stansfield Tank Telemetry & Electrical Service	1	LS	$ 20,000	$20,000
11	Stansfield Tank Mixing Equipment	1	LS	$ 25,000	$25,000
12	Decommissioning of Squirrel Creek Facilities	1	LS	$ 10,000	$10,000
13	Decommissioning of Pine Drive WTP	1	LS	$ 20,000	$20,000
	Sub-Total				**$1,645,000**
	Contractor Mobilization, Overhead & Profit (18%)	15%			$246,750
	Project Subtotal				$1,891,750
	Contingency (30%)	30%			$567,525
	Total Construction Budget				$2,459,275
	ROUNDED CONSTRUCTION BUDGET				**$2,500,000**
	Bond Counsel Fees	0.5%			$16,500
	Design Surveying & Geotechnical	3%			$99,000
	Engineering Design & Bidding	10%			$330,000
	Engineering Construction Phase Services & RPR	6%			$198,000
	TOTAL BUDGET				$3,143,500
	ROUNDED BUDGET PDWD DISTRIBUTION				**$3,100,000**

PROJECT: Beulah Water Works District - Water System Improvements Prelim Design - Alt 2
DATE 9/30/2019
SUBJECT: Opinion of Probable Cost - BWWD WTP Upgrades
CALC: LEL/MMS

No.	Description	Quantity	Unit	Unit Price	Cost
	WTP Building, Piping and Equipment				
1	Diversion Improvements	1	LS	$ 250,000	$ 250,000
2	Treatment Building Improvements	800	SF	$ 30	$ 24,000
3	Exterior Concrete Pads and Walks	1	LS	$ 5,000	$ 5,000
4	Powdered Activated Carbon Feed Equipment	1	LS	$ 20,000	$ 20,000
5	New Solids Pond Lining and Improvements	1	LS	$ 400,000	$ 400,000
6	Other Equipment Upgrades	1	LS	$ 20,000	$ 20,000
7	UV Disinfection	2	EA	$ 100,000	$ 200,000
8	Instrumentation (equipment and installation)	1	LS	$ 35,000	$ 35,000
9	Electrical Wiring & Cabinets, Etc.	1	LS	$ 40,000	$ 40,000
10	Raw Water Pumping from PDWD Diversion	1	LS	$ 60,000	$ 60,000
11	Raw Water Piping to PDWD Diversion	12,400	LF	$ 120	$ 1,488,000
	Subtotal				**$ 2,542,000**
	Contractor Mobilization, Overhead & Profit	15%			$ 381,300
	Project Subtotal				$ 2,923,300
	Contingency	30%			$ 876,990
	Total Construction Budget				$ 3,800,290
	ROUNDED CONSTRUCTION BUDGET				**$ 3,800,000**
	Bond Counsel Fees	0.5%			$ 19,000
	Design Surveying & Geotechnical	3%			$ 114,000
	Engineering Design & Bidding	10%			$ 380,000
	Engineering Construction Phase Services & RPR	6%			$ 228,000
	TOTAL WTP BUDGET				$ 4,541,000
	ROUNDED BUDGET BWWD WTP				**$ 4,600,000**

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PROJECT: Beulah Water Works District - Water System Improvements Prelim Design -
DATE: Alt 2
SUBJECT: 9/30/2019
CALC: Opinion of Probable Cost - Sellers Well

Item	Description	Quantity	Unit	Unit Price	Item Cost
Civil Site Work - Sellers Well					
1	6" Dia Well Discharge Line to Beulah WTP	7,300	LF	$ 80	$ 584,000
2	4" Floor Drain Pipe Outlet w/ Flap Gate	100	LF	$ 50	$ 5,000
3	Site Grading	1	LS	$ 2,500	$ 2,500
4	Pipeline Fencing Restoration	2,000	LF	$ 5	$ 10,000
5	Gravel Access Road (12'Wx3" CL 6)	1,200	LF	$ 40	$ 48,000
6	Bollards	4	EA	$ 750	$ 3,000
7	Security Fence	200	LF	$ 15	$ 3,000
8	Revegetation / Reseeding Allowance	1	LS	$ 2,500	$ 2,500
9	Silt Fence	2,500	LF	$ 3	$ 7,500
10	Raw Water Pumping	1	LS	$ 60,000	$ 60,000
11	Distribution to Raw Water Line Distrobution	1,100	LF	$ 110	$ 121,000
	Civil Site Work - Sellers Well			**Subtotal**	**$ 846,500**
Sellers Well Improvements					
1	Existing Well Site Demolition	1	LS	$ 10,000	$ 10,000
2	Well House Rehabilitation (Slab Fdn, Structure, Finish)	250	SF	$ 450	$ 112,500
3	Well Rehabilitation (Screen, Pack, etc.)	1	LS	$ 20,000	$ 20,000
4	40 hp Submersible Well Pump & Motor	2	EA	$ 30,000	$ 60,000
5	2.5" Sch. 40 Steel Pipe	40	LF	$ 10	$ 400
6	Motor Control Center	1	LS	$ 100,000	$ 100,000
7	480v Variable Frequency Drive	2	EA	$ 10,000	$ 20,000
8	VFD Harmonic Filter	2	EA	$ 2,500	$ 5,000
9	Level Transducer	1	EA	$ 6,000	$ 6,000
10	Well Pump, Piping & Support Installation	1	LS	$ 10,000	$ 10,000
	Sellers Well Improvements			**Subtotal**	**$ 343,900**
Sellers Well Electrical and Controls					
1	Well Site Electrical Service	1	LS	$ 25,000	$ 25,000
2	Well Site Electrical Equipment Installation	1	LS	$ 40,000	$ 40,000
3	Fiber Optic Control Cable and Conduit (Well to WTP)	1300	LF	$ 15	$ 19,500
4	Instrumentation (equipment and installation)	1	LS	$ 15,000	$ 15,000
5	Electrical Wiring & Cabinets, Etc.	1	LS	$ 25,000	$ 25,000
	Sellers Well Electrical and Controls Subtotal				**$ 124,500**
	Subtotal All				**$ 1,314,900**
	Contractor Mobilization, Overhead & Profit (18%)	15%			$ 197,235
	Project Subtotal				$ 1,512,135
	Contingency (30%)	30%			$ 453,641
	Total Construction Budget				$ 1,965,776
	ROUNDED CONSTRUCTION BUDGET				**$ 2,000,000**
	Bond Counsel Fees	0.5%			$ 10,000
	Design Surveying & Geotechnical	3%			$ 60,000
	Engineering Design & Bidding (10%)	10%			$ 200,000
	Engineering Construction Phase Services & RPR	6%			$ 120,000
	Sub Total Sellers Well Budget				$ 2,390,000
	ROUNDED SELLERS WELL BUDGET				**$ 2,400,000**

USDA PER REPORT - TABLE 4-6 - ALTERNATIVES COST COMPARISON PIPELINE REPLACEMENTS

Item	Description	Option 1	Option 2
1	Pipelines	$1,488,000	$2,480,000
2	Water Service Reconnections	$500,000	$500,000
3	Landscaping and Asphalt Repair - Special Circumstance	$80,000	$150,000
4	Fire Hydrants	$75,000	$90,000
	Sub-Total	$2,143,000	$3,220,000
	Contractor Mobilization, Overhead & Profit (18%)	$321,450	$483,000
	Project Subtotal	$2,464,450	$3,703,000
	Contingency (30%)	$739,335	$1,110,900
	Total Budget	$3,203,785	$4,813,900
	ROUNDED BUDGET	**$3,300,000**	**$4,900,000**

PROJECT: Beulah Water Works District - Water Line Replacement Project
DATE 9/30/2019
SUBJECT: Opinion of Probable Cost - REPLACE AND ABANDON COST
CALC: ARR/MMS

C:\MMS\Beulah\Finals\[PER Section 4 DS OPC - 2019 07 16.xlsx]Summary of Options

Item	Description	Quantity	Unit	Unit Cost	Item Cost
1	6-inch diameter PVC pipe (includes excavation, backfill, compaction, disinfection, pressure testing, fittings, valves, asphalt repair, etc.)	12,400	LF	$120.00	$1,488,000
2	Water Service Reconnection	100	EA	$5,000.00	$500,000
3	Landscaping & Asphalt Repair - Special Circumstance	8	EA	$10,000.00	$80,000
4	Fire Hydrants	10	EA	$7,500.00	$75,000
				Sub-Total	$2,143,000
				Contractor Mobilzation, Overhead & Profit (15%)	$321,450
				Project Subtotal	$2,464,450
				Contingency (30%)	$739,335
				Total Budget	$3,203,785
				ROUNDED BUDGET	$3,300,000

PROJECT: Beulah Water Works District - Water Line Replacement Project
DATE 9/30/2019
SUBJECT: Opinion of Probable Cost - REMOVE AND REPLACE COST
CALC: ARR/MMS

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Item	Description	Quantity	Unit	Unit Cost	Item Cost
1	6-inch diameter PVC pipe (includes remove and disposal, excavation, backfill, compaction, disinfection, pressure testing, fittings, valves, asphalt repair, etc.)	12,400	LF	$200.00	$2,480,000
2	Water Service Reconnection	100	EA	$5,000.00	$500,000
3	Landscaping & Asphalt Repair - Special Circumstance	15	EA	$10,000.00	$150,000
4	Fire Hydrants	12	EA	$7,500.00	$90,000
				Sub-Total	$3,220,000
				Contractor Mobilzation, Overhead & Profit (15%)	$483,000
				Project Subtotal	$3,703,000
				Contingency (30%)	$1,110,900
				Total Budget	$4,813,900
				ROUNDED BUDGET	$4,900,000

USDA PER REPORT - TABLE 4.5 - ALTERNATIVES COST COMPARISON - WATER SUPPLY AND TREATMENT

Item	Description	Alternative T1	Alternative T2
1	Beulah WTP	$1,684,000	$749,000
2	Pine Drive WTP	$4,220,000	$660,000
3	Alternate Well Supply		$3,299,900
4	System Improvements	$150,000	$150,000
	Project Subtotal	$6,054,000	$4,859,000
	Contractor Mobilization, OH&P (15%)	$908,000	$729,000
	Project Budget Subtotal	$6,962,000	
	Contingency (30%)	$2,089,000	$1,676,000
	Total Budget	$9,051,000	$7,264,000
	ROUNDED BUDGETS	**$9,100,000**	**$7,300,000**

PROJECT: Beulah Water Works District - Water System Improvement Project
DATE 9/30/2019
SUBJECT: Opinion of Probable Cost - Improve 2 Existing WTPs
CALC: ARR/MMS/LEL

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Item	Description	Quantity	Unit	Unit Cost	Item Cost
	Beulah WTP				
1	Repair Beulah WTP Diversion Structure	1	LS	$250,000	$250,000
2	Treatment Building Improvements	800	SF	$30	$24,000
3	Exterior Concrete Pads and Walks	1	LS	$10,000	$10,000
4	Pretreatment Settling Tank	1	LS	$200,000	$200,000
6	Solids Pond Lining and Improvements	1	LS	$350,000	$350,000
7	Other Equipment Upgrades	1	LS	$20,000	$20,000
8	Ultra Filtration Membrane Treatment Unit	1	LS	$500,000	$500,000
9	Electrical Upgrades	1	LS	$50,000	$50,000
10	Backup power equipment	1	EA	$250,000	$250,000
11	Instrumentation Improvements (equipment and installation)	1	LS	$30,000	$30,000
	Subtotal Beulah WTP				$1,684,000
	Pine Drive WTP				
2	Acquire New WTP Site Out of Floodplain	1	LS	$200,000	$200,000
3	General Site Civil Work	1	LS	$300,000	$300,000
4	Pretreatment Settling Tank	1	LS	$200,000	$200,000
5	Powdered Activated Carbon Feed Equipment	1	LS	$20,000	$20,000
6	New WTP Building	1	LS	$1,000,000	$1,000,000
7	Move and Ugrade Package Plant	1	LS	$300,000	$300,000
8	Ultra Filtration Membrane Treatment Unit	1	LS	$500,000	$500,000
9	New Pumping Equipment	1	EA	$200,000	$200,000
10	Backup power equipment	1	EA	$500,000	$500,000
11	New Solids Pond	1	LS	$600,000	$600,000
12	Electrical	1	LS	$300,000	$300,000
13	Instrumentation (equipment and installation)	1	LS	$100,000	$100,000
	Subtotal Pine Drive WTP				$4,220,000
	System Improvements				
1	Existing Tank Site Improvements	1	LS	$150,000	$150,000
	Subtotal System Improvements				$150,000
				Sub-Total	$6,054,000
				Contractor Mobilization, OH&P (15%)	$908,000
				Project Budget Subtotal	$6,962,000
				Contingency (30%)	$2,089,000
				Total Budget	$9,051,000
				ROUNDED BUDGET	$9,100,000

PROJECT: Beulah Water Works District - Water System Improvement Project
DATE 9/30/2019
SUBJECT: Opinion of Probable Cost - BWWD WTP CONSOLIDATION
CALC: ARR/MMS/LEL

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Item	Description	Quantity	Unit	Unit Cost	Item Cost
	Beulah WTP				
1	Repair Beulah WTP Diversion Structure	1	LS	$250,000.00	$250,000
2	Treatment Building Improvements	800	SF	$30.00	$24,000
3	Exterior Concrete Pads and Walks	1	LS	$10,000.00	$10,000
4	Powdered Activated Carbon Feed Equipment	1	LS	$20,000.00	$20,000
5	New Solids Pond Lining and Improvements	1	LS	$350,000.00	$350,000
6	Other Equipment Upgrades	1	LS	$20,000.00	$20,000
7	Instrumentation (equipment and installation)	1	LS	$35,000.00	$35,000
8	Electrical Wiring & Cabinets, Etc.	1	LS	$40,000.00	$40,000
9	Backup power equipment	2	EA	$250,000	$500,000
	Subtotal Beulah WTP				$749,000
	Pine Drive WTP				
1	Rebuild Pine Drive Infiltration Gallery	1	LS	$350,000	$350,000
2	Replace/Install Pumps for Raw Water Pumping to BWWD WTP	1	LS	$250,000.00	$250,000
3	Electrical	1	LS	$40,000	$40,000
4	Instrumentation (equipment and installation)	1	LS	$20,000	$20,000
	Subtotal Pine Drive WTP				$660,000
	Alternate Well Supply				
1	Raw Water Piping to Sellers Well and PDWD Diversion Connection	13,500	LF	$110.00	$1,485,000
2	Sellers Well and Well House	1	LS	$1,314,900.00	$1,314,900
3	Backup power equipment	1	EA	$500,000	$500,000
	Subtotal Alternate Well Supply				$3,299,900
	System Improvements				
1	Existing Tank Site Improvements	1	LS	$150,000.00	$150,000
	Subtotal System Improvements				$150,000
				Sub-Total	$4,859,000
				Contractor Mobilization, OH&P (15%)	$729,000
				Project Budget Subtotal	$5,588,000
				Contingency (30%)	$1,676,000
				Total Budget	$7,264,000
				ROUNDED BUDGET	$7,300,000

PROJECT: Beulah Water Works District - Water System Improvement Project
DATE 9/30/2019
SUBJECT: Life Cycle Cost Comparison
CALC: ARR/MMS/LEL

C:\MMS\Beulah\Finals\[PER Section 5 WTP Life Cycle Cost - 2019 09 20.xlsx]Life Cycle Cost Summary

The net present value (NPV) is then calculated for each technically feasible alternative as the sum of the capital cost (C) plus the present worth of the uniform series of annual O&M (USPW (O&M)) costs minus the single payment present worth of the salvage value (SPPW(S)):

$$NPV = C + USPW\ (O\&M) - SPPW\ (S)$$

Life Cycle Cost Comparison		
Item	Alternative 1 - Improve 2 WTPs	Option 2 - Upgraded BWWD WTP
Capital Cost	$9,100,000	$7,300,000
O&M Net Present Worth	$3,833,298	$2,171,065
Salvage Value Net Present Worth	$1,255,172	$1,510,345
Project NET PRESENT VALUE (NPV)	$11,678,126	$7,960,720

PROJECT: Beulah Water Works District - Water System Improvement Project
DATE 9/20/2019
SUBJECT: Annual O&M Cost Comparison
CALC: ARR/MMS/LEL

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Item	Description	Option 1 - Improve 2 WTPs	Option 2 - Upgraded BWWD WTP
1	Operator's Salary	$ 110,000	$ 70,000
2	Chemical Costs	$ 60,000	$ 25,000
4	Membrane Module Annual Replacement Budget	$ 7,500	$ 5,000
5	Sampling and Testing	$ 20,000	$ 10,000
6	Electrical Costs	$ 14,026	$ 6,200
7	Phone & Internet	$ 3,600	$ 1,800
8	Equipment, piping, valve, diversions, etc. replacment budget	$ 25,000	$ 18,000
Total		$ 240,126	$ 136,000

20-yr O&M Net Present Worth		
Item	Option 1 - Improve 2 WTPs	Option 2 - Construct 1 New WTP
Annual O&M Cost	$240,126	$136,000
No. of Years for Analysis	20	20
Interest rate for Analysis (reflective of US Treasury Bill discount rate)	2.25%	2.25%
Net Present Worth	$3,833,298	$2,171,065

$$PV = PMT\,\frac{(1+i)^n - 1}{i * (1+i)^n}$$

where:
PV = present value
PMT = annual payment
i = interest rate

PROJECT: Beulah Water Works District - Water System Improvement Project
DATE 7/15/2019
SUBJECT: Annual Electrical Cost Comparison
CALC: ARR

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Pumping Electrical Costs

Parameter	Sellers Well	Pine Drive Membrane Feed	Pine Drive Finished Water	Pine Drive CIP * Backflush	Beulah Membrane Feed	Beulah CIP * Backflush	Units
Head	625	350	350	350	400	350	feet
Flow	125	60	60	60	60	60	gpm
WHP	19.7	5.3	5.3	5.3	6.1	5.3	HP
Pump Ef	0.7	0.7	0.7	0.7	0.7	0.7	%
Motor Ef	0.85	0.85	0.85	0.85	0.85	0.85	%
Motor HP	33.2	8.9	8.9	8.9	10.2	8.9	HP
Motor KW	24.9	6.7	6.7	6.7	7.6	6.7	KW
Avg Day Demand	25000	12500	12500	500	12500	500	gpd
Hours/day pump run	3.33	3.47	3.47	0.14	3.47	0.14	hours
KWH per day	83	23	23	1	27	1	kwh/d
KWH per year	30,256	8,472	8,472	339	9,682	339	kwh/yr
$/KWH (incl demand chg)	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$
Elec $$ per year	$ 7,564	$ 2,118	$ 2,118	$ 85	$ 2,420	$ 85	$

Facility Electrical Costs

Parameter	Pine Drive	Beulah
Monthly Misc Elec Bill	$300	$300
Annual Elec Bill	$3,600	$3,600

Total Elecric Costs

Parameter	Pine Drive	Beulah
Annual Pumping Electricity	$ 4,321	$ 2,505
Annual Misc Electricity	$ 3,600	$ 3,600
Total Annual Elec Cost	$ 7,921	$ 6,105

Salvage Value Present Worth		
Item	Option 1 - Improve 2 WTPs	Option 2 - Upgraded BWWD WTP
Capital Cost	$9,100,000	$7,300,000
Percentage of Capital Cost Value salvaged at 20-years	20%	30%
No. of Years for Analysis	20	20
Interest rate for Analysis (reflective of US Treasury Bill discount rate)	2.25%	2.25%
Net Present Worth	$1,255,172	$1,510,345

$$PV = \frac{A}{(1 + nr)}$$

where:
PV = present value
A = amount to be paid in the future
i = interest rate

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