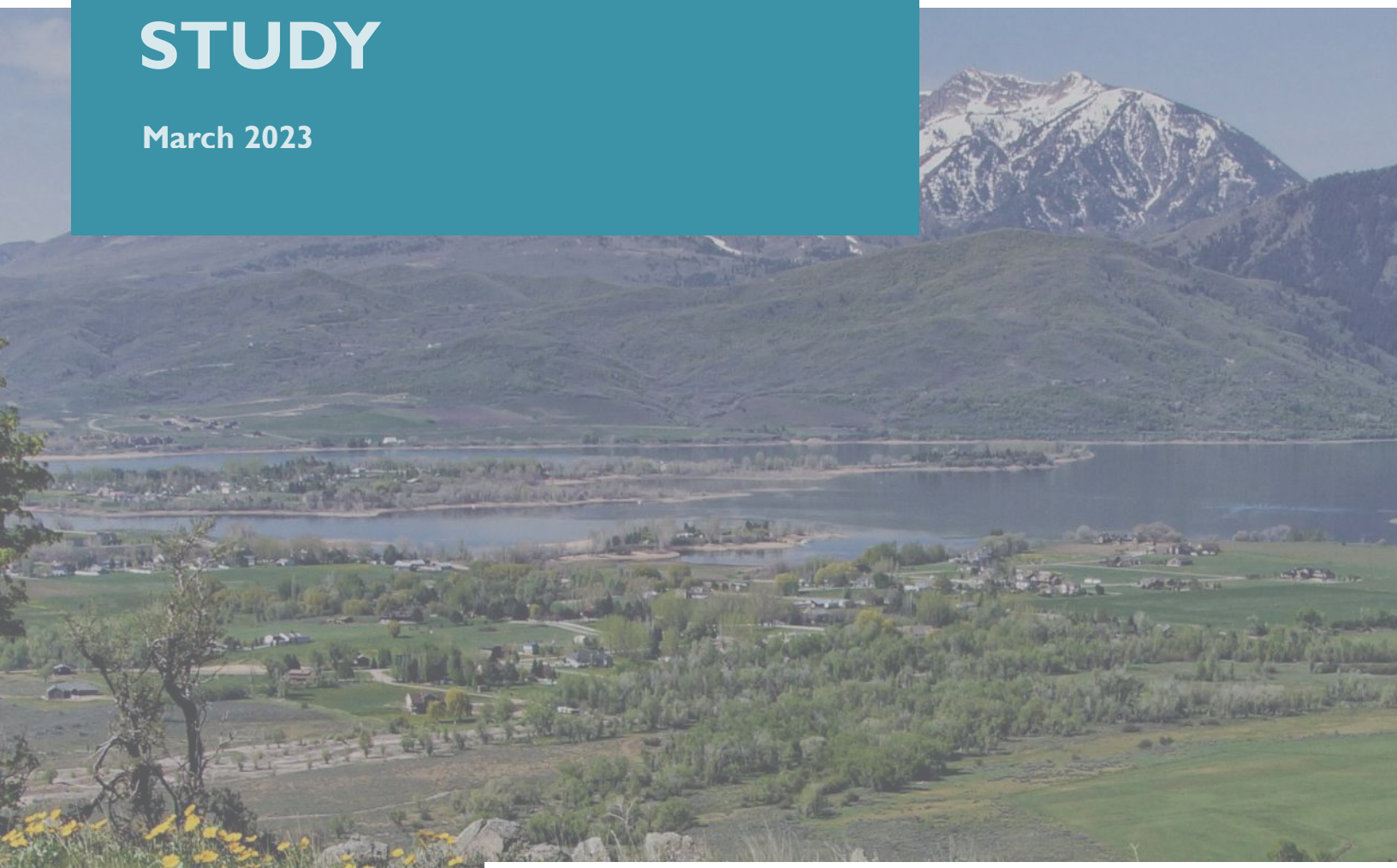
Weber Basin Water Conservancy District &
Weber County

OGDEN VALLEY
WATER SUPPLY AND INFRASTRUCTURE STUDY

March 2023



BOWEN COLLINS & ASSOCIATES

WEBER BASIN WATER CONSERVANCY DISTRICT

WEBER COUNTY

BOWEN COLLINS & ASSOCIATES

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March 17, 2023

Scott Paxman
Weber Basin Water Conservancy District
2837 E Hwy. 193
Layton, Utah 84040

Subject: Ogden Valley Water Supply and Infrastructure Study

Dear Scott Paxman:

The purpose of this letter is to summarize and compile recent work completed for the Ogden Valley Water Supply and Infrastructure Study. The work summarized here will comprise the Water Supply and Infrastructure Study Report.

Background

Weber Basin Water Conservancy District (WBWCD or District) wants to provide its stakeholders with a complete regional water supply and master plan study for the Ogden Valley area. According to recent information, an estimated 83 individual water companies provide water services to residents and businesses in Ogden Valley. However, each of these service companies are limited by the production of their individual water sources. Due to the large number of service providers and the growing number of stakeholders in the Valley, WBWCD has discovered a need for a regional study to better understand the hydrology, service areas, capacities, facilities, and future planning for supplying water to Ogden Valley.

The analysis included in this regional study will help the District, the County, and Ogden Valley water providers identify potential alternatives for supplying additional water to the residents of Ogden Valley.

Summary of Report Components

This report consists of an executive summary and six technical memorandums (TMs). These documents are included in this packet and summarize the analyses, results, and recommendations for supplying water to future residents of the Ogden Valley:

- **Executive Summary - "Ogden Valley Water Supply and Infrastructure Study", BC&A, May 2022** – This document has been prepared to summarize all the major finding and recommendations of the study. For many stakeholders and residents, this document will provide all the information they need in a simple, visual format. As more detailed information is desired, readers may reference the subsequent memorandums detailing each step of the analysis.

- **TM #1 - "Ogden Valley Water Supply and Infrastructure Study - Demand Projections", BC&A, 11 March 2023** – In order to project the future water demands in Ogden Valley, the following tasks were completed in this TM:
    - The Valley's expected buildout population was determined by projecting the growth in Equal Residential Connections (ERC's). With aid from Weber County personnel, it is estimated that Valley can be buildout out to 13,584 connections.
    - Historic water use and demand data was gathered from Ogden Valley water providers to calculate the annual and peak demands on a per unit basis.
    - The calculated unit demands were applied to future growth projections to estimate the overall future demand.
- **TM #2 - "Ogden Valley Water Supply and Infrastructure Study - Supply Analysis", BC&A, 11 March 2022** – This TM evaluates both existing and future water supply in the Valley. Bowen Collins and Associates (BC&A) interviewed operations and/or management personnel from the five larger water providers in the Valley (Huntsville, Eden, Liberty, Wolf Creek, and Nordic Valley) to discuss existing supply availability and source capacity. From the information provided, it is clear that the ability of existing supply to support future growth is very limited. Nearly all future demands will need to be met by new municipal water supply. This water will need to come from one of three alternatives:
    - New Groundwater Development
    - Agricultural Conversion
    - Imported Water Rights

  Potential future supply from each of these sources is discussed in the memorandum.
- **TM #3 – "Ogden Valley Water Supply and Infrastructure Study - Project Planning Demands", BC&A, 11 March 2022** – This TM summarizes the recommended planning water demands for the Valley based on the previous TMs discussing supply and demand within the Valley. The size of future development lots and the amount of development rights transferred to Village Core Areas will have significant effects on the annual and peak day demands in the Valley. The most conservative planning scenario for annual imported water occurs when lot sizes are 0.2 acres with a total projected demand for import water of 5,353 acre-ft per year. The most conservative planning scenario for peak day culinary demand occurs when lot sizes are 0.82 acres with a total projected peak demand of 5,541 gpm.
- **TM #4 – "Ogden Valley Water Supply and Infrastructure Alternatives", BC&A, 09 March 2023** – This TM identifies alternative solutions of how to develop needed culinary supply. Each alternative includes a way to produce culinary water, whether by groundwater or treated surface water, and identified the basic facilities needed deliver the water to where it is needed. This TM focuses primarily on the following four alternatives:
    - New Wells in Ogden Valley
    - Ogden Well Exchange
    - Reservoir Lake Tap and Treatment Plant
    - New South Fork Diversions and Treatment Plant

  While the groundwater alternatives may be worth some more discussion, he recommended source alternative for planning purposes is the New South Fork Diversions and Treatment Plant.

- **TM #5 – "Ogden Valley Water Supply and Infrastructure Study - Recommended Conveyance Improvements", BC&A, 09 March 2022** – This TM focuses on developing a more detailed plan for source improvements needed to meet projected water needs. This includes a conveyance and distribution strategy from the South Fork Diversions and Treatment Plant to the rest of the system including cost estimates and phasing plans.
- **TM #6 – "Ogden Valley Water Supply and Infrastructure Study - Implementation Alternatives"** – This TM identifies the next steps that can be taken if the County wishes to pursue development of additional water in the Valley. It includes consideration of who might build and operate the required facilities and what options exist for financing the improvements.
- **Appendix A – "Ogden Valley Groundwater Development Potential"** – This TM presents findings and recommendations regarding the potential for groundwater development with Ogden Valley. Existing hydrogeologic information was used to identify the potential for new groundwater supply wells and estimating the anticipated yield. The primary challenge to the development of new groundwater in Ogden Valley is expected to be water right issues.
- **Appendix B – "Ogden Valley Water Supply and Infrastructure Plan – Stakeholder and Public Feedback"** – This TM summarizes the outreach and public meetings held throughout the course of the study and includes documentation of stakeholder and public feedback received during the planning process.

Conclusions and Recommendations

Existing water providers in Ogden Valley are not equipped to meet the magnitude of water demands that could be experienced if the Valley continues to develop as currently projected. A plan is needed to develop new wholesale source water to meet future needs.

With an expected peak day demand of up to 5,550 gpm, it is recommended that the South Fork branches of the Ogden River be utilized as a source to meet future water needs. This recommendation will require diversion structures, a water treatment plant, and a new transmission system to deliver culinary water throughout the Valley. The overall cost of constructing these facilities in 2023 dollars is expected to be approximately $64 million. To maximize the cost effectiveness of these improvements, it is proposed that they be constructed in multiple phases as described in TM 5. Depending on phasing and the cost of source water rights, the average annual cost of this water is expected to be $5.00 to $7.00 per thousand gallons.

Sincerely,
Bowen Collins & Associates, Inc.

Keith Larson, PE
Project Manager

cc: Shane R. McFarland – WBWCD Engineer
Weber County Commissioners

OGDEN VALLEY WATER SUPPLY AND INFRASTRUCTURE STUDY

Weber Basin Water Conservancy District & Weber County

Executive Summary

The Ogden Valley area of Weber County needs a plan to manage future water needs.

INTRODUCTION

The Ogden Valley is one of Utah's most sought-after places for families, retirees, and visitors to live and play. Its desirability has resulted in significant growth over the last several years with more future growth expected. The impact of this potential growth is of significant concern to service providers throughout the valley. Of specific interest to this study is the potential impact of growth on water resources and infrastructure.

One of the challenges associated with planning for water needs in the valley is the number of independent water providers. Due to the large number of service providers and the growing number of stakeholders in the Valley, Weber Basin Water Conservancy District (WBWCD) and Weber County have identified a need for a regional study to better understand the hydrology, service areas, source capacities, and facilities within the Valley.

To accomplish this purpose, WBWCD contracted with Bowen Collins & Associates (BC&A) to prepare a regional study of future water needs in the Valley. The following pages summarize our findings, and will provide addtional information.

Plan Components

DEMAND: How much water might be needed to supply future needs in the Valley?

SUPPLY: Where will this additional water come from?

SOURCE DEVELOPMENT: What options exist for developing the new water?

SYSTEM IMPROVEMENTS: What is required to deliver new water to where it is needed in the Valley?

IMPLEMENTATION PLAN: How might these improvements be funded and constructed?

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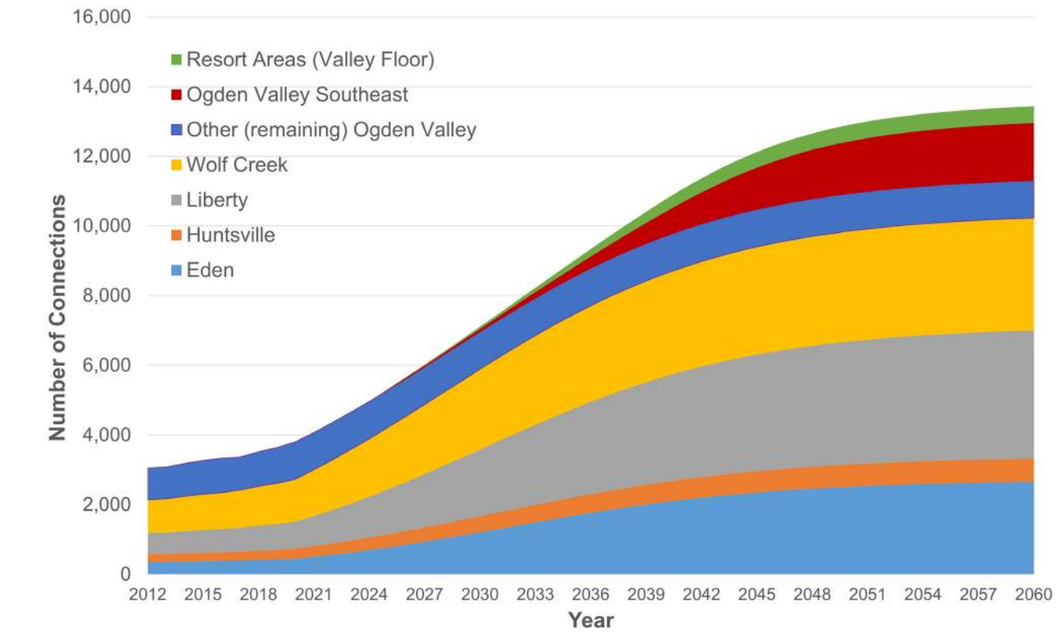
WEBER BASIN WATER CONSERVANCY DISTRICT

WEBER COUNTY

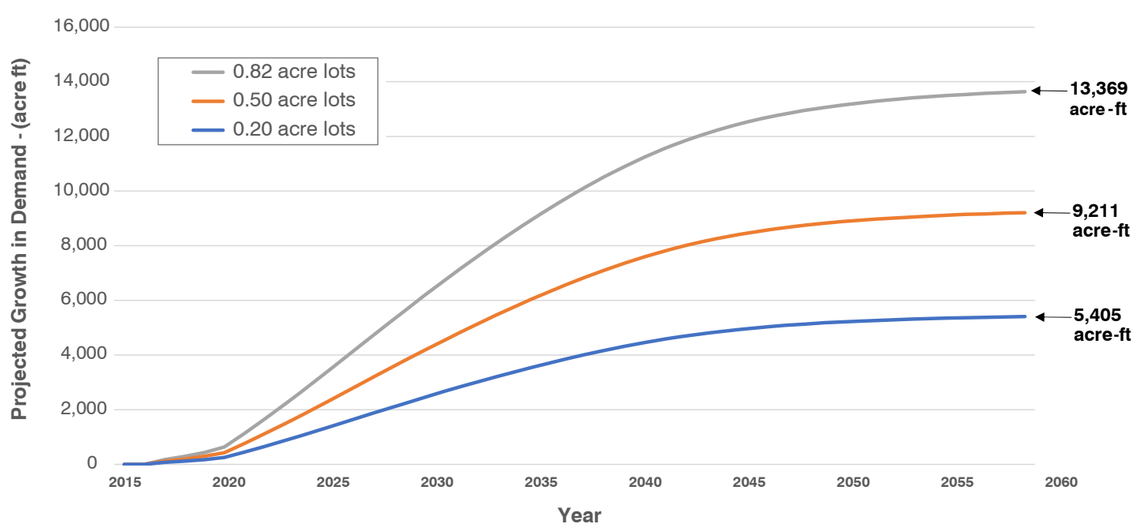
DEMAND

With growing development pressure along the Wasatch Front and the level of expressed interest in the Ogden Valley, the County expects that development in the Ogden Valley will occur much quicker in the future than it has in the past. While there is a significant amount of open space and agricultural land to accommodate development and incoming residents, the County wants to retain the rural feel of the area by promoting and developing Village Core Areas. The figure below outlines the proposed Village Core Areas and the anticipated number of needed water connections by village and year. This figure provides the basis for our demand based on lot sizes going forward.

Demand associated with projected growth will depend on how development occurs. The greatest variable in this regard is lot size. If the County were 100% successful in consolidating growth and correspondingly preserving current agricultural land, average lot sizes would be limited to no larger than 0.2 acres. Conversely, if no consolidation occurs and development rights are allowed to fill the valley floor, average lot sizes could be as large as 0.82 acres. This results in a large variation in projected demand. Based on historic indoor and outdoor water use rates, projected municipal demand for this full range of lot sizes is shown below. As shown in the figure, new demand by 2060 could range between 5,400 and 13,400 depending on how development occurs.



Total New Demand in Ogden Valley System



Indoor Water Use in Ogden Valley

Persons Per Household	2.8
Use Per Person (gpd)	60.9
System Loss	15%
Total Use Per Connection (gpd)	**200.6**
(acre-ft/year)	**0.225**

Outdoor Water Use in Ogden Valley

Lot Size (acres)	Irrigation Rate (acre-ft/year)	System Loss	Total Use per Connection (acre-ft/year)
0.20	2.7	15%	0.39
0.50	2.7	15%	0.69
0.82	2.7	15%	1.13

SUPPLY

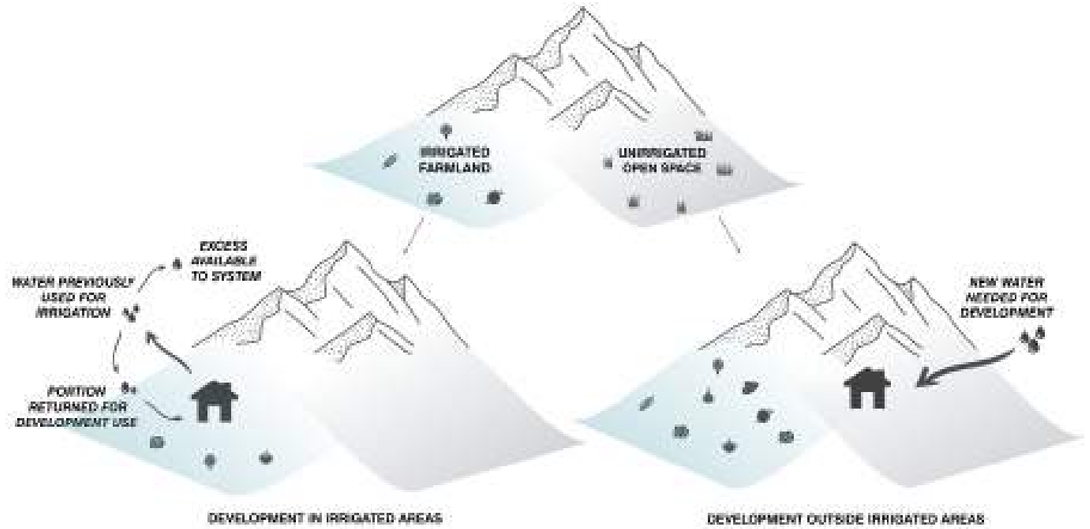
Current water providers in Ogden Valley have communicated that they are not prepared to supply any significant amount of additional water to future development. Therefore, all future municipal water demands in the Ogden Valley will need to be met from new sources. Based on discussions with stakeholders in the area, three alternatives for new municipal supply to the Ogden Valley have been identified for consideration:

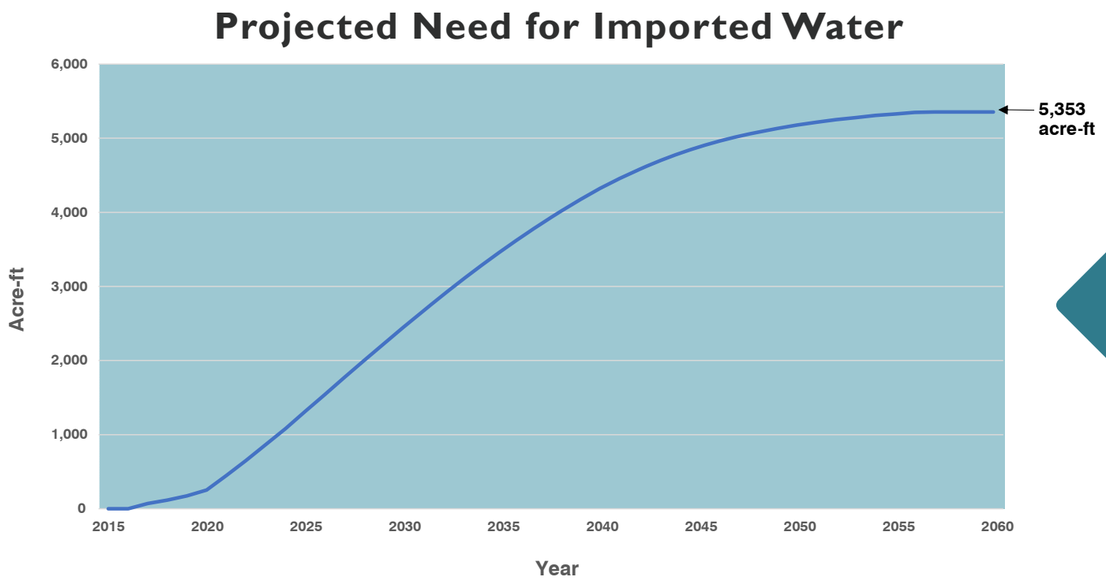
New Groundwater Development: While much of the groundwater capacity in the area is obviously stretched to capacity, stakeholders requested that new groundwater wells be evaluated as a potential new source of supply. It appears that some areas east of Pineview Reservoir may be conducive to the development of wells. However, these locations would likely have significant negative effects on other groundwater rights. Therefore, developing additional groundwater rights appears unlikely.

Agricultural Conversion: Agricultural conversion occurs when land previously used for agriculture is developed and the water that has historically been delivered and used for irrigation becomes available for other uses, often for the development's culinary and secondary needs. Depending on how development occurs, this may be a significant source of new supply. See figure to the right.

Imported Water Rights: If sufficient available water cannot be identified within the Valley, it will need to come from other sources. For the worst case scenario for agricultural conversion (i.e. all new development limited to 0.2 acre lots within currently unirrigated open space), potential need for import water is up to 5,353 acre-ft (see figure below). WBWCD has indicated that it has sufficient remaining available water in Willard Bay that could be made available in the Ogden Valley via exchange to satisfy the 5,353 acre-ft of potential demand.

If further development is to occur within the Valley, additional municipal water must be supplied from other sources. An analysis of available resources suggests that all new supply must come through either conversion of agricultural water or imported water supplies.





	Lot Size		
Water Type	**0.2 Acre**	**0.5 Acre**	**0.82 Acre**
Water Provided by Ag Conversion (acre-ft)			
Culinary	0	1,986	3,093
Secondary	52	3,645	7,326
Total	52	5,631	10,419
Water Provided by Import Water (acre-ft)			
Culinary	2,769	1,390	989
Secondary	2,583	2,190	2,231
Total	5,352	3,579	3,220
Total All Sources	**5,405**	**9,211**	**13,639**

CULINARY SOURCE ALTERNATIVES

It was previously identified that future water supply would either come from ag conversion or WBWCD import water. Future converted ag water will eventually drain into Pineview Reservoir. Additionally, WBWCD's only existing supply in Ogden Valley is Pineview Reservoir water rights. Because both supply options will ultimately come from Pineview Reservoir, any future culinary water system will need to access water rights in Pineview Reservoir and convert them to quality culinary water supply for residents and businesses in the Valley. Four potential alternatives were evaluated as part of this report (see boxes below).

ALTERNATIVE #1: NEW WELLS IN OGDEN VALLEY – Because the majority of Ogden Valley's culinary water supply is provided by existing groundwater wells, one alternative might be to consider developing new culinary wells in Ogden Valley to meet future culinary demands.

Conclusion: While it appears technically possible to develop wells with enough capacity to support projected demands, water right issues and potential interference with other wells are expected to make this alternative nearly impossible.

ALTERNATIVE #2: OGDEN WELL EXCHANGE– Ogden City owns groundwater wells near Pineview Reservoir. This alternative would use a portion of the groundwater from these wells to satisfy demands Ogden Valley in exchange for treated water to be delivered from WBWCD directly to Ogden City.

Conclusion: Although this alternative does have some attractive features, it may not be a good long-term alternative due to unknown costs associated with improving Ogden City's water system. However, using Ogden wells as a short-term bridge to other solutions may be an option.

ALTERNATIVE #3: RESERVOIR LAKE TAP AND TREATMENT PLANT – Utilizing the storage that Pineview Reservoir provides, this alternative would construct a lake tap directly into the reservoir to access water. The water could then be treated at a new treatment plant to meet future culinary demands in Ogden Valley.

Conclusion: It is not recommended to continue an evaluation of a possible lake tap and treatment plant. This is due to the high costs associated with this alternative.

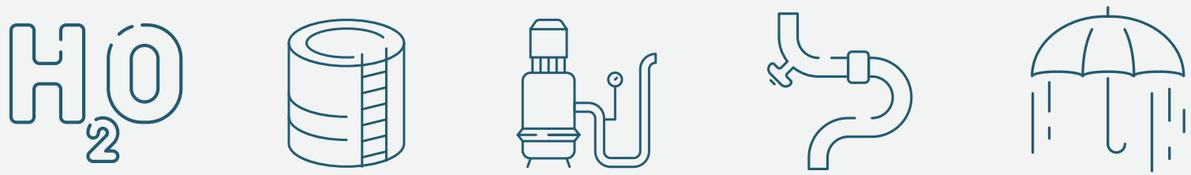
ALTERNATIVE #4: NEW SOUTH FORK DIVERSIONS AND TREATMENT PLANT – The South Fork of the Ogden River has the highest and most consistent flows of rivers entering Pineview Reservoir. This alternative would include the construction of two diversion structures placed along the South Fork along with a new water treatment plant to meet the Valley's future culinary demands.

Conclusion: Due to the absence of any major roadblocks and its moderate estimated cost, it is recommended that this alternative be used as the basis for further evaluation and planning.

Total Capital Costs (2023 Dollars)

	Phase 1 Capital Costs	Future Capital Costs	Total Cost
Alternative 1	$34,920,000	$15,240,000	$50,160,000
Alternative 2	$39,900,000	$19,820,000	$59,720,000
Alternative 3	$95,670,000	$9,850,000	$105,520,000
Alternative 4	**$54,180,000**	**$9,860,000**	**$64,040,000**

RECOMMENDATIONS: After considering each alternative, we recommend that further evaluation and planning be based on Alternative #4: New South Fork Diversions and Treatment Plant. This recommendation is made by comparing the advantages, disadvantages, and cost estimates of each alternative along with receiving feedback from WBWCD personnel, Weber County personnel, and Ogden Valley water providers. Although this alternative is not the lowest cost of the alternatives, it is the lowest cost out of expected feasible alternatives when considering all factors and parties involved.



RECOMMENDED SYSTEM IMPROVEMENTS

The New South Fork Diversions and Treatment Plant alternative (Alternative #4) has been used as the basis for development of proposed improvements to meet future Ogden Valley culinary water needs. The proposed improvements include diversion structures, a water treatment plant, pump stations, storage, and a new network of transmission pipelines. The overall cost of constructing these facilities in 2023 dollars is expected to be approximately $64 million.

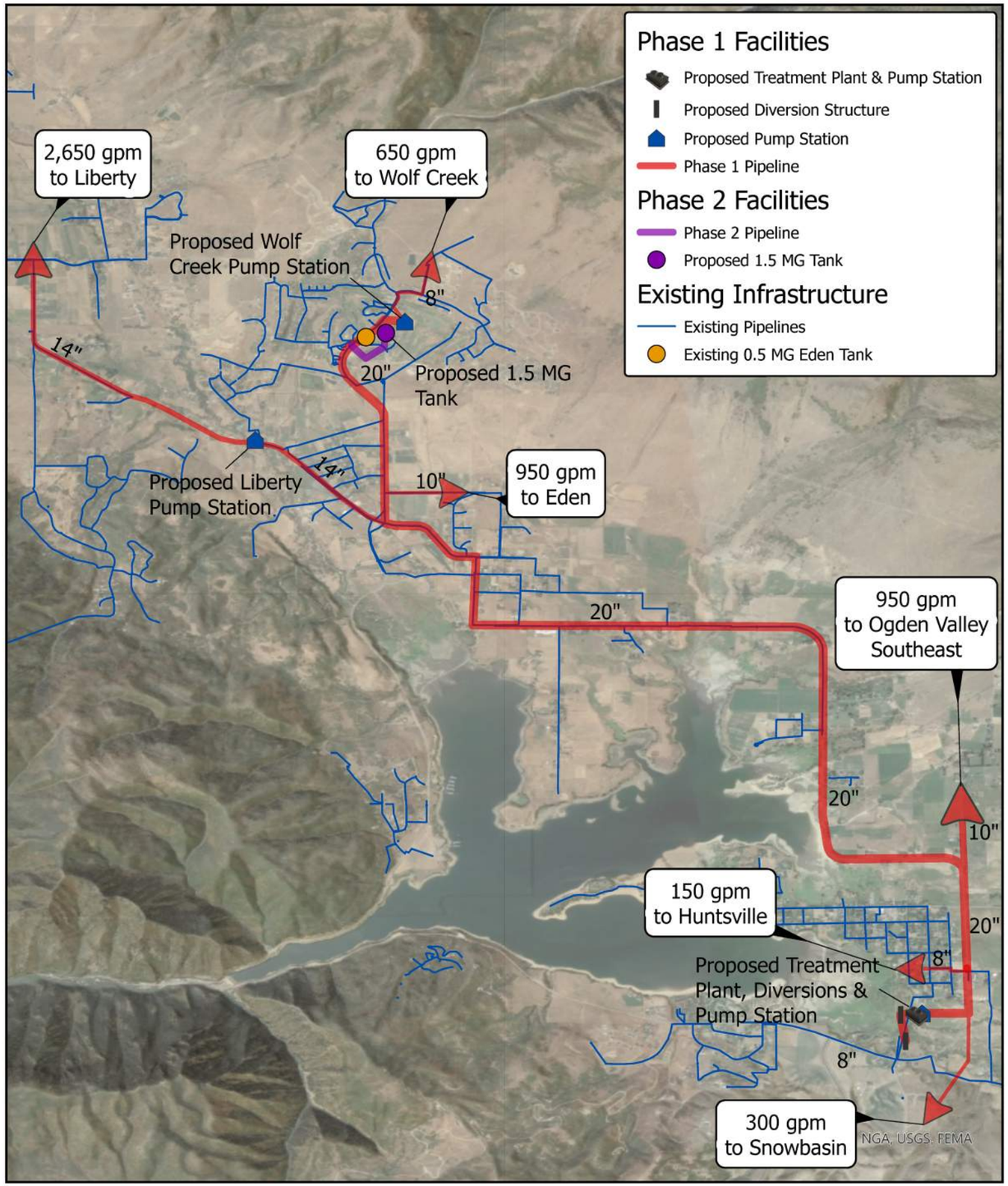
To maximize the cost effectiveness of this alternative, it is proposed that it be constructed in multiple phases:

- ***Phase 1*** includes two diversions on the South Fork of the Ogden River, a new 4 mgd treatment plant, a 20-inch diameter pipeline to distribute water throughout the Valley, and pump stations or metering vaults to each water provider. About $54 million would be required as part of Phase 1 improvements.
- ***Phase 2*** includes expansion of the treatment plant from 4 to 8 mgd and a dedicated 1.5-million-gallon storage tank. About $10 million would be needed for Phase 2 work.

The initial capital cost for Phase 1 capacity is $26,600/acre-ft. However, this will gradually decrease as the system is expanded. Once capacity is fully utilized, the expected capital cost of water will be about $15,700/acre-ft. With financing and water acquisition costs, this equates to an annual cost of about $2,300/acre-ft/year for Phase 1 and $1,600/acre-ft/year for buildout. This equates to between $5.00 and $7.00 for 1,000 gallons.

Cost of New Ogden Valley Water ($/acre-ft/year)

Phase	Capital Costs (with Interest)	Water Acquisition Costs	Total	Cost per 1,000 Gallons
Phase 1 Water Costs (Based on 2,000 acre-ft contracted)	$1,728	$570	$2,298	$7.06
Water Costs at Buildout (Based on 4,080 acre-ft contracted)	$1,021	$570	$1,591	$4.88



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Schematic of Proposed Water Delivery System

Weber Basin Water Conservancy District

Ogden Valley Water Supply Study

NORTH:

SCALE: 0 0.5 1 Miles

FIGURE NO. 6

P:\Provo City\011-22-01 Water Master Plan Update\4.0 GIS\OV Delivery System TM 5.aprx aharris 7/19/2022

IMPLEMENTATION ALTERNATIVES

WHO WILL BUILD AND OPERATE THE IMPROVEMENTS?

Potential System Operators:

- **EXISTING WATER PROVIDER:** One of the existing major providers could step up and build the required infrastructure. However, no one has volunteered for this role and the size and cost of the improvements make this seem unlikely.
- **NEW MUNICIPAL DISTRICT:** A new municipal district could be formed to complete the improvements. A special service district seems to be the best fit for this application.
- **PRIVATE WATER COMPANY:** A private entity could be formed to accomplish the same purpose if a group could be found that was willing to take this role.

While neither WBWCD or Weber County are interested in the long-term ownership and operation of a system in the Ogden Valley, both have indicated they are willing to assist in helping to find a solution to future water needs. WBWCD may be willing to provide water rights and provide technical support. Weber County may be willing to provide planning support and assistance with organization of a new district.

HOW WILL IT BE PAID FOR?

There are many options for funding future water improvements. Funding will be needed at three levels: finding capital to build the initial improvement; collecting money to pay back capital debt; and generating ongoing money to operate the system. Options for each of these are as follows:

Potential Initial Funding:

- **DEVELOPMENT FUNDED**
- **PIONEERING AGREEMENTS**
- **UTILITY REVENUE BOND**
- **GENERAL OBLIGATION BOND**

Potential Capital Payback:

- **IMPACT FEES**
- **TAX ASSESSMENTS**
  (Public Infrastructure District, Special Assessment Area, Tax Increment Financing)

Ongoing O&M:

- **WATER RATES**
- **WATER CONTRACTS**
- **AD VALOREM TAXES**

Once an operating entity is identified, each of the options above can be explored and the best alternatives selected for implementation.

WHAT WOULD THIS MEAN FOR EXISTING RESIDENTS?

The intention of this analysis is that new growth will pay for itself. For many funding alternatives, this means there will be no expense incurred by existing users. For other funding alternatives, some cost may need to be initially funded by existing users and paid back over time by development. This will need to be considered further as a payment strategy is developed.

One benefit of the project for existing users could be interconnecting the major systems in the Valley to improve reliability and redundancy.

WHAT WOULD THIS MEAN FOR FUTURE DEVELOPMENTS?

Regardless of the mechanism of funding (impact fees, taxes, etc.), new growth will ultimately be responsible for paying for its capacity. Cost will vary depending on lot size.

Lot Size	Volume Needed (acre-ft/year)	Approximate Cost
Indoor Only	0.225	$7,000
0.2 acre	0.62	$19,000
0.5 acre	0.92	$29,000
0.82 acre	1.36	$42,000

Note: Does not include water acquisition costs. Current WBWCD costs are $566 acre-ft/year.
Based on use of culinary water for outdoor irrigation.
Includes assumed financing costs at 5% over a 30-year bond.

CONCLUSION

Major conclusions and recommendations from this report include:

- ***The Ogden Valley is facing significant development pressure and increasing water demands.***
- ***Developing additional groundwater rights appears to be unlikely. All new supply must come through either conversion of agricultural water or imported water supplies.***
- ***Weber Basin Water Conservancy District has enough water available via exchange to satisfy projected future demands of up to 5,350 acre-ft.***
- ***The most feasible option for developing new culinary water appears to be constructing new diversions on the South Fork of the Ogden River and building a new treatment plant.***
- ***New water development and distribution systems are expected to be expensive. The initial phase of proposed improvements is expected to cost $54 million. The average cost for water from the project is expected to be $5 to $7 per 1000 gallons.***

Our hope is that this document will allow stakeholders to have a better sense of where future culinary water could come from, and how it could get to their homes and places of business.

If you have questions about the information in this document, or if you just want to know more, please visit our project website at www.bowencollins.com/public-involvement/ogden-valley/ or scan the QR code here to submit any feedback you may have.

BOWEN COLLINS & ASSOCIATES

TECHNICAL MEMORANDUM #1

TO:	Weber Basin Water Conservancy District
COPIES:	File
FROM:	Keith Larson, P.E., Andee Harris, E.I.T., & Kaden Grover
DATE:	16 March 2023
SUBJECT:	Ogden Valley Water Supply and Infrastructure Study – Demand Projections
JOB NO.:	021-21-02

INTRODUCTION

The Ogden Valley area of Weber County needs a plan to manage future water needs. According to recent information, an estimated 83 individual water companies provide water services to residents and businesses in the Ogden Valley. However, each of these service companies is limited by the production of their individual water sources. Due to the large number of service providers and the growing number of stakeholders in the Valley, Weber Basin Water Conservancy District (WBWCD or District) and Weber County have identified a need for a regional study to better understand the hydrology, service areas, source capacities, and facilities within the Valley. This analysis will help the District, the County, and Ogden Valley water providers identify potential alternatives for supplying additional water to the residents of Ogden Valley.

To accomplish this purpose, WBWCD has contracted with Bowen Collins & Associates (BC&A) to prepare a regional study of both culinary and secondary water. Primary objectives of the Ogden Valley Water Supply and Infrastructure Study include:

- Documenting existing water demands and supplies
- Understanding and documenting existing water resources and infrastructure in the Ogden Valley
- Projecting future water demand and supply
- Identifying alternative solutions to meet projected water needs
- Developing a strategy for implementing recommended solutions

The focus of this memorandum is demand projections.

DEMAND PROJECTION METHODOLOGY

In order to project the future water demands in Ogden Valley, the following tasks were completed:

1. Projection of the Valley's expected population at buildout with aid from Weber County personnel.
2. Projection of the rate and location of growth in the Valley based on future expectations. This includes consideration of transfers of development rights to higher density areas

3. Gather historic water use and demand data from Ogden Valley water providers. From this data, calculate existing demands on a per unit basis for both annual and peak demands
4. Apply unit demands to future growth projections to estimate future demand

The following sections detail each of these steps

PROJECTED DEVELOPMENT AT BUILDOUT

Historical Projections of Ogden Valley Development At Buildout

The most recent published projections for Ogden Valley development are contained in the Ogden Valley 2016 General Plan. That plan contained population projections including both existing and buildout residential units along with the estimated amount of agriculture/open land areas remaining in the Valley. Table 1 shows the 2016 General Plan summary of development potential for the Ogden Valley while Figure 1 shows the ag land and open space identified in that plan.

Table 1: Current Connections and Buildout Potential Based on 2016 Ogden Valley General Plan

Built Units:	3,762
Platted Vacant Parcels:	2,563
Approved Resort Units:	5,300
Total Built, Platted, Approved Units in Valley:	11,625
Unplatted, but Zoned Units on Valley Floor:	4,000
Potential Maximum Valley Floor Buildout:	15,625

Updated Projections of Ogden Valley Development At Buildout

The County has since done a more detailed analysis of future units and has concluded that a more accurate conservative buildout value would be 13,583 units instead of the 15,625 units shown in Table 1. Growth projections for the Valley were prepared by Weber County planning personnel and have been organized into six planning areas. This includes the village areas in the Valley along with a category for all other remaining area on the valley floor. The growth for each planning area is shown in Table 2.

Table 2: Ogden Valley Updated Dwelling Projections

	Existing Dwellings	Remaining Rights	Potential Buildout Dwellings
Eden	228	638	866
Huntsville	241	133	374
Liberty	553	1,194	1,747
Wolf Creek	1,219	1,795	3,014
Remainder of Ogden Valley	1,565	5,721	7,286
Resort Areas (Valley Floor)	0	297	297
Total Valley	**3,806**	**9,778**	**13,584**

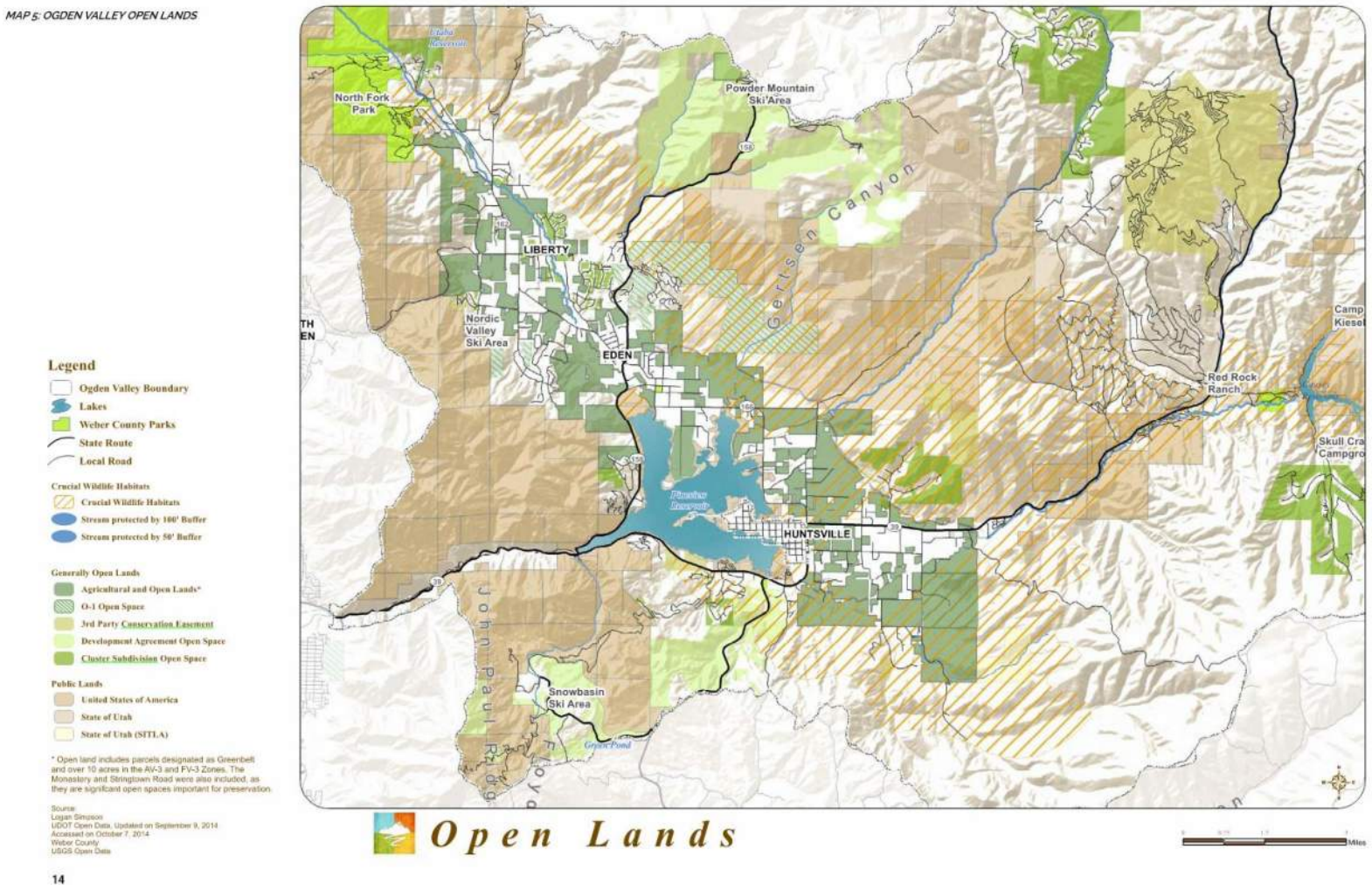


Figure 1: Valley Ag Land and Open Space Based on 2016 Ogden Valley General Plan

The observed decrease in expected buildout units from Table 1 to Table 2 was the result of a more thorough examination of the developable areas within the Valley and remaining development entitlements. Details such as terrain slopes, political restrictions, and more recent population data were considered while revising the buildout value. It should be noted that the values reported here are for the Valley floor only. Additional development at the higher elevation Powder Mountain and Snow Basin properties is outside the scope of this report.

RATE OF GROWTH

With growing development pressure along the Wasatch Front and the level of expressed interest in the Ogden Valley, the County expects that development in the Ogden Valley will occur much quicker in the future than it has in the past. Thus, more aggressive growth rates were used to project the growth that each of the planning areas could experience. Table 3 summarizes historic growth rates from 2012 to 2020 and the future growth rates used for the study. The future growth rates were based on the County's expected year of buildout for each planning area. The resort areas have a higher growth rate of 10.7% because the start of growth in these areas is expected to be delayed compared to the rest of the Valley but will occur rapidly once it begins.

Table 3: Ogden Valley Growth Rates

Entity	Historic Growth Rate (2012-2020)	Future Growth Rate (2020-2050)
Eden	3.1%	7.1%
Huntsville	1.3%	2.8%
Liberty	3.0%	4.2%
Wolf Creek	1.9%	3.8%
Remainder of Ogden Valley	3.1%	3.1%
*Resort Areas (Valley Floor)	-	10.7%

*The Future Growth Rate for the Resorts is calculated from 2030 to 2050.

Figure 2 shows a comparison of the more aggressive planning growth projections vs. the historic growth rates.

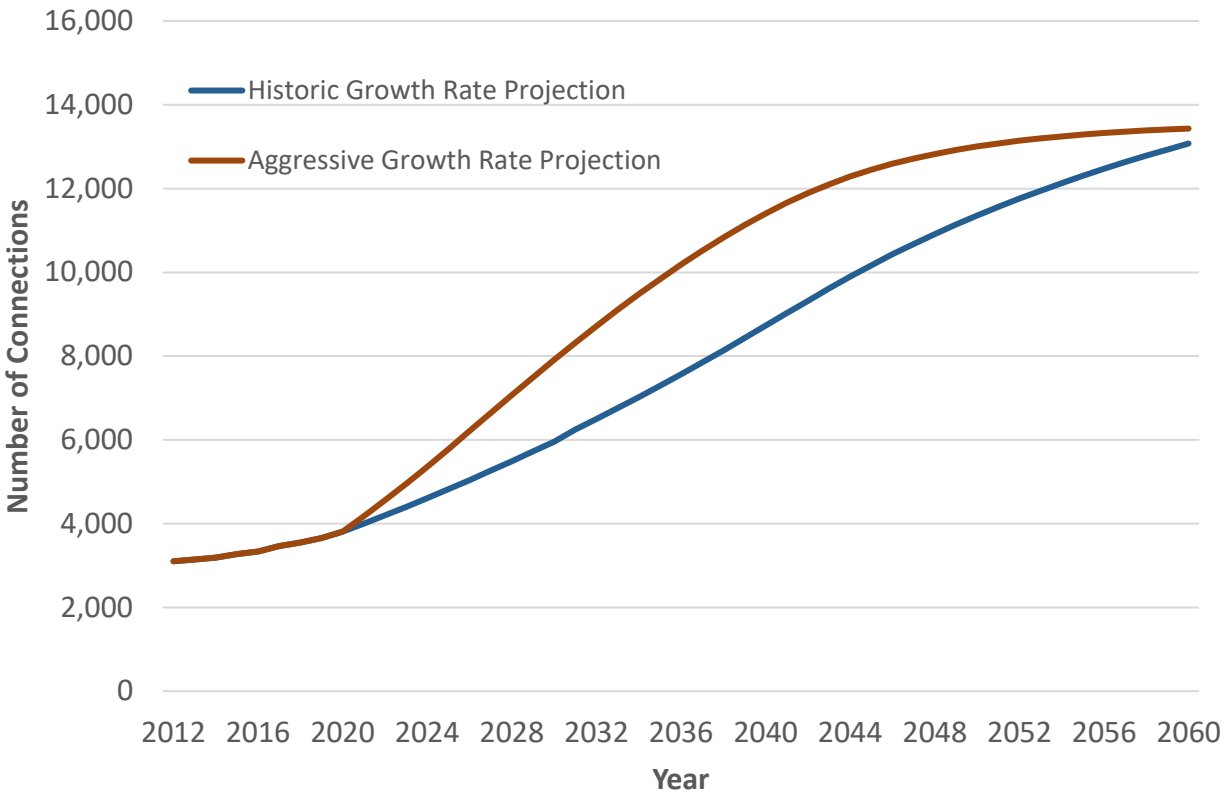


Figure 2: Ogden Valley Growth Rate Projections

LOCATION OF GROWTH

As shown in Figure 1, there is a significant amount of ag land and open space in the Ogden Valley, more than enough to support the proposed level of development discussed above. However, the County would like to retain the rural feel of the area by conserving as much ag land and open space as possible. They plan to do this by promoting "Village Core Areas".

"Village Core Areas" are designated areas in the Ogden Valley that will contain significantly higher population densities than the remainder of the Valley. Ideally, these core areas will contain the majority of the population growth, allowing the remainder of the Valley to remain open and agricultural. Figure 3 shows the County's anticipated locations of Village Core Areas as identified in the 2016 General Plan.

The level of success the County will have in encouraging density transfer to village areas is unknown. However, the Village Core Areas are also useful in that they correlate well with the larger water providers in the valley. The village areas of Liberty, Wolf Creek, Eden, and Huntsville correlate to water providers of the same name (see subsequent technical memos for details regarding water providers). The service areas of these providers generally extend to encompass both the village areas and the likely developable area around each village. Thus, with just a few exceptions, the water service areas can be used to estimate the total expected growth for each provider regardless of the success achieved in consolidating development to the village areas.

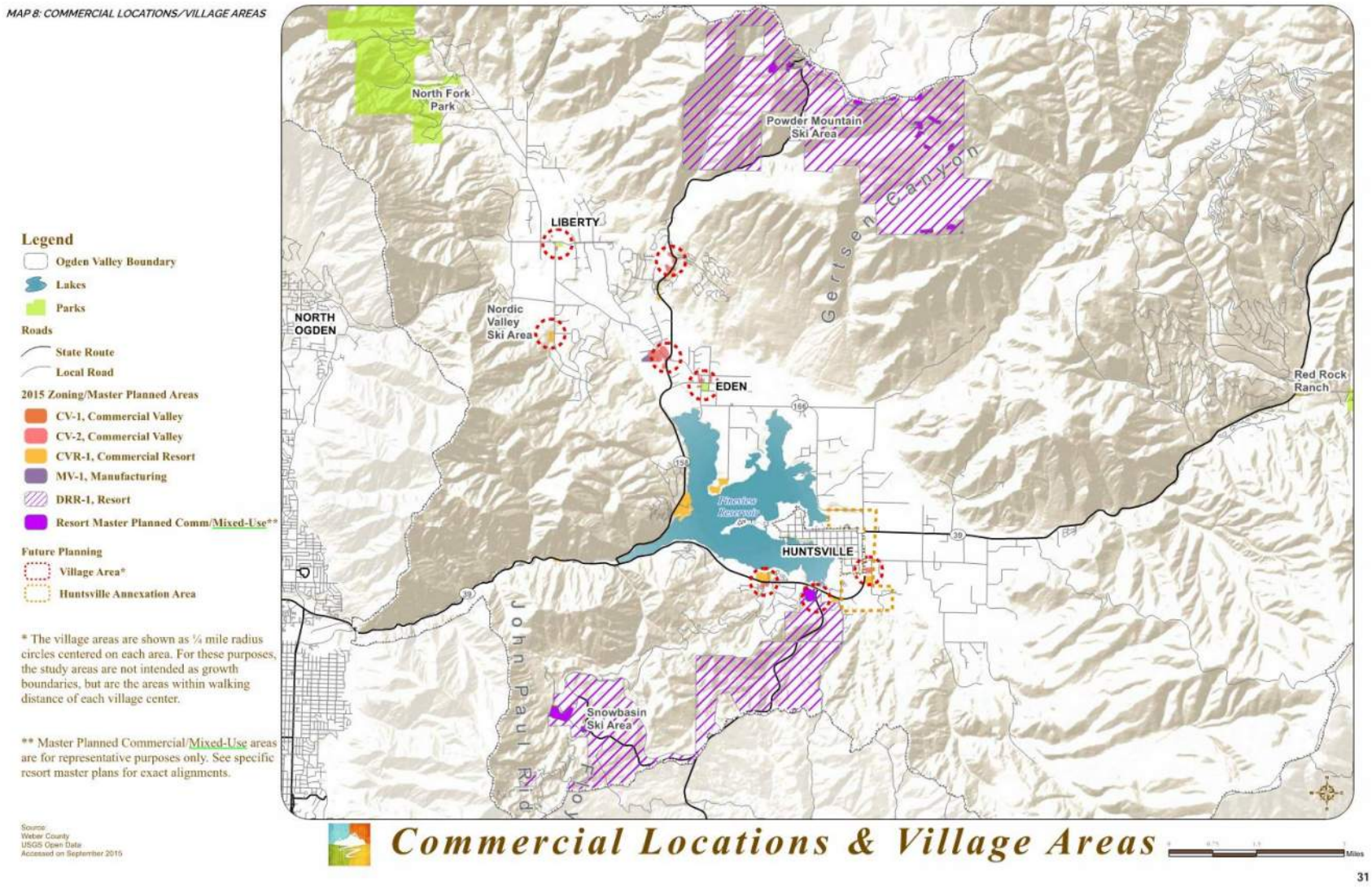


Figure 3: County Plan to Transfer Development To Village Core Areas

The exceptions to this are Nordic Valley, the southeast area of the Valley, and the Resort Areas (Valley Floor):

- Because of its close proximity, Nordic Valley has been grouped with Liberty.
- In the southeast area, service could be provided by Eden, Hunstsville, or perhaps a new water provider. Because the ultimate provider is unknown, the service area was accounted for separately.
- The Resort Areas (Valley Floor) refers primarily to the area at the base of the road leading to Snowbasin. This area was also given its own service area as the future provider is uncertain.

There are also a significant number of other small water providers. For the purpose of this analysis, it was assumed that growth associated with these other providers would be minimal.

This results in seven basic water service areas. For the purpose of this study, the ERC projections prepared by the County in Table 3 were rearranged to correspond to the water service areas as described above. This included capturing all projected growth associated with each village core area along with that portion of the "Remainder of Ogden Valley" that falls within each service area. ERCs associated with "Remainder of Ogden Valley" growth have been allocated based on the amount of developable acreage within each service area. The final projections for each service area are shown in Table 4.

Table 4: Projected ERC's based on Water Service Areas

	Existing Dwellings	Estimated Service Area Remaining Rights	Buildout
Eden	452	2,257	2,709
Huntsville	291	391	682
Liberty[1]	772	2,959	3,731
Wolf Creek	1,219	2,025	3,244
Ogden Valley Southeast	0	1,668	1,668
Resort Areas (Valley Floor)	0	479	479
Other	1,072	0	1,072
Total Valley	**3,806**	**9,778**	**13,584**

[1]Liberty also includes growth expected in Nordic Valley.

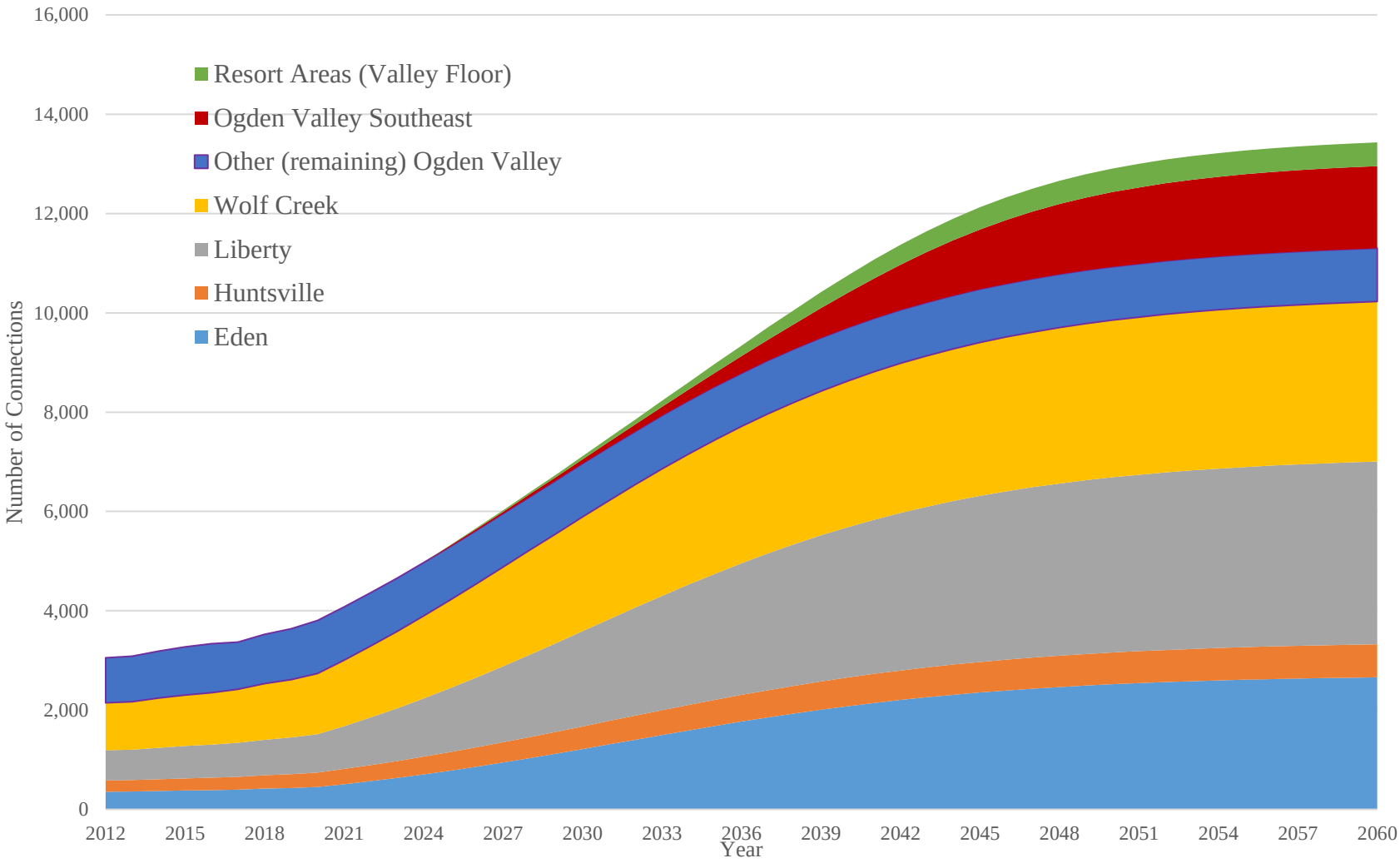


Figure 4: Projected Valley Growth Based on Study Water Service Areas

HISTORIC DEMAND PATTERNS

Indoor Demand

Bowen Collins & Associates (BC&A) and Weber Basin Water Conservancy District (WBWCD) personnel met with each of the major water providers in the Ogden Valley to discuss their historic water demands. The water use data for each of the entities was also collected from the Division of Water Rights (DWRi) website. Unfortunately, some water use data is missing or believed to be incorrect based on feedback from the providers themselves.

With water demand data for each entity on the DWRi website believed to be somewhat unreliable, data from Utah's 2019 Regional M&I Conservation Goals report[1] was used to make average water use assumptions and predict the Valley's future culinary supply needs. The average water use, measured in gallons per capita day (gpcd) meaning the water use per person, recorded in the report is 60.9 gpcd for all of Weber County. However, this must be converted from gpcd to gallons per day (gpd) per Equivalent Residential Connection (ERC, meaning the water usage of an average single-family household) to match the County's growth projections which are measured in residential connections.

Unfortunately, determining household size is not as straight forward as one might suspect. Simply dividing the permanent population of the Valley by number of residential connections results in an estimated household size of 1.8 persons/ERC. However, this fails to recognize the significant population associated with second homes and tourism in the Valley. If second homeowners and tourists are converted to equivalent full-time residents, the estimated effective household size increases to 2.4 persons/ERC. Based on this estimated household size, historic water demands in the Valley is summarized in Table 5. Included in the total demand is metered use as reported at the point of delivery plus 15 percent for estimated system losses.

Table 5: Indoor Water Use in Ogden Valley

	Persons Per Household	Indoor Use (gpcd)	Estimated System Loss	Production (gpcd)	GPD Per Residential Connection	Acre-ft Per Year Per Residential Connection
Historic	2.4	60.9	15%	71.65	172.0	0.193
Planning	2.8	60.9	15%	71.65	200.6	0.225

While 2.4 persons/ERC is believed to be an accurate estimate of existing household size, it may not be entirely representative of future development. As population increases and the economy of the Valley grows, it is expected that household size could increase to be closer to that of the rest of Weber County. This is especially true given recent legislation that makes the addition of auxiliary dwelling units (ADUs, e.g. basement apartments, sublets, etc.) much easier. With this in mind, the planning value for future household size was conservatively increased to 2.8 persons/ERC, the average household size in Weber County overall. Demands associated with this increased household size are also shown in Table 5.

[1] Hansen Allen & Luce Inc. Engineers and Bowen Collins & Associates. November 2019. Utah's Regional M&I Water Conservation Goals. Utah division of Water Resources. https://conservewater.utah.gov/wp-content/uploads/2021/05/Regional-Water-Conservation-Goals-Report-Final.pdf

Outdoor Demand

To project the Ogden Valley's future outdoor water demands, the average landscaped area and irrigation rates for both Weber and Morgan County were examined in the 2019 Regional M&I Conservation Goals report. These data points were chosen as potentially representative of future outdoor demands in the Ogden Valley[2]. The average outdoor water use and production for each county are shown in Table 6.

Table 6: Outdoor Water Use Comparisons

	Lot Size (sq-ft)	Landscape Area (sq-ft)	Outdoor Use (acre-ft/connection)	Estimated System Loss	Outdoor Supply Production (acre-ft/connection)	Irrigation Rate (acre-ft/acre)
	Historic Averages					
Weber County	11,880	6,828	0.42	15%	0.49	3.15
Morgan County	21,033	10,704	0.50	15%	0.59	2.4
	Recommended Planning Values for Ogden Valley					
0.2 acre	8,712	5,007	0.33	15%	0.39	2.7
0.5 acre	21,780	11,084	0.59	15%	0.69	2.7
0.82 acre	35,934	17,967	0.96	15%	1.13	2.7

As shown in the table, the residential outdoor irrigation rate (volume of water needed per irrigated area) is 3.15 acre-ft/acre for Weber County and 2.4 acre-ft/acre for Morgan County. It is not surprising that Weber County has a higher irrigation rate as most of the developed portions of the county are located at a lower elevation and have a higher evapotranspiration (ET) rate than Morgan County. However, if the irrigation rate is adjusted for the difference in ET (18.7 inches per year in the Valley vs. 21.6 inches per year along the Wasatch Front portion of the County), the irrigation rate is still 2.7 acre-ft/acre, a bit higher than observed in Morgan County. To be conservative, estimated outdoor water use in the Valley has been based on the slightly higher value for converted Weber County irrigation rates.

Even with the irrigation rate set, projected outdoor demands in the Valley will still vary significantly depending on lot size. Table 6 includes projections for total outdoor water demands for a range of lot sizes[3]. These values will be used for planning activities moving forward.

Peak Demands

Limited historical data exists for peak day demands in the Valley. Therefore, peak demands were calculated based on the average indoor and outdoor peaking factors as calculated by BC&A for dozens of other municipalities throughout the State. An average indoor peaking factor of 1.25 was applied to indoor water use projections and an average outdoor peaking factor of 3.33 was applied to outdoor water use projections.

PROJECTED DEMANDS

The final step in developing demand projections is to multiply the projected growth in development by the appropriate unit demand.

[2] Weber County was selected as the Valley is part of the County. Morgan County was selected as it is immediately adjacent to the Valley and has similar climate.

[3] The lots sizes referenced here have been strategically selected based on some water supply assumptions as discussed in Chapter 2. An average lot size of 0.2 acre-ft results in the maximum need for imported water, while 0.82 acre-ft is the maximum possible average lot size for the available remaining developed area. See Chapter 2 for additional details.

Projected Culinary Demand

Culinary demand includes 100 percent of indoor demand along with some portion of outdoor demand. To determine the appropriate demands for both the culinary and secondary systems, it was necessary to divide the outdoor demand into culinary irrigated and secondary irrigated. The four large water providers in the Ogden Valley have summarized their historic use of culinary versus secondary water when irrigating with conservative percentages shown for culinary irrigation and these portions are shown in Table 7. It should be noted that Wolf Creek and Huntsville currently report 100 percent secondary irrigation coverage, but a small amount of culinary irrigation was assumed to be conservative.

Table 7
Culinary and Secondary Irrigated Water Use

Water Entity	Culinary Irrigated	Secondary Irrigated
Eden	10%	90%
Liberty	30%	70%
Wolf Creek	5%	95%
Huntsville	5%	95%
Other (Weighted Average)	16%	84%

For projecting culinary demand for each entity, it has been assumed that these percentages will continue to apply to water use by future development. For areas without historic use (primarily the Ogden Valley Southeast area) it was assumed that outdoor water will be supplied consistent with the weighted average for the Valley (16 percent culinary, 84% secondary).

Figures 9 and 10 show the projected total culinary supply needs and culinary peak day needs depending on the size of lots used for future development and the assumed secondary coverage for outdoor irrigation as documented above. As shown in the figures, culinary demands range between 3,900 and 5,200 acre-ft per year by 2060 (depending on average future lot size) with a corresponding range of 4,000 to 7,000 gpm of peak day demand. These represent significant increases from existing system demands.

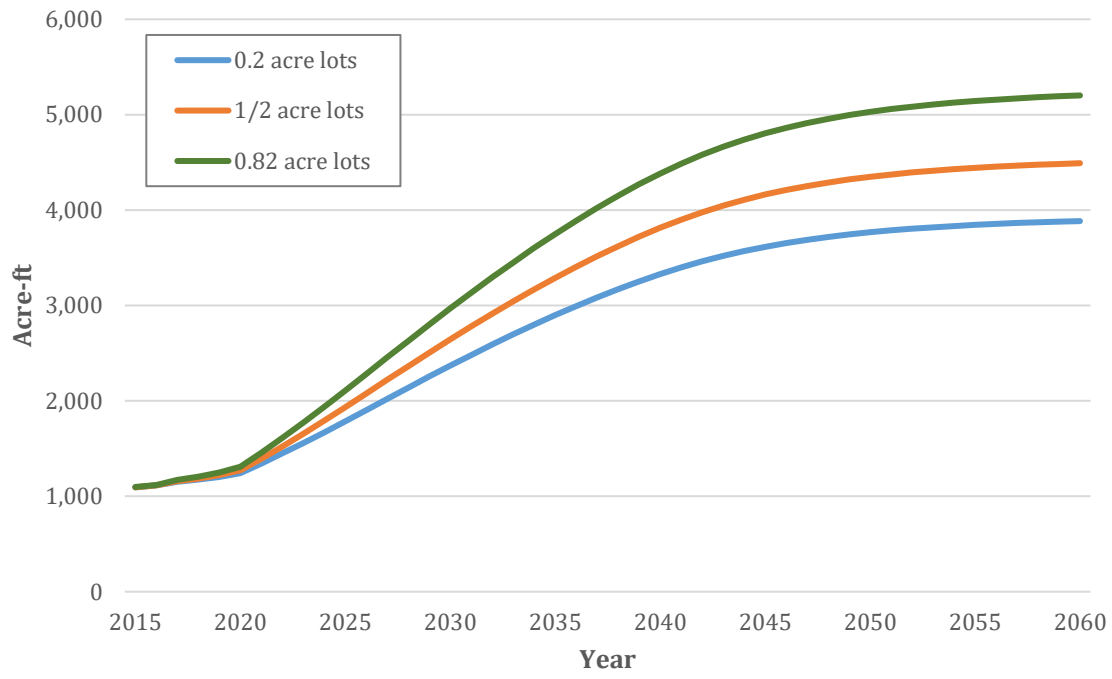


Figure 9:
Projected Culinary Supply Needs

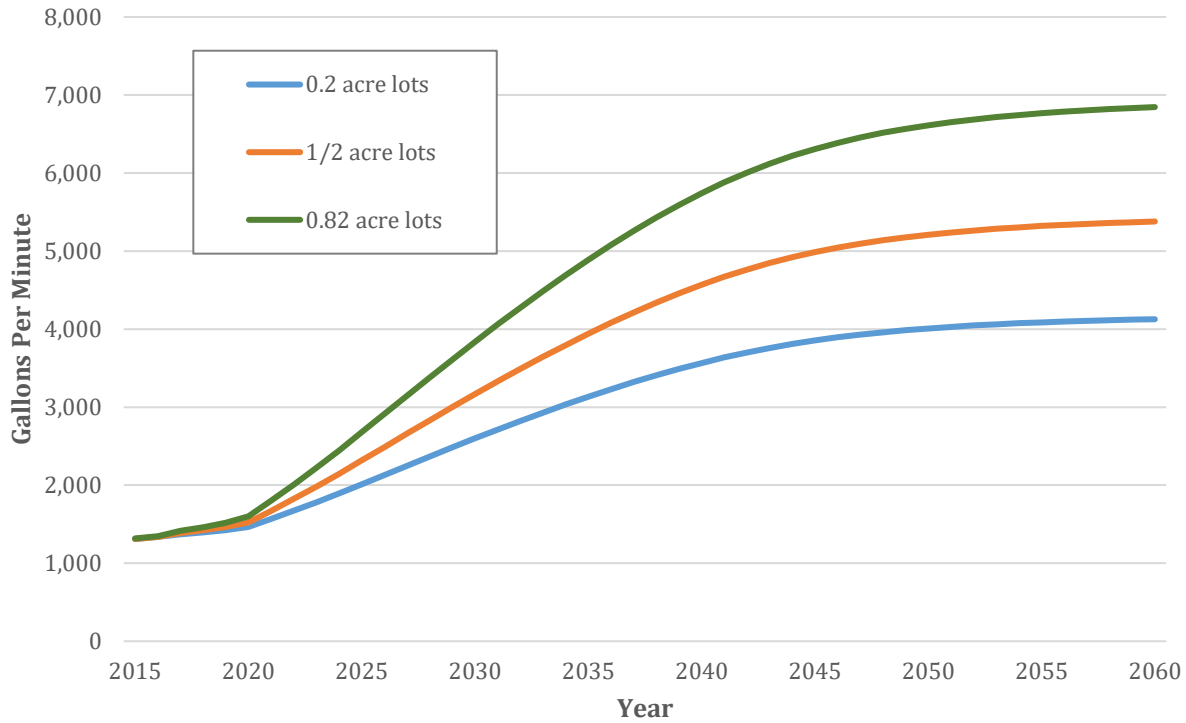


Figure 10:
Projected Culinary Peak Day Needs

Projected Secondary Demand

Figures 11 and 12 show the projected secondary supply needs and secondary peak day needs based on the size of lots used for future development. As shown in the figures, secondary demands range between 4,500 and 11,500 acre-ft per year by 2060 (depending on average future lot size) with a corresponding range of 9,500 to 24,000 gpm of peak day demand. Because secondary demands are solely determined by outdoor demand, the impact of lot size is even greater than it is for culinary demands.

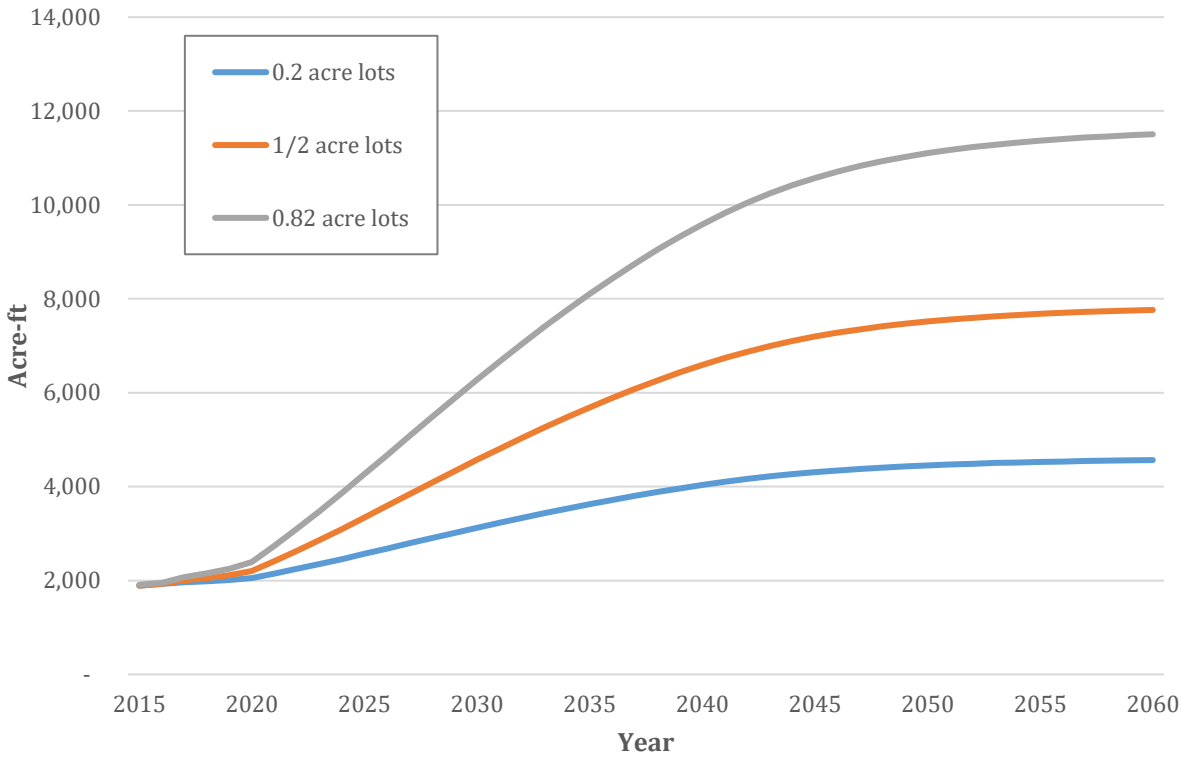


Figure 11:
Projected Secondary Supply Needs

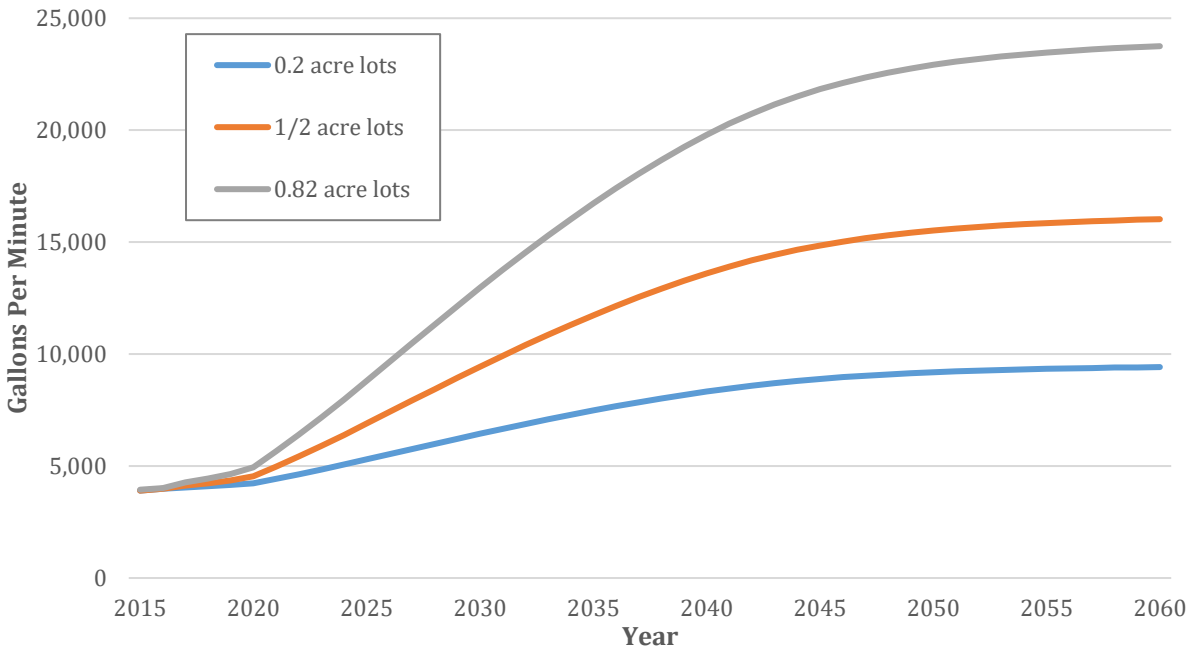


Figure 12:
Projected Secondary Peak Day Needs

CONCLUSION

WBWCD and Weber County personnel agree that Ogden Valley will likely experience a significant increase in population over the next several decades. Therefore, aggressive growth rates were used to conservatively project buildout populations throughout Ogden Valley.

Total municipal demand in the Valley will vary significantly depending on the size of lots ultimately built. This will be discussed in greater detail in subsequent chapters. But even with modest lot sizes, increases in municipal demand are significant and will require major improvements in water infrastructure.

BOWEN COLLINS & ASSOCIATES

TECHNICAL MEMORANDUM #2

TO:	Weber Basin Water Conservancy District
COPIES:	File
FROM:	Keith Larson, P.E., Andee Harris, E.I.T., & Kaden Grover
DATE:	11 March 2022
SUBJECT:	Ogden Valley Water Supply and Infrastructure Study – Supply Analysis
JOB NO.:	021-21-02

INTRODUCTION

The Ogden Valley area of Weber County needs a plan to manage future water needs. According to recent information, an estimated 83 individual water companies provide water services to residents and businesses in the Ogden Valley. However, each of these service companies is limited by the production of their individual water sources. Due to the large number of service providers and the growing number of stakeholders in the Valley, Weber Basin Water Conservancy District (WBWCD or District) and Weber County have identified a need for a regional study to better understand the hydrology, service areas, source capacities, and facilities within the Valley. This analysis will help the District, the County, and Ogden Valley water providers identify potential alternatives for supplying additional water to the residents of Ogden Valley.

To accomplish this purpose, WBWCD has contracted with Bowen Collins & Associates (BC&A) to prepare a regional study of both culinary and secondary water. Primary objectives of the Ogden Valley Water Supply and Infrastructure Study include:

- Documenting existing water demands and supplies
- Understanding and documenting existing water resources and infrastructure in the Ogden Valley
- Projecting future water demand and supply
- Identifying alternative solutions to meet projected water needs
- Developing a strategy for implementing recommended solutions

The focus of this memorandum is existing and future water supply.

EXISTING SUPPLY

Area Municipal Supply

Currently the water supply to the Ogden Valley is provided by a large number of entities. As development began to spread into the unincorporated areas of the Ogden Valley, a number of water providers sprung up to provide water. Most were created by developers needing to provide a water system for their associated land development project. Over the years many of those systems evolved

into private water companies, private mutually owned companies or special service districts formed by the County such as Huntsville Town, Eden Water Works, etc. There are also some developments that still rely on individual wells to provide water to residential homes. Many (but not all) of the providers are shown in Figure 1.

In terms of planning for future water needs, most of the providers in the Valley are too small to contribute much to a future overall supply plan. For the Valley's smaller providers, it has been assumed that they will have no net effect on future water needs (i.e. they have sufficient supply for their current needs but no additional supply to help satisfy future demands). Based on this assumption, it was decided that analysis of existing municipal supply would be limited to the five largest water providers in the Valley. These large water providers include Huntsville Town Corporation Municipal Water System, Eden Water Works Company, Liberty Pipeline Company, Nordic Mountain Water Company, and Wolf Creek Water and Sewer Improvement District[1]. Each provider's historic and existing water supply was found on the Utah Division of Water Rights website (DWRi) and the reliable sources and supply are shown in Figures 2 through 6.

As can be seen in the figures, data over the last several decades is incomplete in many cases and may be incorrect in others. To augment the available data, BC&A interviewed operations and/or management personnel with each of the providers to discuss supply availability and source capacity. In addition to meeting with personnel from each of the five larger water providers in the Valley, meetings were also held with personnel representing Powder Mountain Water and Sewer Improvement District and Snowbasin Resort (resorts). Additional insight into municipal supply gathered during the interviews includes the following:

- **Huntsville** – Huntsville has historically supplied its residents with water from springs, the more substantial being Bennett Spring. Over the last several years, these springs have seen significant decreases in flow. The decreases in flow along with use of the springs by other entities led the Town to develop a new well known as the Wishing Well. While the Town will still take water from Bennett Spring when available, the new well allows the Town more reliable delivery of its water rights. All water (either from the spring or well) receives additional treatment at a recently built plant. The capacity of the treatment plant is sufficient to treat the full capacity of the well along with a little additional water from the springs. Huntsville indicates it currently has adequate supply for its service area and will only require additional supplies if development growth is approved outside its service area.

  It should be noted that Huntsville Town has additional water rights (516 acre-ft) to divert out of South Fork. However, it does not currently have facilities in place to make this diversion and its current treatment plant is not designed for the type of treatment that would be needed for this type of source.

- **Eden** –Eden is primarily supplied water from a spring known as Burnett Spring. This spring is augmented as needed with water from wells (Clark East and Reservoir). In recent years, Eden has experienced less production from its water sources. The most recent water year (2021) has been especially challenging. Eden recently purchased 240 acre-ft of replacement water from WBWCD for expected population growth. Eden believes it is quickly nearing the

[1] Note that Ogden City also has a number of municipal groundwater wells in the Valley. Water produced from these wells are conveyed out of the Valley for use in Ogden City. Because production from these wells is not used in the Valley, this supply will not be considered as an "Ogden Valley municipal supply" here, but will be discussed as part of groundwater development alternatives in a subsequent section.

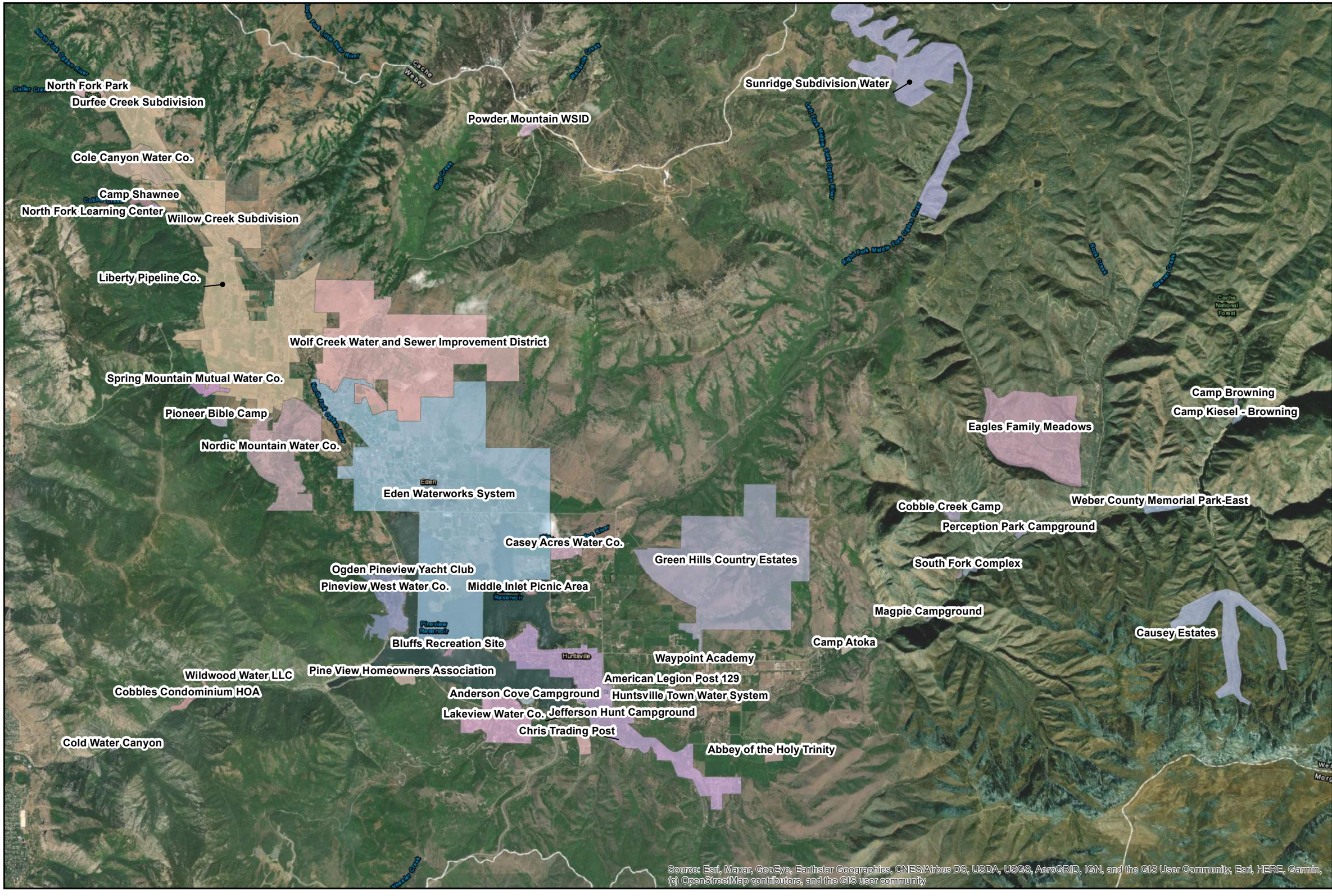
end of its existing supplies and will not have capacity to supply any significant amount of future growth without another source.

- **Liberty** – Liberty is also supplied through a combination of groundwater sources. Its primary source is the Smith Well, augmented by Cutler Canyon Springs and the Durfee Creek Well. Similar to Eden, the production of Liberty's springs and wells was much lower in 2021 than in recent years due to drought conditions. The Durfee Creek Well actually went completely dry around June 21 of 2021. Liberty is nearing the end of its available supply and would be interested in purchasing additional water from a regional wholesaler if available in the future.

- **Wolf Creek** – Wolf Creek is supplied culinary water primarily from the Warm Springs Artesian Well. This well is augmented from time to time with water from the Wolf Creek Spring. Wolf Creek personnel believe they are at the edge of their ability to supply culinary water and will need additional supply to satisfy expected future development. Correspondingly, Wolf Creek is actively exploring options of constructing more wells for future growth. However, since groundwater development has proven to be difficult in the area, purchasing additional supply from a regional wholesaler would be a solution Wolf Creek would be interested in exploring.

- **Nordic Valley** – Nordic Valley has three wells that supply water to its system. These wells have been producing relatively steady flow, even during the recent drought period. While the expected service area for Nordic Valley is limited, the area is expecting to see significant growth in the near future. However, Nordic Valley believes it has purchased sufficient water rights for its expected growth.

Estimated supply for each entity based on the observed data and reported capacities are summarized in Table 1.



SCALE: 1 in. = 1.3 miles

NORTH: NORTH

OGDEN VALLEY WATER PROVIDERS

WEBER BASIN WATER CONSERVANCY DISTRICT

OGDEN VALLEY MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 1

P:\Weber Basin WCD\2021-21-02 Ogden Valley Master Plan\4.0 GIS\Ogden Valley Water Providers.mxd aharris 8/26/2021

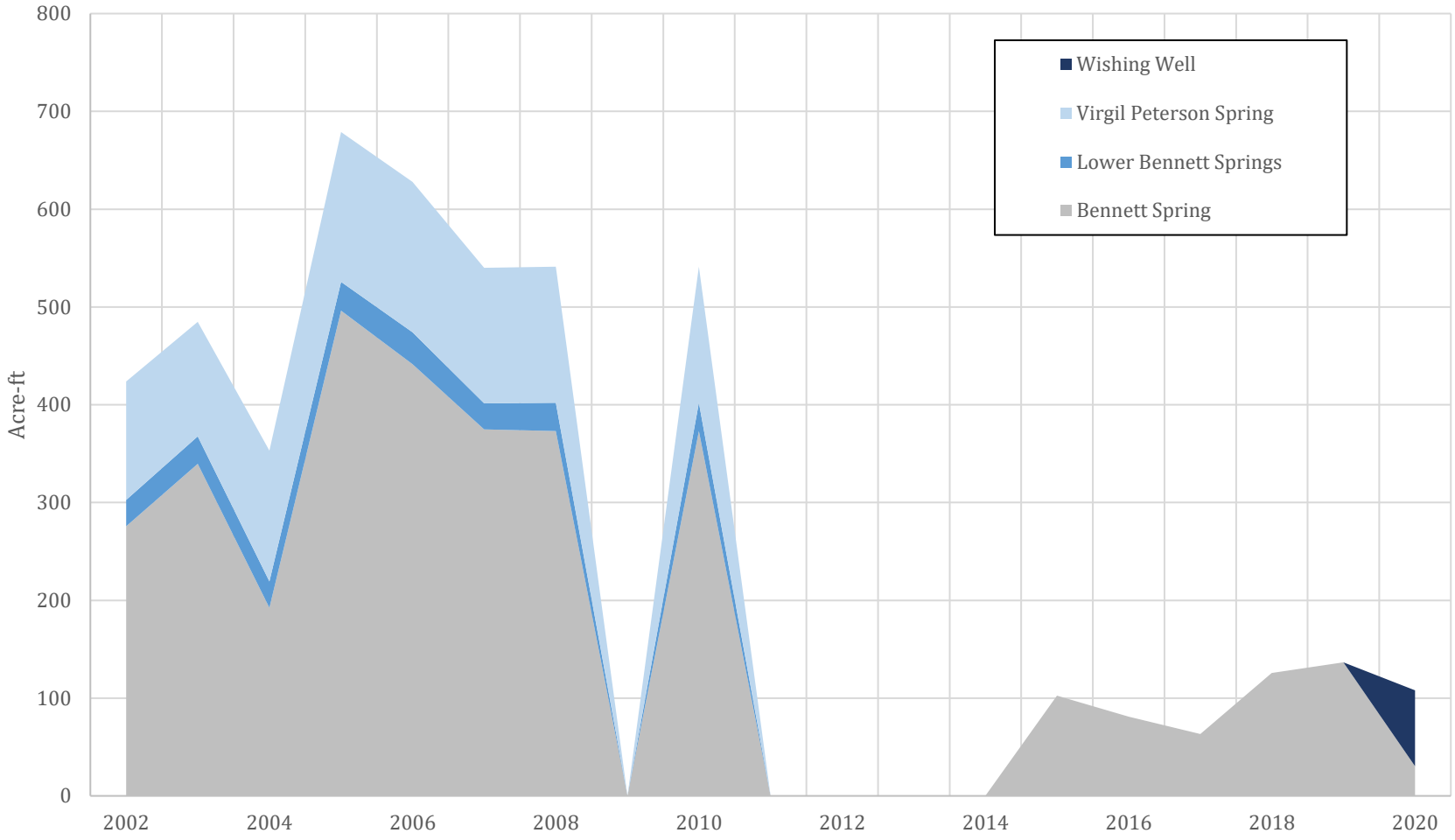


Figure 2 Huntsville Town Corporation Municipal Water System

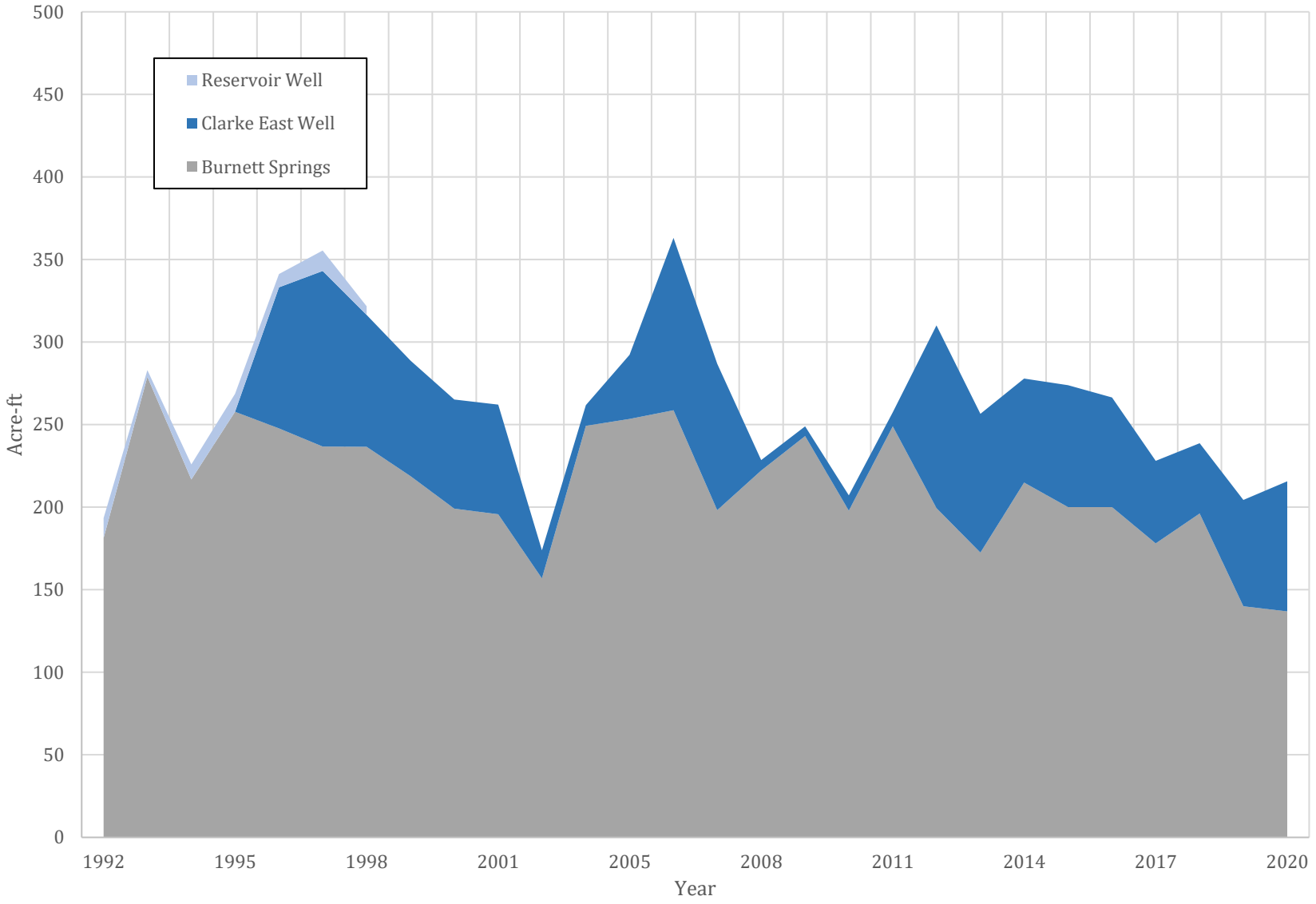


Figure 3 Eden Water Works Company

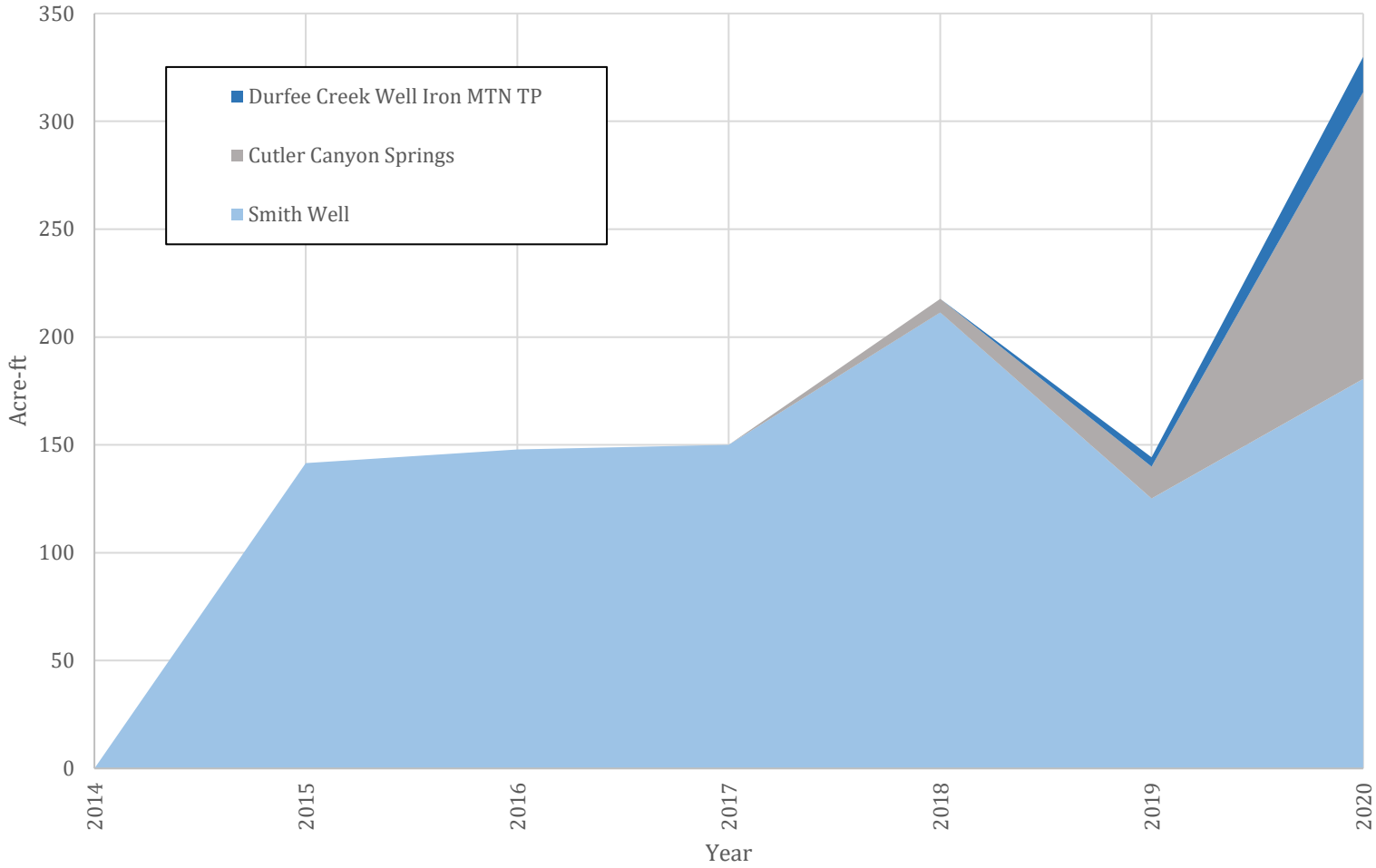


Figure 4 Liberty Pipeline Company

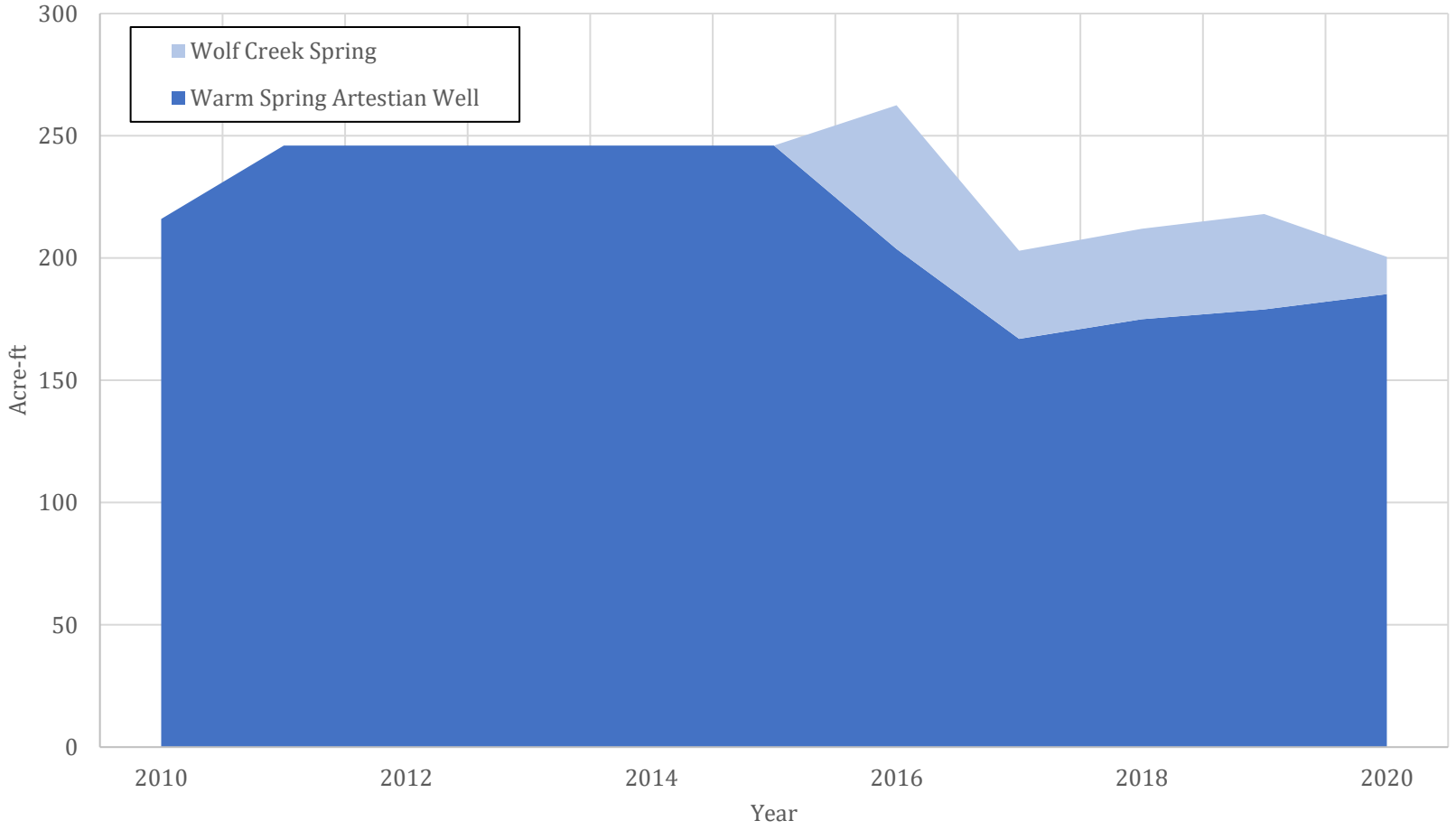


Figure 5 Wolf Creek Water and Sewer Improvement District - Culinary

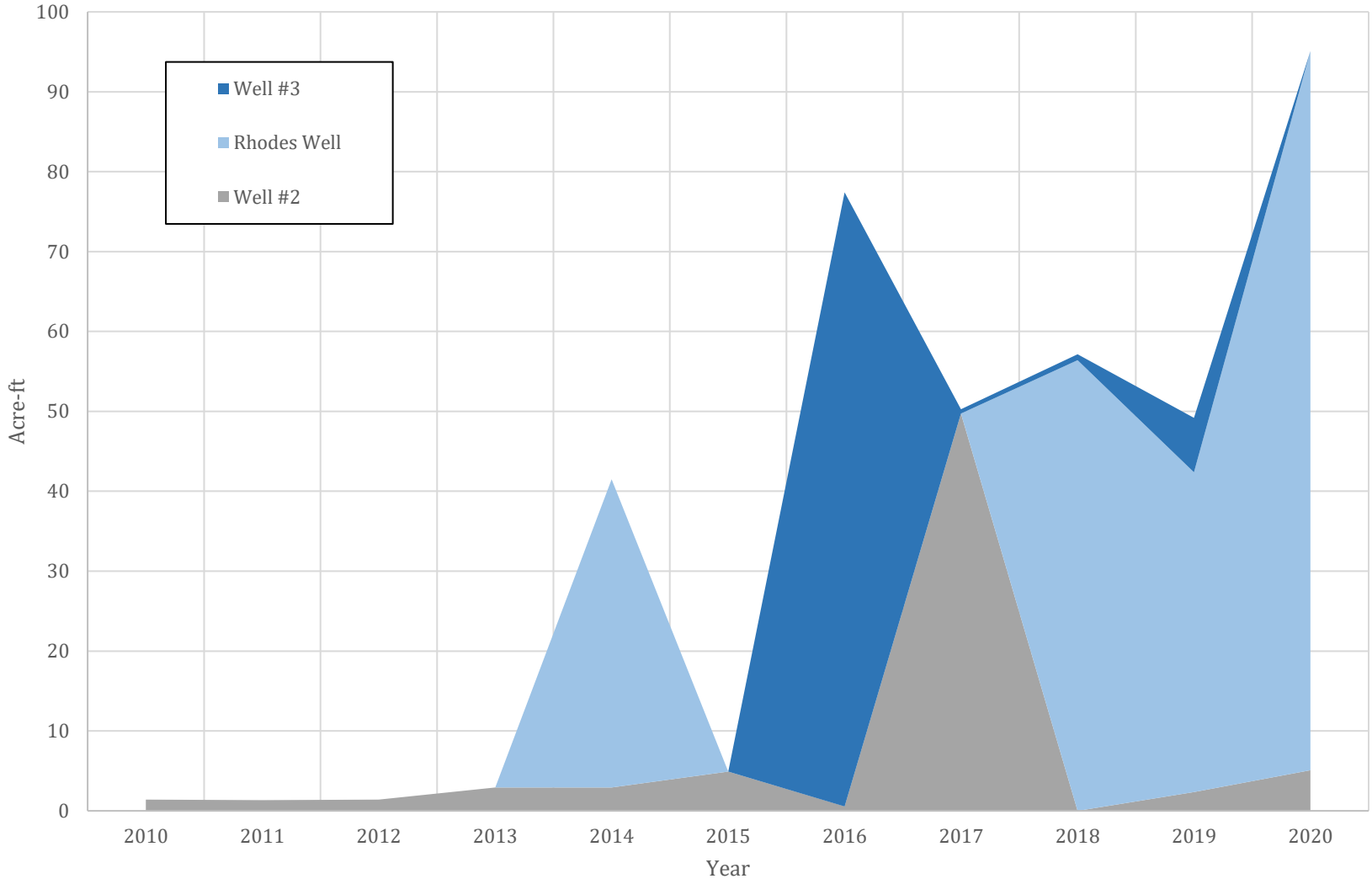


Figure 6 Nordic Mountain Water Company

Table 1
Ogden Valley Culinary Sources

Reliable Sources	Estimated Reliable Production (acre-ft/year)	Reported Peak Production (gpm)
Huntsville Town		
Bennett Spring	30	dry
Lower Bennett Springs	0	dry
Virgil Peterson Spring	0	Not Treated
Wishing Well	323[1]	400
Treatment Plant Capacity	-	500
Huntsville Subtotal	*353*	*400[2]*
Eden		
Burnett Springs	137	90
Clarke East Well	178[1]	220
Reservoir Well	32[1]	40
Eden Subtotal	*347*	*350*
Liberty		
Smith Well	323[1]	400
Cutler Canyon Spring	133	92
Durfee Creek Well	16	Dry
Liberty Subtotal	*472*	*492*
Wolf Creek		
Warm Spring Artesian Well	204	200
Wolf Creek Spring	0	Dry
Wolf Creek Subtotal	*204*	*200*
Nordic Valley		
Rhodes Well	90	700
Well #2	50	70
Well #3	77	70
Nordic Valley Subtotal	*217*	*840*
Total of All Entities	**1,593**	**2,282**

[1] Estimated maximum potential yield based on 6 months of pumping at peak capacity.
[2] Treatment Plant Capacity for Huntsville Town does not add to the total because it does not generate its own supply. It simply treats other supplies already represented above.

If the total supply of existing municipal sources (1,593 acre-ft/year and 2,282gpm) is compared to projected culinary demands from Chapter 2 (1,310 acre-ft/year and 1,600 gpm in 2020), it may

initially appear that there is some excess capacity in existing municipal supplies that could be used to support growth for the next several years. This is not generally the case for several reasons:

- Water providers in the Valley have system infrastructure (e.g. wells, water pipelines, tanks) that is generally separated from other water providers. This means that individual providers cannot currently share or exchange water with another. Most entities feel that this existing structure of separate water providers is best because it allows each the privilege to control and maintain its own sources (the majority being ground water wells), infrastructure, and usage without constraints from others. However, this also means that it is nearly impossible to move available water from one system to another.

- Most of these systems have relied on groundwater as the primary source of municipal and industrial (M&I) water. A few small springs have been developed to supplement the wells. The Ogden Valley is a secluded area with shared aquifers, and studies have shown that these aquifers are limited in storage capacity and are recharged primarily through precipitation, either rain or snowfall, falling within the Valley with relatively short recharge periods. As a result of recent drought conditions, most entities stated that one or more of their wells are currently dry or significantly lower than a typical year. Thus, even if wells have produced excess water in years past, this may not be indicative of reliable supply moving forward.

The overall conclusion from most of the water providers was that they are concerned about ongoing supply for their own existing customers and do not have excess water for sharing with other development. Each is concerned with the accuracy of the data available on the Division of Water Rights' website and several have wells that are showing signs of stress with the recent drought.

Based on this feedback, it is recommended that it be conservatively assumed that no excess supply is available from current municipal sources and that all future development will need to be supplied from new sources. Future interconnections between entities may still be prudent as a source of emergency backup but should not be considered a long-term source of supply.

Area Secondary and Agricultural Supply

As discussed in Chapter 1, most of the larger water providers including Eden, Liberty, Wolf Creek, and Huntsville, satisfy the majority of their outdoor irrigation demands through secondary water supplies. Detailed data on secondary source capacity is even less available than for culinary sources. Correspondingly, the same assumption will be made for secondary supplies as was made for culinary supplies – specifically that existing secondary supplies will be adequate to satisfy existing secondary demands but that no excess secondary supplies exist to serve future growth.

It should be noted that this conclusion is limited to current municipal secondary supply. Water currently used for agricultural purposes may become available depending on the magnitude and location of future development. This is discussed in detail in a subsequent section.

WBWCD Water Rights

WBWCD currently supplies some water in the Valley through replacement water contracts. Replacement water contracts encompass agreements in which water users purchase water from the District, but this water is not used directly from a District source. Instead, the water user is allowed to develop a groundwater source in exchange for the District releasing water elsewhere in the system. The estimated volume of water currently supplied through replacement water contracts is 7,184 acre-ft. Because of the challenges associated with developing additional groundwater in the

Valley, use of additional replacement water cannot be a significant part of any future supply plan. Correspondingly, it has been assumed that no additional supply in the Valley will come from replacement water contracts.

FUTURE SUPPLY

As summarized in the discussion above, there is no substantial additional water available from existing municipal sources. If further development is to occur within the Valley, additional municipal water must be supplied from other sources. Based on discussions with stake holders in the area, three alternatives for new municipal supply to the Ogden Valley have been identified for consideration[2]:

1. **New Groundwater Development:** While much of the groundwater capacity in the area is obviously stretched to capacity, there may be some areas where additional supply is possible. Stakeholders have requested that new groundwater wells be evaluated as a potential new source of supply.

2. **Agricultural Conversion:** Agricultural conversion occurs when land previously used for agriculture is developed and the water that has historically been delivered and used for irrigation becomes available for other uses, often for the development's culinary and secondary needs. Depending on how development occurs, this may be a significant source of new supply.
3. **Imported Water Rights:** If sufficient available water cannot be identified within the Valley, it will need to come from other sources.

Each of these alternatives are discussed in greater detail in the following sections.

New Groundwater Development

Groundwater in the Valley has been examined in detail in a report prepared by the Utah Geological Survey[3]. Major conclusions from that report and their application to this study are summarized in Appendix A. In short, while new groundwater will be subsequently considered and discussed as a potential delivery mechanism for municipal water, development of new groundwater rights as an additional source of supply appears to be extremely unlikely. This is the result of concern about depleting the Valley's aquifers. If new groundwater is developed, it would almost certainly need to be accompanied existing water rights from other sources.

Agricultural Conversion

It is estimated that approximately 17,200 acre-ft of water was applied to an estimated 6,342 acres of irrigated land in Ogden Valley in 2016[4]. Using this data, an average amount of secondary water per acre of ag land can be calculated as 2.7 acre-ft. Consequently, if any agricultural land is developed, approximately 2.7 acre-ft of water will become available for other purposes.

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[2] It should be noted that wastewater reuse has also been proposed as a future source of municipal water. While wastewater reuse may ultimately be an important source for municipal irrigation, it does not represent a new supply for the Valley. All wastewater currently disposed of through septic systems remains in the hydrologic cycle and is already accounted for in downstream supplies. If some portion of this wastewater is converted to reuse, it will need to be offset with new supply from one of the additional sources identified here. Thus, wastewater reuse will be discussed subsequently as a method of municipal water delivery but will not be discussed as a new supply here.

[3] Characterization of the Groundwater System in Ogden Valley, Weber County, Utah, with Emphasis on Groundwater-Surface-Water Interaction and the Groundwater Budget, Utah Geological Survey (UGS), 2019

[4] Utah Geological Survey (UGS), 2019

The volume of water available through agricultural conversion will clearly vary depending on where and how development occurs. As shown in Figure 7, any development that occurs on dry open land (unirrigated open space) will not result in any agricultural conversion and will require a separate water supply. Conversely, if development occurs on currently irrigated ag land, the water historically used for irrigation can be used to satisfy development demands (and for most development densities will actually generate excess water that can be used for other purposes).

Because the available water from ag conversion is dependent on the amount of ag land used for future development, lot size and development location become a critical factor in projecting both demand and available supply. If lot sizes are smaller, total demands are reduced as discussed previously. However, this also means that more development can fit in less space resulting in less available ag conversion water. If lot sizes are larger, demand increases, but so does the availability of converted ag water.

To consider the net effect of lot size on overall demands, water demand projections were made for the full range of potential average lot sizes that could occur in the Valley. Detailed results for culinary and secondary water production are shown for three sample lot sizes (0.2, 0.5, and 0.82 acre lots[5]) from 2015 to 2060 in Figures 8 through 10. For each scenario, it was assumed that development will first occur on the approximately 2,000 acres of unirrigated open space in the Valley. This ensures that agricultural conversion is not overestimated for any lot size scenario. Once the unirrigated acres are used up, development is allowed to occur within the estimated 6,342 acres of existing ag land.

[5] The reason for selecting these particular lot sizes will be explained subsequently. In short:

- 0.2 acres is the maximum lot size if development is limited to only areas that are currently unirrigated
- 0.5 acres is the current average lot size for residential development
- 0.82 acres is the maximum lot size if development were to use all remaining developable area (including irrigated ag lands)

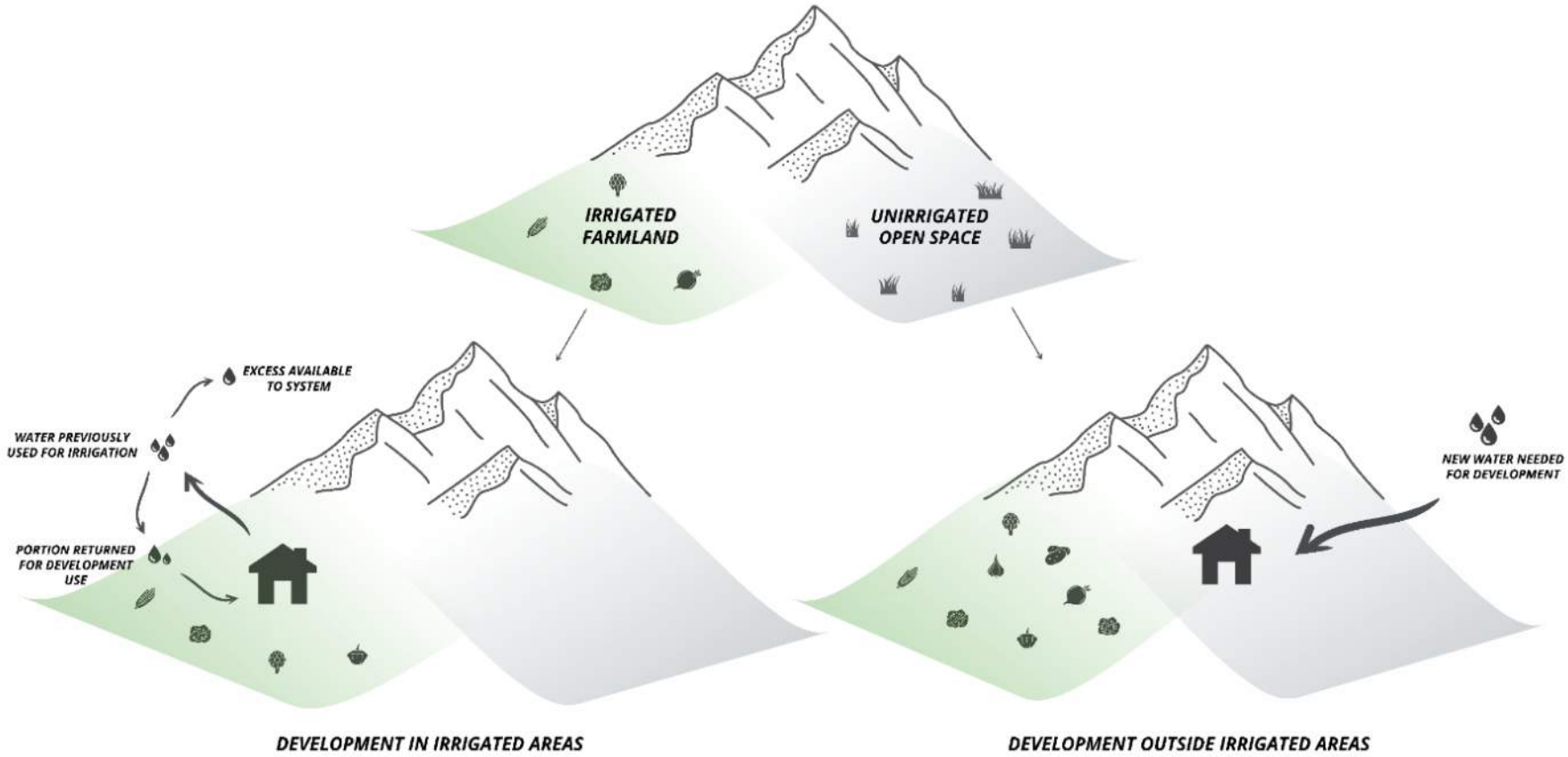


Figure 7: Development on Irrigated Ag Land vs Unirrigated Open Space

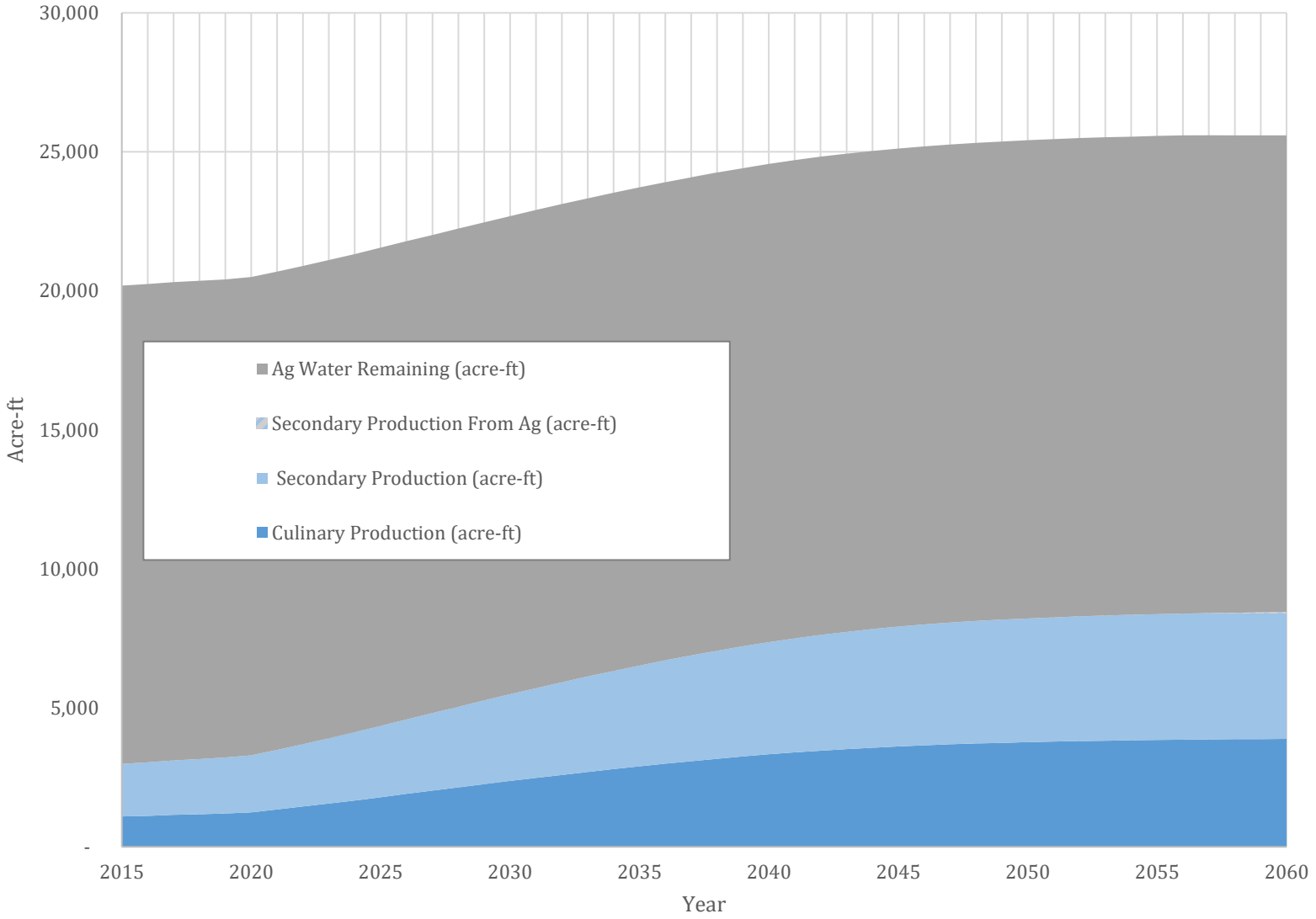


Figure 8: Projected Ogden Valley Water Production with 0.2 Acre Lot Sizes

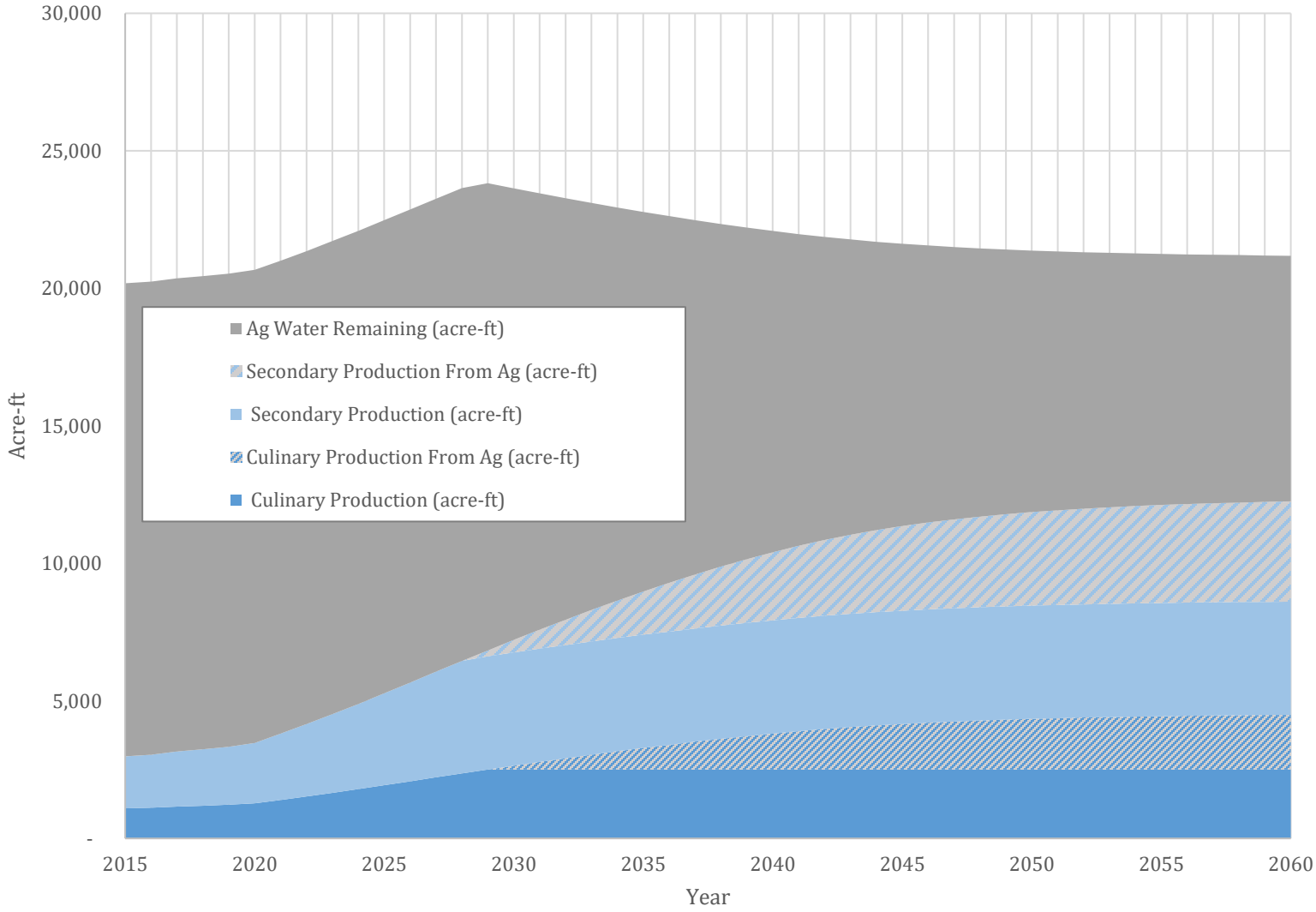


Figure 9: Projected Ogden Valley Water Production with 0.5 Acre Lot Sizes

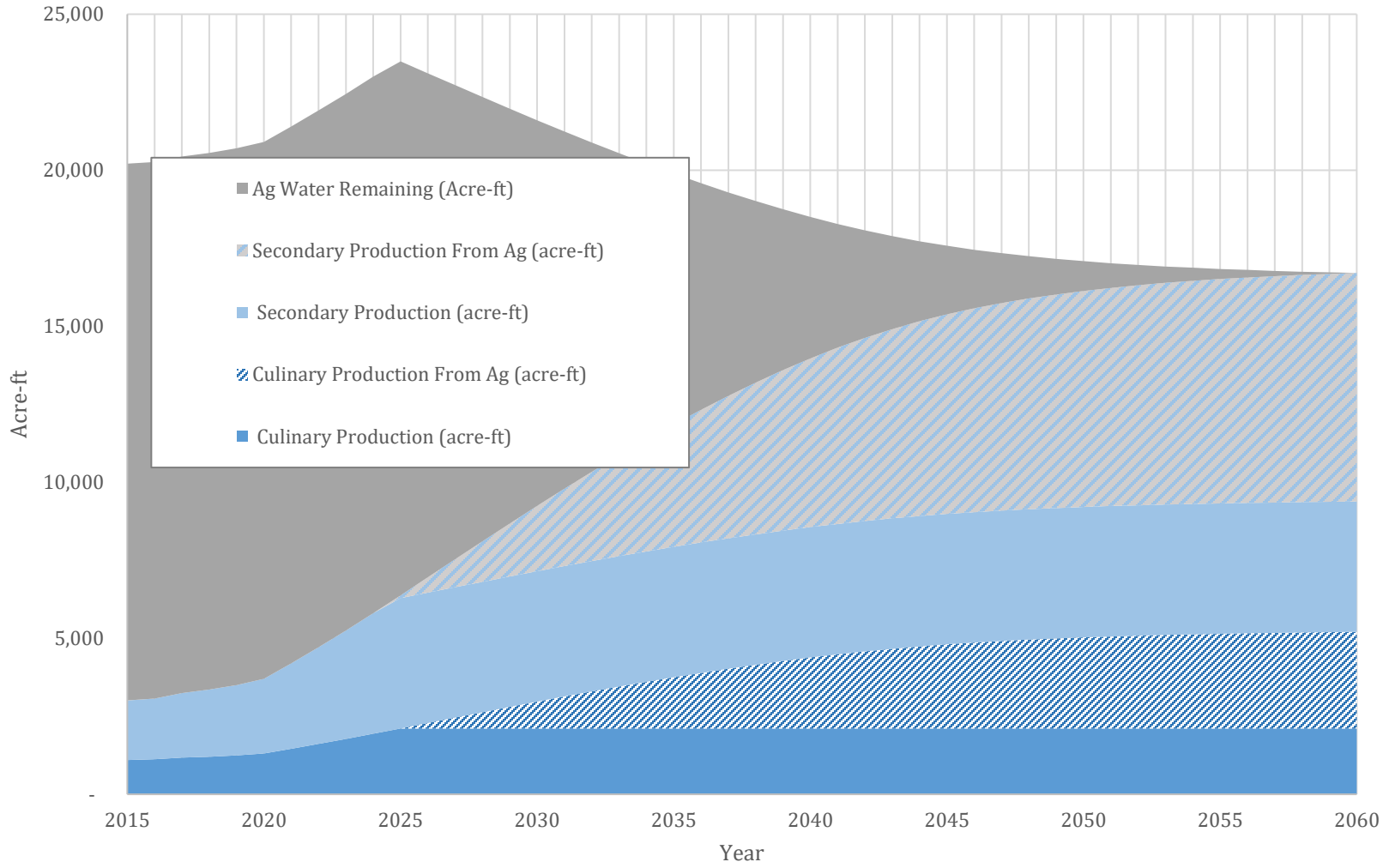


Figure 10: Projected Ogden Valley Water Production with 0.82 Acre Lot Sizes

A few conclusions can be made from the figures. First, the larger the lot size, the larger the overall municipal demand. More than 15,000 acre-ft of water production is required when lot sizes are 0.82 acres, but less than 8,500 acre-ft is required when lot sizes are 0.2 acres. While this is a rather obvious and expected conclusion, the figures do put in perspective the magnitude of the increase and also demonstrate how much of the demand can be satisfied through agricultural conversion.

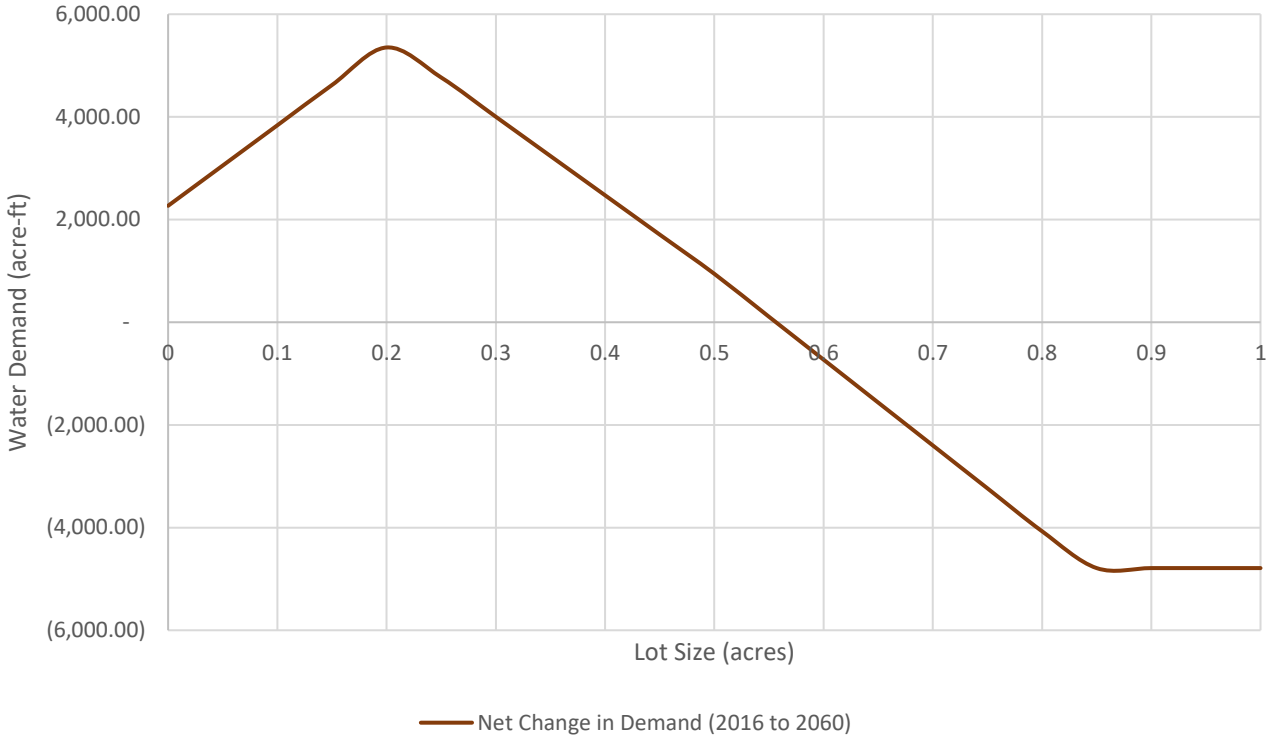
As second, less obvious conclusion can be made based on consideration of total demand (including both municipal and agricultural). As shown in the figures, the difference in total demand at the end of the planning window varies depending on lot size. Compared to 2015 data, the difference in total demand for each scenario is as follows:

- For 0.2 Acre Lots – Increased demand of 5,353 acre-ft per year
- For 0.5 Acre Lots – Increased demand of 943 acre-ft per year
- For 0.82 Acre Lots – Decreased demand of 4,789 acre-ft per year

The net difference in demand is an important value to consider because it represents the additional water that must be introduced from sources other than ag conversion. In other words, even though the total municipal water demand increases with larger lot sizes, the amount of ag conversion water also increases. In the case of the very largest lots, more water is produced as a result of ag conversion than is created through new development. If this were to occur, the Valley would need no additional resources and would actually be able to export excess water.

Thus, the larger lot size scenario is not the worst-case scenario that the District should plan for in terms of additional water supply needs. Figure 11 shows the comparison of lot size to total increase in demand. As shown in the figure, the maximum increase in total demand is 5,353 acre-ft and occurs when the average lot size of new development is 0.2 acres. This maximum occurs because it is the point where new development fills up all remaining developable unirrigated land. At larger lot sizes, the development displaces ag uses and ag conversion begins to decrease the total need for water.

Figure 11:
Net Increase in Water Demand vs. Lot Size



It should be noted that the figure considers only the final difference in demand. In reality, even the largest lot sizes will result in an early increase in demand during early phases of development if growth is first focused on the unirrigated portions of the Valley. Returning to the figures presented previously, it can be observed that the maximum increase in demand for each scenario is as follows:

- For 0.2 Acre Lots - 5,353 acre-ft per year at 2060
- For 0.5 Acre Lots – 3,580 acre-ft per year at 2029
- For 0.82 Acre Lots – 3,220 acre-ft per year at 2025

While this does demonstrate the potential need for some additional supply regardless of the ultimate average lot size, it confirms that the maximum need for additional water beyond agricultural conversion is 5,353 acre-ft per year.

Imported Water Rights

As documented in the previous sections, needed additional water supply beyond agricultural conversion may be up to 5,353 acre-ft. The most likely source for this water will be WBWCD. The District owns or manages water rights from the Weber Basin Project, other various surface water, groundwater, and other water rights that have been obtained since the organization of the District. The District's total water supply includes nearly 250,000 acre-ft of which 231,000 acre-ft is currently contracted for. The District has roughly a two-year supply when storage reservoirs are full.

While most of the District's water is already committed elsewhere, District management has indicated that a portion of its existing Willard Bay water could likely be made available for potential

use in Ogden Valley via exchange. This would be accomplished by delivering water from Willard Bay to irrigators along the Wasatch Front that have historically received water from Pineview Reservoir. This would leave water in the reservoir available for use in the Ogden Valley. While the details of such an exchange have not been finalized, the District is confident there is sufficient remaining available water in Willard Bay to satisfy the 5,353 acre-ft of potential demand identified above.

There also appears to be sufficient water passing through the Pineview Reservoir to make such an exchange. Even in the recent drought years of 2021 and 2022, more than 22,000 acre-ft have been captured and subsequently released by WBWCD in the Pineview drainage. While a minimum of 3,600 acre-ft must continue to be released to satisfy fish flows in the Ogden River, this leaves more than adequate volume to cover the 5,353 acre-ft identified for potential exchange.

CONCLUSION

Current water providers in Ogden Valley have communicated that they are not prepared to supply any significant amount of additional water to future development. Therefore, all future municipal water demands in the Ogden Valley will need to be met from new sources. Developing additional groundwater rights appears to be unlikely. Therefore, all new supply must come through either conversion of agricultural water or imported water supplies.

Due to the unique effect that lot size and location have on the necessary imported water supply, several lot size scenarios were considered with development occurring first on currently unirrigated lands. This allowed for determining the worst-case scenario, or the scenario where the most amount of imported water is required. The results show that lot sizes of 0.2 acres require the most imported water at 5,353 acre-ft per year. For planning purposes, it is recommended that development of water resources include consideration of importing at least 5,353 acre-ft of water. The most likely source of imported water is expected to be from WBWCD via exchange water from Willard Bay.

BOWEN COLLINS & ASSOCIATES

TECHNICAL MEMORANDUM #3

TO:	Weber Basin Water Conservancy District
COPIES:	File
FROM:	Keith Larson, P.E., Andee Harris, E.I.T.
DATE:	11 March 2022
SUBJECT:	Ogden Valley Water Supply and Infrastructure Study – Project Planning Demands
JOB NO.:	021-21-02

INTRODUCTION

The Ogden Valley area of Weber County needs a plan to manage future water needs. According to recent information, an estimated 83 individual water companies provide water services to residents and businesses in the Ogden Valley. However, each of these service companies is limited by the production of their individual water sources. Due to the large number of service providers and the growing number of stakeholders in the Valley, Weber Basin Water Conservancy District (WBWCD or District) and Weber County have identified a need for a regional study to better understand the hydrology, service areas, source capacities, and facilities within the Valley. This analysis will help the District, the County, and Ogden Valley water providers identify potential alternatives for supplying additional water to the residents of Ogden Valley.

To accomplish this purpose, WBWCD has contracted with Bowen Collins & Associates (BC&A) to prepare a regional study of both culinary and secondary water. Primary objectives of the Ogden Valley Water Supply and Infrastructure Study include:

- Documenting existing water demands and supplies
- Understanding and documenting existing water resources and infrastructure in the Ogden Valley
- Projecting future water demand and supply
- Identifying alternative solutions to meet projected water needs
- Developing a strategy for implementing recommended solutions

The focus of this memorandum is to recommend projected planning demands for Ogden Valley based on the previous technical memorandums discussing supply and demand within the Valley.

RECOMMENDED PLANNING DEMANDS

Up to this point, system demands have been projected based on total demands with only minimal consideration of how those demands will be satisfied. However, in order to accurately identify and design the improvements needed to meet future growth, it is necessary to clearly define how specific

demands will be satisfied. With this goal in mind, the purpose of this memorandum is to define the specific planning demands to be used for improvement alternatives.
Planning demands for improvement alternatives will be based on the following major assumptions:

1. It is assumed that existing supply is sufficient for existing demands and existing demands only. All future demands will be satisfied through new infrastructure.
2. Needed new water will come through a combination of agricultural conversion and imported water.
3. New culinary water will be treated and delivered through new facilities that are to be built for this purpose. Projected planning demand should specifically identify demands on these new facilities.
4. New secondary water use will be highly dependent on the location, timing, and type of future development. Correspondingly, it is beyond the scope of this analysis to identify exactly when or where secondary water supplies will be required. For the purposes of this report, it will be assumed that both agricultural conversion and import water can be delivered to Pineview Reservoir and then moved by exchange to future points of demand. This may or may not be true but is the best that can be assumed until the locations of demands and converted ag water are better understood. When this information becomes more defined for specific areas, additional secondary system evaluation should be completed.

Based on these assumptions, the remainder of this section will focus on the net need for import water and the net culinary demand on new infrastructure proposed for the Valley.

Projected Yearly Demand for Imported Culinary Water

As discussed in a previous technical memorandum, the concept of converting irrigated agricultural land (ag land) significantly impacts the amount of imported water required to meet future demands. When ag land is converted for developmental purposes, it allows the developments to utilize the water previously used for irrigation. This conversion concept decreases or increases the amount of import water needed depending on average lot sizes in the Valley. If larger lot sizes are developed, more ag land will be converted thus providing available water supply. However, if smaller lot sizes are developed, then less ag land will be converted requiring additional import water.

To summarize information presented previously, Figure 1 shows the comparison of lot size to required imported water.

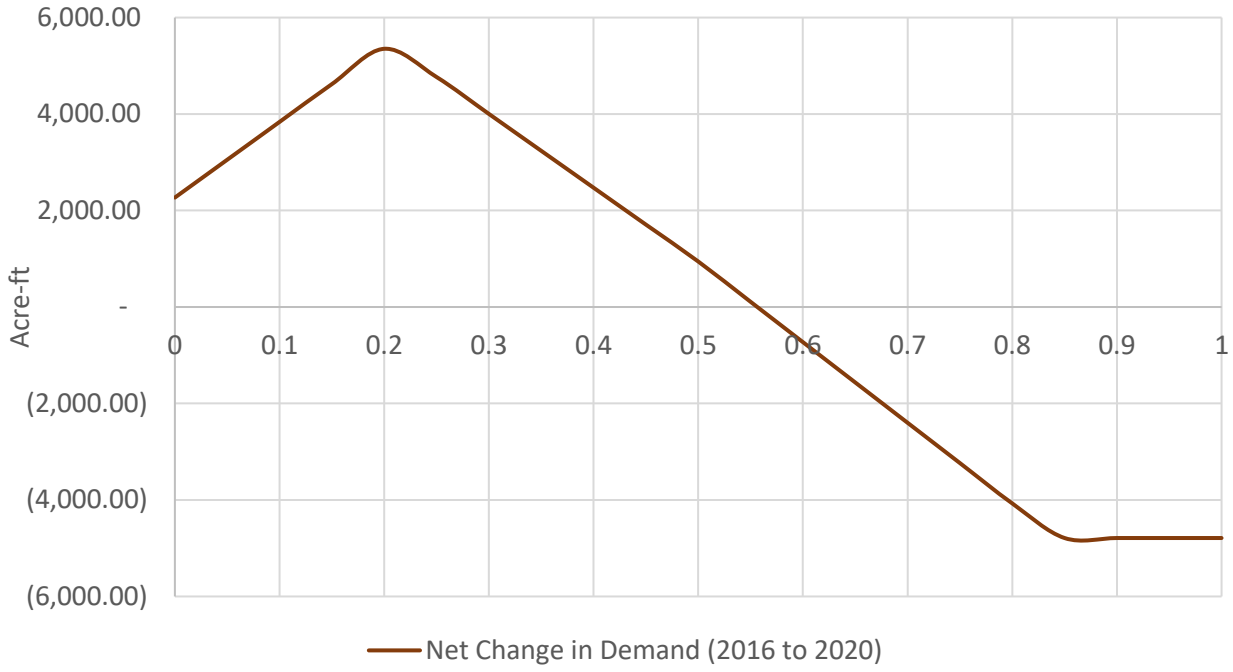


Figure 1:
Net Change in Import Culinary Water Demand vs. Lot Size

Initially, Figure 1 shows that demand for imported water increases as lot sizes increase. However, this only applies so long as development lots can be placed on the approximately 2,000 acres of developable, unirrigated land in the Valley. Once average lot sizes surpass about 0.2 acres, additional water becomes available as agricultural land is converted for development. This results in a decreased demand on net imported water which continues until lot sizes reach 0.82 acres (maximum average lot size based on remaining developable land in the Valley).

Although larger lot sizes would result in greater overall water demands, smaller lot sizes (ranging from 0 to 0.2 acres) require greater amounts of imported water. For the purpose of this study, it is proposed that planning demands be based on the worst-case scenario. As shown in Figure 1, the maximum amount of imported water occurs when the lot sizes are 0.2 acres and totals 5,353 acre-ft. Figure 2 shows the maximum projected need for import water over time assuming average lot sizes of 0.2 acres are used for development.

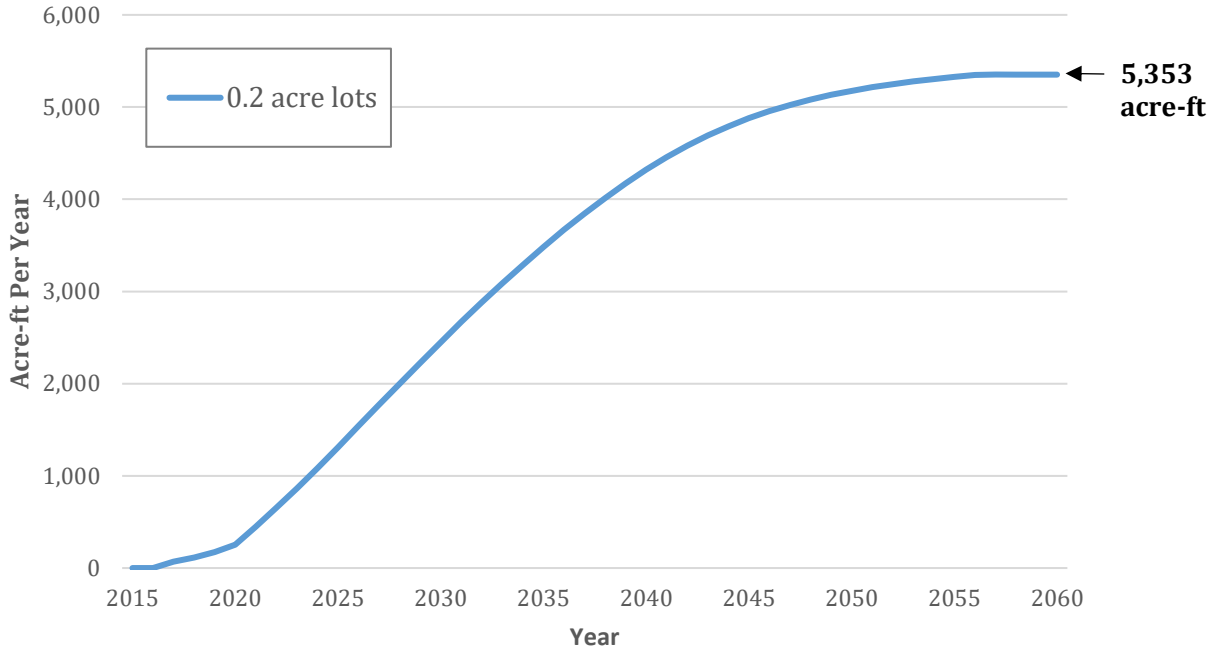


Figure 2:
Maximum Projected Annual Need for Import Water

Projected Culinary Demand for New Culinary Infrastructure

To meet the projected water needs of Ogden Valley, total culinary demands must be identified. While an average lot size of 0.2 acres results in the highest demand for import water, total culinary demands will be greater for larger lot sizes. The most conservative planning scenario for culinary demands on the new improvements would be to assume that all future development is constructed on 0.82 acre lots. These larger sized lots impose larger water demands (specifically for those portions of the Valley that will satisfy outdoor demands with culinary water). Whether the water into the system is coming from imported water or converted agricultural water, larger infrastructure will be needed for the delivery of culinary water.

For average lot sizes up to 0.82 acres, the projected culinary needs for new infrastructure are shown in Figures 3 and 4 for annual and peak day demands, respectively. As shown in the figures, estimated peak demands could reach a maximum of up to 4,078 acre-ft[1] and 5,541 gallons per minute[2]. This is the demand that should be used for planning infrastructure such as pipelines, pump stations, and a treatment plant to treat and deliver future culinary water.

[1] Note that this is for new demands only. Total projected annual culinary demand in the Valley of 5,197 acre-ft (see TM #1) has been reduced by the capacity of existing sources (1,119 acre-ft).

[2] Note that this is for new demands only. Total projected peak day culinary demand in the Valley of 6,885 gpm (see TM #1) has been reduced by the capacity of existing sources (1,344 gpm).

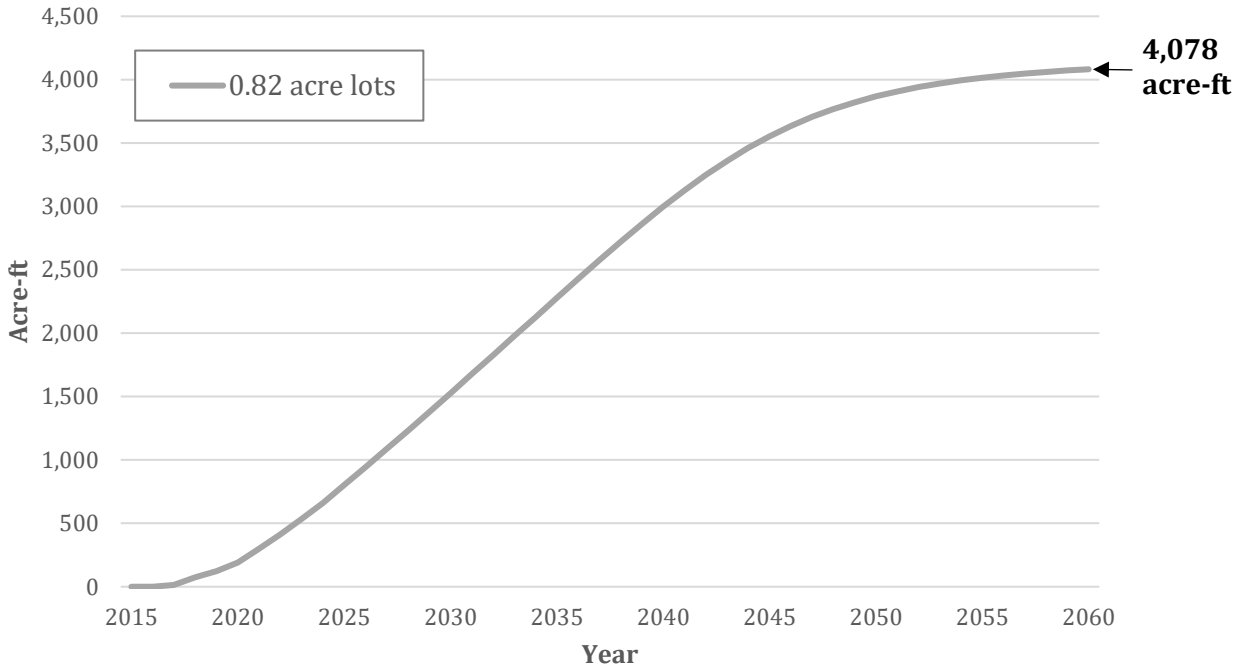


Figure 3:
Projected Annual Culinary Demand With 0.82 Acre Lots

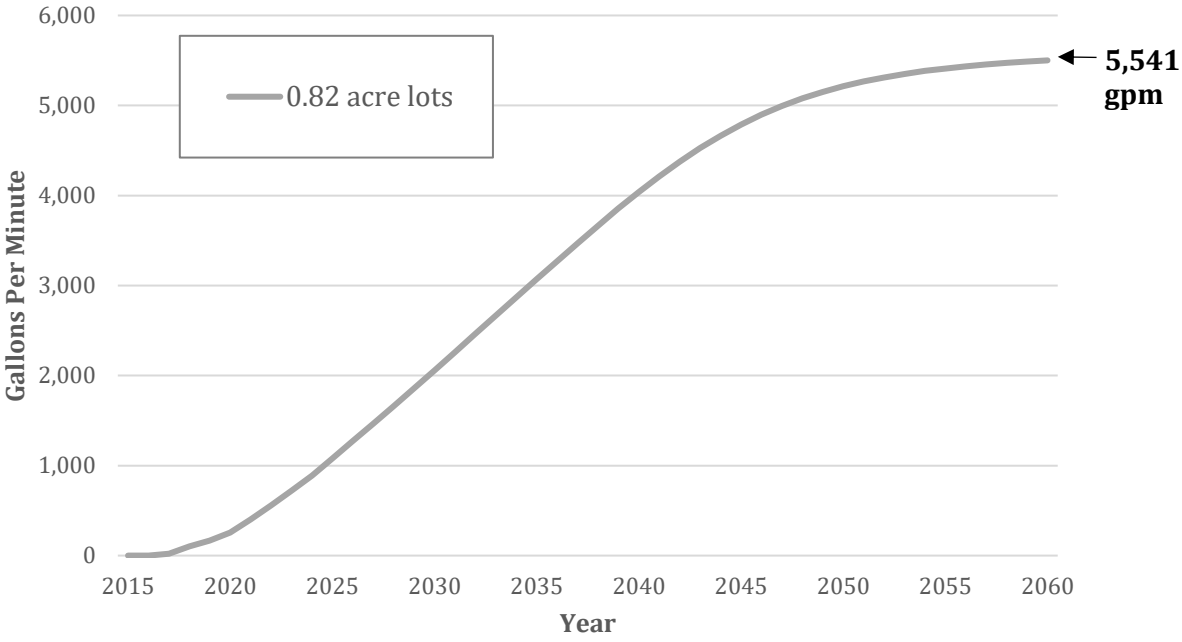


Figure 4:
Maximum Projected Peak Culinary Demand

In addition to defining total demands, it is equally important to understand where and how this water will be divided between the various entities. Tables 1 and 2 summarize maximum annual and peak demands for each expected major service area in the Valley (as defined in Technical Memorandum 1). Included in Table 2 is the Effective Peaking Factor based on the percentage of outdoor culinary irrigation identified in Technical Memorandum 1. These demands will be useful for sizing infrastructure to specific points of delivery.

Table 1:
Water Service Area Annual Demands (acre-ft per year)

Entity	2025	2030	2035	2040	2050	2060
Eden	132	278	436	570	719	766
Huntsville	35	58	77	92	109	117
Liberty	350	706	1,055	1,329	1,612	1,696
Wolf Creek	205	352	463	533	595	611
Ogden Valley Southeast	9	28	71	166	496	680
Snowbasin	4	27	78	152	205	207
Total (acre-ft)	**734**	**1,449**	**2,180**	**2,842**	**3,736**	**4,078**

Table 2:
Planning Area Peak Demands (gpm)

Entity	2025	2030	2035	2040	2050	2060	Effective Peaking Factor
Eden	159	336	526	687	867	924	1.94
Huntsville	36	60	80	95	113	121	1.67
Liberty & Nordic	542	1,093	1,635	2,059	2,497	2,628	2.50
Wolf Creek	212	364	478	551	615	632	1.67
Ogden Valley Southeast	12	39	99	231	692	948	2.25
Snowbasin	6	38	108	212	286	289	2.25
Total (gpm)	**967**	**1,929**	**2,926**	**3,835**	**5,069**	**5,541**	**2.19**
Total (cfs)	**2.2**	**4.3**	**6.5**	**8.5**	**11.3**	**12.3**	**-**

CONCLUSION

WBWCD and Weber County personnel agree that Ogden Valley will likely experience a significant increase in population over the next few decades. Therefore, aggressive growth rates were used to conservatively project buildout populations and water demand throughout Ogden Valley. After analyzing the supply and demand projections which include details such as population density, location of future development, and development lot sizes, it was determined that Ogden Valley residents could require up to 5,353 acre-ft per year of imported water to meet future needs. This water would likely come from WBWCD.

When designing a culinary water delivery system, it is necessary to determine peak demands for infrastructure sizing requirements. The most conservative planning scenario for peak day demands

would be to assume that all future development is constructed at an average lot size of 0.82 acres. These larger sized lots would require the maximum amount of culinary water, whether converted from current agricultural uses or imported. The projected culinary peak day needs are estimated to reach a maximum of 5,541 gallons per minute. It is recommended that WBWCD use the projected overall demand of 4,078 acre-ft per year with a peak day demand of 5,541 gallons per minute.

It should be noted that these planning projections are based on conservative assumptions of projected growth and development and actual future demands could be significantly less. It is recommended that phasing of improvements be considered where possible to avoid overbuilding infrastructure and allow modifications to the plan over time as development patterns become more established.

BOWEN COLLINS & ASSOCIATES

TECHNICAL MEMORANDUM #4

TO:	Weber Basin Water Conservancy District
COPIES:	File
FROM:	Keith Larson, P.E., Andee Harris, E.I.T.
DATE:	16 March 2023
SUBJECT:	Ogden Valley Water Supply and Infrastructure Alternatives
JOB NO.:	021-21-02

INTRODUCTION

The Ogden Valley area of Weber County needs a plan to manage future water needs. According to recent information, an estimated 83 individual water companies provide water services to residents and businesses in the Ogden Valley. However, each of these service companies is limited by the production of their individual water sources. Due to the large number of service providers and the growing number of stakeholders in the Valley, Weber Basin Water Conservancy District (WBWCD or District) and Weber County have identified a need for a regional study to better understand the hydrology, service areas, source capacities, and facilities within the Valley. This analysis will help the District, the County, and Ogden Valley water providers identify potential alternatives for supplying additional water to the residents of Ogden Valley.

To accomplish this purpose, WBWCD has contracted with Bowen Collins & Associates (BC&A) to prepare a regional study of both culinary and secondary water. Primary objectives of the Ogden Valley Water Supply and Infrastructure Study include:

- Documenting existing water demands and supplies
- Understanding and documenting existing water resources and infrastructure in the Ogden Valley
- Projecting future water demand and supply
- Identifying alternative solutions to meet projected water needs
- Developing a strategy for implementing recommended solutions

The focus of this memorandum is to identify alternative solutions to meet projected water needs. Each alternative must include a way to produce culinary water, whether by groundwater or treated surface water, and a way to deliver it to where it is needed. This memorandum will primarily focus on source development with a subsequent memorandum dedicated to delivery.

SUMMARY OF POTENTIAL ALTERNATIVES

It was previously identified that future water supplies would either come from ag conversion or WBWCD import water. Future converted ag water will eventually drain into Pineview Reservoir and WBWCD's only existing supply in Ogden Valley is Pineview Reservoir water rights. Because both supply options will ultimately come from Pineview Reservoir, this technical memorandum will focus

on source development alternatives that can access water rights in Pineview Reservoir and convert them to culinary quality water supply.

The following four source development alternatives have been identified:

1. **New Wells in Ogden Valley** – Because the majority of Ogden Valley's culinary water supply is provided by existing groundwater wells, one alternative might be to consider developing new culinary wells in Ogden Valley to meet future culinary demands.
2. **Ogden Well Exchange** – Ogden City owns groundwater wells near Pineview Reservoir which help meet the City's current culinary water demands. This alternative would use a portion of the groundwater from these wells to satisfy demands Ogden Valley in exchange for treated water to be delivered from WBWCD directly to Ogden City.
3. **Reservoir Lake Tap and Treatment Plant** – Utilizing the storage that Pineview Reservoir provides, this alternative would construct a lake tap directly into the reservoir to access water. The water could then be treated at a new treatment plant to meet future culinary demands in Ogden Valley.
4. **New South Fork Diversions and Treatment Plant** – After evaluating the rivers and streams in Ogden Valley, it was found that the South Fork of the Ogden River has the highest and most consistent flows entering Pineview Reservoir. This alternative would include the construction of two diversion structures, placed along the North and South Branches of the South Fork along with a new water treatment plant to meet the Valley's future culinary demands.

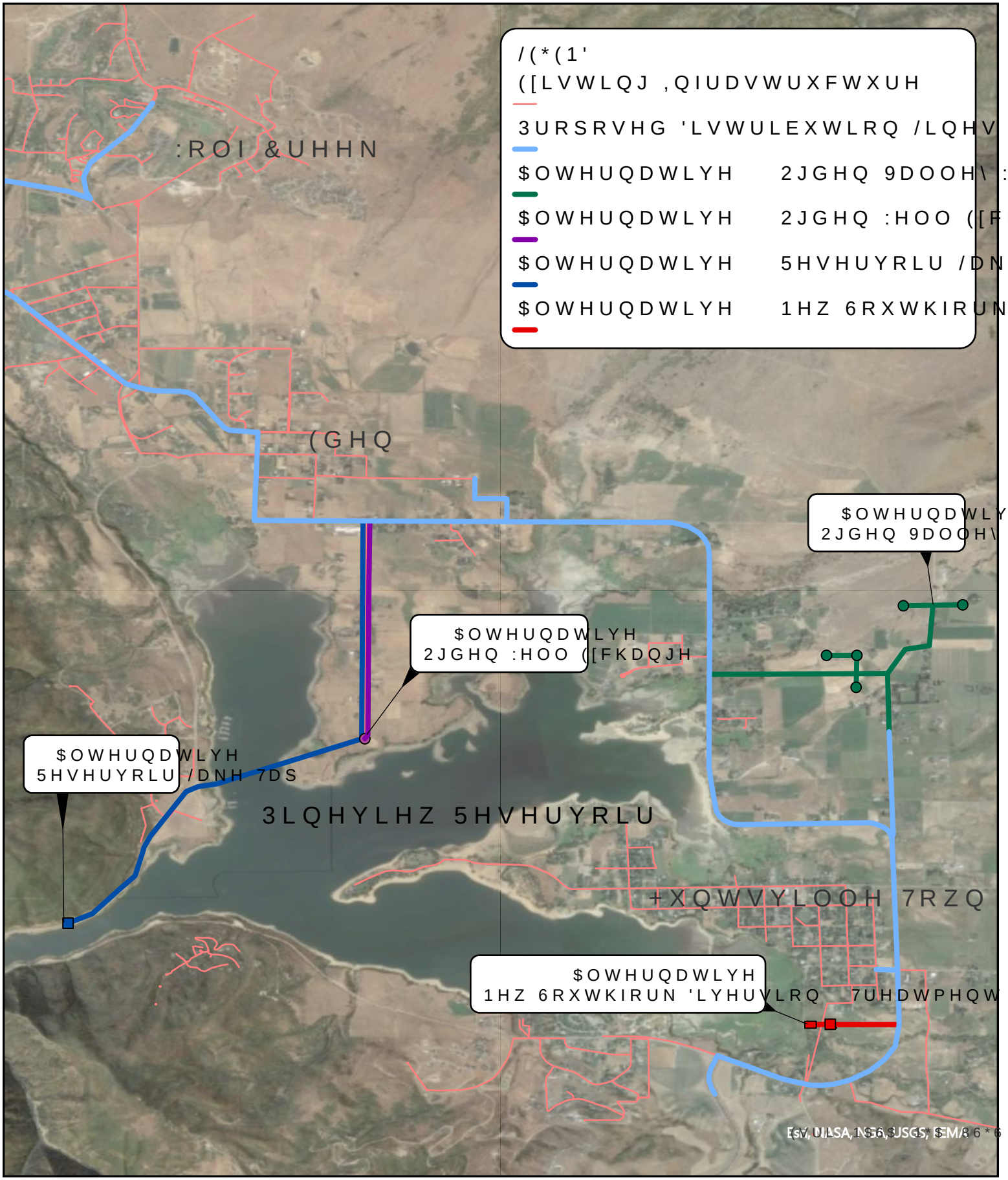
It will be noted that the original scope of this project stated that, "two of the most promising alternatives will be selected for further evaluation". However, since each of the four source development alternatives appear to have its own unique advantages, they have each been evaluated in this technical memorandum. Subsequent memorandums will focus on a single alternative selected by the stakeholder group.

Overall Infrastructure Needed for Alternatives

In order to fairly compare each of the four proposed source development alternatives, a water delivery system must be developed and evaluated with each source. Figure 1 shows the Valley's existing infrastructure along with a preliminary layout of each source development alternative and delivery system. The purpose of this figure is to give an overview of each alternative for comparative purposes only. Details of a proposed delivery system including the sizes and locations of pipes, pump stations, tanks, and other delivery facilities are included in a subsequent memorandum.

Included in the figure are the proposed transmission lines used for each alternative. Because Ogden Valley consists of several individual water providers, the existing infrastructure in the Valley is fragmented with few (if any) connections existing between water system providers. This means that, if a wholesale provider were to service the entire Valley, new infrastructure would be needed to connect and deliver the imported water to each individual provider.

Because each of the source development alternatives is located near Pineview Reservoir, there are a group of basic improvements that are common to all alternatives. These improvements are shown in light blue in the figure and are labeled as "Proposed Transmission Lines". Additional improvements needed for individual alternatives are then separately identified.



BOWEN COLLINS & ASSOCIATES

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EVALUATION PROCESS OF SUPPLY ALTERNATIVES

Evaluating each supply alternative involved a similar process. To facilitate presentation of the alternatives and subsequent discussion, the steps used to evaluate each alternative have been organized into the following sections:

- ***Description of Alternative Concept.*** This section will discuss the overall concept of the alternative. It will identify the major diversion, treatment, and conveyance facilities required to implement the alternative.
- ***Advantages and Opportunities.*** Based on the overall features of each concept, the advantages and opportunities of the alternative in comparison to others will be summarized in this section.
- ***Disadvantages and Limitations.*** Based on the overall features of each concept, the disadvantages and limitations of the alternative in comparison to others will be summarized in this section.
- ***Cost.*** This section will present the estimated total cost of the alternative Where phasing options exists, present value cost information will be provided for both initial capital costs and future phases. Included in the cost of each alternative is $26.4 million, the cost of facilities common to all alternatives (see subsequent technical memorandums for additional details).
- ***Conclusion.*** Based on the discussion above, this section will summarize the overall evaluation of the alternative and include a recommendation on whether the alternative should be considered further.

SUPPLY ALTERNATIVE EVALUATIONS

1. WBWCD Wells in Ogden Valley

Concept

This alternative would include the development of multiple new groundwater wells in the principal aquifer east of Pineview Reservoir as shown in Figure 1. For planning purposes, it has been assumed that the development of the wells would include a phased approach with two initial wells producing 1,500 to 2,000 gpm. Two wells are recommended to provide source redundancy. As additional development occurs within the Valley, more wells would be constructed to meet the increased water demands. Depending on the final location of the wells, they could pump directly into the main transmission pipeline, or a collection pipeline could collect flow from the several wells.

Based on this approach, expected phasing of infrastructure would be as follows:

- Phase 1
    - (2) Deep groundwater wells – 1,500 to 2,000 gpm each
    - Collection piping (as necessary)
- Phase 2 (Between 2027 and 2040[1])
    - Additional deep groundwater well – 1,500 to 2,000 gpm

[1] Timing will vary depending on growth rate and developed lot sizes. Earliest estimate is based on most conservative projections.

  - Collection piping (as necessary)
- Phase 3 (Between 2035 and 2060)
  - Additional deep groundwater well – 1,500 to 2,000 gpm
  - Collection piping (as necessary)

Advantages

Based on available information, expected advantages of this alternative include:

- **Cost –** The cost of this alternative is significantly lower than all the other alternatives because no new water treatment facilities will be necessary.
- **Opportunity for Phasing –** This alternative provides maximum flexibility for phasing. Because each well can produce 1,500 to 2,000 gpm, wells be constructed in phases only when additional supply is needed. This means that less investment is required up front and capacity will only be added when (or if) needed. This also allows the decision on total capacity to be postponed for longer. For example, if lot sizes end up being 0.2 acres or smaller, the third phase of well development may not ever be needed.
- **Water Quality –** Water quality is expected to be good with a TDS concentration between 250-350 mg/L and nitrates are expected to be below 3.0 mg/L within the confined portion of principal aquifer in the area.
- **Operation and Maintenance –** Compared to surface water treatment, groundwater wells are simple to operate and maintain. This alternative could be operated with minimal staff.
- **Reliability –** Groundwater is readily available and less vulnerable to drought. Wells can be cost effectively built in multiples to provide redundant supply in the event one well is inoperable.

Disadvantages

Based on available information, expected disadvantages of this alternative include:

- **Water Rights Issues –** The Ogden Valley is closed to new appropriations for groundwater rights. Development of any new groundwater will be conditional on change applications being filed to successfully move water from existing surface water rights in Pineview Reservoir. The process of acquiring approved change applications for this type of water transfer is expected to be very difficult. It would require demonstrating that the new wells would not adversely impact the existing Ogden City wells or any of the small domestic wells in the area used by Ogden Valley residents. Available hydrogeologic information suggests that this would be very difficult to demonstrate.

  The project team met with Ogden City to discuss the possibility of this type of groundwater development. In no uncertain terms, Ogden City personnel have indicated they would <u>not</u> be supportive of any change application that allowed more groundwater development in the area.
- **Source Uncertainty –** While it is fully expected that deep groundwater will exist in the area identified for potential well development, very few drilling logs exist below 250 feet east of Pineview Reservoir. Before pursuing a large diameter production well, an exploratory boring would need to be drilled to confirm the presence and quantity of groundwater. The estimated total cost of exploratory boring alone is between $250K and $750K depending on depth and analysis performed on the borehole.

- **Required Acquisition of Multiple Properties –** The preferred approach to developing wells is to access multiple 1-acre properties to allow for construction and each well. These properties should be located approximately 1,000 feet apart (or more) and a minimum of 150-ft from a septic and sanitary sewer pipeline.

Cost

As shown in Table 1, the expected overall cost of constructing wells in Ogden Valley is approximately $50 million[2]. Taking into account potential phasing and the time value of money (assume 3% construction cost inflation and 5% return on investment), the total present value cost of the alternative is $46.4 million. About $35 million of this would be required as part of Phase I improvements.

Table 1: WBWCD Wells in Ogden Valley
Cost Estimate

Item	Cost (2023 $'s)	Year of Construction	PV Cost
Well 1 (1500-2000 gpm)	$1,470,000	2023	$1,470,000
Well 2 (1500-2000 gpm)	$1,470,000	2023	$1,470,000
Well 3 (1500-2000 gpm)	$1,470,000	2033	$1,212,821
Well 4 (1500-2000 gpm)	$1,470,000	2043	$1,000,635
Well House 1	$2,100,000	2023	$2,100,000
Well House 2	$2,100,000	2023	$2,100,000
Well House 3	$2,100,000	2033	$1,732,601
Well House 4	$2,100,000	2043	$1,429,479
2,700 ft of 20" pipe	$594,000	2023	$594,000
Property Acquisition	$2,100,000	2023	$2,100,000
30% Contingency	$5,092,200		$4,562,861
Alternative Subtotal	**$22,066,200**		**$19,772,397**
Common Facilities	$28,090,088		$26,598,069
TOTAL	**$50,156,288**		**$46,370,466**

Conclusion

If water rights issues and potential interference with other wells could be addressed, this would be a very attractive alternative. Costs are lower than other alternatives requiring a pump station and treatment plant and can be phased with development. Unfortunately, developing new wells and creating change applications for water rights is expected to be nearly impossible. Opposition from Ogden City and other existing groundwater users is expected to be intense and available hydrogeologic information suggests interference with other wells is likely. Because of these disadvantages, it is not recommended that this alternative be pursued any further.

[2] Costs have been reported based on 2023 dollars to match the year of expected construction for most improvements. Costs in 2023 have been estimated based on 5 percent inflation from current (2022) construction cost estimates.

2. Ogden City Well Exchange

Concept

Ogden City originally had artesian wells where Pineview Reservoir is now located. These wells have since been replaced with the Ogden City well field on the peninsula between the North Fork and Middle Fork of the Ogden River as shown in Figure 1. These wells currently provide Ogden City with a significant portion of its overall water supply.

The purpose of this alternative is to exchange water supply from the Ogden City wells for treated water from WBWCD down in Ogden City. To accomplish this, a portion of the water from the Ogden City wells would be pumped into the new Ogden Valley system. Whatever volume was used would be replaced with treated water from WBWCD through existing connections to Ogden City.

In the Ogden Valley area, this exchange could be accomplished relatively easily. All that would be needed would be a new pump station and pipeline from the existing Ogden City wells to the new Ogden Valley transmission system. Delivering water from WBWCD to Ogden City is more complicated. While some capacity does existing in existing WBWCD and Ogden City facilities, it is not enough to fully support the proposed exchange. Identifying the improvements required to effectively convey water from WBWCD to the locations in Ogden City where the water is needed is outside the scope of this project, but these improvements are expected to be significant.

Advantages

Based on available information, expected advantages of this alternative include:

- **Cost –** The cost of this alternative is relatively low. The Ogden City wells are already existing and minimal infrastructure would be needed to convey some of their water to the Ogden Valley system. Costs are more than drilling new wells because the exchange water delivered to Ogden City would still require treatment by WBWCD. The cost of buying into existing WBWCD treatment facilities has been included in the alternative total.
- **Water quality –** Water quality is known to be good as it is currently used as a source for Ogden City.
- **Operations –** Compared to surface water treatment, groundwater wells are simple to operate and maintain. This alternative could be operated with minimal staff. Treatment of WBWCD water would obviously require additional operational effort, but this does not add significantly to the total operational effort since it would be occurring at larger, existing WBWCD plants.
- **Reliability & Water Rights –** Groundwater is readily available, and the wells are currently servicing Ogden City, so no additional water rights are necessary in the Valley and wet water is reliably available.
- **Construction Timeline -** The required time for project design and construction would likely be less than all other alternatives because of the availability of existing Ogden City wells.

Disadvantages

Based on available information, expected advantages of this alternative include:

- **Ogden City's Water System -** Ogden City's water system is designed to deliver most of its water from the mouth of Ogden Canyon to the remainder of the City. This is because the City's supply primarily comes from the groundwater wells near Pineview Reservoir and the City's existing treatment plant at the top of Ogden Canyon. All water from both these sources is then

conveyed down Ogden Canyon. This means that, if water supply were to come from elsewhere, significant changes would need to be made to the City's internal delivery system.

- **Ogden City Approval –** Because of the delivery challenges noted above, Ogden City personnel have expressed hesitancy when presented with this alternative. It seems likely that significant evaluation would be needed to identify how the water could be effectively delivered before City personnel would be willing to give their approval.
- **Potential Additional Costs -** Additional costs are expected in conjunction with this alternative because of the improvements necessary for Ogden City's water system to utilize treated water from Willard Bay Reservoir. These costs are currently unknown but could be substantial.

Cost

As shown in Table 2, the expected overall cost of the Ogden Well Exchange alternative is approximately $60 million. However, it should be noted that this does not include any costs associated with possible improvements to deliver water to Ogden City. While nearly all of the infrastructure would be required up front, some of the cost of treatment for exchange water from WBWCD could likely be phased over time. Taking into account potential phasing and the time value of money, the total present value cost of the alternative is $54.8 million. About $40 million of this would be required as part of Phase I improvements.

Table 2: Ogden City Well Exchange Cost Estimate

Item	Cost (2023 $s)	Year of Construction	PV Cost
Contract to Use OC Well	?	2023	-
Ogden City Improvements	?	Unknown	-
WBWCD Treatment – Phase 1	$5,333,333	2023	$5,333,333
WBWCD Treatment – Phase 2	$5,333,333	2033	$4,400,256
WBWCD Treatment – Phase 3	$5,333,333	2043	$3,630,423
Pump Station	$5,600,000	2023	$5,600,000
Water Tank (0.1 MG)	$210,000	2023	$210,000
6,700 ft of 20" Pipe	$1,470,000	2023	$1,470,000
Property Acquisition	$1,050,000	2023	$1,050,000
30% Contingency	$7,299,000	-	$6,508,204
Alternative Subtotal	**$31,629,000**		**$28,813,217**
Common Facilities	$28,090,088		$26,598,069
TOTAL	**$59,719,088**		**$54,800,286**

Conclusion

The Ogden City wells are fully functional and currently servicing Ogden City meaning that this alternative is expected to be one of the easiest to implement from an engineering and permitting standpoint. Much of the infrastructure has already been built and water availability and quality are established. However, unknown costs are associated with improving Ogden City's water system and Ogden City personnel have indicated that they are hesitant to approve this alternative given the uncertain impact on their system.

Because this alternative does have some attractive features, it is recommended that additional conversation regarding the alternative be conducted with Ogden City personnel. At a minimum, this alternative may provide a temporary bridge to begin providing water to the system while other, more complicated options are in the process of design and construction. However, if Ogden City does not express more willingness to explore this option, it is not recommended that this alternative be pursued further.

3. Reservoir Lake Tap and Treatment Plant

Concept

This alternative would divert directly from Pineview Reservoir. Based on feedback from the US Bureau of Reclamation (owner of Pineview Reservoir) on other similar projects, diversion from the reservoir will require construction of a "lake tap". This involves the construction of a large diameter vertical shaft that is connected to Pineview Reservoir with a lateral tunnel. This is an established construction method that has been implemented for several water supply projects to provide reliable water from reservoirs with fluctuating water levels.

The proposed location for the lake tap is shown on Figure 1 and is on the southwest side of the reservoir. Because this location is near the dam, it will provide a more reliable and consistent water supply due to the depth. A treatment plant would then be built on the peninsula northeast of the lake tap near the existing Ogden City well field.

Advantages

Based on available information, expected advantages of this alternative include:

- **Reliability –** The construction of a lake tap would provide a very reliable water supply. It would directly utilize water stored in Pineview Reservoir and could access the full depth of the reservoir.
- **Ownership and Independence –** This alternative could be built without requiring the approval or cooperation of other entities. While some permitting would obviously be needed from outside entities, the infrastructure would be owned and controlled independently and the right to the water in the reservoir is clearly established.

Disadvantages

Based on available information, expected disadvantages of this alternative include:

- **Location -** In order to obtain a consistent supply of water, the intake must be located near the dam where the water is deepest. This is to ensure that, during low water seasons, supply is still available for the Valley. Unfortunately, this location is far from existing infrastructure in the Valley's main service areas. Additional study of historical reservoir elevations should be performed to determine an ideal location for the lake tap.
- **Cost –** This is the most expensive of all alternatives. Cost is high for several reasons:
    - Constructing a lake tap to meet USBR requirements is exceedingly expensive.
    - Utilizing reservoir surface water will require a water treatment plant to provide culinary water to the Valley. A treatment plant will significantly increase the cost of this alternative.
    - The pipeline alignment will need to cross a portion of the reservoir for delivery to the major service areas in the Valley. This pipeline alignment will also significantly increase the cost of this alternative.

Cost

As shown in Table 3, the expected overall cost of constructing a reservoir lake tap and water treatment plant is approximately $105 million. Taking into account potential phasing and the time value of money, the total present value cost of the alternative is $103 million. About $96 million of this would be required as part of Phase I improvements.

Table 3: Reservoir Lake Tap & Treatment Cost Estimate

Item	Cost (2023 $'s)	Year of Construction	PV Cost
Lake Tap	$32,400,000	2023	$32,400,000
Treatment Plant & Pump Station – Phase 1 (4 mgd)	$16,500,000	2023	$16,500,000
Treatment Plant & Pump Station – Phase 2 (Additional 4 mgd)	$3,000,000	2038	$2,248,227
20" Pipe Crossing Reservoir	$1,653,750	2023	$1,653,750
13,000 ft of 20" Pipe	$2,860,000	2023	$2,860,000
Property Acquisition	$3,150,000	2023	$3,150,000
30% Contingency	$17,869,125		$17,643,593
Alternative Subtotal	**$77,432,875**		**$76,455,570**
Common Facilities	$28,090,088		$26,598,069
TOTAL	**$105,522,963**		**$103,053,639**

Conclusion

Unless all other alternatives are eliminated, it is not recommended that the District continue its evaluation of a possible lake tap and treatment plant. This is due to the high costs associated with this alternative.

4. New South Fork Diversions and Treatment Plant

Concept

This alternative would divert water from both the north and south branches of the Ogden River's South Fork. Diversions could be constructed on these two South Fork branches downstream of all other uses, just before they feed into the southeast corner of Pineview Reservoir near Huntsville. These two branches were estimated to produce a total of approximately 8.5 mgd (about 5,800 gpm) in the drought conditions of 2021. The available flow of water under these conditions is expected to be just enough for the future needs of the Ogden Valley. In average water years, flows would be well in excess of projected needs.

As shown in Figure 1, needed improvements to implement this alternative would include two diversion structure (one on each branch), a new treatment plant, and two new pump stations (a low head pump station from the diversions to the treatment plant and a larger pump station from the treatment plant into the transmission system).

Advantages

Based on available information, expected advantages of this alternative include:

- **Ownership and Independence –** This alternative could be built without requiring the approval or cooperation of other entities. While some permitting would obviously be needed from outside entities, the infrastructure would be owned and controlled independently.
- **Water Rights –** A change application would be needed to move the water from the reservoir to the diversions, but since the diversions would be located immediately upstream of the reservoir, this is not expected to be controversial.

Disadvantages

Based on available information, expected disadvantages of this alternative include:

- **Cost -** The cost of this alternative is expected to be in the middle of the various options. It is higher than groundwater options as a result of necessary diversion and treatment infrastructure, but significantly less than Alternative 3. Ongoing operation and maintenance costs are also expected to be higher than the groundwater alternatives.
- **Reliability –** The biggest disadvantage of this alternative is that it relies on surface water flows that may be subject to reductions in availability during periods of drought. Based on 2021 observations, the South Fork of the Ogden River appears to provide enough flow to satisfy projected demand in the Valley through buildout. However, flow observations in 2021 were based on visual estimations only, not detailed flow measurement. Additionally, even if the flow estimations are accurate, 2021 does not necessarily represent the worst case long-term flow for the river. Natural climate variability or the effects of climate change could result in lower available flows at some future point. If this were to occur, there could be less water available than projected system demands.

Cost

As shown in Table 4, the expected overall cost of constructing diversion structures along the South Fork with a water treatment plant is approximately $64 million. Taking into account potential phasing and the time value of money, the total present value cost of the alternative is $61.6 million. About $54 million of this would be required as part of Phase I improvements.

Table 4: South Fork Diversions & Treatment Cost Estimate

Item	Cost (2023 $'s)	Year of Construction	PV Cost
2 Diversion Structures & low head pump	$5,000,000	2023	$5,000,000
Treatment Plant & Pump Station – Phase 1 (4 mgd)	$16,500,000	2023	$16,500,000
Treatment Plant & Pump Station – Phase 2 (Additional 4 mgd)	$3,000,000	2038	$2,248,227
Property Acquisition	$3,150,000	2023	$3,150,000
30% Contingency	$8,295,000		$8,069,468
Alternative Subtotal	**$35,945,000**		**$34,967,695**
Common Facilities	$28,090,088		$26,598,069
TOTAL	**$64,035,088**		**$61,565,764**

Conclusion

Due to the absence of any major roadblocks and its moderate estimated cost, it is recommended that the District use this alternative as the basis for further evaluation and planning. While supply reliability of the South Fork Diversion should be considered further, it appears likely there is enough reliable water available to address at least the initial phases of this project. This alternative will be used as the basis for further detailed analysis in subsequent memorandums.

RECOMMENDATION

Total cost for each of the alternatives are summarized in Tables 5 and 6.

Table 5: Total Capital Costs (2023 Dollars)

	Phase 1 Capital Costs	Future Capital Costs	Total Cost
Alternative 1	$34,920,000	$15,240,000	$50,160,000
Alternative 2	$39,900,000	$19,820,000	$59,720,000
Alternative 3	$95,670,000	$9,850,000	$105,520,000
Alternative 4	$54,180,000	$9,860,000	$64,040,000

Table 6: Total Capital Costs (Present Value)

	Phase 1 Capital Costs	Future Capital Costs - Present Value	Total Present Value Cost
Alternative 1	$34,920,000	$11,450,000	$46,370,000
Alternative 2	$39,900,000	$14,900,000	$54,800,000
Alternative 3	$95,670,000	$7,380,000	$103,050,000
Alternative 4	$54,180,000	$7,390,000	$61,570,000

Based on the evaluations of each alternative presented above, it is recommended that further evaluation and planning be based on the New South Fork Diversions and Treatment Plant alternative. This recommendation is made by comparing the advantages, disadvantages, and cost estimates of each alternative along with receiving feedback from WBWCD personnel, Weber County personnel, and Ogden Valley water providers. Although this alternative is not the lowest cost of the alternatives, it is the lowest cost out of expected feasible alternatives when considering all factors and parties involved.

Subsequent chapters will discuss the recommended conveyance improvements and implementation plan based on the assumption that the New South Fork Diversions and Treatment Plant alternative will be constructed to meet projected water needs.

BOWEN COLLINS & ASSOCIATES

TECHNICAL MEMORANDUM #5

TO:	Weber Basin Water Conservancy District
COPIES:	File
FROM:	Keith Larson, P.E., Andee Harris, E.I.T.
DATE:	09 March 2022
SUBJECT:	Ogden Valley Water Supply and Infrastructure Study - Recommended Conveyance Improvements
JOB NO.:	021-21-02

INTRODUCTION

The Ogden Valley area of Weber County needs a plan to manage future water needs. According to recent information, an estimated 83 individual water companies provide water services to residents and businesses in the Ogden Valley. However, each of these service companies is limited by the production of their individual water sources. Due to the large number of service providers and the growing number of stakeholders in the Valley, Weber Basin Water Conservancy District (WBWCD or District) and Weber County have identified a need for a regional study to better understand the hydrology, service areas, source capacities, and facilities within the Valley. This analysis will help the District, the County, and Ogden Valley water providers identify potential alternatives for supplying additional water to the residents of Ogden Valley.

To accomplish this purpose, WBWCD has contracted with Bowen Collins & Associates (BC&A) to prepare a regional study of both culinary and secondary water. Primary objectives of the Ogden Valley Water Supply and Infrastructure Study include:

- Documenting existing water demands and supplies
- Understanding and documenting existing water resources and infrastructure in the Ogden Valley
- Projecting future water demand and supply
- Identifying alternative solutions to meet projected water needs
- Developing a strategy for implementing recommended solutions

The focus of this memorandum is identifying alternative solutions to meet projected water needs. A previous memo discussed each of the water supply options and recommended Alternative 4 – South Fork Diversions and Treatment Plant as the basis for further planning and evaluation. This memorandum uses that supply alternative as a basis to develop a more detailed plan for conveyance and distribution.

REQUIRED WATER SYSTEM DELIVERIES

Water delivery systems are designed based on maximum water demand or peak demand of a specific area. This is to ensure that, as water demands vary throughout the day and throughout the year, the delivery system will be capable of meeting the full range of demands in the system. In previous

memorandums, the projected population growth and annual water use demands were shown from 2025 to 2060 and were used to estimate the peak demands in gallons per minute (gpm) for each major planning area in Ogden Valley (as defined by Weber County personnel). Peak demands associated with the proposed new culinary water system are shown in Table 1. Demands shown only include new demands on the system as existing needs are assumed to be met by the current water providers and existing infrastructure.

Table 1
Planning Area Peak Culinary Demands (gpm)

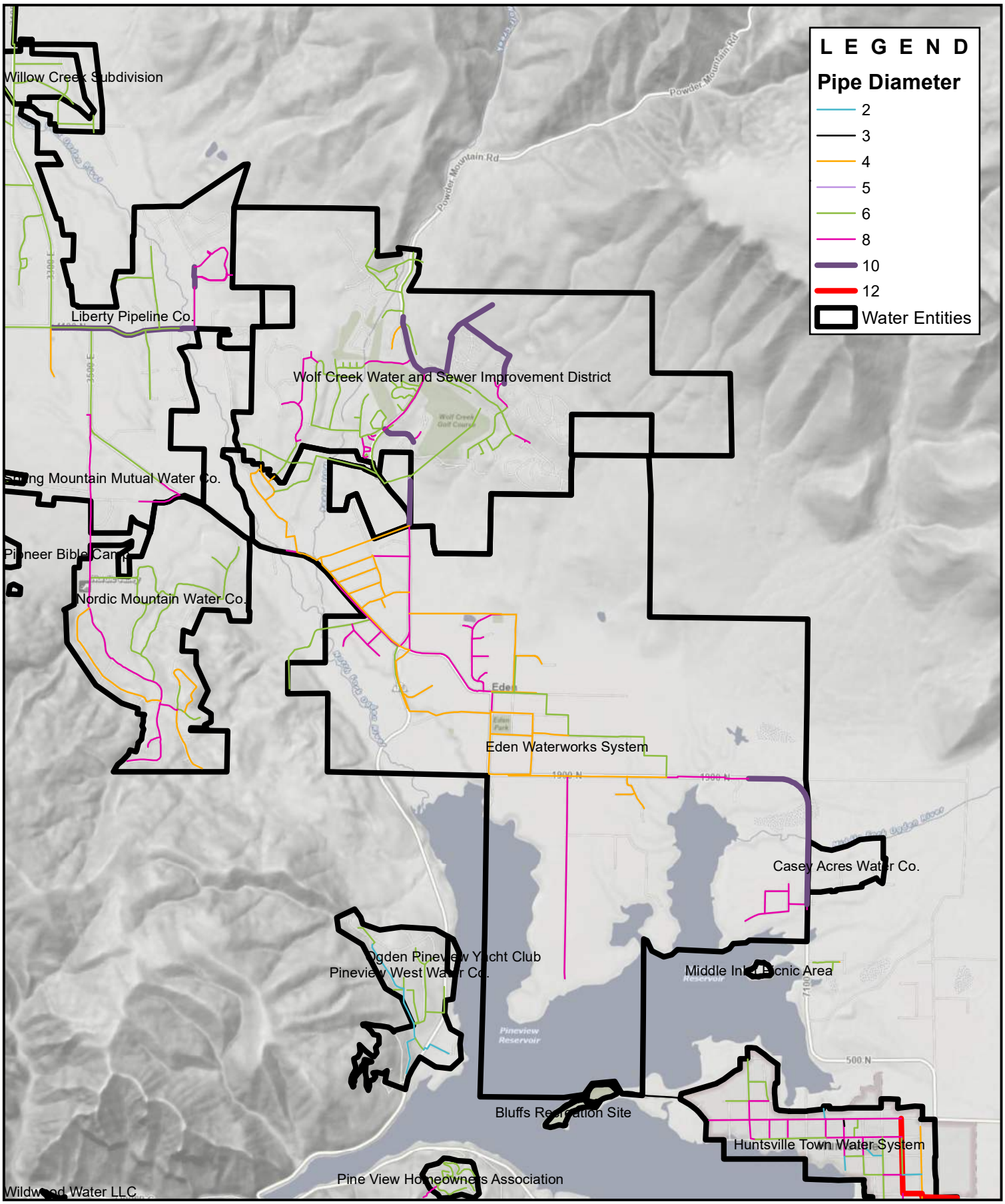
Entity	2025	2030	2035	2040	2050	2060	Effective Peaking Factor[1]
Eden	159	336	526	687	867	924	1.94
Huntsville	36	60	80	95	113	121	1.67
Liberty & Nordic	542	1,093	1,635	2,059	2,497	2,628	2.50
Wolf Creek	212	364	478	551	615	632	1.67
Ogden Valley	12	39	99	231	692	948	2.25
Snowbasin	6	38	108	212	286	289	2.25
Total (gpm)	**967**	**1,929**	**2,926**	**3,835**	**5,069**	**5,541**	**2.19**
Total (cfs)	**2.2**	**4.3**	**6.5**	**8.5**	**11.3**	**12.3**	**-**
Total (mgd)	**1.4**	**2.8**	**4.2**	**5.5**	**7.3**	**8.0**	**-**

OGDEN VALLEY EXISTING INFRASTRUCTURE

As discussed in previous memorandums, several water providers exist in Ogden Valley due to the way development occurred in unincorporated areas of the Valley. Most were created by developers needing to provide a water system for their associated land development project. Over the years, many of these systems evolved into private water companies, private mutually owned companies, or special service districts formed by the County such as Eden Water Works, Wolf Creek Water and Sewer Improvement District, etc. Because the existing water systems were developed independently, each has its own infrastructure including pipelines, storage tanks, pressure zones, etc. This makes introducing a wholesale provider a difficult task as additional water supply must be delivered to each major planning area individually.

Figures 1 through 3 show the existing infrastructure in Ogden Valley for all the larger water providers while Figure 4 shows a schematic of each system's pressure zones relative to others. As can be seen in the figures, there are not very many large pipelines in the area that could be used as the backbone for future conveyance efforts. The vast majority of pipelines in the area are 8 inches or less in diameter. Any new water deliveries throughout the Valley will likely need to be supported through the construction of independent transmission pipelines.

[1] Historically WBWCD has required that contracted entities have an effective peaking factor of no more than 2.0. Future agreements will need to consider how entities can best address the higher peaking factors shown in Table 1.



BOWEN COLLINS & ASSOCIATES

EXISTING EDEN & WOLF CREEK WATER SYSTEM INFRASTRUCTURE

WEBER BASIN WATER CONSERVANCY DISTRICT

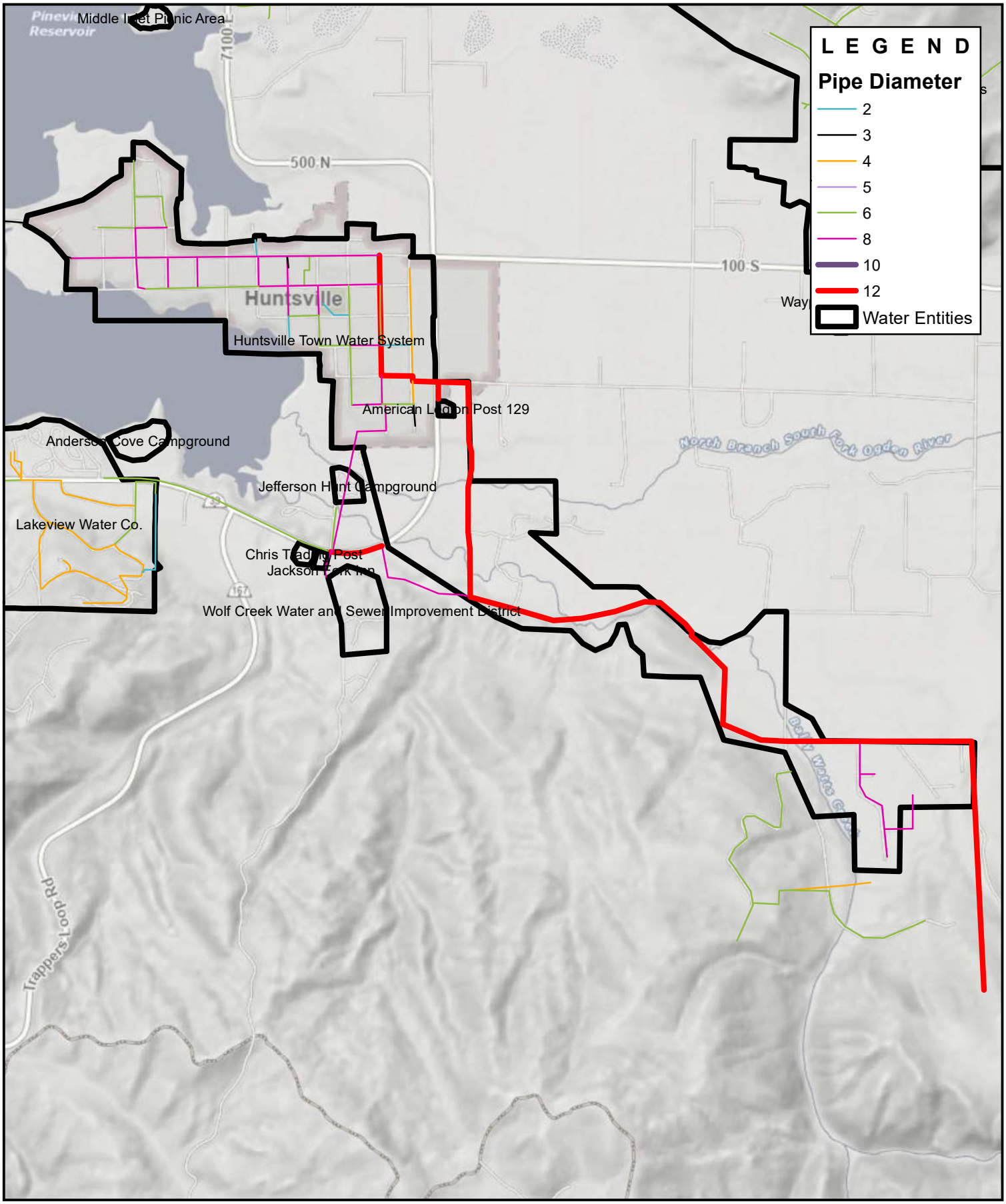
OGDEN VALLEY MASTER PLAN

NORTH:

SCALE: 0 0.4 0.8 Miles

FIGURE NO. 1

P:\Weber Basin WCD\021-21-02 Ogden Valley Master Plan\4.0 GIS\Eden & Wolf Creek Infrastructure.mxd aharris 4/11/2022



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EXISTING HUNTSVILLE TOWN WATER SYSTEM INFRASTRUCTURE

WEBER BASIN WATER CONSERVANCY DISTRICT

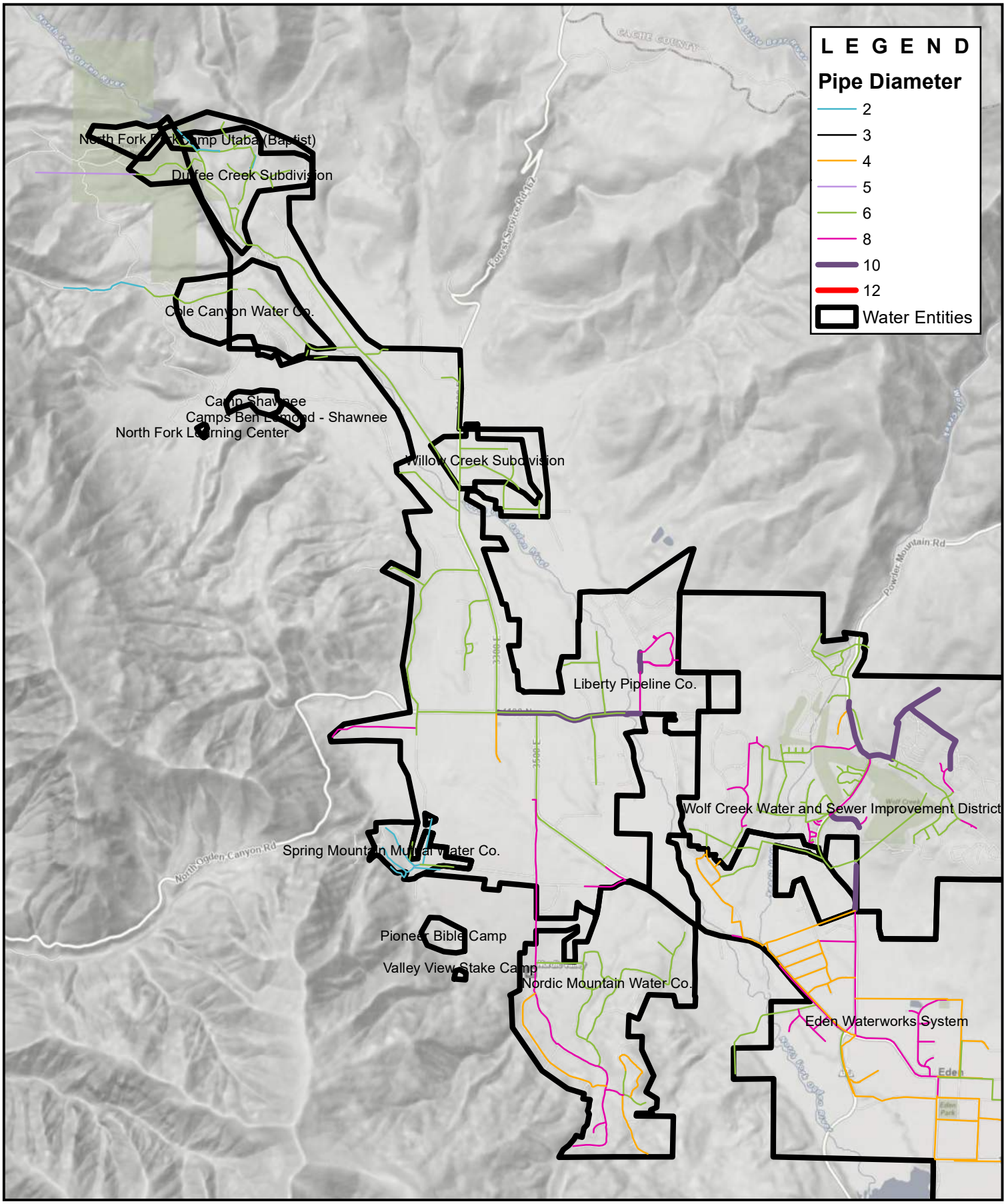
OGDEN VALLEY MASTER PLAN

NORTH:

SCALE: 0 0.25 0.5 Miles

FIGURE NO. 2

P:\Weber Basin WCD\021-21-02 Ogden Valley Master Plan\4.0 GIS\Huntsville Town Infrastructure.mxd aharris 4/11/2022



BOWEN COLLINS & ASSOCIATES

EXISTING LIBERTY & NORDIC MOUNTAIN WATER SYSTEM INFRASTRUCTURE

WEBER BASIN WATER CONSERVANCY DISTRICT

OGDEN VALLEY MASTER PLAN

NORTH:

SCALE: 0 0.4 0.8 Miles

FIGURE NO. 3

P:\Weber Basin WCD\021-21-02 Ogden Valley Master Plan\4.0 GIS\Liberty & Nordic Infrastructure.mxd aharris 4/11/2022

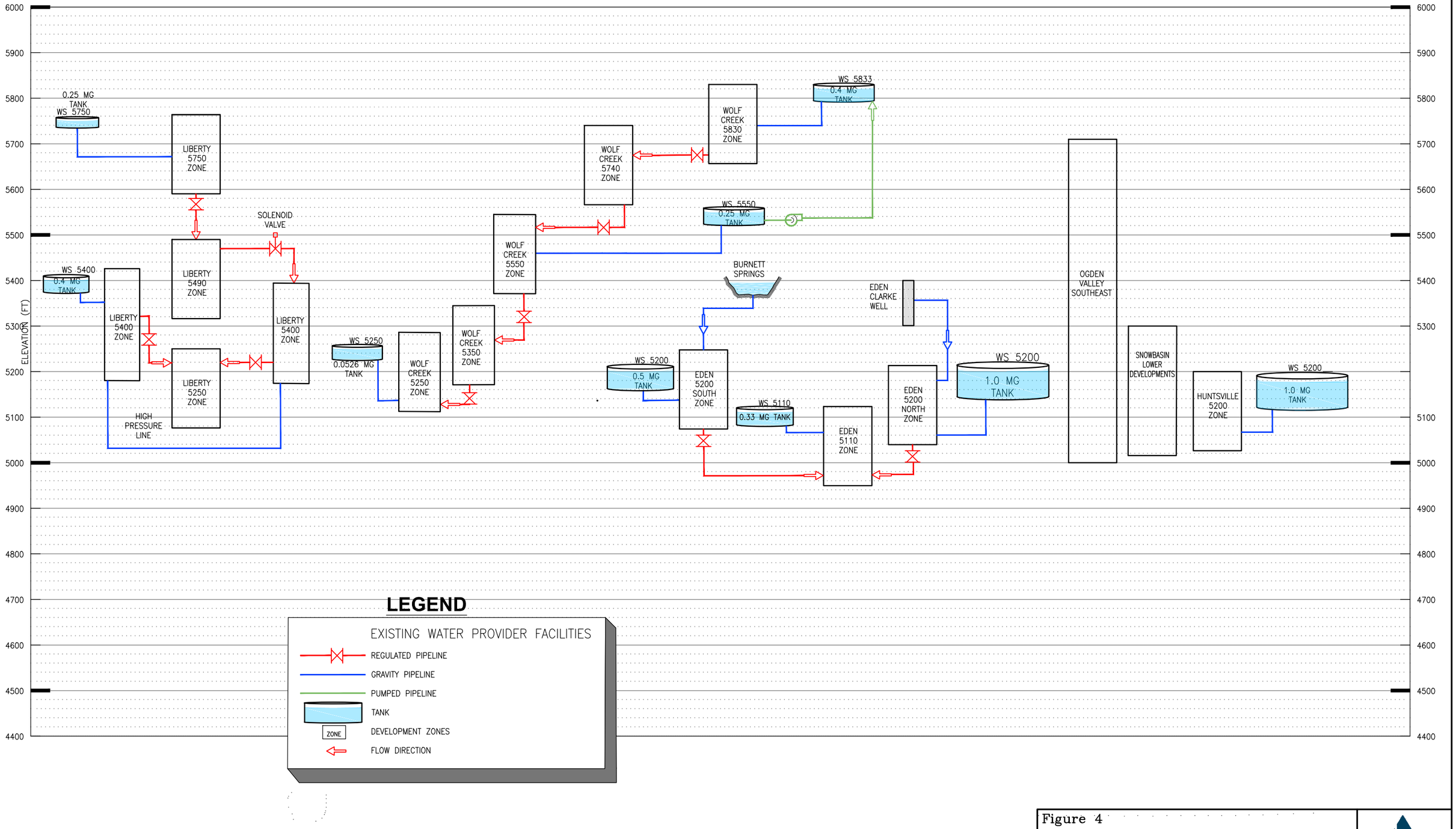


Figure 4

WEBER BASIN WATER CONSERVANCY DISTRICT
EXISTING OGDEN VALLEY INFRASTRUCTURE

BOWEN COLLINS & ASSOCIATES

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HYDRAULIC DELIVERY STRATEGY

Based on the system schematic, the following should be considered when laying out a new system to deliver water in the Valley:

- All of the service areas at the south end of the Valley can or should be able to receive water at a hydraulic grade of 5,200 feet.
    - Both Huntsville and Eden have major tanks at this elevation.
    - Neither the Snow Basin nor the Ogden Valley Southeast service areas currently have existing facilities to receive water in this area. However, their potential service areas include significant portions of developable property that could be well served at this hydraulic grade.
- Service at the north end of the Valley will require higher pressure.
    - Wolf Creek does include a small tank at an elevation of 5,250 feet. However, this tank has minimal volume and facilities to convey water from this elevation to the rest of the Wolf Creek system are limited. It is expected that deliveries to Wolf Creek will need to be conveyed to Wolf Creek's existing tank at 5,550 feet.
    - Liberty's lowest existing tank sits at an elevation of 5,400 feet. It is expected that deliveries to Wolf Creek will need to be conveyed to at least this elevation.

Based on these factors, the proposed hydraulic delivery strategy for new culinary infrastructure is shown in the revised system schematic shown as Figure 5. As shown in this figure, the overall approach includes the following improvements:

- Construct a new storage tank near the intersection of the Eden, Wolf Creek, and Liberty service areas. The floor elevation of the tank should be at about 5,220 feet.
- Pump water from a new culinary water treatment plant to the new tank. The hydraulic grade in the pipeline from the plant to the tank will float off the new tank at 5,220 feet. This will be adequate head to deliver flow by gravity to Huntsville, Eden, and the future service areas of Snow Basin and Ogden Valley Southeast.
- Construct two new pump stations and delivery pipelines at the north end of the system to deliver water to Wolf Creek and Liberty.

RECOMMENDED SYSTEM IMPROVEMENTS

Based on the proposed delivery strategy above, recommended system improvements are shown in Figure 6. Additional details regarding recommended system improvements are described in the following sections.

South Fork Diversions or Bank Infiltration

Flows from the South Fork of the Ogden River have recently been estimated during the drought conditions in 2021. Based on visual observations, it is estimated that the North Branch of the South Fork was producing about 6 cfs and the South Branch of the South Fork was producing about 7 cfs (combined flow of 13 cfs or 5,800 gpm). With a maximum projected future demand of 12.3 cfs (5,550 gpm) as shown in Table 1, it appears that diversion structures will be required on both branches of the South Fork to support maximum future demands during drought years. Considerations for design of the diversions include:

- **River Flows -** It should be emphasized that South Fork flow observations in 2021 were based on visual estimations only, not detailed flow measurement. Additional investigation of actual flow would be recommended before finalizing any design.

- **Phasing -** While diversions from both branches are projected to be needed at peak flows, it may be possible to satisfy demands during initial phases from a single diversion. One diversion with a reliable capacity of at least 6 cfs would be capable of satisfying projected demands through at least 2030.
- **Capacity -** Since flow during normal and wet years will be significantly higher than the drought year yield estimates, it would be prudent to design each diversion with capacity to divert the full future demand of 12.3 cfs (5,550 gpm). In non-drought years, this will provide flexibility to divert from either branch as needed.
- **Winter Diversion Issues –** WBWCD currently maintains multiple diversion structures that encounter winter weather issues such as frazil ice. To avoid issues associated with winter weather, it is recommended that a bank infiltration system or shallow wells be used in place of diversion structures. However, additional analysis should be performed to determine which diversion method is most appropriate. For budget purposes, its assumed that bank infiltration will be used.
- **Water Rights -** To avoid interfering with other water rights, the diversions will need to be located downstream of all other water users. This means they will likely be located immediately adjacent to Pineview Reservoir. This location will very likely require a low head pump station to be constructed to convey the water from the diversions to a new treatment plant.

Water Treatment Plant

Because surface water will be utilized as culinary or potable water, a water treatment plant will be required to treat the flow from the South Fork of the Ogden River to drinking water standards. It is recommended that the treatment plant be located south of Huntsville Town adjacent to the proposed diversion structures. Design considerations for the treatment plant include:

- **Sizing -** The maximum projected future demand on the treatment plant is projected to be 5,550 gpm or 8 million gallons per day.
- **Phasing -** Because the population growth in the Valley is not projected to reach buildout until sometime after 2060, it is recommended that the treatment plant be built in multiple phases. For planning purposes, it has been assumed that the initial phase will be constructed large enough to accommodate the buildout capacity of 8 mgd but include treatment trains within the plant for only about half of the capacity (4 mgd). This will provide adequate capacity to satisfy demands for the first several years. The second phase would include the construction of additional treatment trains to expand the capacity from 4 mgd to the full 8 mgd buildout capacity. Timing of this second phase will depend on growth rates and development densities but is expected to be needed no earlier than 2030.
- **Treatment Type –** Because information regarding water quality is limited, the exact nature and type of treatment to be implemented is not known. A more detailed study should be conducted to determine if components such as pre-treatment or granular activated carbon (GAC) will be required for high turbidity removal or color. For budgetary purposes, it has been assumed that this will be a packaged conventional filtration plant.
- **Property –** For planning purposes, it is estimated that approximately 5 acres of land will be required to construct an 8 mgd water treatment plant and corresponding pump station (see next section).

Primary Pump Station

The treatment plant will be located at an elevation of around 4,880 feet. To pump to the needed hydraulic grade of 5,220 feet as discussed in the hydraulic delivery strategy, a new primary pump station will be needed. Design considerations for the primary pump station include:

- **Capacity -** The primary pump station will likely be located near or within the proposed treatment plant facility and include the following capacity based on maximum projected future demand:
    - Flow Capacity: 5,550 gpm
    - Estimated Suction HGL = 4,880 feet (at treatment plant)
    - Estimated Discharge HGL = 5,400 feet (5,220 feet at reservoir + 180 feet friction losses)
    - Estimated Lift at Pump Station: 520 feet
    - Corresponding Pump Size: 1,300 HP (includes 25% redundant capacity)
- **Phasing -** Similar to treatment plant improvements discussed above, the primary pump station may be constructed in multiple phases as growth occurs in Ogden Valley and demands increase. For planning purposes, it has been assumed that Phase 1 will be constructed in 2023 and include an initial capacity of 500 HP. Sometime after 2030, an additional 800 HP will necessary to service growing demands.

Pipelines

As mentioned previously, the majority of existing pipelines in the Ogden Valley are smaller than 8 inches in diameter. This means that the potential to use existing pipelines for conveyance is limited and larger infrastructure will be required. To convey the projected buildout demands to each area. pipeline improvements are needed as shown in Figure 6. The proposed transmission system consists of a major "backbone" pipeline from the treatment plant to the Eden area with branches as necessary to each provider.

The total peak day demand for Ogden Valley is projected to reach 5,550 gpm at buildout. At recommended velocities, peak flow rates would require a 20-inch diameter pipe for conveyance. It may be possible to phase some of the backbone pipeline, similar to what is being recommended for the treatment plant and primary pump station. However, for cost estimating purposes, a single 20-inch pipeline in Phase 1 has been assumed.

Based on this approach, the proposed pipeline phases are shown in Figure 6 and described below.

- **Phase 1 -** Phase 1 will be required with the initiation of the project and includes connections to each of the potential water providers. The sizing of each pipeline is based on the projected peak day demands for each pipeline as discussed in previous technical memorandums (see Technical Memorandum 3). Table 2 describes the pipelines required in Phase 1 and the expected timing of each.

Table 2:
Phase 1 Pipelines

Pipeline	Pipe Diameter (inches)	Estimated Length (feet)	Year of Construction
Main Conveyance Pipeline	20	46,000	2023
Huntsville Connection	8	200	2023
Snowbasin Connection	8	1,000	2023
Ogden Valley Southeast Connection	10	1,000	2023
Eden Connection	8	300	2023
Wolf Creek Connection	8	500	2023
Liberty Connection	14	16,500	2023
Total	**-**	**65,500**	**2023**

Water pipeline sizing criteria aims to limit head loss in the system and minimize wear of interior coatings and in-line valves. Pipeline velocities must be less than 7 feet per second for all operating conditions, including peak demand conditions. In most operating conditions, velocities will be limited to no more than 5 feet per second. It should be noted that, based on future growth and demand projections, several areas in the Valley could be served with a pipe diameter of 8 inches or smaller, but for design purposes, the smallest recommended diameter is 8 inches.

- **Phase 2 -** Phase 2 will include a short section of 20-inch pipe after a new storage facility is constructed. This will connect the Phase 1 system to the future Phase 2 storage facility (see Storage section) as shown in Figures 5 and 6. Table 3 describes each pipeline in Phase 2 and the expected timing of each.

Table 3:
Phase 2 Pipelines

Pipeline	Pipe Diameter (inches)	Estimated Length (feet)	Year of Construction
Storage Connection	20	500	2038

Storage

Because this evaluation involves providing water by means of a wholesale provider, distribution type storage (equalization, fire flow, and emergency) is not required for this delivery system. This type of storage will be provided by existing storage facilities of the retail providers in the Ogden Valley. However, some operational storage is recommended in order to provide a stable boundary condition in the system, to accommodate wholesale demand fluctuations, and provide flexibility when operating the delivery system. Design considerations for a new storage facility include the following:

- **Storage Sizing –** It is recommended that the future storage facility be sized to meet peak day demands at buildout (5,550 gpm) for 4 hours. This is based on expected operating conditions for the system. It is expected that flow will be delivered at a generally constant rate to each entity based on requests for water. While demands will not fluctuate through the day like

they would in a retail system, it is expected that each entity will be able to change the amount of flow requested a few times each day. If the reservoir is operated around halfway full, the recommended storage sizing would accommodate a change in demand (either an increase or decrease) equal to the full peak day demand for at least an hour. This would allow system operators adequate time to ramp flow at the treatment plant up or down to match demands. This results in a need for approximately 1.5 million gallons of storage.

- **Phase 1 -** If excess capacity is available, it is likely that initial phases of demand can be satisfied by connecting to Eden Waterworks' existing 0.5-million-gallon tank, located at an elevation of 5,200 feet. This would allow the system to get up and running until additional storage is required. This would also reduce some initial project costs while providing storage for operation flexibility within the delivery system. An agreement would need to be reached with Eden Waterworks to confirm that excess storage is available and permissible for use on an interim basis.
- **Phase 2 –** In time, system demands will increase to where excess capacity in Eden Waterworks' existing tank will no longer be sufficient to satisfy system needs. At that time, a new 1.5-million-gallon storage tank would be required and constructed near the existing Eden tank at an elevation of approximately 5,220 feet as shown in Figure 5 and 6.

Additional Delivery Pump Stations

As discussed previously, Wolf Creek and Liberty's service areas are located at higher elevations and will require two additional pump stations to discharge at hydraulic grades of 5,570 feet and 5,450 feet respectively. Approximate locations for these pump stations are shown in Figure 6 and the following design requirements and calculations were made:

- Wolf Creek:
  - Flow Capacity – 650 gpm
  - Estimated Suction HGL = 5,200 feet (at new storage reservoir, near empty)
  - Estimated Discharge HGL = 5,590 feet (5,570 feet at reservoir + 20 feet friction losses)
  - Estimated Lift at Pump Station: 390 feet
  - Pump Size – 125 HP (includes 25% redundant capacity)
- Liberty:
  - Flow Capacity – 2,650 gpm
  - Estimated Suction HGL = 5,200 feet (at new storage reservoir, near empty)
  - Estimated Discharge HGL = 5,500 feet (5,450 feet at reservoir + 50 feet friction losses)
  - Estimated Lift at Pump Station: 300 feet
  - Pump Size – 350 HP (includes 25% redundant capacity)

Both pump stations will be required as part of Phase 1. Some phasing may be possible in how many pumps are initially installed.

Metering and Flow Control Vaults

When delivering water to each service area, it will be important to meter water usage and be able to control how much water is delivered to each system. Accordingly, water meters and flow control valves will be required at each future connection. Table 4 shows the proposed connection sizing coming into each metering and control vault (see Table 2) as well as the approximate meter and

control valve size based on expected maximum flows and the expected timing of each. It should be noted that flow to Eden may not initially need a flow control valve because it is anticipated that a temporary connection will be made directly into an Eden storage tank until additional storage is required.

Table 4:
Required Pipeline Diameters (gpm)

Area	Maximum Flow (gpm)	Required Connection Size (inches)	Year of Construction
Huntsville	150	8	2023
Liberty	2,650	14	2023
Wolf Creek	650	8	2023
Ogden Valley	950	10	2023
Snowbasin	300	8	2023
Eden	950	10	2030

ELEVATION (ft)

0.25 MG TANK WS 5750

LIBERTY 5750 ZONE

LIBERTY 5490 ZONE

SOLENOID VALVE

WS 5400 0.4 MG TANK

LIBERTY 5400 ZONE

LIBERTY 5250 ZONE

HIGH PRESSURE LINE

WS 5250 0.0526 MG TANK

WOLF CREEK 5250 ZONE

WOLF CREEK 5350 ZONE

WOLF CREEK 5550 ZONE

WOLF CREEK 5740 ZONE

WOLF CREEK 5830 ZONE

WS 5833 0.4 MG TANK

WS 5550 0.25 MG TANK

BURNETT SPRINGS

EDEN CLARKE WELL

OGDEN VALLEY SOUTHEAST

SNOWBASIN LOWER DEVELOPMENTS

HUNTSVILLE 5200 ZONE

WS 5200 1.0 MG TANK

WS 5200 1.0 MG TANK

WS 5220 PROPOSED 1.5 MG TANK

WS 5200 0.5 MG TANK

EDEN 5200 SOUTH ZONE

WS 5110 0.33 MG TANK

EDEN 5110 ZONE

EDEN 5200 NORTH ZONE

PROPOSED WOLF CREEK PUMP STATION

PHASE 1 8" TO WOLF CREEK

FUTURE PHASE 2 20" PIPE & TANK

FUTURE PHASE FLOW CONTROL VALVE

PHASE 1 10" CONNECTION TO EDEN

PHASE 1 14" TO LIBERTY

PHASE 1 20"

PHASE 1 20"

PHASE 1 10" CONNECTION TO OGDEN VALLEY SOUTHEAST

FLOW CONTROL VALVES

PHASE 1 8" CONNECTIONS TO HUNTSVILLE & SNOWBASIN

PROPOSED LIBERTY PUMP STATION

PROPOSED TREATMENT PLANT AND PUMP STATION

PROPOSED DIVERSION STRUCTURE

LEGEND

PROPOSED NEW FACILITIES

- PHASE 1 PIPELINE
- FUTURE PIPELINE
- PROPOSED FLOW CONTROL VALVES
- PROPOSED TANKS

EXISTING WATER PROVIDER FACILITIES

- REGULATED PIPELINE
- GRAVITY PIPELINE
- PUMPED PIPELINE
- TANK
- ZONE — DEVELOPMENT ZONES
- FLOW DIRECTION

Figure 5

WEBER BASIN WATER CONSERVANCY DISTRICT
OGDEN VALLEY WATER SYSTEM SCHEMATIC

BOWEN COLLINS & ASSOCIATES

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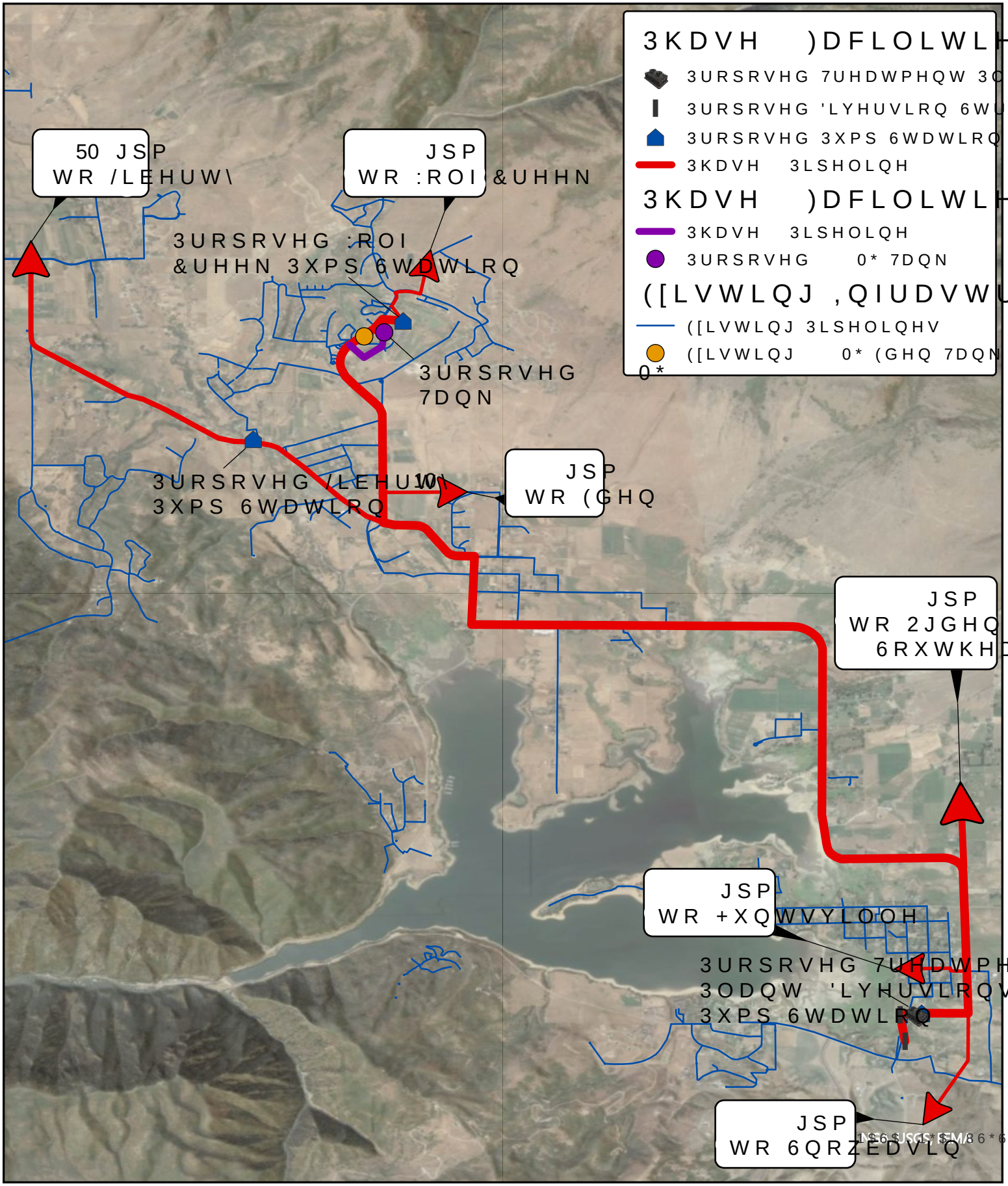

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2JGHQ 9DOOH\ :DWHU Supply Study

BOWEN COLLINS & ASSOCIATES

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COST

Initial Capital Cost

Based on the system improvements discussed above, cost estimates were developed for Phase 1 and Phase 2 of the overall project. These estimates are shown in Table 5 with an overall cost of $64 million.

Table 5:
Cost Estimate

Item	Cost (2023 $'s)	Year of Construction
Phase 1		
2 Diversion Structures & Low Head Pump (shallow wells)	$5,000,000	2023
Treatment Plant & Primary Pump Station – Phase 1 (4 mgd)	$16,500,000	2023
46,000 ft of 20" Pipe	$10,120,000	2023
1,000 ft of 10" Pipe to Ogden Valley Southeast and Eden	$235,000	2023
16,500 ft of 14" Pipe to Liberty	$3,465,000	2023
2,000 ft of 8" Pipe to Huntsville, Wolf Creek, and Snowbasin	$182,000	2023
Metering and Flow Control Vaults (5)	$500,000	2023
Additional Delivery Pump Stations	$2,525,760	2023
Property Acquisition	$3,150,000	2023
30% Contingency	$12,503,328	-
Phase 1 Total	$54,181,088	-
Phase 2		
Treatment Plant & Pump Station – Phase 2 (Additional 4 mgd)	$3,000,000	2038
1.5 MG Storage Tank	$4,500,000	2038
Metering and Flow Control Vault - Eden	$80,000	2038
30% Contingency	$2,274,000	-
Phase 2 Total	$9,854,000	-
TOTAL COST	**$64,035,088**	**-**

Figure 7 shows the projected cost in 2023 dollars per contracted acre-foot. The annual demand is shown from 0 acre-feet to the buildout value of 4,078 acre-feet. As shown in the figure, the cost per acre-foot decreases as annual demand increases with the exception of a slight increase when Phase 2 improvements are required. Phase 2 improvements are required when annual demands surpass 2,000 acre-feet. Because Phase 1 improvements are only sufficient up to 2,000 acre-feet, the cost per acre-foot reaches a minimum of approximately $26,600 for Phase 1. If the projected annual buildout demand of 4,078 acre-feet is reached, the final cost per acre-foot is approximately $15,700 in 2023 dollars.

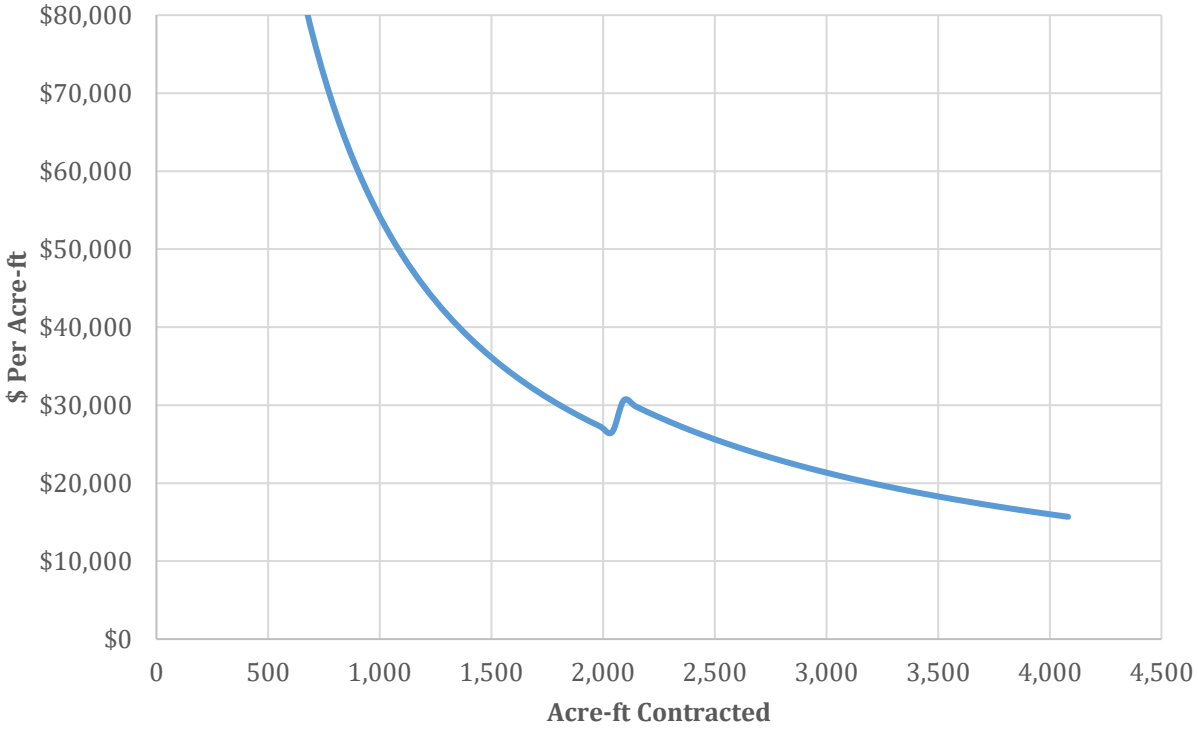


Figure 7:
Cost Estimate Per Acre-ft

Annual Water Cost

It should be noted that the costs shown in Tables 5 and Figure 7 are capital costs only. The cost to acquire untreated source water (via exchange from WBWCD, agricultural conversion, or other raw water sources) will add additional annual costs. Financing costs will also add to the annual cost of the water:

- **Water Acquisition Costs** – The cost to acquire water will depend on how and when it is secured. It is expected that most of the water for this project would be acquired as import water from WBWCD. Current rates for untreated District Block 3 water is $566.86/acre-ft/year. However, it should be noted that this rate increases each year to account for increasing operation and maintenance costs. The District is also very near to using all of its remaining Block 3 water. Block 4 water costs have not been determined.
- **Financing costs** – If Phase 1 improvements ($54.2 million) are financed with a 30-year bonding agreement at a 5 percent interest rate and the full Phase 1 volume of 2,000 acre-ft can be contracted for, the annual cost per acre-foot will be approximately $1,728/acre-ft/year (principal and interest). If the full cost of $64 million (including Phase 1 and 2) is included and the full buildout volume is contracted for, it is estimated that the cost per acre-foot will drop to $1,021 (assuming a 5 percent interest rate for 30 years).

Combining capital, financing, and water acquisition costs, the total estimated cost of developing new water in the valley is as summarized in Table 6.

Table 6:
Cost of New Ogden Valley Water ($/acre-ft/year)

Phase	Capital Costs (with Interest)	Water Acquisition Costs	Total	Cost per 1,000 Gallons
Phase 1 Water Costs (Based on 2,000 acre-ft contracted)	$1,728	$570	$2,298	$7.06
Water Costs at Buildout (Based on 4,080 acre-ft contracted)	$1,021	$570	$1,591	$4.88

It should be noted that this is the wholesale cost of producing and delivering water only. Additional costs for retail service would be in addition to the cost shown here.

CONCLUSION

The New South Fork Diversions and Treatment Plant alternative has been used as the basis for development of proposed improvements to meet future Ogden Valley culinary water needs. The proposed improvements include diversion structures, a water treatment plant, pump stations, storage, and a new network of transmission pipelines. The overall cost of constructing these facilities in 2023 dollars is expected to be approximately $64 million.

To maximize the cost effectiveness of this alternative, it is proposed that it be constructed in multiple phases. Phase 1 includes all the necessary infrastructure to begin delivering water to entities in the valley. Additional improvements would be constructed as needed for additional capacity. These include expansion of the treatment plant from 4 to 8 mgd, and a dedicated 1.5-million-gallon storage tank. About $54.2 million would be required as part of Phase 1 improvements. The initial capital cost for Phase 1 capacity is $26,600/acre-ft. However, this will gradually decrease as the system is expanded. Once capacity is fully utilized, the expected capital cost of water will be about $15,700/acre-ft.

With financing and water acquisition costs (at current WBWCD Block 3 rates), this results in an annual cost of about $2,300/acre-ft/year for Phase 1 and $1,600/acre-ft/year for buildout. This equates to between $5.00 and $7.00 for 1,000 gallons.

BOWEN COLLINS & ASSOCIATES

TECHNICAL MEMORANDUM #6

TO:	Weber Basin Water Conservancy District
COPIES:	File
FROM:	Keith Larson, P.E., Andee Harris, E.I.T., & Kaden Grover
DATE:	15 July 2022
SUBJECT:	Ogden Valley Water Supply and Infrastructure Study – Implementation Alternatives
JOB NO.:	021-21-02

INTRODUCTION

The Ogden Valley area of Weber County needs a plan to manage future water needs. According to recent information, an estimated 83 individual water companies provide water services to residents and businesses in the Ogden Valley. However, each of these service companies is limited by the production of their individual water sources. Due to the large number of service providers and the growing number of stakeholders in the Valley, Weber Basin Water Conservancy District (WBWCD or District) and Weber County have identified a need for a regional study to better understand the hydrology, service areas, source capacities, and facilities within the Valley. This analysis will help the District, the County, and Ogden Valley water providers identify potential alternatives for supplying additional water to the residents of Ogden Valley.

To accomplish this purpose, WBWCD has contracted with Bowen Collins & Associates (BC&A) to prepare a regional study of both culinary and secondary water. Primary objectives of the Ogden Valley Water Supply and Infrastructure Study include:

- Documenting existing water demands and supplies
- Understanding and documenting existing water resources and infrastructure in the Ogden Valley
- Projecting future water demand and supply
- Identifying alternative solutions to meet projected water needs
- Developing a strategy for implementing recommended solutions

The focus of this memorandum is to summarize available alternatives for implementation of the recommended solutions.

OPERATING ENTITY ALTERNATIVES

Before any infrastructure can be built, it must be determined who will build and operate the infrastructure. Potential system owners can be organized into two categories – existing entities and new entities.

Existing Entity Alternatives

Potential existing entities that could build and operate the required new facilities include:

- **Weber Basin Water Conservancy District** – It is expected that WBWCD will provide most of the water rights for water that will ultimately be treated and delivered in the Ogden Valley. However, WBWCD has indicated that, while it is willing to provide water rights, it is not willing to finance, construct, or operate a new water system. Therefore, WBWCD has been removed from further consideration.
- **Weber County** – The County has indicated it is not interested in constructing and operating a new water system. This is outside of its primary mission and purpose. However, it would be willing to consider the creation of a new district to accomplish this purpose (see below).
- **Existing Water Provider** – One of the existing major providers could step up to build the required infrastructure and then wholesale water to other providers. It is unclear whether any of the existing providers would be willing to serve this role. The size and cost of the required infrastructure makes this seem unlikely.

In summary, the only possibility for ownership by an existing entity is for one of the existing water providers to volunteer for this role. While further exploration of this option with the existing providers should be done, it seems likely a new entity will be needed to build and operate the new water infrastructure.

New Entity Alternatives

Potential new entities that could build and operate the required new facilities include:

- **Creation of a Local District** – A new local district could be formed with the purpose of building the required infrastructure to wholesale water to current and future retail water providers. A "local district" can take a variety of forms such as a basic local district, an improvement district, and a water conservancy district. While the various types of local district vary somewhat as to powers and responsibilities, each local district is an independent political subdivision of the State of Utah and, once created, remains in existence and operation and not subject to oversight by the municipality or county that created the local district.

  A local district is governed by a board of trustees that can be either elected or appointed. A local district has authority to both charge fees for services or facilities provided by the district and to impose a property tax levy on taxable property within the district boundaries.

  If a local district is created for this project, a number of details would need to be resolved (e.g., Who would initiate the process? What areas would be included in the district? How would the district be governed?) Note also that the creation of a local district requires voter approval (with a few exceptions, not relevant here). However, this does appear worth further consideration.

  Example: Bear River Water Conservancy District

- **Creation of a Special Service District** – A special service district (or "SSD") operates much like a local district. In general, the operations of a special service district are governed by an administrative control board, whose members may be elected or appointed. The reality, however, is that the ultimate responsibility for the operation of the special service district rests with the governing body of the entity that created the special service district. The authority of the administrative control board only exists to the extent that such authority has been delegated to it by the county commission. Some issues cannot be decided by the administrative control board and instead must be addressed by the county commission (levying taxes or assessments, issuing debt, or holding an election).

  Like a local district, a special service district has the authority to both levy taxes and charge fees. However, a major advantage of a special service district is that it does not require voter approval for creation. So long as Weber County is willing to shoulder some of this burden, a special service district is a viable option.

  Example: Mountain Regional Water Special Service District

- **Creation of an Interlocal Entity** – An interlocal entity can be thought of as a partnership of multiple governmental entities created to achieve some common purpose. In essence, the interlocal entity can exercise all powers held by the governmental entities that created it, but cannot exercise any powers beyond those of its member entities. The exact structure, governance, and operation of an interlocal entity is established when the entity is created, subject to few statutory limitations. For this situation, an interlocal entity could be formed with membership consisting of some combination of various municipalities in the Ogden Valley, Weber County, WBWCD, and any other water suppliers that are public entities.

  Example: Heber Light & Power Company

- **Creation of a Private Water Company –** The owner and operator of the improvements would not necessarily need to be a public entity. A private entity could be formed to accomplish the same purpose. Use of a private water company would have implications in terms of methods of funding (see next section) but appears to be a possibility if a group willing to lead the formation of a private entity could be identified.

FUNDING ALTERNATIVES

Several alternatives for funding the improvements have been identified and are discussed in the following sections. Not all of these alternatives can be used in all of the operating entity alternatives. Nor are these alternatives all mutually exclusive (i.e. more than one type of funding might be possible depending on the circumstances). Applicability of the various options to each operating entity will be discussed subsequently.

Impact Fees

Concept:	Impact fees are calculated to identify the capital cost of providing service for a new service connection. As development occurs, an impact fee is paid by each new connection to compensate for capacity to be used in the system. Impact fees are usually paid at the building permit phase.
Advantages:	New development pays its own way based on the proportionate share of capital costs used by each development. Could be a long-term repayment source for other funding mechanisms
Disadvantages:	Receipt of impact fees takes place over many years. Thus, it does not provide the initial source of funding for construction of needed improvements. Impact fees are not guaranteed (i.e. if there is a slowdown in the economy and development is reduced, the stream of income associated with impact fees will also slow). Correspondingly, any repayment plan based on impact fees needs a contingency plan for potential loss of this revenue stream.

Ad Valorem Property Taxes

Concept:	Some entities such as local districts have the ability to levy taxes in their service area based on property value (ad valorem). They are adopted through a strict, public process in accordance with State code and are generally used for operation and maintenance expenses.
Advantages:	Stable, reliable revenue source. Could be a part of overall revenue source for other funding mechanisms.
Disadvantages:	Receipt of taxes takes place over many years. Thus, it does not provide the initial source of funding for construction of needed improvements. The rate for this type of tax is limited depending on entity type. For a typical local district, the tax levy may not exceed 0.0008 of the taxable value. This limits how much property tax revenue can be generated from this source, especially before properties in the district are developed and their taxable value is low.

Water Rates/Contracts

Concept:	Once the entity is up and running, it will be able to charge for water provided. This may include costs associated with both operations and maintenance as well as capital expenditures. For retail service, this type of revenue is most often collected in the form of a monthly water bill. This will normally include both a fixed base rate and a variable volume charge based on the amount of water used. For wholesale service, this type of revenue is usually collected through a water supply contract with each retail provider. The structure of these contracts can vary but are often set up as "take or pay" contracts in which each retail provider agrees to pay a set fee for a fixed volume of water. The full fee must be paid whether the full volume is used or not. In many cases, the wholesale contract also

defines the terms for purchasing additional water (if available) above and beyond the take or pay amount.

Advantages: Stable, reliable revenue source.
Could be a long-term repayment source for other funding mechanisms.

Disadvantages: Receipt of rate revenue takes place over many years. Thus, it does not provide the initial source of funding for construction of needed improvements.
If used as the sole source of funding, this would require all retail agencies to step up and commit to paying for the full volume of water from the start. It is unlikely water providers will be willing to commit to this level of funding.

Public Infrastructure District

Concept: A public infrastructure district or "PID" would be formed of properties interested in participating in the improvements. The PID would be created by the County and requires 100% consent of the property owners within the PID boundaries. This is typically only successful in areas that have one or two large property owners. The PIDs sole purpose is to finance the public infrastructure projects inside the PID or that benefit the PID. All infrastructure financed and built by the PID is dedicated back to the local government entity that would maintain the operation and maintenance costs of the project. Once bonds are issued by the PID it would implement a new tax levy on properties within the PID boundaries at a tax levy of up to 0.015 or as limited by the County. The PID is also able to issue other types of bonds including General Obligation Bonds (as described above), Special Assessment Bonds or Fee Based Lien Bonds. Once bonds are paid off, the PID will dissolve and no longer exist.

Advantages: Used instead of impact fees and is a steady stream of revenue.
Those who benefit pay.
Borrowing costs are generally lower than other development financing options.
PID debt would not be a liability or a balance sheet item of the County.
General Obligation Bonds are treated like property tax foreclosure. If a property owner in the PID decides not to pay their tax payment, then the process goes through property tax foreclosure. If by 40 years (the time the PID must levy their tax) the PID is unable to pay back its bond obligation to investors, then the risk will fall onto the investor and the bonds will be written off without claiming default.

Disadvantages: Willingness of all property owners to establish a PID – may be difficult to project which properties will develop and need the water.
Ongoing PID governance until bonds are paid off. The Governing Document that the PID must adhere too needs to be done with lots of due diligence to ensure that the PID is being done fair and equitability between all parties.

Special Assessment Area

Concept:	A special assessment area (SAA) is similar in function to a PID. It implements a new tax on participating properties to pay for bond funding for improvements. It is different from a PID in that the SAA is not a separate entity but must be created and administered by the County. Thus, bonding is issued by the County and the county is ultimately responsible for all activities of the SAA. Formation of a SSA cannot occur if more than 40 percent of those to be assessed protest the formation of the special assessment area. Percentage is calculated using expected assessed cost based on the method of assessment.
Advantages:	Those who benefit pay. Could be used in conjunction with tax increment financing, thereby encouraging development and use of increment to pay assessments.
Disadvantages:	Willingness of all property owners to establish a SAA – may be difficult to project which properties will develop and need the water. Need to come up with equitable assessment method (Could possibly use ERUs but may be difficult to establish number of ERUs upfront.) County is fully responsible for bond payment. In the event of non-payment by properties, County may foreclose on properties but still must make the bond payment. Detailed and sometimes difficult process to form an SAA.

Tax Increment Financing

Concept:	"Project areas" can be formed to incentivize private development. These areas would be created by a community redevelopment agency through a County ordinance. Within the project areas, all taxing entities would agree to dedicate all or a portion of "tax increment dollars" to the redevelopment agency for a period of time (usually around 20 years). Tax increment dollars are property tax dollars received above and beyond an established baseline. This baseline is typically the property taxes generated prior to the creation of the project area. After the designated time, taxes would return to the taxing entities that levy the property taxes. The redevelopment agency would use the tax increment dollars to pay back bonds used to fund improvements.
Advantages:	All taxing entities contribute to revenue stream. Could be a repayment source for utility revenue bonds or SAA or PID.
Disadvantages:	Requires significant support from the County. County must bond for infrastructure yet repayment source of tax increment is uncertain. Political will of taxing entities to forego increased property taxes for a period of time.

Utility Revenue Bond

Concept:	Entities may borrow money using a utility revenue bond based on an entities promise to pay it back using a portion of their revenue stream.

Bond payments can be met through other funding options discussed here (i.e. impact fees, rates/contracts, taxes, etc.). The amount of bonding possible is limited by the size of the revenue stream. Entities will need to maintain at least a 1.25 debt service coverage ratio (i.e., net revenues before debt service compared to the debt service itself).

Advantages: Immediate funding
No public vote required

Disadvantages: Water entity may lack sufficient bonding capacity given large cost of project

General Obligation Bond

Concept: General Obligation bonds ("GO") are paid for using a specific tax on properties within a jurisdiction. GO bonds are subject to simple majority voter approval by the constituents of the issuing entity. General obligation elections can be held once each year, in November, following certain notification procedures that must be adhered to in accordance with State Statutes in order to call the election (pursuant to Utah State Code 11-14-2 through 12).

Advantages: Lowest cost form of borrowing

Disadvantages: Timing issues; limited date to hold required G.O. election. Once given the approval to proceed with the issuance of the bonds, it would take approximately 90 days to complete the bond issuance.
Risk of a "no" vote while still incurring costs of holding a bond election
Possibility of election failure due to lack of perceived benefit to majority of voters
Must levy property tax on all property even if some properties receive limited or no benefit from the proposed improvements
Can only bond for physical facilities, not ongoing or additional operation and maintenance expense

Pioneering Agreement

Concept: Those interested in receiving water would come up with the funding to complete the required improvements. A pioneering agreement would then be developed that would require any new users that desire to connect to the system to pay back those who initially financed the system.

Advantages: Those who need the water take full responsibility up front for infrastructure costs.
No financing liability for the County.

Disadvantages: Lack of control over timing.
Willingness and availability of property owners to step up and make the commitment, especially given the large initial cost of the project.

Public-Private Partnerships (P3s)

Concept: Private equity investors are sought to provide financing for the project.

Advantages: New revenue stream that pays for infrastructure.
Disadvantages: Relatively untried for water infrastructure.
Potential increase cost for users due to need for private sector to make a profit.
Potential for Public Service Commission regulation.
Potential to lose control of rates to private investor.
Would all public entities be willing to work with a private investor (Division of Drinking Water, WBWCD, retail water providers)?

OVERALL ALTERNATIVES

As noted above, final funding of improvements will likely involve a number of these mechanisms, but not all of these alternatives can be used in all of the operating entity alternatives. Potential applicability of each funding alternative to each operating entity alternatives is summarized in Table 1.

Table 1
Applicability of Funding Alternatives to Operating Entity Alternatives

Funding Alternative	Existing Water Provider	New Municipal Entity	Private Water Company
Impact Fees	✓	✓	✓
Ad Valorem Taxes	✓	✓	
Water Rates/Contracts	✓	✓	✓
Public Infrastructure District	✓	✓	
Special Assessment Area	✓	✓	
Tax Increment Financing	✓	✓	
Utility Revenue Bond	✓	✓	✓
General Obligation Bond	✓	✓	
Pioneering Agreement	✓	✓	✓
Public-Private Partnership			✓

RECOMMENDATIONS

During conversations with the existing water providers conducted as part of this study, none indicated any interest in taking the lead on this project. Thus, it appears likely a separate, new entity will be required to build the new infrastructure – either a new municipal district or a private water company.

How this new entity comes about will depend on how active a role County leadership wishes to take in this process. Two possible paths of action are highlighted below:

If the County does not wish to actively lead efforts to secure more water –

Recommended actions are as follows:

1. **Carefully scrutinize all new proposals for access to water before approving additional development in the Ogden Valley.** The results of this report indicate that there is very little additional water available in existing water systems in the Valley. The County should not approve any additional development except in limited instances where access to available water can be shown. As part of this action, a process should be put in place that formalizes what information will be required to demonstrate access to water for new development – both water rights and physical access to useable water.

With this action in place, the burden of finding and securing new water supply will shift entirely to private developers.

If the County decides to take an active role in securing more water –

Recommended actions are as follows:

1. **Secure legal and financial advisor assistance.** The information above is intended to provide a high-level overview of potential entity and funding alternatives. If the County wishes to pursue any of these options in more detail, it will likely need assistance from licensed advisors in each of these areas.
2. **Identify potential funding partners.** Before deciding which types of funding will be most applicable, additional research will be needed into which properties are ready to participate and whether there is enough interest to viably fund the improvements. Potential funding partners will include:
    - Existing retail providers willing to contractually commit to purchase water.
    - Developers with existing cash or financing in place to contribute to the system now (potential partners in pioneering agreements).
    - Property owners without funding but willing to participate in a PID or SSA. (Note: Tax increment financing is not recommended for this application).
3. **Further engineering study and design.** This is a conceptual level study. If funding appears to be possible, additional engineering should be pursued. This will allow the County to verify the viability of the selected approach and develop more detailed cost estimates.
4. **Form a new municipal district.** While looking for potential private partnerships is probably prudent, no existing partners are known at this time. Formation of a new municipal district (local, special service, or interlocal) to construct and operate the improvements will allow the project to continue to proceed. A special service district appears to be the best fit for this application.
5. **Select and finalize funding mechanisms.** Assuming a new municipal district is formed, it is expected that multiple funding mechanisms will be needed. This will likely include most if not all of the following:
    - Some cash contributed up front by developers and potentially the County.
    - Bond financing in some form.
    - A tax repayment strategy (PID or SSA).
    - Impact fees from future development to buy into constructed infrastructure.

- Ongoing rates, contracts, and possibly ad valorem taxes to pay for ongoing operation and maintenance.

6. **Proceed with final design and construction of improvements.** Once financing and an operational entity are in place, projects can be completed and water can begin to be delivered.

APPENDIX A

GROUNDWATER DEVELOPMENT POTENTIAL

BOWEN COLLINS & ASSOCIATES

TECHNICAL MEMORANDUM

TO:	Weber Basin Water Conservancy District
COPIES:	File
FROM:	Chris DeKorver, P.G.
DATE:	March 22, 2022
SUBJECT:	Ogden Valley Groundwater Development Potential
JOB NO.:	021-21-02

The purpose of this Technical Memorandum (TM) is to present findings and recommendations regarding the potential for groundwater development within the Ogden Valley located in eastern Weber County, Utah. The evaluation uses existing hydrogeologic information to identify the potential for development of new groundwater supply wells and estimating the anticipated yield.

BACKGROUND

The Ogden Valley area of Weber County needs a plan to manage future water needs. Weber Basin Water Conservancy District (WBWCD or District) and Weber County have identified a need for a regional study to better understand the hydrology, service areas, source capacities, and facilities within the Valley. This analysis will help the District, the County, and Ogden Valley water providers identify potential alternatives for supplying additional water to the residents of Ogden Valley.

To accomplish this purpose, WBWCD has contracted with Bowen Collins & Associates (BC&A) to prepare a regional study of both culinary and secondary water. As part of this study, a potential need for up to 4,100 acre-ft of new culinary water source with a projected peak production capacity of up to 5,550 gpm has been identified. One possible source for at least a portion of this water is new groundwater development. This memorandum will consider the feasibility of developing new culinary wells to help satisfy projected future water needs in the Valley.

SUMMARY OF REGIONAL HYDROGEOLOGY AND AQUIFER DATA

The geology and hydrogeology of the Ogden Valley has been previously described by many sources including Avery (1994), Snyder & Lowe (1998) and the recent comprehensive report, Jordan (2019)[1]. The appendix provides a general geologic map of the area.

In these previous studies, three main hydrogeologic divisions have been identified in Ogden Valley. These water yielding unconsolidated sediment aquifers are defined as follows:

1. Shallow Unconfined Aquifer
2. Confined Portion of the Principal Aquifer

[1] Characterization of the Groundwater System in Ogden Valley, Weber County, Utah, with Emphasis on Groundwater-Surface-Water Interaction and the Groundwater Budget, Utah Geological Survey (UGS), 2019

3. Unconfined Portion of the Principal Aquifer

These aquifers are defined relative to their relationship to a geological formation know as the "principal confining unit." The principal confining unit is a layer of soil consisting of lacustrine silt and clay in the southwestern portion of Ogden Valley, near and around Pineview Reservoir. The extents of the confining unit are approximately shown in Figure 21 of the appendix. It is estimated to be approximately 100 feet in thickness in the western most portion of the valley and thins towards the valley margins to the north, east and south. Relative to this confining layer, the three aquifers referenced above can be generally described as follows:

- **Shallow Unconfined Aquifer –** Sitting on top of the confining unit is the shallow unconfined aquifer. This aquifer consists of coarse-grained sediments (sand and gravel) and mixed sediments (clay, silt, sand, and gravel). Not many wells exist in the shallow unconfined aquifer. The flow from the shallow unconfined aquifer discharges to Pineview Reservoir.
- **Confined Portion of the Principal Aquifer –** The aquifer underlying the confining unit is known as the confined portion of the principal aquifer. The aquifer consists primarily of fluvial and alluvial-fan sand and gravel with some silt and clay lenses (Jordan, 2019). The sediments near the top of the confined portion of the principal aquifer are well sorted and permeable. Correspondingly, many wells are completed in the upper portion of the aquifer and this aquifer is the principal source of culinary water in the valley for municipal use. Ogden City's original artesian wells were located in the confined portion of the principal aquifer on the floor of Pineview Reservoir prior to its development. These wells have since been abandoned and replaced with the Ogden City well field on the peninsula between the North Fork and Middle Fork of the Ogden River, but still draw from the confined portion of the principal aquifer.
- **Unconfined Portion of the Principal Aquifer –** As shown in Figure 21 of the appendix, the confining unit does not extend to the full limits of the Ogden Valley. Beyond the confining unit, especially to the north and east, are areas of valley fill where groundwater is unconfined. These areas are referred to as the unconfined portion of the principal aquifer. Many of the small domestic wells in the valley are completed in the unconfined principal aquifer east and north of the reservoir. This is also considered the primary recharge zone within the valley and is most susceptible to nitrate loading from septic systems and agriculture.

Aquifer Thickness

Results of a gravity survey performed in the 2019 report by the UGS were used to assess the thickness of the alluvial sediments within the Ogden Valley. The data obtained was used to calculate the Complete Bouguer Gravity Anomaly (CBGA) for the available stations. The appendix includes Figure 11 and Figure 12 from the UGS report displaying the results of the CBGA field. The results interpreted as low CBGA values equate to thicker fill material in the southern portion of the valley east of Pineview Reservoir. The two transects, Line 1 and Line 2, are shown in Figure 12 and indicate that approximately 2,100 feet of valley fill is present above the underlying bedrock, the Norwood Tuff.

The UGS also created an isopach map of the Ogden Valley unconsolidated valley-fill sediments (Figure 13 in the appendix). The isopach map was created by using existing drillers logs and the CBGA gravity survey results. The contouring suggests that the thickest area in the valley is east of Pineview Reservoir and north of Huntsville where the maximum thickness is about 2,300 feet.

Existing Well Depths

There is currently no known drilling that has occurred for exploratory purposes or completed wells beyond the depth of 747 feet within the valley fill sediments based on the Utah Division of Water Rights (DWRi) interactive website. Additionally, there are very few wells on file that were drilled beyond 250 feet located east of Pineview Reservoir. The Ogden City well field completed depths vary between 274 feet and 511 feet. Most of the wells in the valley have been completed using the cable-tool method which is limited on depth and diameter due to the nature of the drilling process. Rotary drilling operations could provide additional depth capabilities for future drilling.

Pump Test Data

Most wells completed in the Ogden Valley have been completed for domestic purposes and do not include a constant rate pump test. In the UGS report (Jordan, 2019), a total of nine aquifer tests were evaluated for public water supply wells completed in the principal aquifer. A total of five were tested in the confined portion of the principal aquifer and four were tested in the unconfined portion of the principal aquifer. Pumping rates from the Ogden City well field vary between 1,700 to 3,200 gpm and are all located in the confined principal aquifer. Specific Capacities (SC) varied between 17.8 gpm/ft to 91.2 gpm/ft in the Ogden City well field. Transmissivity (T) values for the principal confined aquifer ranged from 1,800 ft^2/day to 69,030 ft^2/day. The principal unconfined aquifer transmissivity ranged from 60 ft^2/day to 2,406 ft^2/day. This suggests that the confined portion of the aquifer is more transmissive than the unconfined portion and more prolific.

Groundwater Levels

The potentiometric surface in the Ogden Valley from the UGS report (Jordan, 2019) indicates that there is a cone of depression around the Ogden City well field due to the pumping at these wells (Figure 21 in the appendix). Water levels in Ogden Valley tend to follow a seasonal trend of increasing water levels in April, peaking in June and decreasing by September. Before the construction of the Pineview Dam, water levels in the confined principal aquifer around the reservoir flowed artesian. Currently, the Ogden City well field has seen approximately 50 feet of decline between 1937 and 2016, where approximately 30-40 feet was observed between 1985 to 2016. The cone of depression has expanded over time without an increase in withdrawal from the Ogden City well field, therefore indicating the confined principal aquifer in the area has not reached equilibrium (Jordan, 2019). Water levels beyond the Ogden City well field appear to remain relatively consistent with very little to no change (<10 feet) between 1985 and 2016. Static water levels are reported to be near ground level up to approximately 20 feet below ground level east of Pineview Reservoir and within the confined principal aquifer. Water levels are generally below the surface of Pineview Reservoir, indicating that some downward leakage from the reservoir to the principal aquifer may also occur (Avery, 1994).

Water Quality

Generally, the groundwater quality in the Ogden Valley is of very good quality. The Total Dissolved Solids (TDS) in wells in the valley have an average value of 255 mg/L (ppm). Figure 34 in the appendix provides a map of select well locations with TDS and nitrate levels in the principal aquifer. Water quality results are also summarized in the appendix, Tables D-5 and D-7. Table D-5 includes results of water samples collected for the 2019 UGS report from the alluvial and bedrock aquifers including the principal aquifer (confined and unconfined). Table D-7 includes results of water samples collected in 2013 (Ruben, 2013) from the shallow unconfined aquifer.

In the principal aquifer (both confined and unconfined portions), nitrate concentrations are generally reported to be below the primary drinking water standard, MCL, of 10 mg/L. The highest reported values in Table D-5 were from wells completed in the principal unconfined aquifer. Of the results available, there are three wells in the Ogden Valley that have levels reported above 3.0 mg/L[2] in the principal aquifer. One is completed in the confined portion of the principal aquifer while the other two are in the unconfined portion of the principal aquifer.

Nitrate concentrations in the shallow unconfined aquifer is considerably higher than the principal and bedrock aquifers (Jordan, 2019). In Table D-7, eight results exceeded the MCL of 10 mg/L and a large majority of results exceeded 0.3mg/L.

Water quality results for the Ogden City well field were obtained through the Utah Division of Drinking Water Chemical Analysis Report portal. The search occurred between the years 2000 to 2022. The results reported are all between the years 2000 and 2007. The results varied between 0.48 mg/L to 1.62 mg/L, all of which are substantially below the MCL or 10 mg/L. Figure 1 shows a plot of the nitrate results from the Ogden City well field between April 2000 to June 2007.

A new well completed in the principal aquifer would be expected to be similar to existing sources and fall within Utah drinking water standards.

POTENTIAL FOR GROUNDWATER DEVELOPMENT

In evaluating the potential for new groundwater development in the Ogden Valley, it is important to consider two types of potential constraints:

- *Physical Constraints* – How much water can the aquifer actually produce? Is there enough wet water in the ground to produce the volumes and flow rates necessary to meet future demands?
- *Water Right Constraints* – If it is physically possible to access the wet water needed, can the water be accessed within the water rights that do or could exist within the valley?

The following sections examine these two potential constraints.

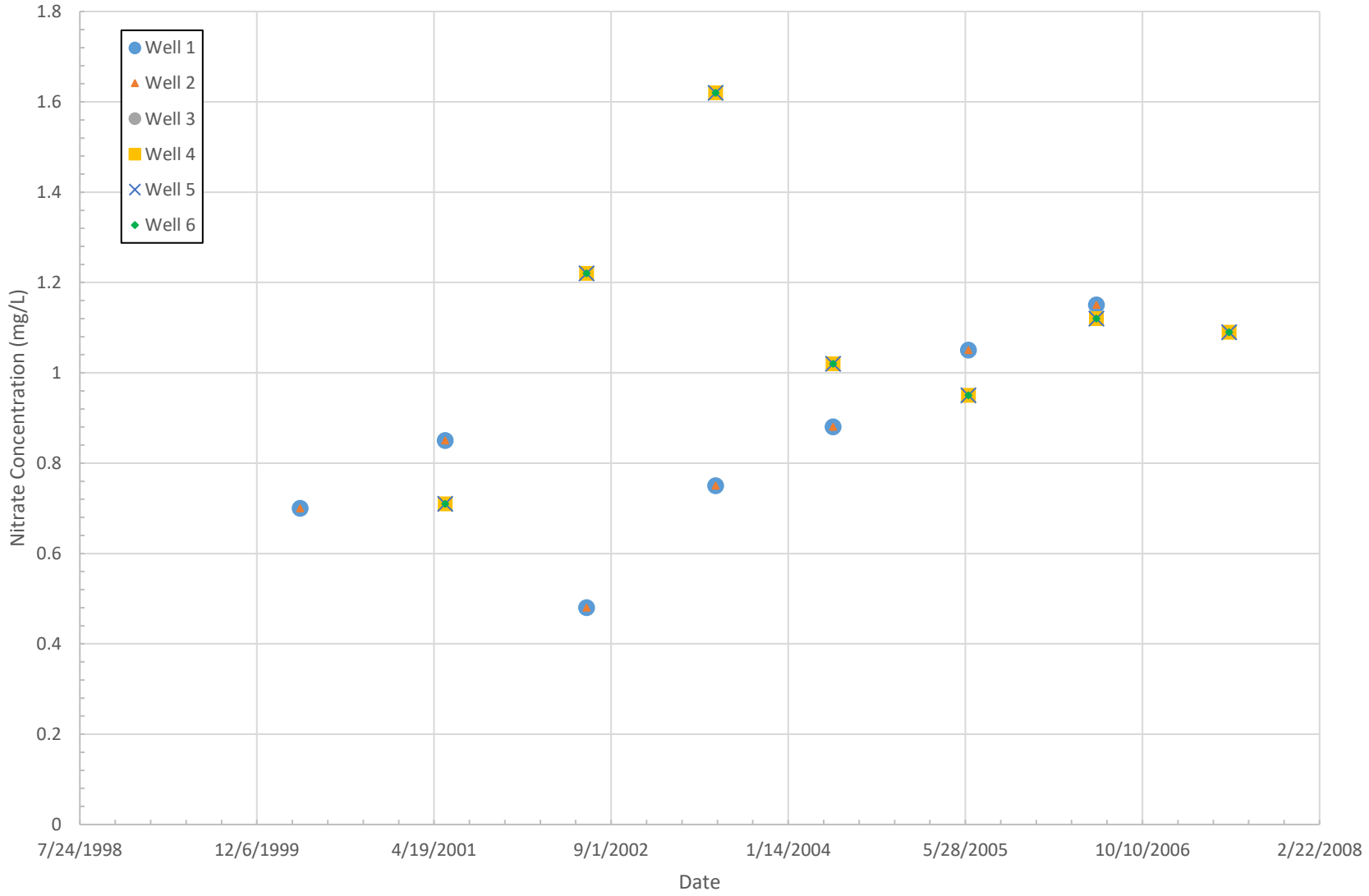
Physical Constraints

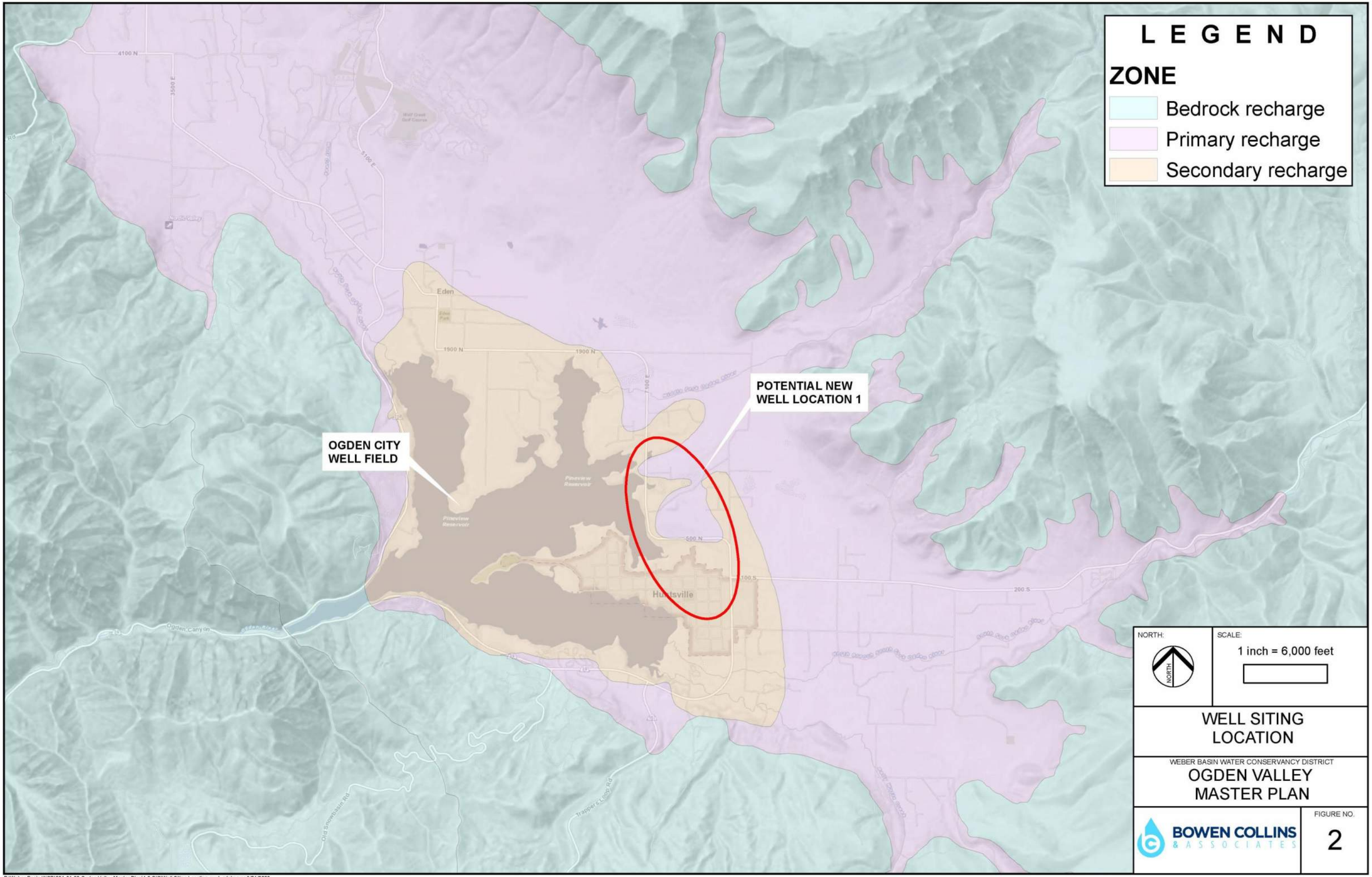
In considering the physical availability of groundwater for potential development, sites located east of Pineview Reservoir and north of Huntsville are preferred. Figure 2 shows the identified areas. These locations are preferred based on:

- **Depth of Sediment –** The gravity survey and isopach map discussed in the recent 2019 UGS report and the Ogden City well field show the depth to the basement rock (Norwood Tuff) in this area is estimated at over 2,300 feet. This is the thickest alluvial sediment in the Ogden Valley. The transmissivity of the sediment present is unknown below existing well depths; however, it appears that it is unconsolidated and likely holds water.
- **Water Quality –** Water quality at depth is unknown, however, is expected to be of similar quality as existing sources and fall within State of Utah drinking water standards.

[2] Results reported above 3.0 mg/L are typically associated with human or animal influence.

Figure 1 - Ogden City Well Field
Available Water Quality Results - Nitrate
(April 2000 to June 2007)





P:\Weber Basin WCD\021-21-02 Ogden Valley Master Plan\4.0 GIS\Well Siting Location.mxd cdekorver 3/24/2022

- **Needed Property for Well Development –** For planning purposes, a minimum 0.5-acre site is needed to accommodate a rotary drilling operation and a 1.0-acre site is preferred. The larger site will allow for staging of materials and equipment needed for the drilling. The area identified is primarily agricultural land with opportunities for finding adequate area for well development.
- **Source Protection –** For source protection purposes and approval, the well location is required to be at a minimum of 100-feet from a septic system and sanitary sewer pipeline. While septic systems do exist in this area, the abundance of agricultural land leaves ample space for well development.
- **Groundwater Levels –** Water levels are expected to be under confined conditions with static levels between ground level and 15 feet below ground level. Artesian conditions are not expected, but this area generally appears to be outside the cone of depression associated with pumping of the Ogden City Wells.

Potential performance of wells in this area is difficult to predict with certainty; there are very few large production wells in the Ogden Valley greater than 10-inch diameter and greater than 250 feet in depth. However, six existing wells of this size and depth are owned and operated by Ogden City for public water supply. The wells produce between 1,700 to 3,200 gpm each based on drillers reports and equipping information. Based on the performance of these wells, it is expected that a new well(s) completed in the confined portion of the principal aquifer could produce similar quantities (1,500-3,000 gpm). An anticipated depth for completion of this type of well is approximately 1,000 feet. An expected well diameter is 16 to 20 inches.

If a total capacity of up to 5,550 gpm was needed (see demand projections documented separately), multiple wells would be required. A likely configuration of wells would be four wells with a capacity of between 1,500 and 2,000 gpm each. This would allow the required capacity to be satisfied by three wells with the fourth available for redundancy. The spacing of multiple wells, as in a well field, may be a critical factor in long-term operation. Interference that occurs from adjacent wells or by the newly installed well field may reduce the actual production rate. While more detailed hydrogeologic information is needed to provide any type of accurate recommendation on well spacing, a minimum spacing of 1,000 feet should be assumed for planning purposes. Monitoring of both water quality and water levels (pumping and static) is recommended in the event new wells are installed.

Water Right Constraints

While it does look like wells could physically access water at the appropriate capacity and water quality needed for this project, securing water rights for this purpose is likely a greater challenge. The Weber and Ogden River areas are currently not approving any new appropriations for groundwater above the mouths of the canyons, meaning that Ogden Valley is closed to new water right appropriations. Development of new projects must be accomplished by change applications on owned or acquired rights.

As discussed elsewhere as part of this analysis, water rights available for future development will fall under one of two categories: conversion of agricultural water or imported water from WBWCD. Either way, the basis of these water rights will be surface water that is eventually stored in Pineview Reservoir. Any change application to develop groundwater will need to move the rights from Pineview Reservoir into the ground.

Changes from surface to underground sources, and vice versa, are considered on their individual merits, with emphasis on their potential to interfere with existing rights and to ensure that there is no enlargement of the underlying rights. Thus, it is useful to consider the potential water right impacts of a new well relative to both local interference and long-term sustainability.

- **Local Interference.** While there are no other major municipal production wells in the near vicinity of the proposed well development area, there are a number of smaller domestic wells. A new well(s) installed in the recommended area and pumping at the anticipated production rate(s), may have an impact on these surrounding wells/water rights. At the specific capacities of the Ogden City wells of approximately 20 gpm per foot of drawdown, a new well in the area may experience between 75 to 150 feet of drawdown at 1,500 to 3,000 gpm, respectively. Interference is also dependent upon the transmissivity (T) of the aquifer at the well location. A larger T equates to less drawdown as it is the ability of the aquifer to transmit water.
- **Long-Term Sustainability** – To successfully argue that a new groundwater diversion will not affect the long-term sustainability of other rights in the area, it will be necessary to demonstrate that water associated with the underlying rights (in Pineview Reservoir) will ultimately recharge groundwater volumes in the principal aquifer. The connection between surface water/shallow groundwater and the Ogden City well field was studied and is described in the recent UGS report. The gradient between the reservoir and the principal aquifer is dependent upon the reservoir level. When the reservoir is full, the gradient is likely downward, and likely opposite (upward) when the reservoir level drops below the potentiometric surface. The current potentiometric surface below the surface of the reservoir ranges roughly between 4820 and 4900 (see the appendix, Figure 21). For most of the reservoir, the surface is closer to the top end of this range. Operating water surface elevations in the reservoir range between roughly these same elevations. Thus, estimating the net gradient (and the subsequent movement of water between the reservoir and groundwater in the principal aquifer) would require a complicated analysis of operation patterns in the reservoir and the impact of new wells on the potentiometric surface of the aquifer.

  If it can be demonstrated that there is net gradient from the reservoir to the principal aquifer, it will also be necessary to demonstrate that this is adequate to convey the volume of water to be used. Seepage studies (Avery, 1994) indicate that the permeability of the confined unit is between 0.01 to 0.04 ft/day, indicative of a lower permeability silt. Leakage may be occurring at the abandoned Ogden City artesian wells located at the bottom of the reservoir. Deterioration of the well casing, abandonment material, etc. may allow for leakage to occur between the reservoir and the principal aquifer.

  In terms of total volume of leakage, environmental tracers such as tritium and nitrate suggest that there is interaction between younger water and the principal aquifer. This was evidenced in one of the Ogden City wells. The amount of mixing or leakage is unknown. Estimations of the mass balance model in the 2019 UGS report suggests approximately 20-25% contribution from surface water/shallow groundwater to the underlying principal aquifer. This equates to approximately 2,700 acre-ft. This estimation is based on the pumping of the Ogden City wells as they are the main producer of water from the confined portion of the principal aquifer.

  Overall, high-capacity public supply wells completed in the confined portion of the principal aquifer are likely to experience at least some contributions from surface water (Pineview) and/or shallow groundwater. However, based on available information, it appears that it will

be extremely difficult to demonstrate that this contribution will equal the volume needed for this project (up to 4,000 acre-ft).

In summary, the primary challenge to the development of new groundwater in the Ogden Valley is expected to be water right issues. It is expected that any change application that moves water rights into the principal aquifer would be met with protests from other water right holders, both over local interference and long-term sustainability issues. While some evidence of water movement from Pineview Reservoir to the principal aquifer exists, it is unlikely that this is adequate to support expected needs.

ADDITIONAL GROUNDWATER DEVELOPMENT CONSIDERATIONS

The following sections provide additional guidance if it is decided that groundwater development should be pursued further.

Need for Additional Investigation

Very few wells have been drilled below a depth of 250 feet east of Pineview Reservoir. Before any additional groundwater development can be seriously considered, it is recommended that an exploratory boring be drilled. The exploratory drilling options include conventional mud-rotary or air-rotary with casing advance. The advantage to conventional mud-rotary is the ability to obtain geophysical logs of the borehole. Additionally, zone tests for water quality, head differential and potential quantity of target zones. The advantage to air-rotary drilling is additional real time information on depth to water, production rate estimates and water quality information. Costs for exploratory drilling to a depth of 1,000 feet are estimated to be $300K to $400K for either method.

Depths of up to 2,000 feet may be explored to assess the total depth of alluvial-fill material in the valley and additional water availability. It is uncertain what may be encountered as there is no record of drilling occurring below a depth of 757 feet below existing ground level. Costs for exploring up to 2,000 feet are estimated to be $500K to $750K.

Drinking Water Source Protection

A municipal well located east of Pineview Reservoir will likely be under confined conditions based on existing well logs and the delineation of the primary and secondary recharge zones as shown on Figure 16 in the appendix (Jordan, 2019). The proposed areas are expected to include over 30 feet of clay/confining zone, suggesting a “protected aquifer” status. This means that a new well would not require land use agreements in the 250-day time of travel capture zone. Weber County also has a source protection ordinance in place that protects watersheds and drinking water wells, therefore, land use agreements are not required.

For the completion of a new well, a Preliminary Evaluation Report (PER) will be required for submittal to DDW for review and approval. Exploratory boreholes do not require a PER unless it is expected they will subsequently be converted into a production well.

CONCLUSION AND RECOMMENDATIONS

1. The preferred location for an exploratory boring and new well is on the east side of Pineview Reservoir north of Huntsville, Utah. The location is preferred because of the potentially available saturated alluvial fill thickness. The potentiometric surface (water level surface) in the area has had very little to no change in the last 30-35 years.
2. Based on the available information, a new well constructed east of Pineview Reservoir has the potential to produce similar to the Ogden City wells at 1,500 to 3,000 gpm. Water quality is expected to be good with a TDS concentration between 250-350 mg/L. Nitrates are expected to be below 3.0 mg/L within the confined principal aquifer in the area.
3. The area is closed to new appropriations for water rights. Development of new or different consumptive use projects in these areas must be accomplished by change applications on owned or acquired rights.
4. As evidenced in the Ogden City wella, contributions from shallow groundwater or surface water (Pineview) may occur with the pumping of a new high-capacity public supply well at the recommended location. However, it is unlikely that this volume is adequate to support expected needs.
5. Overall, the primary challenge to the development of new groundwater in the Ogden Valley is expected to be water right issues. It is expected that any change application that moves water rights into the principal aquifer would be met with protests from other water right holders, both over local interference and long-term sustainability issues.
6. If there is desire to pursue a groundwater supply well in the delineated area, we recommend that an exploratory borehole with the ability to obtain water quality and quantity parameters be performed. Exploratory drilling costs are expected to be between $300K to $750K depending on depth and analysis performed on the borehole.

REFERENCES

Characterization of the Groundwater System in Ogden Valley, Weber County, Utah, With Emphasis on Groundwater-Surface-Water Interaction and the Groundwater Budget.: Utah Geological Survey Special Study 165 (Jordan, Smith, Inkenbrant, et. al., 2019).

Ground-Water Hydrology of Ogden Valley and Surrounding Area, Eastern Weber County, Utah, and Simulation of Ground-Water Flow in the Valley-Fill Aquifer System, United States Geological Survey, Technical Publication No. 99 (Avery, 1994).

Map of Recharge Areas for the Principal Valley-Fill Aquifer, Ogden Valley, Weber County, Utah. Utah Geological Survey Map 176 (Snyder & Lowe, 1998).

Nutrient Contribution of the Shallow Unconfined Aquifer to Pineview Reservoir: Logan, Utah State University, Ph.D. dissertation, 159 p. (Ruben, T.N., 2013).

APPENDIX
HYDROGEOLOGIC INFORMATION
OF OGDEN VALLEY


Pineview Reservoir
WILLARD THRUST
MAPLE CANYON THRUST
BROWNS HOLE FAULT
Huntsville
North Branch
South Branch
OGDEN
(Jordan, 2019)

(Jordan, 2019)

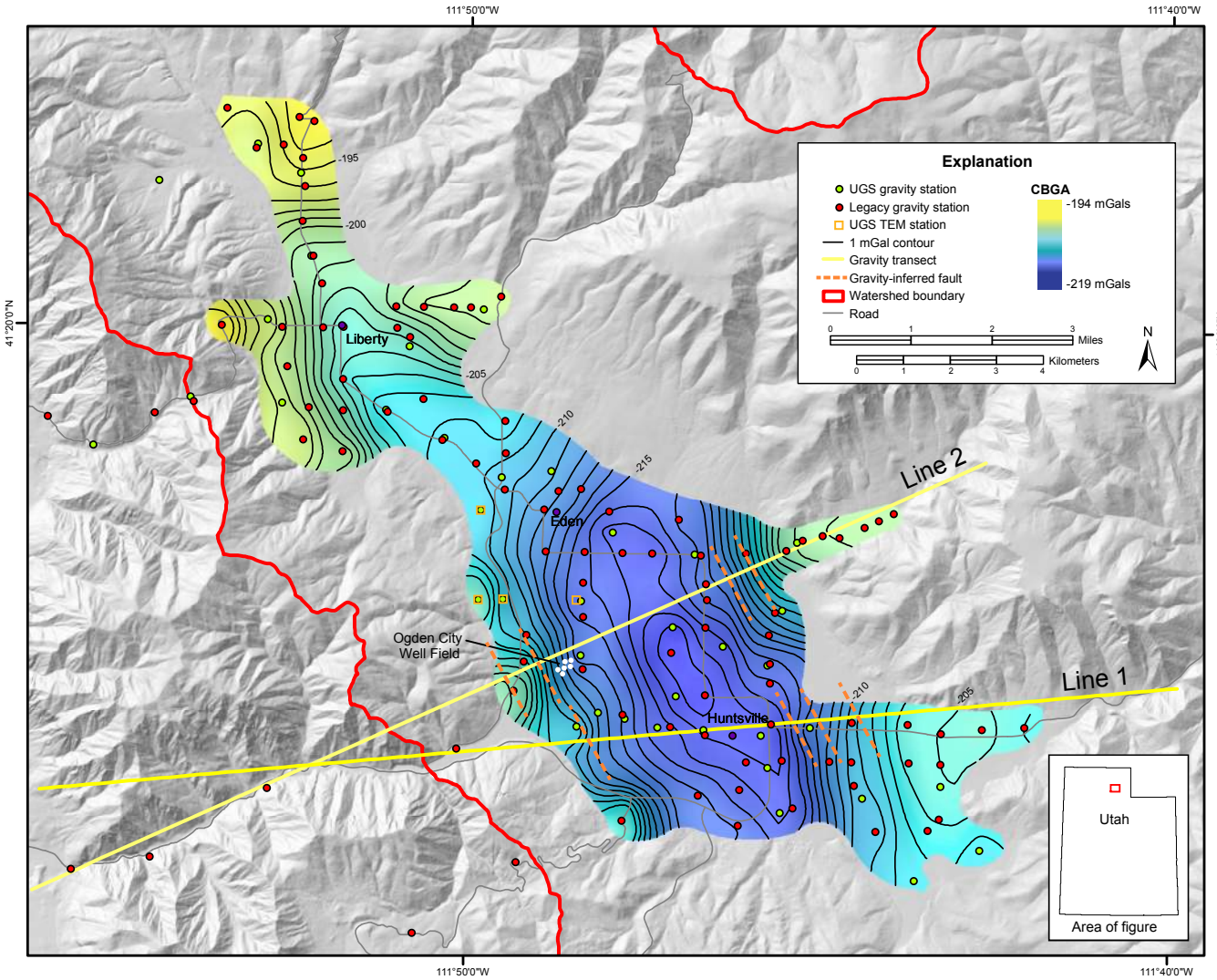


Figure 11. *Complete Bouguer gravity anomaly (CBGA) and gravity stations for Ogden Valley. Gravity transects shown on figure 12.*

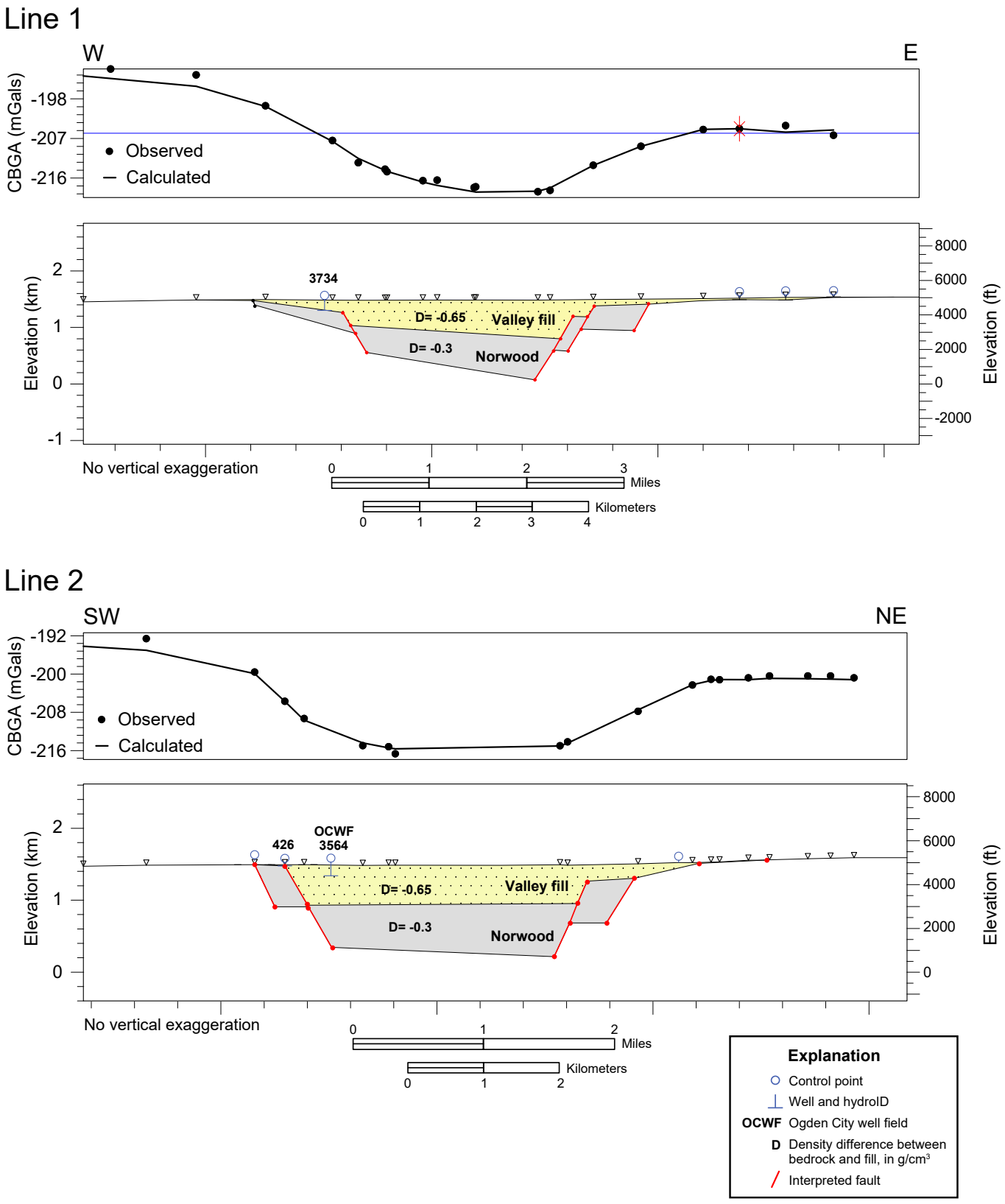


Figure 12. *Two-dimensional gravity model cross sections and interpreted subsurface geology along two transects through Ogden Valley (see figure 11 for transect locations). CBGA, complete Bouguer gravity anomaly.*

(Jordan, 2019)

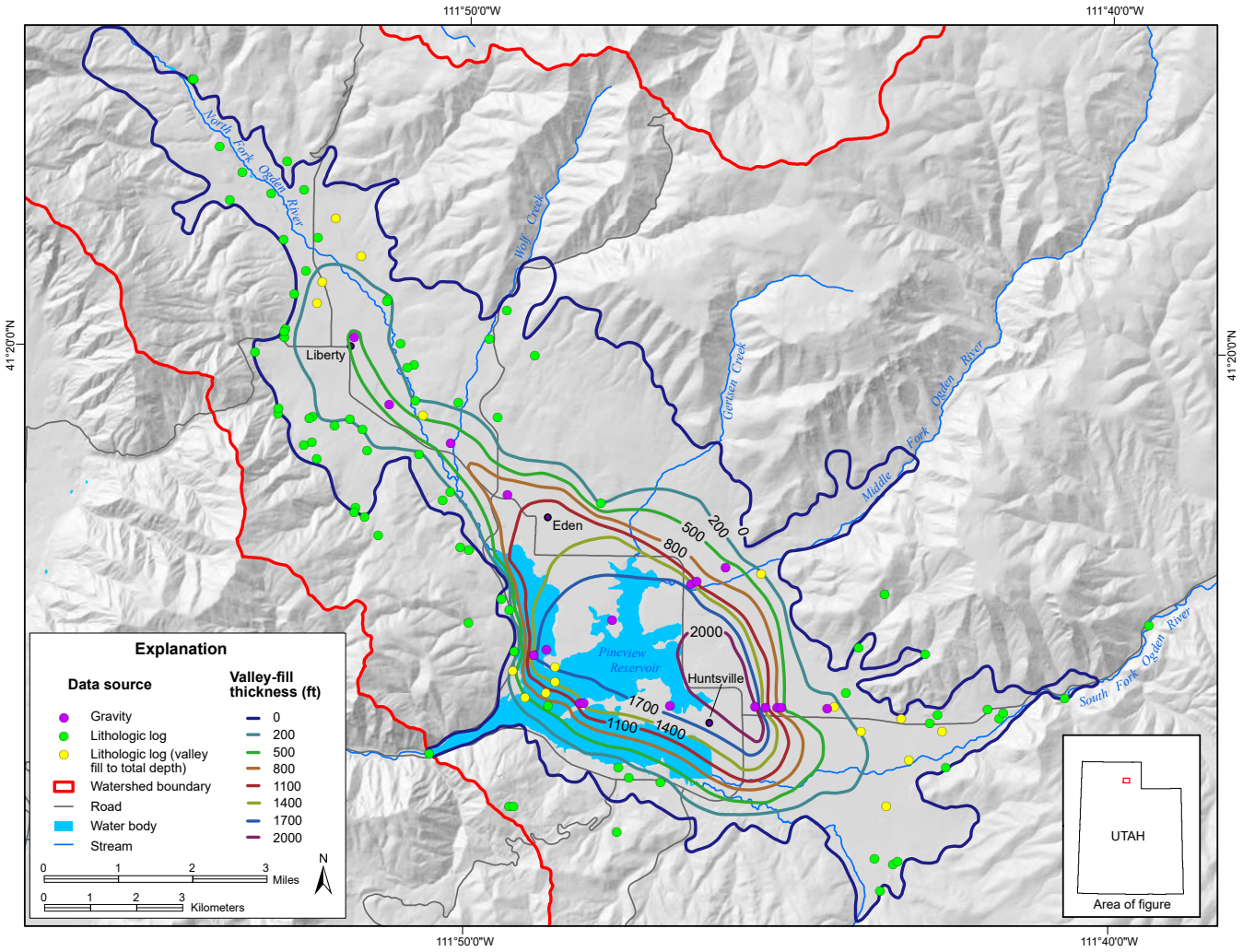


Figure 13. *Thickness of valley-fill sediments, not including Tertiary Norwood Tuff and Tertiary conglomeratic rocks.*

(Jordan, 2019)

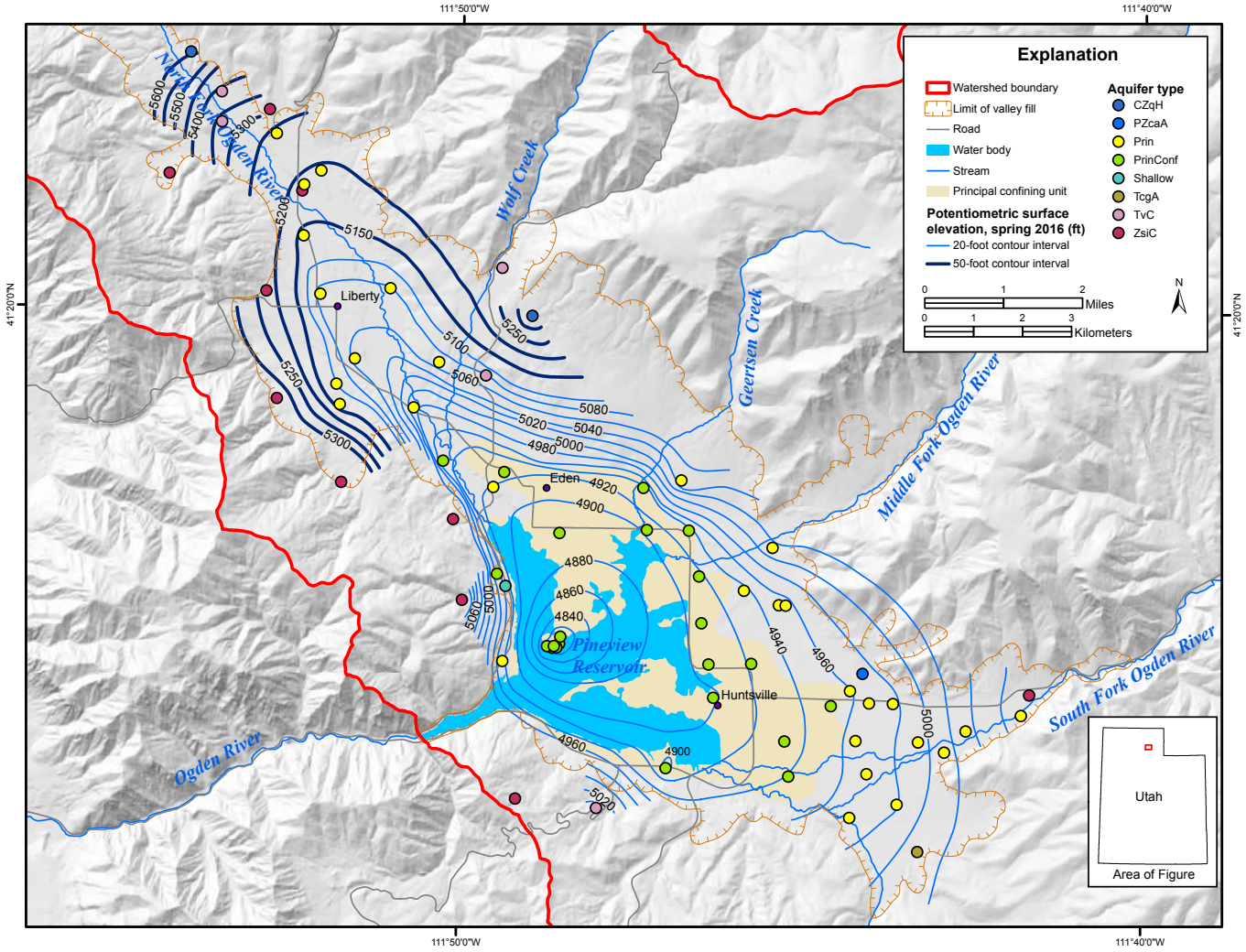


Figure 21. *Potentiometric-surface contour map of water levels in the Ogden Valley aquifer system, March and April 2016. See figure 9 for aquifer designations.*

(Jordan, 2019)

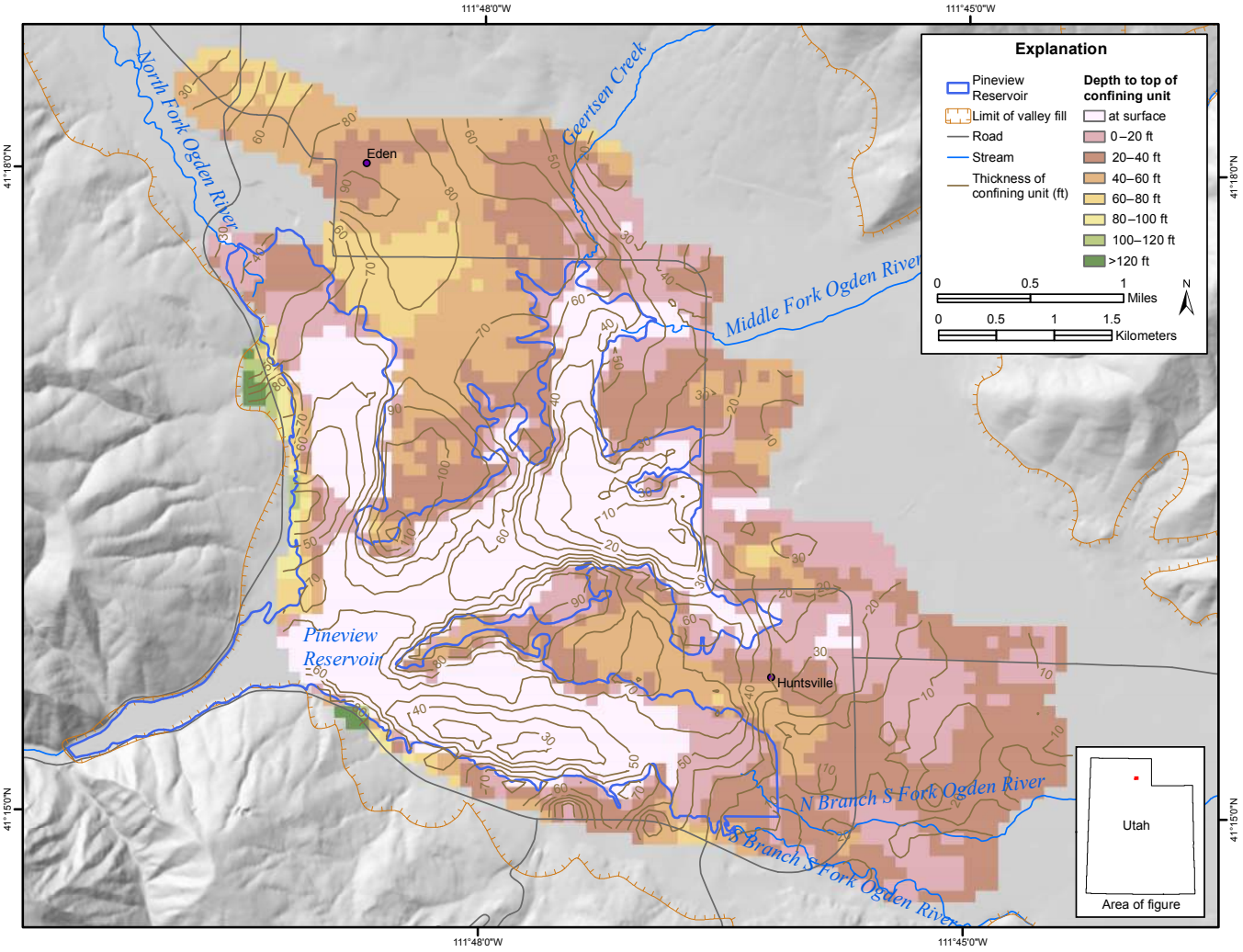


Figure 16. *Depth to the top and thickness of the confining unit.*

(Jordan, 2019)

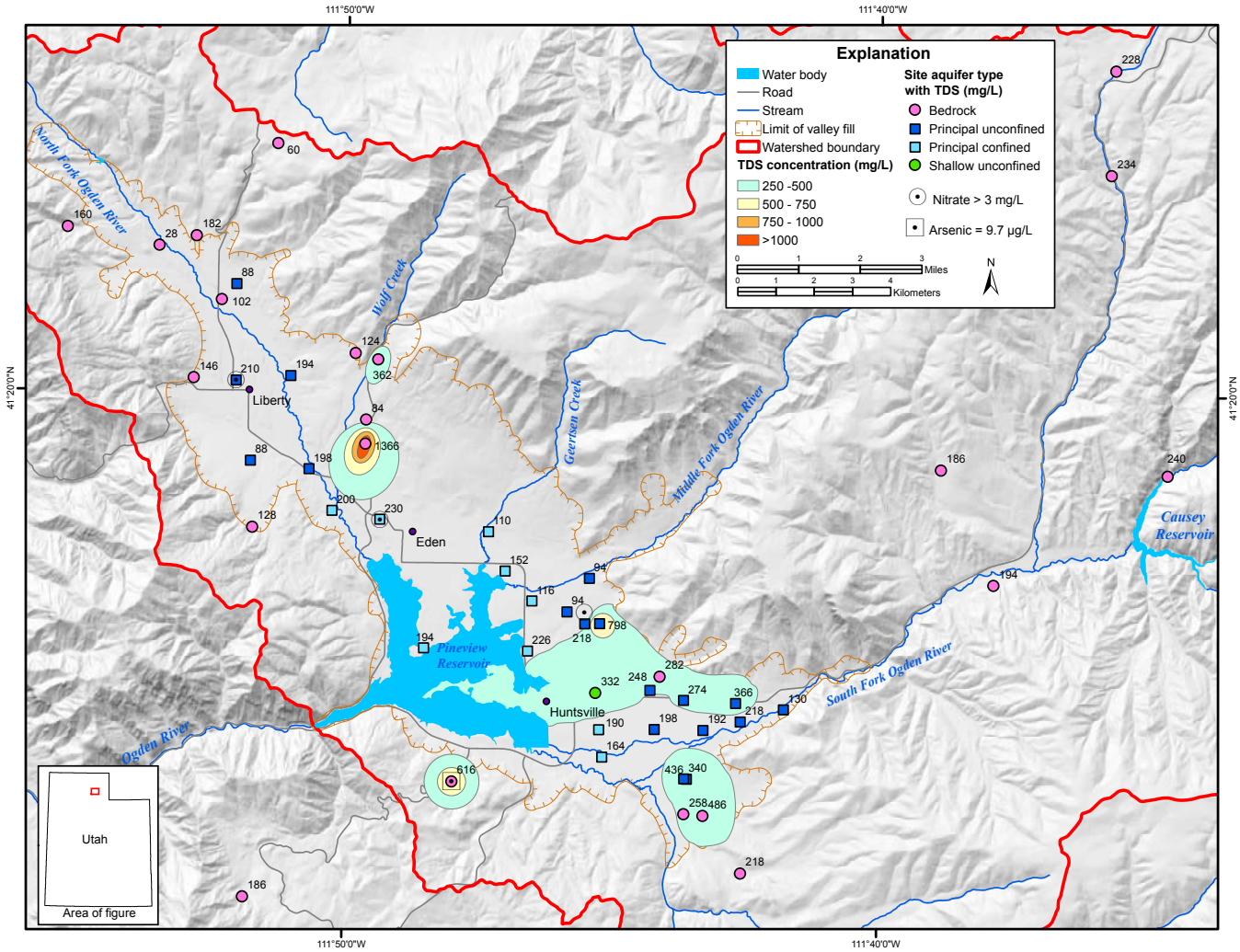


Figure 34. *TDS concentration in groundwater of Ogden Valley, and location of wells having elevated nitrate and arsenic.*

Table D-5. *Inorganic chemistry of samples from wells, springs, and surface-water in the Ogden Valley study area.*

Hydro ID[1]	Sample date	Aquifer[2]	pH[3]	Temp (°C)[3]	Cond. (µS/cm)[3]	TDS	Water type	Na^+ (mg/L)	K^+ (mg/L)	Ca^{2+} (mg/L)	Mg^{2+} (mg/L)	Cl^- (mg/L)	HCO_3^- (mg/L)	SO_4^{2-} (mg/L)	$NO_3 + NO_2$ as N (mg/L)	NH_4^+ as N (mg/L)	PO_4^{3-} (mg/L)	Charge balance (%)
WL-58	09/22/2016	KTcgA	7.77	12.0	315	189	Ca-HCO_3	4.1	1.3	47.6	16.7	<3.5	210	<20	0.19	-	<0.003	0.0
WL-83	05/18/2016	TvC	7.24	10.9	1760	1366	Ca-Cl	100.0	<1.0	230.0	22.9	402.0	312	<20	1.15	<0.02	0.022	2.5
WL-108	05/23/2016	PrinConf	7.07	10.1	297	194	Ca-HCO_3	18.3	1.2	38.1	9.8	33.7	136	12[a]	1.43	-	-	1.5
WL-120	05/24/2016	Prin	-	10.2	372	-	-	-	-	-	-	-	-	-	3.36	-	-	-
WL-123	09/22/2016	KTcgA	7.50	9.6	304	186	Ca-HCO_3	5.9	<1.0	57.1	7.6	9.3	200	<20	0.50	-	0.008	-2.6
WL-129	07/13/2016	PrinConf	6.90	11.7	407	230	Ca-Na-HCO_3	22.7	1.9	38.3	11.1	48.7	132	<20	3.28	<0.05	0.012	-1.2
WL-141	05/25/2016	TvC	8.78	12.0	800	616	Na-HCO_3	199.0	8.7	34.7	14.7	126.0	421	42	0.64	0.03[a]	0.031	2.1
WL-156	05/17/2016	Prin	7.64	12.0	559	248	Ca-HCO_3	17.5	1.9	72.3	18.4	34.8	270	10[a]	2.17	<0.02	0.047	2.7
WL-158	05/25/2016	ZsiC	8.21	8.9	220	128	Ca-HCO_3	10.2	1.0	26.9	10.4	7.4	127	11[a]	0.06	-	-	2.9
WL-159	05/17/2016	Prin	7.77	10.5	890	436	Na-Cl	98.9	2.1	56.1	18.4	170.0	192	39	0.66	<0.02	0.072	-0.5
WL-170	05/23/2016	Prin	7.12	10.4	1185	798	Na-Cl	224.0	5.3	63.1	17.6	334.0	320	13[a]	1.13	-	-	-1.6
WL-172	05/24/2016	Prin	7.72	8.5	413	198	Ca-HCO_3	7.6	<1.0	53.1	14.3	13.3	214	9[a]	0.32	<0.02	0.007	1.4
WL-184	05/17/2016	PrinConf	7.77	9.8	400	190	Ca-HCO_3	9.0	1.0	56.9	14.8	13.2	222	9[a]	0.32	<0.02	0.009	3.2
WL-187	05/23/2016	Prin	7.20	10.4	362	194	Ca-HCO_3	11.3	1.0	55.8	6.3	24.1	161	<4	0.38	<0.02	0.052	5.7
WL-189	05/24/2016	TvC, ZsiC	8.28	16.2	297	182	Na-HCO_3	46.0	3.6	14.2	10.6	2.1	176	31	0.01	-	-	1.1
WL-226	05/17/2016	Prin	7.69	12.7	728	366	Ca-HCO_3	35.8	1.3	78.8	22.1	95.6	250	14[a]	1.96	<0.02	0.029	1.8
WL-233	05/17/2016	Prin	7.15	9.2	266	130	Ca-HCO_3	9.8	<1.0	35.0	9.1	11.1	134	8[a]	0.20	<0.02	0.091	4.8
WL-282	06/01/2016	PZcaA	7.97	12.4	516	282	Ca-Na-HCO_3	48.3	<1.0	39.8	12.0	60.2	176	12[a]	0.35	-	-	2.7
WL-285	05/24/2016	PrinConf	7.20	12.2	354	226	Ca-Na-HCO_3	27.1	1.4	38.4	9.9	36.3	144	16[a]	2.70	-	-	3.0
WL-288	05/25/2016	Prin	10.10	7.4	195	094	Ca-HCO_3	5.4	1.4	23.4	5.8	8.2	89	8[a]	0.75	0.02[a]	0.307	1.6
WL-311	05/18/2016	Prin	7.35	10.6	184	088	Ca-Na-HCO_3	11.9	<1.0	18.0	6.3	10.4	81	11[a]	0.70	<0.02	0.023	3.0
WL-315	05/25/2016	Prin	7.22	10.0	422	218	Ca-Na-HCO_3	44.6	1.2	31.4	8.7	62.0	128	8[a]	0.75	<0.02	0.027	2.9
WL-317	05/24/2016	Prin	7.26	8.9	190	094	Ca-HCO_3	5.2	2.3	24.5	4.4	5.3	95	15[a]	0.21	<0.02	0.052	-3.9
WL-325	05/23/2016	PrinConf	7.39	11.4	254	116	Ca-HCO_3	5.6	<1.0	37.8	7.6	10.9	123	9[a]	0.07	<0.02	0.012	4.9
WL-348	05/17/2016	Prin	7.65	12.3	524	274	Ca-HCO_3	11.5	<1.0	75.7	17.2	13.0	288	16[a]	2.85	<0.02	0.036	2.7
WL-349	05/17/2016	Prin	7.86	10.0	401	192	Ca-HCO_3	9.4	<1.0	54.5	15.0	16.3	216	8[a]	0.53	<0.02	0.010	2.6
WL-363	05/17/2016	PrinConf	7.94	8.6	376	164	Ca-HCO_3	7.7	<1.0	49.4	13.9	11.7	208	4[a]	0.27	-	-	1.9
WL-375	05/25/2016	TcgA	8.21	10.0	860	486	Na-HCO_3	162.0	1.6	22.7	8.2	54.0	268	112	0.06[a]	<0.02	0.015	3.8
WL-386	05/23/2016	ZsiC	6.81	10.4	225	102	Ca-HCO_3	5.6	<1.0	24.1	6.8	22.5	63	16[a]	1.64	<0.02	0.016	0.8
WL-406	05/23/2016	Prin	6.99	10.7	170	088	Ca-Na-HCO_3	12.2	<1.0	12.6	5.0	9.3	65	13[a]	2.57	<0.02	0.012	-0.1
WL-413	05/24/2016	PrinConf	7.42	11.0	178	110	Ca-HCO_3	8.3	1.1	15.6	4.8	23.1	48	4[a]	0.19	<0.02	0.040	1.3
WL-418	05/18/2016	Prin	7.55	9.4	384	210	Ca-HCO_3	8.5	<1.0	59.1	7.7	22.2	155	10[a]	7.56	<0.02	0.007	8.2
WL-422	05/24/2016	PrinConf	6.84	11.3	330	152	Ca-HCO_3	14.0	2.0	31.2	8.1	24.4	121	15[a]	0.05	0.12	0.857	-1.7

Table D-5. *Continued.*

Hydro ID[1]	Sample date	Aquifer[2]	pH[3]	Temp (°C)[3]	Cond. (µS/cm)[3]	TDS	Water type	Na^+ (mg/L)	K^+ (mg/L)	Ca^{2+} (mg/L)	Mg^{2+} (mg/L)	Cl^- (mg/L)	HCO_3^- (mg/L)	SO_4^{2-} (mg/L)	NO_3 + NO_2 as N (mg/L)	NH_4^+ as N (mg/L)	PO_4^{3-} (mg/L)	Charge balance (%)
WL-433	05/18/2016	ZsiC	7.89	10.7	280	146	Ca-HCO_3	13.7	<1.0	31.2	10.5	9.3	151	12[a]	0.01	<0.02	0.025	0.9
WL-440	05/23/2016	TvC	7.03	11.4	77	028	Ca-HCO_3-SO_4	2.2	<1.0	8.0	2.1	2.5	20	17[a]	0.47	<0.02	0.003	-4.1
WL-452	05/17/2016	Prin	7.95	9.8	445	218	Ca-HCO_3	13.6	1.0	58.7	15.6	21.5	228	10[a]	0.58	<0.02	0.021	3.0
WL-468	05/17/2016	Prin	7.73	10.7	663	340	Ca-Na-HCO_3	45.5	1.9	59.5	20.4	71.3	238	25	2.09	<0.02	0.023	1.8
WL-474	05/26/2016	TvC	8.15	13.4	484	362	Ca-HCO_3-SO_4	20.4	<1.0	69.4	25.6	21.9	177	122	0.01	-	-	3.4
WL-477	05/23/2016	Prin	7.41	9.7	392	198	Ca-HCO_3	13.9	<1.0	54.2	11.5	20.2	183	15[a]	1.10	<0.02	0.007	5.0
WL-520	05/25/2016	TcgA	6.87	11.7	439	258	Ca-HCO_3	15.4	2.8	56.9	17.7	39.6	210	18[a]	1.69	-	-	1.0
ST-734	09/20/2016	-	8.58	13.4	359	170	Ca-HCO_3	3.9	<1.0	47.2	16.8	6.3	210	<20	<0.10	-	0.009	-1.3
ST-3353	09/20/2016	-	8.63	18.1	257	122	Ca-HCO_3	6.9	<1.0	36.3	6.1	11.7	134	<20	<0.10	-	0.007	-5.5
ST-3367	09/21/2016	-	7.72	14.6	144	076	Ca-HCO_3	2.7	<1.0	15.2	6.3	4.5	60	<20	<0.10	-	0.013	-3.8
SP-3416	09/22/2016	KTcgA	8.17	7.0	310	194	Ca-HCO_3	18.8	2.9	44.2	5.6	30.6	150	<20	0.37	-	0.008	-2.5
SP-3438	09/21/2016	ZsiC	7.88	11.1	288	160	Ca-HCO_3	2.6	<1.0	49.3	5.2	3.6	159	<20	<0.10	-	0.061	-1.5
WL-3587	05/24/2016	TvC	7.22	23.9	152	084	Ca-Na-HCO_3	11.1	2.1	13.3	5.4	9.4	69	12[a]	0.21	-	-	-0.2
SP-3595	09/21/2016	PZcaA	7.70	12.4	446	218	Ca-HCO_3	7.5	<1.0	57.9	17.6	10.1	255	<20	0.58	-	0.023	-2.0
WL-3603	05/26/2016	PrinConf	8.02	10.2	328	200	Ca-HCO_3	13.2	<1.0	56.2	10.7	25.5	172	12[a]	1.85	-	-	6.1
RES-3636	09/22/2016	-	8.15	18.2	320	170	Ca-HCO_3	8.8	1.2	43.1	9.4	15.9	156	<20	<0.10	-	0.016	-1.3
SP-3650	09/22/2016	KTcgA	7.74	7.4	390	234	Ca-HCO_3	3.5	<1.0	58.2	22.9	5.2	277	<20	0.47	-	0.005	-1.4
SP-3652	06/29/2016	PZcaA	7.90	9.0	461	240	Ca-HCO_3	5.0	<1.0	67.1	22.6	4.8	282	16[a]	-	-	-	3.4
SP-3653	09/22/2016	KTcgA	7.44	10.5	366	228	Ca-HCO_3	3.4	<1.0	76.4	7.4	4.8	257	<20	<0.10	-	0.009	-1.8
SP-3656	09/27/2016	ZsiC	-	13.1	236	124	Ca-HCO_3	7.2	<1.0	28.6	7.1	9.9	113	<20	0.33	-	0.008	-4.1
SP-3658	09/22/2016	PZcaA	7.70	5.9	364	186	Ca-HCO_3	2.4	<1.0	47.6	15.8	<3.5	209	<20	0.37	-	0.007	-1.8
ST-3670	09/22/2016	-	8.07	12.3	436	238	Ca-HCO_3	7.0	2.6	55.8	16.4	17.7	218	<20	0.60	-	0.016	0.2
SP-3671	09/21/2016	Shallow	7.16	11.5	620	332	Ca-HCO_3	22.6	1.6	72.7	19.1	45.1	275	<20	1.76	-	0.019	0.2
SP-3672	09/21/2016	CZqH	8.74	8.0	73	060	Ca-HCO_3-SO_4	2.8	<1.0	7.1	1.7	5.2	17	<20	2.00	-	0.011	-13.3

[1] HydroID is the unique site identifier used in this report

[2] Aquifer codes: PrinConf = principal confined valley-fill aquifer, Prin = principal unconfined valley-fill aquifer, Shallow = shallow unconfined aquifer, TcgA = Tertiary conglomerate aquifer, TvC = Tertiary volcanic confining unit (Norwood Fm), KTcgA = Cretaceous and Tertiary conglomerate aquifer (including Wasatch Fm), PZcaA = Paleozoic carbonate aquifer, CZqH = Cambrian and Proterozoic quartzite heterogeneous unit, ZsiC = Proterozoic siliciclastic confining unit

[3] Parameter measured in field

[a] Analyte detected and reported below minimum reporting limit

Table D-7. *Nitrate + nitrite (NO_3 + NO_2 as N in mg/L) concentrations in samples collected by Utah State University from shallow unconfined aquifer wells. Data from Reuben (2013, appendix G).*

Sample date	Well number								
	1	2	3	4	5	6	7	8	9
04/05/2010	2.5	2.8	2.7	4.8	3.5	N.A.	N.A.	N.A.	N.A.
04/19/2010	8.4	2.9	2.7	5.0	3.9	N.A.	N.A.	N.A.	N.A.
05/04/2010	4.5	2.6	2.4	4.2	3.5	N.A.	N.A.	N.A.	N.A.
06/08/2010	4.0	2.9	0.1	5.6	1.3	N.A.	N.A.	N.A.	N.A.
06/22/2010	8.9	3.0	0.2	5.6	4.2	N.A.	N.A.	N.A.	N.A.
07/20/2010	6.7	3.7	1.9	5.3	4.4	N.A.	N.A.	N.A.	N.A.
08/03/2010	2.8	3.5	2.9	5.2	4.8	N.A.	N.A.	N.A.	N.A.
10/05/2010	3.7	N.D.	3.0	4.4	3.6	N.A.	N.A.	N.A.	N.A.
10/12/2010	5.4	4.2	2.8	4.0	3.0	N.A.	N.A.	N.A.	N.A.
11/09/2010	5.8	4.3	2.8	0.0	4.0	N.A.	N.A.	N.A.	N.A.
12/07/2010	5.4	1.4	1.0	1.4	1.2	N.D.	0.2	N.A.	N.A.
01/13/2011	10	4.1	2.5	4.9	3.0	N.D.	0.1	N.A.	N.A.
02/08/2011	15	4.7	3.6	6.6	4.1	N.D.	0.1	N.A.	N.A.
03/22/2011	47	3.6	2.6	4.9	4.3	N.D.	1.2	N.A.	N.A.
04/19/2011	16	3.4	2.6	5.2	3.9	0.2	1.6	3.8	12
05/03/2011	28	3.9	3.0	6.0	4.6	0.7	1.4	4.9	13
06/07/2011	8.6	3.9	3.3	5.3	1.7	0.6	0.8	0.1	5.9
08/22/2011	5.5	5.3	2.9	6.3	8.8	0.4	0.4	4.2	3.6
09/19/2011	3.6	5.1	3.2	7.0	4.8	0.4	0.8	4.2	2.3
10/17/2011	4.5	5.0	2.5	7.2	4.6	0.5	0.4	4.8	2.0
11/14/2011	12	5.1	2.5	6.9	1.2	0.3	0.4	4.2	2.1

N.D. = not determined; N.A. = not applicable because the well was not constructed yet.

Geometric mean all samples n=136: 2.7

Statistics for samples collected 12/7/2010 through 11/14/2011

n	11	11	11	11	11	7	11	7	7
mean	14.1	4.1	2.7	5.6	3.8	0.4	0.7	3.7	5.8
std. dev.	13.0	1.1	0.7	1.6	2.1	0.2	0.5	1.7	4.8

Geometric mean of the arithmetic means of each well: 3.0

Reuben, T.N., 2013, Nutrient contribution of the shallow unconfined aquifer to Pineview Reservoir: Logan, Utah State University, Ph.D. dissertation, 159 p.

APPENDIX B

PUBLIC OUTREACH AND FEEDBACK

BOWEN COLLINS & ASSOCIATES

TECHNICAL MEMORANDUM

TO:	Weber Basin Water Conservancy District
COPIES:	File
FROM:	Keith Larson, P.E., Andee Harris, E.I.T.
DATE:	16 March 2023
SUBJECT:	Ogden Valley Water Supply and Infrastructure Study - Public Outreach and Feedback
JOB NO.:	021-21-02

INTRODUCTION

The Ogden Valley area of Weber County needs a plan to manage future water needs. According to recent information, an estimated 83 individual water companies provide water services to residents and businesses in the Ogden Valley. However, each of these service companies is limited by the production of their individual water sources. Due to the large number of service providers and the growing number of stakeholders in the Valley, Weber Basin Water Conservancy District (WBWCD or District) and Weber County have identified a need for a regional study to better understand the hydrology, service areas, source capacities, and facilities within the Valley. This analysis will help the District, the County, and Ogden Valley water providers identify potential alternatives for supplying additional water to the residents of Ogden Valley.

To accomplish this purpose, WBWCD has contracted with Bowen Collins & Associates (BC&A) to prepare a regional study of both culinary and secondary water. Primary objectives of the Ogden Valley Water Supply and Infrastructure Study include:

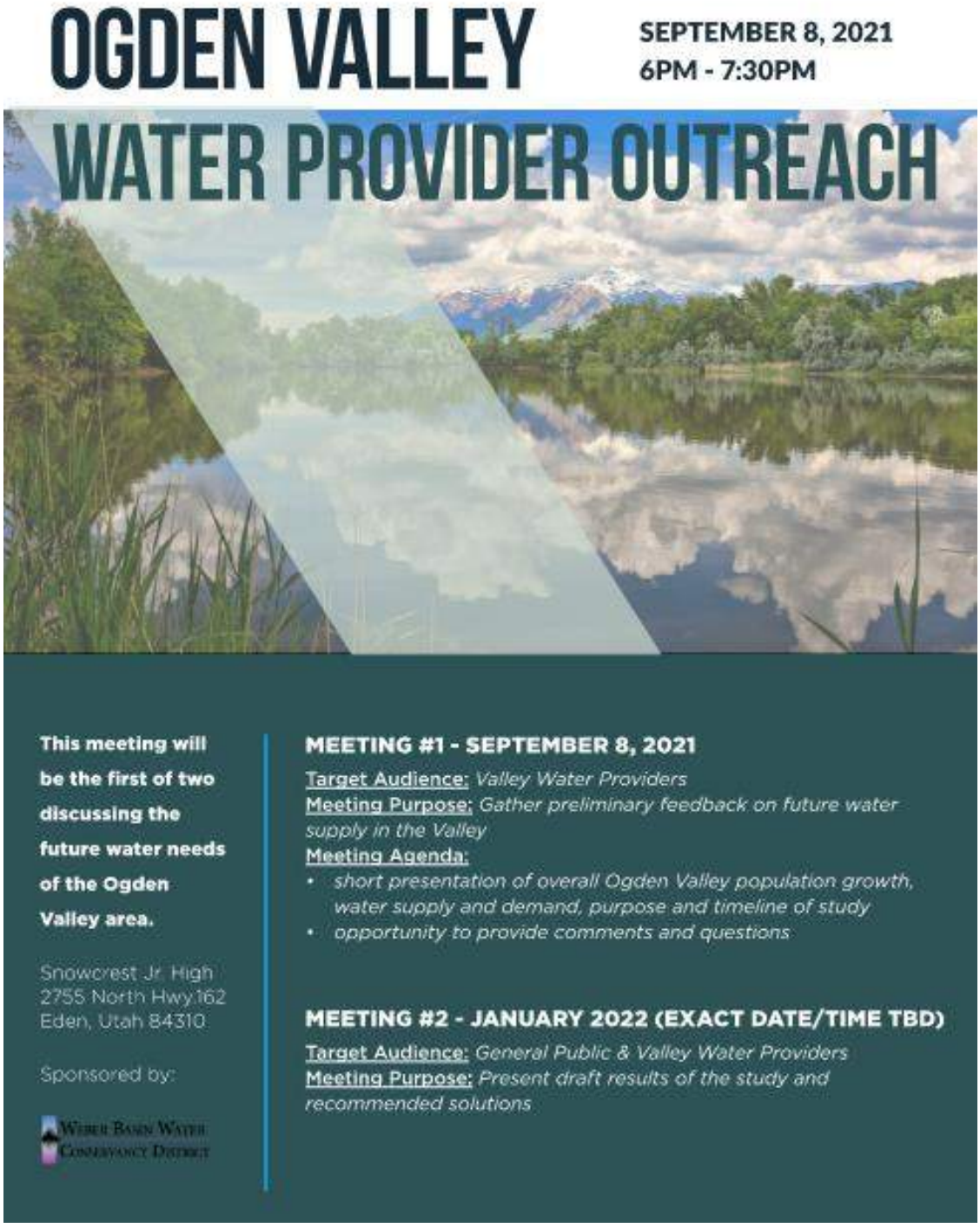
- Documenting existing water demands and supplies
- Understanding and documenting existing water resources and infrastructure in the Ogden Valley
- Projecting future water demand and supply
- Identifying alternative solutions to meet projected water needs
- Developing a strategy for implementing recommended solutions

The focus of this memorandum is to summarize the public outreach strategy used for the study and the feedback received from both existing water providers and Ogden Valley residents.

WATER PROVIDER OUTREACH

As stated above, the Ogden Valley area consists of an estimated 83 individual water companies and WBWCD has strived to contact each company to send information on the study and receive feedback. State data was used to determine contact information for each of the water companies and it is believed that all Ogden Valley water companies and providers listed in the State database have been contacted. An initial meeting was held on September 8, 2021, at Snowcrest Jr. High to gather

preliminary feedback from Valley water providers on future water supply in the Valley. A short presentation was given of the Valley's population growth, expected water supply and demand, and to review the purpose and timeline of the study. The following flyer was sent to the known water providers in the Valley:



In preparation for the meeting, a short survey was created to help gather feedback comments from the water providers and companies. The survey can be accessed through the QR code below or at the project website: www.bowencollins.com/public-involvement/ogden-valley. The website was created to provide project information and updates on the Ogden Valley Water Supply and Infrastructure Plan.

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LARGER WATER PROVIDERS

Because of the limited scope and timeline of this study, individual meetings were held with only the larger water providers which include Huntsville Town Corporation Municipal Water System, Eden Water Works Company, Liberty Pipeline Company, Nordic Mountain Water Company, and Wolf Creek Water and Sewer Improvement District. These meetings were held to discuss existing water supply, infrastructure, and expected growth. Direct communication was also held with Powder Mountain Water and Sewer Improvement District and Snowbasin Resort (resorts). The following sections will summarize the information gathered from each of these meetings.

Huntsville Town Corporation Municipal Water system

- Huntsville Town is concerned about current capacity and would require additional source capacity for growth.
- Wishing Well has safe yield of 400 gpm and can serve a capacity of 700 equivalent residential units (ERCs) at current DDW standards. Water levels appear to be stable and have not dropped in 2021.
- Huntsville has an existing water treatment plant that treats water from the Wiching Well with a capacity of 500 gpm.
- Water is for culinary use only. Irrigation company handles all outdoor use.
- The town has 516 AF of additional water rights for growth in South Fork, but no current treatment capacity.
- The town does not have specific plans for annexation/expansion outside of a request for 80 acres between 100 South and 500 South. Will assess future opportunities as they arise.

Eden Water Works

- 75 percent of Eden's system is on pressurized irrigation with 15 percent on flood and 10 percent using culinary water.

- Supply is primarily from wells (Clark and Reservoir Wells) and Burnett Springs. A third well (Cobabe Well) was removed back in the 1990's. Well and spring capacity was reduced in 2021. Burnett Springs typically runs at 170 to 180 gpm in the late summer. In 2021, flows were down to 90 gpm.

- Eden has purchased 240 shares from WBWCD which are available for future growth. One share is equivalent to one residential unit.

- Eden prefers to continue as an independent water system.

Liberty Pipeline Company

- Cutler Spring is Liberty's main source with a normal capacity of 130 to 140 gpm. In 2021 it's capacity was down to 90 gpm (40 percent below normal capacity).

- Liberty also takes water from two wells. Smith Well has a capacity of 400 gpm and serves lower Liberty. Its production has held fairly steady and it received a new motor in 2020. Durfee Well has a capacity of 50-52 gpm but went dry in summer of 2021.

- JUB has completed a water master plan for Liberty. The Master Plan includes a new booster station to feed the upper zones for both supply and fire flow needs.

- Liberty limits sale of shares in the company to 6 water shares per year.

- 70 percent of system is secondary with 30 percent culinary.

Nordic Mountain Water Company

- Currently 100 percent culinary irrigation.

- Nordic has newer infrastructure, but system debt.

- Nordic is served by 3 wells. The Rhodes well is comparatively new and has a capacity of 700 gpm. Well #2 and Well #3 have capacities of 70 gpm each.

- Nordic is aware of big plans for development in the near future.

Wolf Creek Water and Sewer Improvement District

- Serving 1100 to 1200 units with a commitment to serve another 300 units. Long-term plan calls for 2500 units total. This is what wastewater facilities have been sized for.

- Currently 0 percent culinary irrigation. Secondary irrigation provided by Wolf Creek Irrigation Company. 1 share = 1 ERU. Wolf Creek Irrigation owns all of water rights in North Creek. Creek is not able to keep up with demand (even in decent water years) and is supplemented with water from the Warm Spring Well.

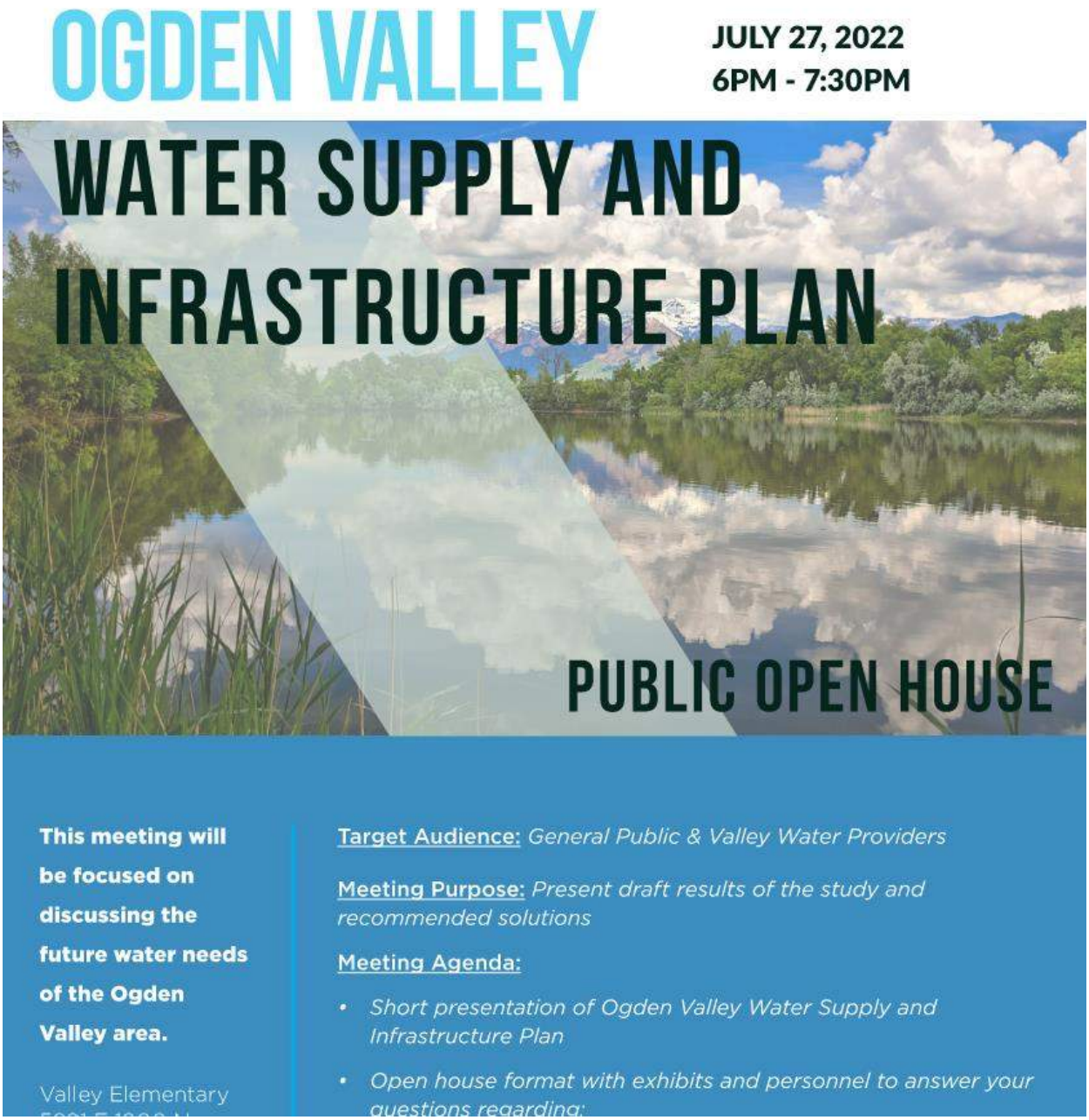
- Culinary sources are Wolf Creek Spring and Warm Springs Well.

- Wastewater reuse used for irrigation of golf course in summer. Infiltrated via Rapid Infiltration Basin in winter.

- Has explored drilling another new well in the area but is concerned that any new well might end up competing for the same water with other wells in the area.

PUBLIC OPEN HOUSE

A public open house was held on July 27, 2022 at the Valley Elementary School in Ogden Valley. Short presentations were given by both BC&A and Sunrise Engineering on the water and sewer studies respectively. After the presentations personnel from BC&A and WBWCD were available to answer questions and receive comments. The following flyer was produced for the open house.



BOWEN COLLINS & ASSOCIATES

TABLE 1

PUBLIC COMMENTS RECEIVED

Comment Number	Name of Commenter	Comment	Response
1a	Peter Turner	I attended the presentation on July 27, 2022. Here are some of my comments. This project seems to be solely for the benefit of future growth in the valley. And the summary suggests that importing water into the Valley is the only viable solution for that. However the one solution not suggested is to stop growth as we have reached the calculated sustainability balance of water supply and demand. This solution provides the best solution for all current Valley residents, except for a small handful of developers and builders.	This and several other comments are suggesting that the County revisit the master plan for development in the Valley. While this is a valid perspective, it is outside the scope of this study. The purpose of this study was to identify alternatives to meet water needs specifically for the current master plan. Correspondingly, this feedback has been forwarded to county planning personnel but will not be addressed further here.
1b	Peter Turner	Importing water is a classic solution for a variety of western water and urban planning. (The Colorado River Project and its supporting reservoirs are a current example of the misguided master planning and possible failure of that water diversion project with massive negative implications for the Southwest.) Importing water usually results in environmental and often economic devastation in the area the water comes from to benefit the area the water is sent to (see Owens Valley). But the infrastructure and maintenance costs are enormous and usually require federal subsidies and greater costs to the residents, businesses, and agriculture (unless subsidized) receiving the water. In our particular case we have the drying up and toxification of the Great Salt Lake (GSL). Caused almost exclusively by growth in the basin and somewhat by drought and climate change. We can only directly affect one of those variables. All water that gets used by growing the Valley population, whether by direct diversion or from importing the water, removes water that could otherwise flow into the GSL. Stopping growth is the lowest cost and best environmental solution for the Valley. It also is the best solution to preserve the very attributes that the current residents value in this area, instead of negatively altering or destroying them forever. If we acknowledge that we have reached the sustainable carrying capacity of the water in Ogden Valley why is the Weber Conservancy still selling water for exchange that does not exist anymore and the DWR continuing to grant well drilling diversions in the Valley? This is unsustainable and must be stopped immediately. Unless the strategy is to get so far behind in water delivery that it forces us into this proposed water import project.	Residents of the State of Utah are currently discussing GSL and how to best manage water to support its future. We are fully supportive of these discussions and are hopeful that positive and meanful solutions will result. However, predicting what solutions will eventually be reached and how they will affect specific water rights related to the Valley is well beyond the scope of this project. Subsequently, it is necessary to limit this analysis to water rights as they exist today. If larger issues associated with GSL affect the availability of water rights associated with import water or agricultural conversion, the plan can be adjusted to reflect the changes.

Comment Number	Name of Commenter	Comment	Response
1c	Peter Turner	And the whole concept of exchanging water that is pumped or mined in the Valley only to release an estimated equivalent from the bottom of the Pineview Dam is a false water balance. That false shell game should be stopped immediately. Calling, assuming, or using water from the South Fork of the Ogden River is not actually importing water. That water already flows into the Valley and is utilized already to certain degrees to recharge the groundwater we are currently diverting, directly being surface diverted, or to fill Pineview with some of the water that is already being sold by Weber Conservancy and being release at the bottom of the dam. This is NOT importing water but rather further diverting water already coming into the Valley. It is water that should be allowed to flow into Pineview Reservoir and/or released to the GSL to protect it for the greater good of a greater number of Utah citizens and businesses. Not for future growth in the Valley. If this water project is actually implemented there should be a legal recourse plan to protect existing companies in interference litigation. When there are such occurrences, the Big Water Wholesaler should provide the makeup water.	The claim of a "false water balance" is inaccurate. The importation of water refers only to the exchange of water rights with Willard Bay, meaning that less water would be released to water users on the Wasatch Front from the Pineview Reservoir dam and instead those downstream water users would be supplied water from Willard Bay Reservoir. Pineview Reservoir water would be retained in Ogden Valley. With less water leaving the reservoir, more would become available for the Valley with no enlarged diversion.
1d	Peter Turner	I do observe there are no plans to provide water to the west side of the lake. This is an area already suffering from the water exchange process where the hill is being pumped dry and water is release from the bottom of Pineview Dam without actually replacing the diverted water, which is required by state law. And there is extensive development occurring in that area and negatively affecting the senior water companies and diversions in the area. Those with the most money (developers) win in our system. The older more senior water users are protected by law but lose in the financial reality of seeking protection. The cost of being right can be overwhelming. Our water laws, water usage, and now this plan, are based on an antiquated reality when there was ample water and few people. The situation is reversed now and the drought and climate change are aggravating the situation. New rules and concepts are needed for this new realty. Your suggested solutions are antiquated, and in reality quite destructive. They are not helping us, just helping a handful of developers, politicians, and bureaucrats at a great cost to the current citizens and the environment. The study's analysis for needs of future development for people who don't live here yet may be solid. But the solution is unacceptable.	Needs on the west side of the lake were considered and included in the study. At this level of study, however, it is not possible to evaluate and show all potential connections needed. Focus was limited to the major delivery facilities in the system. Individual connections and exchanges between the various smaller water providers will need to be worked out separately.

Comment Number	Name of Commenter	Comment	Response
2	Kristen Healey	I could only catch bits and pieces of the presentation from last night over zoom- it was mostly unintelligible. But I very much feel that limiting development to the current zoning limitations or even less is 100% the way to go. Also, we in the Wolf Creek Water and Sewer district have been paying triple what our water bill used to be to pay for the construction and operation of the sewage treatment system. I'm happy to do so- I think it's the right thing to do. But now are we also going to be asked to pay for the rest of the valley to either join this system or build their own when they haven't been paying extra for the past 10-15 years as we have? That seems unfair. Would love to have a link provided to the recorded audio of the presentation at Valley Elementary if it's better than the live audio was.	Technical Memorandum #6 outlines several different options for paying for the improvements. While no final decisions have been made on how infrastructure might be funded, most of the options identified place the burden of paying for improvements on new users.
3	Jamie Hadlock	I attended the July 27th presentation. My concern is that there is not enough focus on the drought. Liberty Pipeline currently has a moratorium in place and will not sell additional shares until conditions improve. What is the county doing to curb the development? The water isn't available and trying to secure additional water for future developers will only intensify the residents frustrations. Until drought conditions improve Weber County should also be placing a moratorium of future construction in the Valley.	As residents of Utah, we all understand that drought conditions are not uncommon. As a result, any solution to water supply in the Valley must consider drought. One potential benefit of the alternatives identified here is that they would provide an additional source and would better connect the various water providers in the Valley. This would increase reliable supply and improve redundancy for all residents, especially in times of drought. For the purpose of planning, this study was prepared using drought conditions to project future reliable water supply.
4a	Joseph A. Sgambato	It is quite clear from the study that continued development in Ogden Vally needs to be curtailed or stopped altogether, before there is No Water Available for anyone. Yet, Osprey Ranch and Cobabe Ranch continue as does the Nordic Valley expansion. Nordic was recently tabled. Why not denied? What in God's name do the county commissioners think? Give the OK for these largescale developments to the Good Ole Boy's network? Names are not necessary as the developers involved are well known, as are their projects. The ones listed here are just two, there are more, quite a few more. I have owned a lot in The Highlands, that the connection fees have been paid, now at $39,000. The Highlands was plated and the water, culinary and secondary we' re OK'd at that time. That is until greedy developers started the massive expansion of Ogden Valley. How is it they can get water and I cannot, even though the connection fees have been paid, as well as a $39 per month standby fee? But still no "Can and Will Serve letter, therefore no building permit. Isn't it time that private, individual homes, occupied by full time residents in the Valley get preference over large scale Developers projects for part time occupancy homes that will be rezoned for Short Term Rentals?	Refer to comment 1a response.

Comment Number	Name of Commenter	Comment	Response
4b	Joseph A. Sgambato	However, there was a distinct difference in the slide labeled "Implementation - Conclusions" in the 7/18/2022 presentation to the Commissioners (slide #18) and the one slide just labeled "Implementation" at the 7/27/2022 public meeting (slide #23). The slide used at the 7/27/2022 public meeting did not include "Conclusions" in the title and it omitted the following statement regarding the valley water issue: If the County does not wish to actively lead efforts to secure more water, ... then, Significantly limit approval of additional development in Ogden Valley" Suffice it to say, this is a serious statement, and if the County does not want to lead the effort to secure more water for Ogden Valley (most of which is unincorporated), then who will? If there is no activity to secure more water, will the rapid pace of development just continue in Ogden Valley? LIMITING or CHANGING information given to the public by the County Commissioners is fraud, deceitful and may be illegal. The Valley residents need to unite and deal with the fraudulent County Commissioners regarding water.	This change was made to solely make the material applicable to each audience. There was no intent to deceive. Both presentations are available as part of the public record.
5a	Miranda Menzies	Comment 1. This report is based upon assumed development/growth which derives from the 2016 Ogden Valley General Plan land use zoning etc. approved by Weber County Commissioners. In my view, there needs to be a bigger picture consideration of water consumption in the Ogden Valley in the context of the region and state. The content of this report should be considered by policy makers at State and County levels from that perspective. Specifically, we have had declining groundwater levels (USGS groundwater watch) for 70 years in Davis and Weber County. This is in addition to the much-reported declines in the Great Salt Lake levels. Most concern should be directed to recovery of the groundwater levels in the Wasatch Front before they drop BELOW the elevation of the historic GSL, and start to cause irreparable salt-water intrusion to aquifers. These declining levels indicates that the net use of water in the Wasatch Front through evapotranspiration from agriculture and landscaping, exceeds the overall ability of the regional hydrologic system to support it. (Back of the envelope – the overdraft exceeds 250,000 AF per year!) What BC&A are recommending here will INCREASE that regional use, by further development of second homes and rentals, which use both culinary, and specifically secondary/landscape water, while not addressing the full-time residential housing shortage. In short, the Wasatch Front may need this 5,353 AF / 5,550 gpm of water.	Refer to comment 1a and 1b responses, but also see comment 5b.

Comment Number	Name of Commenter	Comment	Response
5b	Miranda Menzies	On page TM#2 page 18, BC&A documents that if larger lot sizes are the development focus, the overall demand of the valley will DECREASE from present by 4,789 AF per year. I.E. there could be a net positive contribution of roughly 10,000 AF of water per year from the Ogden Valley, based upon policy decisions at the County. In view of this finding, Ogden Valley development goals should be reconsidered, and redirected to a combination of high-density village developments, and large lot sizes outside of these areas, both of these combined with stringent limited landscaping requirements, and encouragement of "reuse" for secondarywater. This would allow the area to be kept as a water resource generator, while contributing to the bringing the Wasatch Front towards water supply balance. The results of limited landscaping do not appear to result in lower property values as demonstrated by multi-million dollar neighborhoods such as Promontory (Summit County). Limited landscaping also results in lower maintenance costs – a highly desirable feature for second homes.	The report notes that water supply for the identified culinary improvements can come from one of two sources: import water or agricultural conversion. This comment is essentially suggesting that no import water be used, but that all future supply come from ag conversion. Thus, this suggestion is just a variation within the overall recommended alternative. This would require that some currently irrigated agricultural land be taken out of production but is a viable option for consideration by county officials.

Comment Number	Name of Commenter	Comment	Response
5c	Miranda Menzies	Comment 2. The underlying assumption is that there is enough water in the South Fork to supply 5353 AF / 5,550 gpm – however it appears BC&A is recommending to divert 95% (seriously??!!) of the available winter (?) baseflow observed (no date given) during a "drought year" – without considering a) whether the drought could get worse, or even on average simply stay the same; and b) where the water is coming from. If the observed flow was during the period when the South Fork flow from Monte Cristo is fully diverted, or during winter "baseflow" then the water is, in fact, discharging groundwater from either lower or upper reaches of the South Fork. At times when the South Fork is dry below the Eden Canal diversion, the water is likely discharging shallow groundwater, though its water quality with respect to nitrate doesn't currently show impacts related to septic systems. In order to preserve this quality, it will be critical to require sewage treatment in the South Fork upgradient area. The South Fork flow is ultimately dependent on the net difference between precipitation and evapotranspiration in the overall Ogden Valley hydrologic system, as presented in the Utah Geological Survey Ogden Valley Hydrogeological Report (Special Report 165) from 2019, based upon 2016 data. Since data collection for that report, both snowpack declines and summer temperature increases have continued, and based on 2021/2 data may have accelerated. I.E. it is unclear whether this water that the report recommends as a source will exist in the future. Consequently, the BC&A report should include re-consideration of 1) the long-term data for the South Fork and the source of the South Fork flow, and 2) its realistic long-term safe yield, before recommending to spend $64m to divert it for culinary use. Specifically, there should be 1) real-time, accurate gauging of the South Fork flows at the planned points of diversion for at least 5 years, and 2) recovery of Pineview Reservoir levels to "full-pool", before proceeding further.	We generally agree with this recommendation. While it appears the South Fork flow has sufficient flow to meet the Valley's water needs during a typical drought year, additional analysis is needed. As stated in the report, BC&A recommends that this alternative be used as the basis for further evaluation and planning but that further evaluation of the South Fork flow should be conducted before any improvements are constructed.

Comment Number	Name of Commenter	Comment	Response
5d	Miranda Menzies	Comment 3. In thinking through the overall scheme for the Ogden Valley, we also need to consider what will happen to the water after it is used, as well as how it is supplied. Is this report consistent with the Sewer Study, being put together simultaneously by Sunrise Engineering?? – One would hope so. In that report, Reuse is the planned "disposal method" for the Valley by DWQ, with winter storage until summer disposal by irrigation. Infiltration to groundwater is not being encouraged, and surface water discharge is prohibited. So that would mean that the approximately 10,000 additional connections will be generating 2250 AF of water needing to be stored (just the culinary portion). So, are we going to need 225 acres of storage ponds 10 feet deep?? That's $45 m for land acquisition at a conservative $200,000 per acre. Pond construction on that scale is around $40,000 / acre-ft ($90 m). So, the cost of development proposed here is actually roughly $300 million or more ($65m for the water, roughly $100m capital cost for treatment facilities, and $135m for the reuse storage). The quantity of "reuse water", will likely be 80% of the culinary annual average flow (0.225 AF/connection x 0.8) = 0.18 AF/yr, plus whatever infiltration and inflow (I and I) into the sewer system occurs. This I and I can be significant, and once in the sewer system has to be treated and disposed – Hence my assumption above of 0.225 AF/yr per connection as a total culinary to wastewater transfer. The report assumes secondary demand 0.39 AF/connection/year on TM#1 Table 6 for 0.2 Ac lot size, but reduced in total based upon assumptions of a constant percentage of culinary water going to secondary TM#1 Table 7. In practice, the percentage of "culinary irrigation" may change significantly with time, unless there is a continuing policy requirement at the County to install secondary water supply systems in all new developments, except those with xeriscaping. A clear policy to INCREASE the number of developments with metered secondary systems would then be a beneficial part of the system for the reuse disposal. [Incidentally, the average secondary metered flow for retail connections in Wolf Creek District is 0.36 AF/year consistent with the report. We believe typically 24 ins per year is applied to spray-irrigated areas – i.e. no great difference from Wasatch Front single family homes. Less is used in drip-irrigation, limited landscaping settings. Application rates in other areas of the valley are likely closer to or exceed the 2.7 AF/AC secondary application assumed.]	Data used in this report was provided to Sunrise Engineering who prepared the Sewer Study. Data from the Sewer Study is not included in this report; however, Weber County personnel are being provided with data from both studies. Thank you for this additional information. It will be sent to Weber County personnel.

Comment Number	Name of Commenter	Comment	Response
5e	Miranda Menzies	Comment 4. When is the Peak Production (TM#3) BC&A are projecting? Keep in mind that for some water systems the peak demand is due to summer irrigation with culinary water, and for other systems it is winter ski season. And as noted in Comment 3, reuse is going to be directed towards irrigation – which may affect assumptions of annual patterns of demand.	The peak demand shown in TM#3 (5,541 gallons per minute) is the combination of each entities projected demands in 2060. The entities included are Eden, Huntsville, Liberty & Nordic, Wolf Creek, Ogden Valley Southeast (general area), and Snowbasin. Given that each entity's peak day demand likely occurs on different days throughout the year, the approach shown in the memo estimates a conservatively high peak day demand as it assumes that all projected peak demands coincide on the same day.
5f	Miranda Menzies	Comment 5. BC&A states that Powder Mountain and Snowbasin are not included in the assessment. However, the water demands of Powder Mountain actually remove flow from the Wolf Creek channel, which affects secondary supply to Wolf Creek District and Eden Water Works Service areas, among other effects. Snowbasin's increasing water withdrawals may also affect the Valley. Further, TM#5 Figure 6 shows an amount of 300 gpm going to Snowbasin on the aerial photo water delivery schematic. The supply needs of these entities should be included in the overall report, and explanation of the 300 gpm to Snowbasin "Lower Developments" should be added.	The scope of this study was necessarily limited to the Valley flow. A portion of Snowbasin's future developments have been accounted for in the study because they are at a lower elevation and fall within the footprint of study service area. Powder Mountain and Snowbasin personnel were contacted throughout the development of this report but have been informed that any development beyond what has been specifically identified here will need to be supported by water sources outside the Valley.
5g	Miranda Menzies	Comment 6. TM#1 p10 para 3 Reference to Table 8 should probably be Table 6.	This has been updated. Thank you.
5h	Miranda Menzies	Comment 7. TM#1 p11 The BC&A report states that the current percentage of "culinary irrigated" will continue to apply. This assumption is questionable, since many desirable development areas (with "view lots), as noted on TM#2 Figure 7 are in areas with low availability of secondary (ag) water. Developers appear to be willing to pay for the extension of the existing providers system infrastructure to these higher elevation areas, moving water from valley aquifers "uphill", due to the high value of new building lots. See also Comment 3.	It is certainly difficult to predict exactly how future development will occur. This comment makes a logical argument for a higher percentage, but the extent of a potential increase is unknown. No change has been made here, but if a project proceeds forward, this should certainly be revisited as part of the next steps of design.
5i	Miranda Menzies	TM#2 p 12 Footnote should be included in text discussion and expanded. The report logic appears flawed in the light of DWQ stated positions.	It is not clear what the concern is here. The footnote does not attempt to address any water quality issues, only issues from a water balance perspective. As a result, we are not aware of any conflict with DWQ stated positions.

Comment Number	Name of Commenter	Comment	Response
5j	Miranda Menzies	Comment 8. TM#4 p6 Statement about 100 ft setback from septic and sewers is inconsistent with Weber County code – Weber Morgan Health Department requires 150 ft in many cases.	This has been updated. Thank you.
5k	Miranda Menzies	Comment 9. Appendix A p 4 Nitrate data, with the most recent data from 2007? Really? A GRAMA request to DDW will yield the data up to 2021, though it is for a "blended" sampling station – this would allow correction / amendment of the graph.	Thank you for the suggestion. If any applicable concepts move forward, we will update the information.
6	Charles Graff	Thanks for this report and presentation. Based off the findings and conclusions as a full time Eden resident I'm very concerned about the future approved expansion plans of the valley. The current resources clearly will not support more development and all projects and plans in the que should be stopped until a 20-30yr plan can be completed. The valley very well might not be able to support much if any additional housing. The wants of a few should not out weigh the clear and present danger to the valleys water and resources.	Refer to comment 1a response.
7	Joseph Donavan	"If the County does not wish to actively lead efforts to secure more water, ... then, Significantly limit approval of additional development in Ogden Valley" says it all. No longer can we allow RE Developers, Construction Company owners and RE brokers to be making decisions on additional developments.	Refer to comment 1a response.
8	Lauren Lockwood	My main comment is basically that development needs to stop /extremely limit because Ogden Valley does NOT have enough water for agriculture, culinary, sewer or secondary – period! As your study says, "Implementations-Conclusion: if Weber County does not wish to actively lead efforts to secure more water: Significantly limit approval of additional development in Ogden Valley." There does not exist water to be secured and drought is a constant and continuing reality in our America West. Also existing residents should not have to pay for water development for future residents. The developers ravage the Ogden Valley land and line their pockets with money while existing residents suffer. So main people purchasing newly developed lands are from out of state and do not even live here. Local actual residents should not be having their neighborhoods changed for the worse for people who don't live here and aren't Utahans!	Refer to comment 1a response.

Comment Number	Name of Commenter	Comment	Response
9a	Larry Irvin	New projects requiring increased density and any new "village" zoning changes that can not be supported by existing valley water and sewer capacities, should not currently be considered. The latest water and sewer studies even recommend to "Significantly limit approval of additional development in Ogden Valley." The path ahead to provide the resources necessary to support the projected buildout in Ogden Valley will be lengthy and will require fundamental changes to our water and sewage infrastructure. This process will also require significant funding. Ogden Valley has been using the current General Plan since 2016. For at least a year prior, the general plan was being developed with public input. A new element introduced in the plan was the usage of Form Based Codes in the form of "villages" in an attempt to cluster much of the future development into higher density areas. These are exactly the type of projects that our current resources cannot adequately support.	Refer to comment 1a response.

Comment Number	Name of Commenter	Comment	Response
9b	Larry Irvin	The current development being proposed in Nordic Valley has exposed issues with the implementation of the 2016 General Plan in regard to villages, including water and sewer infrastructure. Nordic Valley is not an appropriate site for the village concept and is noticeably unlike the other identified future village locations in the General Plan. Nordic Valley is a hillside 200-300+ feet higher in elevation over the valley floor. The current density of the community is low with 1 acre or greater lots and, other than the Nordic ski facility, there is no other current mixed use. This area is sloping and the streets are typically fairly steep and winding making it much less the walkable area that the villages are intended to benefit from. No other future village location is like Nordic Valley. With a village zoning and implementation comes density at a level that could triple the number of dwelling units in this small community. Nordic Mountain Water has already declared that there is no additional water for new development of this size, in this area. Additionally, the septic capacity is already at levels that flirt with water table contamination there. The village approach will not work in this area. The community doesn't want it and any Ogden Valley public input, from 2015, that may have had a favorable response to the village concept, was never aware that it could be applied to the hillside community of Nordic Valley in the way it is proposed. It will triple the number of dwelling units in the area by building on their treasured open space. Sewer and water infrastructure were also not the topics back then that they are now. It is reasonable to assume that the public would be even less inclined now considering the challenges we are currently facing with these valley resources. Whatever forces are pushing the valley planners to support such increased density, clashes with our current infrastructure realities. We need to step back and reevaluate the priorities and our interpretation of the General Plan. Perhaps this plan will not be able to serve us moving forward in the way that is needed. It was generated at a different time, used flawed population buildout projections and did not project the level of our current water/sewer issues. Village zoning should not be forced upon Nordic Valley. The proposed project driving this change is essentially a ski resort development being shoehorned into a village implementation! Without the zoning change, the ski resort developer will have to propose a project that complies with current zoning, not consume the valuable open space and have to be viable with current resource capabilities, including our sewer and water resources. Future villages or other increased density that can not be supported by our current water and sewer infrastructures, should not be considered. Our General Plan should be consistent with this reality. Until we have a new Plan the interpretations of the current plan, by the planning department and all decision makers, needs to also reflect our realities.	A discussion of individual zoning decisions is outside the scope of this study, but these comments have been forwarded to county planning personnel.

Comment Number	Name of Commenter	Comment	Response
10	Denise Trella	The current infrastructure is inadequate/ and or failing and water infiltrates my foundation. My sump pump fires 24 hours a day from January until June. Beginning October of 2021, after additional culverts and storm drains were tied into the channel next to my home, it started flowing in October . This is an additional 3 months per year, during a drought. What happens with additional development and water diversion if the current system isn't being maintained or operating correctly, now let alone during normal or heavy snow pack years ?	A discussion of flooding and infrastructure maintenance is outside the scope of this study but these comments have been forwarded to county planning personnel.
11	Elizabeth Keswick	It is a well publicized fact that the Great Salt Lake is at its lowest historical depth. The South Fork is a tributary to the Ogden River. The Ogden River flows into the WeberRiver which feeds the Great Salt Lake. Diverting upstream water to facilitate more development which will suck more water from the Great Salt Lake, seems reckless. No matter how many water rights are available to justify this. At what point do people responsible for the future, say this diversion will likely have a long term detrimental effect? I was highly encouraged when the last slide called out to the County leaders that should they not actively want to pursue securing more water, future development should be curtailed. However that slide was omitted at the public meeting. I would submit that regardless of whether or not the County leaders want to pursue securing more water, it is is reckless to divert upstream water from the Great Salt Lake. What happens to the Great Salt Lake if every similar area diverts water? In the report, what is the rationale for an accelerated rate of growth? Thank you for preparing this report.	Refer to comment 1b response.
12	Alan Wheelwright	The cost of the new infrastructure will be onerous to existing valley residents and only increase property taxes. The current system is adequate for the existing residents. I believe that the true cost will be much higher than anticipated. This only benefits developers of Ogden Valley.	Refer to comment 2 response.
13	Elliot Lewis	Just because there is water doesn't mean that it should be used for development. Everyday I read both local and national news citing scientific data that suggest catastrophic impacts to our economy, air and society if the Great Salt Lake dries up, about the dwindling waters of the Great Salt Lake and yet here we are debating yet more water diversions away from the lake. And on the backs of the water that Ogden City may need. My city. Don't you dare come after our water. If you ain't got water, don't build. Period.	Refer to comment 1a and 1b responses.

Comment Number	Name of Commenter	Comment	Response
14	John Allaire	Hello, I wanted to follow up to a brief conversation I had with Keith Larson Friday, 7/22/22.My wife and I live in the Durfee Creek subdivision, on the far north end of the upper Ogden Valley in Liberty. Water service to Durfee Creek is provided by Liberty Pipeline (LPC). LPC took over full ownership and management of the DC water system in 2008. In total , the LPC water system has approximately 680 connections. The majority of these are active. Approximately 80%, or 540 of LPC's connections are in what is known as the southern end of the system. The southern end of the system is serviced by the Smith Well and two storage tanks. The tanks are just under two miles apart. Since the tanks are at the same elevation, they work in tandem: 1) Sheep Creek Tank (Above Sheep Creek / The Preserve): Capacity 500,000 gallons. Elevation: 5410'. 2) Bailey Tank (Above Bailey Acres): Capacity: 250,000 gallons. Elevation: 5410'. The north end of the LPC (approximately 140, or 20% of LPC connections) system is serviced by two water sources: 1) Cutler Springs 2) Durfee Creek well. The north end of the LPC system is serviced by two tanks at separate elevations:1) Cutler Tank (Located in North Fork Park): Capacity: 250,000 gallons. Elevation: 5770'. 2) Durfee Creek Tank (Located in Durfee Creek common area): Capacity: 100,000 gallons. Elevation: 5980'.All homes in/adjacent to the Durfee Creek subdivision can only be serviced by the Durfee Creek tank due to elevations and pressure requirements of these 68 connections. LPC engaged with JUB to provide a master plan for all future projects. To bring the Durfee Creek HOA into compliance with Weber Fire District fire flow requirements (2000 GPM over two hours = 240,000 gallons), additional storage adjacent to the Durfee Creek tank location or upsized booster pumps are required. Instead of adding storage at the DC tank location, LPC has opted for two large booster pumps and upsized lines from the Cutler tank to the booster pumps, and booster pumps to the DC tank to satisfy WFD requirements. LPC and JUB are aware that both sources on the north end of the LPC system are inadequate. The Durfee Creek well ran dry several times in the summer of 2021, and the flow from Cutler Springs can drop to the 40 GPM range later in the summer. To resolve the source issue for the north end, LPC plans to install a south to north booster line (using water from the Smith well source) to feed the Cutler tank location on the north end of the system. LPC also plans to add 500,000 gallons of storage adjacent to the Cutler tank location. I am providing this information to ensure you are aware of a few of the challenges and issues currently being discussed with LPC and JUB. In summary, the north end of the system (approximately 20% of ERCs) is deficient for source, and Durfee Creek (1/2 of north end ERCs), is deficient for storage. I serve on the Durfee Creek water committee. I would be happy to provide additional information based on our research if you are interested.	Thank you for providing this information. It has been incorporated into applicable portions of the study and will be valuable for future phases.

Comment Number	Name of Commenter	Comment	Response
15	John Glabe	Our recommendation would be to limit the amount of development in the Ogden Valley. Over-development just uses more resources and contributes to congestion and pollution.	Refer to comment 1a response.
16	Jan Fullmer	Given that one of the recommendations of the outcome of the water study was to discontinue the drilling of more wells in Ogden Valley, will the Weber Basin Water Conservancy District continue to issue permits for drilling new wells? If yes, could someone please explain why.	Permits for drilling new wells are issued by the State Division of Water Rights.
17	Marguerite Ulmer Power	My husband and I have been residence in the beautiful Ogden Valley for 15 years. We love living there, but we have become more and more concerned about the water situation, for obvious reasons. Pineview Reservoir is seriously depleted, and most of its water goes to Ogden anyway. There is a serious lack of water in the valley, and drilling for more groundwater will only delay the reckoning. Wolf creek just drilled and drilled for a well and found that it would be taking the needed water from elsewhere, so I had to close the drilling. What would we do if the ground water is depleted? The construction in the valley is unprecedented, and of course is complicating the water situation. To keep building in this fashion is to ignore the future, the beauty of the valley, the climate crisis which will only get worse, and the fact that Moore construction will also damage our roads and our quality of life. Please take all these issues under consideration. Do not ruin our beautiful valley. Thank you. Marguerite.	Refer to comment 1a response.
18	Josh Klisch	There was a Conclusion slide stating that if the county does not aggressively address the water shortage problem, no future development should be permitted. That Conclusion did not appear in the final version. This appears to be intentionally sticking our head in the sand which is what we will be left with if we don't get serious about this.	Refer to comment 4b response.
19	Anonymous	Make it happen and make sure I don't have to pay for any of it!	Thank you for your feedback. Also see comment 2 response.
20	Anonymous	Why not let existing water sources determine growth in the Valley? It's okay to say, "enough is enough". Land ownership doesn't guarantee development. When the water is gone, say, "stop".	Refer to comment 1a response.

Comment Number	Name of Commenter	Comment	Response
21a	Leslie Loeffel	Hello Commissioners, After attending the public meeting on the "Ogden Valley Water Supply and Infrastructure Study" and reviewing the document on your website, I have the following comments. Basically, I object to several assumptions made by the study and disagree with the proposed solution. 1) Water conservation was not at all mentioned in the study, as it was not part of the scope. The County should be taking a lead role in educating about and encouraging water conservation among users. The County should mandate any water reduction that is within its purview. The County should also be advocating for incentives and other creative ideas at the state level. Reducing water usage is a part of a better solution to the Valley's water problem than a huge water project.	We agree that conservation is important and should be encouraged as part of the comprehensive water supply strategy. It was only excluded in the calculations to make sure projections were sufficiently conservative to avoid overallocation of resources.
21b	Leslie Loeffel	2) Removing more water from the South Fork will inevitably have a negative effect on wildlife and the environment. Nature matters. In-stream flows should be maintained.	The proposed location for the diversion is at the very bottom of South Fork (immediately upstream of Pine View Reservoir). As a result, in-stream flows in the creek will not be affected.
21c	Leslie Loeffel	3) Most importantly, why must we allow the Valley to buildout at 13,584 water connections? This assumption needs to be revisited. A better way to reduce demand would be to limit the number of new users, perhaps by buying individuals' development rights. Thank you for considering my opinion. Leslie Loeffel	Refer to comment 1a response.
22	Jean Kluk	Please hit the pause button on development in Ogden Valley to provide time for further research and truthful representation of the OV water situation from Weber County. To rob existing homeowners of their water supply in order to enrich a few developers is extremely short sighted planning! Where is all the surface water going to come from? What is your basis for those projections knowing that this drought could continue indefinitely and become the permanent change in precipitation levels. The pro-development Weber County commissioners need to listen to their residential constituency rather than to just a few developers!	Refer to comment 1a response.
23	Michaeline Smith	I attended the meeting at valley elementary on July 27th. I didn't expect much but was still shocked at how bad all the "options" were. I say "options" because they opened up the presentation with an absolute non-option since there is no way to do it. Yet they presented it anyway like true salesmen. The only real option is to stop large scale developments. We cannot support this continued growth. This study proves it.	Refer to comment 1a response.
24	Helene Liebman	I am very concerned that commissioners apparently changed study conclusions to eliminate the warning that the county either lead the effort to find new sources of water or reduce development. The commissioners are actively threatening our basic needs. You owe the citizens--your constituents--not the developers.	Refer to comment 4b response.

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