

PIKES PEAK REGIONAL WATER AUTHORITY REGIONAL REUSE STUDY



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FORSGREN
Associates Inc.

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ACKNOWLEDGMENTS

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ACRONYMS

AF:	acre-feet
AFY:	acre-feet per year
CCF:	hundred cubic feet
CMD:	Cherokee Metropolitan District
CSU:	Colorado Springs Utilities
CWCB:	Colorado Water Conservation Board
FT:	feet
FT-MSL:	feet, mean sea level
GAL:	gallons
GPCD:	gallons per capita per day
GPD:	gallons per day
GPM:	gallons per minute
HP:	horsepower
IPR:	Indirect potable reuse
KGAL:	one thousand gallons
MCL:	maximum contaminant level
MGAL:	one million gallons
MGD:	million gallons per day
PER:	persons
PPRWA:	Pikes Peak Regional Water Authority
SAFB:	Schriever Air Force Base
SDS:	Southern Delivery System
SFE:	single family equivalent
WRF:	water reclamation facility
WSMP:	water supply master plan
WTP:	water treatment plant
WWTF:	waste water treatment facility

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EXECUTIVE SUMMARY

The Pikes Peak Regional Water Authority (PPRWA) is made up of several El Paso County water providers with shared interests in water supply planning and water quality. Many of the PPRWA water providers depend heavily on nonrenewable Denver Basin water supplies, which will not be economically viable over time given their declining water levels. Other providers also see the need to make full use of their water supplies to the extent practicable. Therefore, the PPRWA initiated this study to evaluate the feasibility of capturing and reusing return flows from lower Fountain Creek. The specific PPRWA members participating in this study are:

- Cherokee Metropolitan District (CMD)
- Colorado Springs Utilities (Springs Utilities)
- Donala Water and Sanitation District (DWSD)
- Forest Lakes Metropolitan District (FLMD)
- Town of Monument
- Security Water and Sanitation District (DWSD)
- Triview Metropolitan District (TMD)
- Woodmoor Water and Sanitation District (WWSD)

Following review of background information and previously developed concepts and alternatives specifically addressing the recapture, storage, and delivery of reuse water, our study team conducted interviews with each entity to identify how they could benefit from a regional reuse concept. We quantified participant return flows that can be recaptured from lower Fountain Creek for return and reuse. But we also identified how the return system could also allow for beneficial use (or better use) of their water rights available for diversion from lower Fountain Creek. Based on projected average-year return flows of 8,750 AFY in 2050 and water rights flows of 4,670 AFY, the planned system would deliver a total of 13,420 AFY.

After an initial screening with the participants, we developed a series of eight conceptual alternatives with diversions at or downstream of the Las Vegas WWTF and located on the east side of Fountain Creek and Interstate I-25, generally affording closer proximity to Springs Utilities' SDS transmission pipeline. Those alternatives vary with respect to the diversion, storage, treatment and conveyance of water from Fountain Creek into the SDS.

We then compared the alternatives through numerical scoring of: Selection Criteria, Site Development, Technical Criteria-Reservoir Storage and Conveyance, and Environmental/ Permitting Criteria. After review and adjustments, we moved forward with six alternatives for comparison on the bases of capital costs, operation and maintenance costs, total present worth and net production after water losses.

A regional water reuse system as described in this study is feasible and could prove to be very cost effective to implement once all costs are identified. Each participant can benefit from the "savings of scale" that a single regional system offers vs. having each entity independently develop their own

system. The regional system could also provide the means for delivery of current and future water rights available from Fountain Creek. Overall costs for the recommended alternatives are shown in Table ES-1.

Table ES-1: Cost Comparison

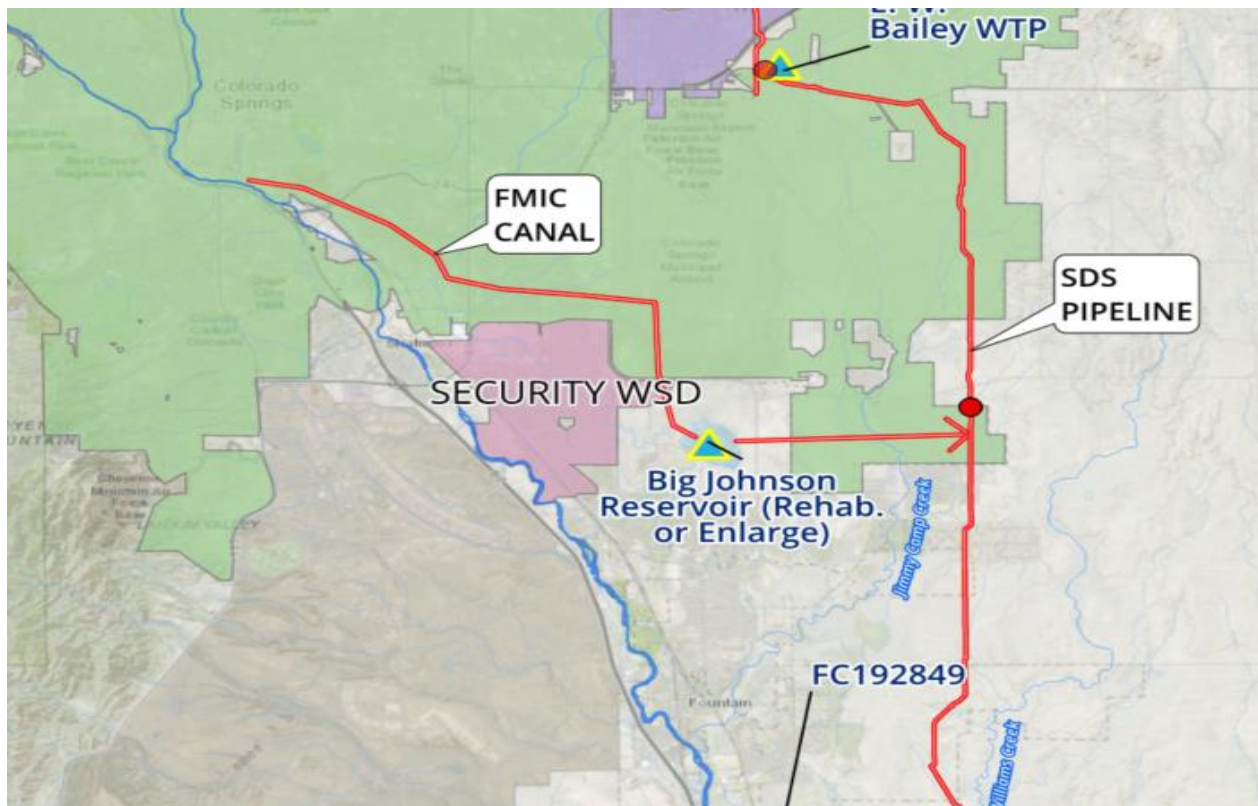
ALTERNATIVE	CAPITAL COST	ANNUAL O&M	TOTAL PRESENT WORTH	COST PER ACRE-FOOT DELIVERED
ALT A-2 Without Pretreatment	\$14.6-18.7M	\$0.25M	\$27.4-31.4M	\$2,790
ALT A-3 With Pretreatment	\$46.0-50.1M	\$1.44M	\$69.7-73.6M	\$6,140

When considering the yield and costs for each alternative, Alt A-2 is the lowest cost at \$2,790 per AFY delivered if no pretreatment is required. Alt A-3 is the lowest cost at \$6,140 per AFY delivered if pretreatment is required (see figures that follow).

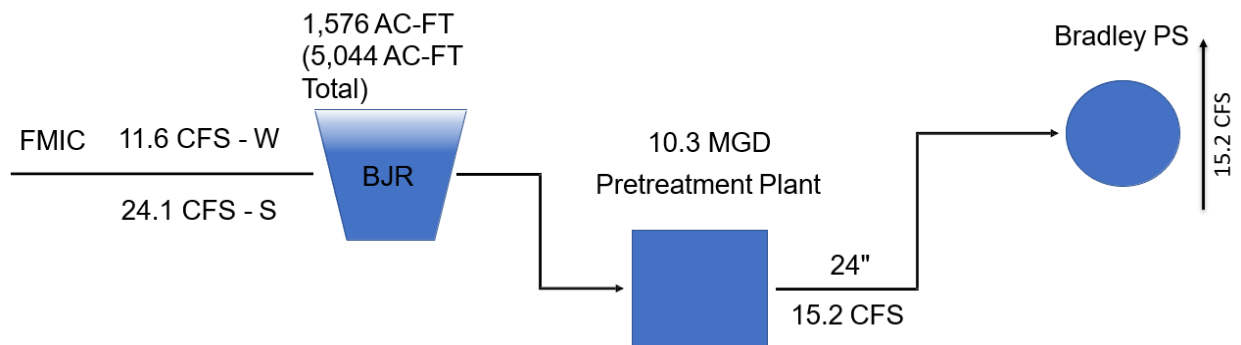
Costs need to be confirmed (or identified) for three critical topics before the full financial picture can be known. Specifically, those areas are: (1) FMIC/Big Johnson Reservoir; (2) pretreatment vs. treatment consolidation at the Bailey WTP; and (3) Springs Utilities charges for treatment/delivery.

- The alternatives making use of the FMIC canal and 500 AF of expanded storage in Big Johnson Reservoir are the more cost-effective options. The participants should open discussions with the rest of the FMIC ownership to explore the possibilities of how they can mutually benefit from shared use of the FMIC facilities as a key part of the regional reuse system.
- It will likely be more cost effective to consolidate treatment of Fountain Creek water at the SDS-Bailey WTP rather than provide some level of pretreatment at a separate facility. To confirm, Springs Utilities will need to determine what (if any) treatment modifications would be needed at Bailey and what operational costs could be incurred.
- Moreover, Springs Utilities will need to charge each of the other participants for their respective share of finished water treatment and delivery costs to points of connection to those other water systems. Those cost shares will need to be factored into the overall cost determination for each participant.

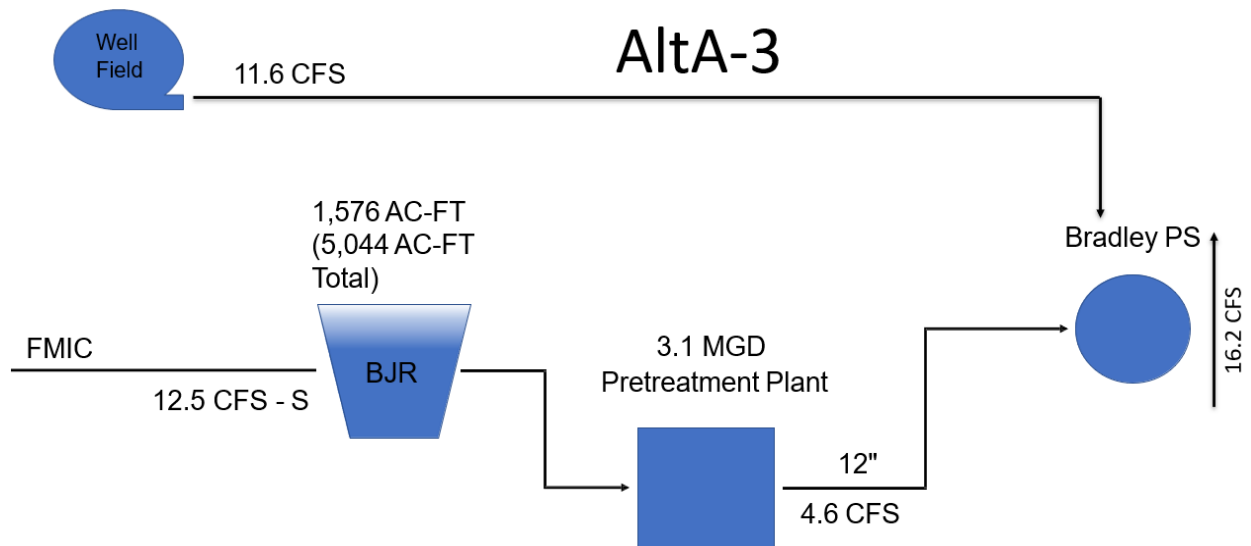
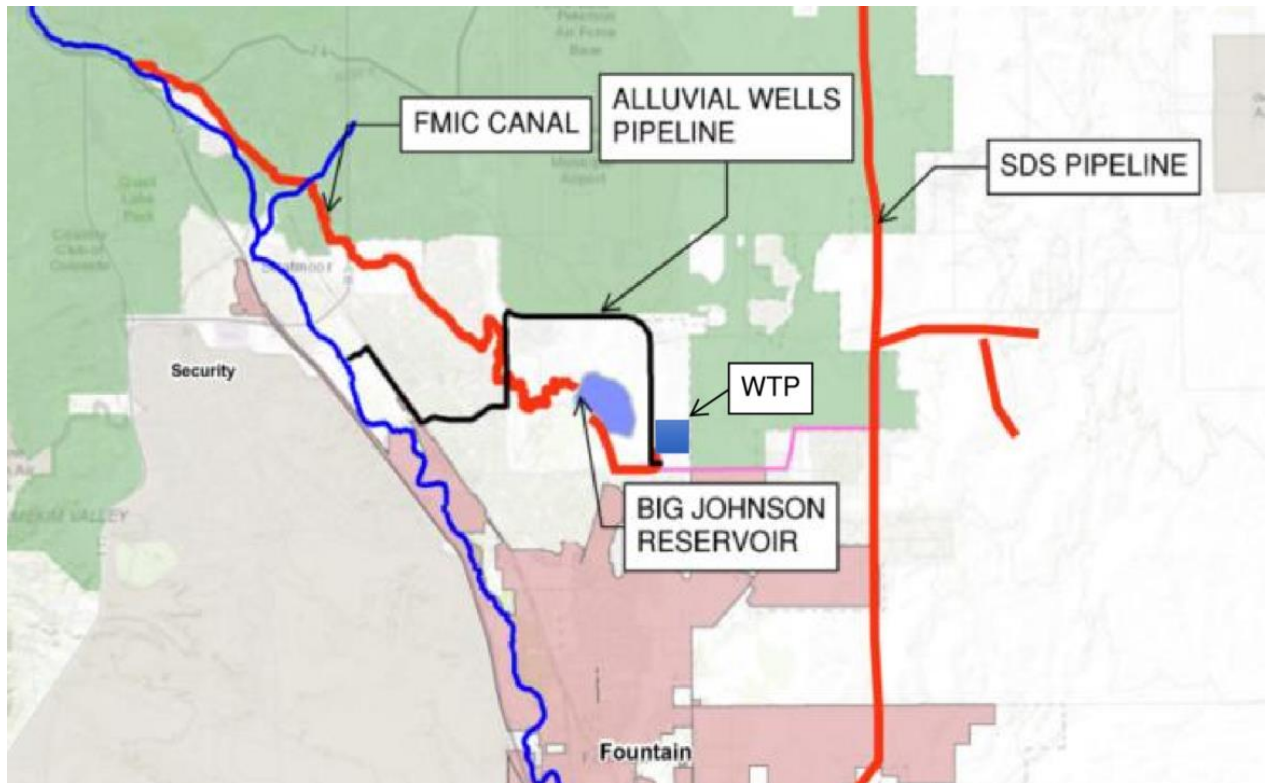
Map & Diagram AltA-2



AltA-2



Map & Diagram AltA-3



CHAPTER 1 INTRODUCTION

The Pikes Peak Regional Water Authority (PPRWA) is made up of several El Paso County water providers with shared interests in water supply planning and water quality. At the forefront of discussion among the group's members is availability of water supply considering rapid population growth throughout El Paso County. Many of the PPRWA water providers depend heavily on nonrenewable Denver Basin water supplies, which will not be economically viable over time given their declining water levels. Other providers also see the need to make full use of their water supplies to the extent practicable. Therefore, the PPRWA initiated this study to evaluate the feasibility of capturing and reusing return flows from lower Fountain Creek. The specific PPRWA members participating in this study are:

- Cherokee Metropolitan District (CMD)
- Colorado Springs Utilities (Springs Utilities)
- Donala Water and Sanitation District (DWSD)
- Forest Lakes Metropolitan District (FLMD)
- Town of Monument
- Security Water and Sanitation District (DWSD)
- Triview Metropolitan District (TMD)
- Woodmoor Water and Sanitation District (WWSD)

This study builds upon concepts developed in prior PPRWA studies. The first of those was the Water Infrastructure Planning Study (WIPS) [R](#). The WIPS took a broad view of alternatives to use Denver Basin supplies more efficiently, and acquire and deliver new, renewable water supplies to the Monument area. PPRWA's Regional Infrastructure Study (RIS) [R](#) in 2015 developed the concept of connecting Springs Utilities' Southern Delivery System (SDS) to CMD's Sundance Pipeline to provide a regional backbone for water deliveries from the Fountain to Monument areas, along with reservoir storage, treatment and pumping facilities. PPRWA's Area 3 Preliminary Engineering Report [R](#) provided greater detail on the northernmost of the three RIS project areas.

1.1 PURPOSE

The PPRWA members share an interest in securing more water supplies while also optimizing use of current supplies for a more sustainable water portfolio. In this Regional Reuse Study, we evaluate the physical facilities needed to capture return flows from lower Fountain Creek and deliver them to the respective service areas as potable water via Springs Utilities infrastructure. Additionally, some of the service providers have water rights that can be accessed from lower Fountain Creek in addition to their reusable return flows. We also consider in this study what additional facilities or upsizing would be needed to make use of those supplies as well.

This study identifies alternatives to divert, store, and treat water from Fountain Creek and cost effectively deliver it to each participating member's service area. Additionally, this analysis identifies other water storage needs within El Paso County that could also be addressed with the storage

contemplated as part of this effort. The Regional Reuse Study facilitates a collaborative effort between participating entities in achieving a common goal to make best of their existing water supplies, while also positioning them to access additional supplies that may be developed in the Arkansas River basin.

1.2 SCOPING AND OBJECTIVES

The work of this Study was completed in four phases:

1. Reconnaissance

This phase consisted of reviewing background information and previously developed concepts and alternatives. We reviewed project data and concepts performed in the region over the last 10 years specifically addressing the recapture, storage, and delivery of reuse water. We then prepared an inventory of previously identified water storage needs within El Paso County. Each participating water provider was interviewed to develop minimum operational criteria for storage, conveyance capacity needed, ability to connect to existing infrastructure, and general treatment requirements for potential recapture, storage, and delivery. We then prepared a summary table of water recapture, storage and delivery needs that could be met through regional cooperation.

2. Comparative Analysis

This phase consisted of using the identified criteria to evaluate the viability of each concept. Based on feedback from the participants, we developed a set of qualitative and quantitative criteria to compare project concepts. Each criterion was numerically weighted then scores were tallied for each concept. Each was given a total score with the highest scoring concept receiving the top overall ranking.

3. Feasibility Analysis

In this phase, we carried forward all of the alternatives and developed the concepts further to allow for some very preliminary cost comparisons. Each identified concept was evaluated for costs of diversion, storage, treatment and transmission. Capital, operational and maintenance, and total present-worth costs were compared and some of the more costly alternatives were screened out.

4. Refined Costs

In the final phase of the study, we refined the conceptual capital, operational and maintenance, and total present-worth cost considerations for the top two recommended alternatives. The more favorable of two alternatives will depend on a closer analysis of whether pretreatment will be necessary prior to combining the Fountain Creek water with the SDS supply.

CHAPTER 2 RECONNAISSANCE

This chapter summarizes our review of background information and previously developed concepts and alternatives specifically addressing the recapture, storage, and delivery of reuse water. We also conducted interviews with each entity to identify how they could benefit from a regional reuse concept and their specific needs regarding collection, storage, treatment, and delivery components. Our reconnaissance work included the following:

- Collected and reviewed relevant project work performed in the region over the last 10 years, specifically addressing reuse water.
- Gathered data and formulated an inventory of previously identified water storage needs within El Paso County.
- Developed minimum operational criteria (conveyance capacities, storage volumes, potential treatment requirements, and delivery points to existing infrastructure).
- Formulated concept plans in sufficient detail to evaluate the viability of identified alternatives.
- Developed criteria to facilitate a qualitative screening of the alternatives.

Existing studies providing background information varied from large-scale planning documents covering all of El Paso County (e.g., El Paso County Water Master Plan, Forsgren 2019) to local, purpose-specific studies of particular infrastructure projects (e.g., Feasibility Study for Big Johnson Reservoir Enlargement, Applegate 2009). These studies were performed for a variety of different entities and purposes at varying levels of detail. However, we reviewed them for information relevant to the purposes of this study for consideration and possible inclusion. Below are brief summaries highlighting the relevance of a few prior studies.

2.1 POTENTIAL RETURN FLOWS AND CONVEYANCE

- The PPRWA Area 3 Preliminary Engineering Report proposed using flows from five water systems, assuming 75 percent of the effluent was available for recapture. This would add about 1680 to 2570 AFY of available water.
- The Monument Water Master Plan proposed making use of returns derived from lawn irrigation return flows (LIRFs) and treated wastewater effluent from the Tri-Lakes WWTP. Monument anticipated net return flows of 150 AFY, deducting the flows committed to augmentation.
- The Monument/Woodmoor Water Reuse Plan considered reusing flows by conveying and discharging WWTF effluent upstream of Monument Lake. This system would allow the water to be withdrawn from Monument Creek downstream of Monument Lake through a new raw water intake at Woodmoor's existing diversion. Monument's share would be treated through a new WTP and pumped into their water distribution system. WWSD would

- be able to capture a greater share of their return flow than currently possible, either pumping the water to Lake Woodmoor or to their existing South WTP. This system could have the capacity to convey 0.76 MGD to Monument and 2.16 MGD to WWSD.
- The *El Paso County Water Authority Water Report R* proposed reuse options that distinguished between the northern and southern water providers in the region. The northern water providers would capture treated wastewater return flows using a new or existing reservoir. All but one of the southern water providers are already interconnected and have the means to reuse water via a system of water rights in Pueblo Reservoir and wells in the Widefield alluvial aquifer. Although the southern providers have a system in place, they still need raw water storage to aid in the reuse/recapture efforts.
 - The Springs Utilities *Integrated Water Resource Plan Tech Memo No. 23* explored using available SDS capacity in the months of May-September and October-April. The October-April window showed sufficient capacity to convey all regional demands considered. Up to 36,000 AFY total could be conveyed.

2.2 STORAGE

- The *PPRWA Area 3 Preliminary Engineering Report* options included:
 - Home Place Ranch Reservoir, which would be newly constructed,
 - Enlargement of Monument and Woodmoor Lakes, identified as too costly for the minimal storage increase,
 - Aquifer storage and recovery (ASR) well conversions in Springs Utilities' Northgate well field, and
 - Upper Black Squirrel Creek (UBSC) alluvial storage using existing CMD water transmission lines that cross the basin.
- The PPRWA Regional Infrastructure Study included the following storage options:
 - Fountain gravel pits would store water from Fountain Creek, with storage capacity of 4,100 – 15,900 AF.
 - Callahan Reservoir could be enlarged from its current storage capacity of 674 AF. The reservoir is filled with Fountain Creek water conveyed by the Chilcott Ditch. The enlargement of Callahan would increase storage capacity to 3,200-8,400 AF.
 - Big Johnson Reservoir could be enlarged from its current capacity of 5,000 AF to its design capacity of 10,000 AF. Big Johnson Reservoir is filled from Fountain Creek using the FMIC Canal.
- The 2009 Feasibility Study for Big Johnson Reservoir Enlargement proposed the dam crest be raised 15 feet to create more storage. This was considered the most feasible option in the study and would increase storage by 5,000 AF.
- The El Paso County Water Authority Water Report outlined similar options for storage as in the PPRWA Study including:
 - Purchase of Lake Woodmoor, however, the reservoir was under restrictions from a dam safety standpoint. This option, if viable, would yield 936 AF of capacity.

- Monument Lake to be used as a future terminal storage facility following rehabilitation.
 - Bristlecone and Pinion Reservoirs were considered surplus storage that could aid in regulating direct flow rights.
 - Springs Utilities could offer storage if available in either Bostrom or Williams Creek Reservoirs, if constructed, to other county water providers.
 - Jimmy Camp and New Forest Lakes Reservoirs could be used as reuse storage. The reservoirs were estimated to have sufficient storage capacity to supply 2,550 AF and 2,480 AF, respectively. The total supply of 7,440 AFY would potentially meet demands for the northern water providers that took part in the study.
 - Alluvial storage in the UBSC Designated Groundwater Basin would include rapid infiltration basins for indirect potable reuse of CMD’s treated effluent.
 - Gravel pits in the Fountain area could be converted into water storage reservoirs.
- *The City of Fountain Gravel Pit Reservoir Feasibility Study* reviewed the feasibility of using two gravel pits for two separate uses; augmentation, and pre-treatment. Three different gravel pits were considered in the study, with Schmidt and LaFarge being the two pits considered able to meet the target volume of 1,400 AF – 5,000 AF.
 - *The Springs Utilities Integrated Water Resource Plan Tech Memo No. 23* explored the Lower Arkansas and the Upper Williams Creek Reservoir Expansion (later named Bostrom Reservoir) as potential storage options. Conveyance and storage possibilities for the Upper Williams Creek Reservoir would store 40,000 AF – 50,000 AF. This option was selected due to being readily available to provide new supply storage in the best location for meeting local demands.
 - *The Springs Utilities Regional Water and Wastewater Service Technical Studies* presented new projects that were added to the Integrated Water Resource Plan buildout portfolio, including the expansion of Bostrom Reservoir and Fountain Creek Effluent Storage. These projects would add up to 22,000 AF and 20,000 AF respectively.
 - *In Bird Strike Hazard Assessment for LaFarge Reservoir*, the City of Fountain proposed acquiring the LaFarge property to be used as a storage reservoir. This would allow it to store up to 2,500 AFY of water supplied from the SDS pipeline as the City expected water demands to increase significantly in the following years.

2.3 PARTICIPANT INTERVIEWS

As part of this study, the eight participating entities were interviewed about potential reuse opportunities through future recapture, storage, and delivery projects. Representatives of each entity were asked the following questions, and their responses are summarized in Appendix II.

- Why is this organization participating in this study?
- Each organization has participated in the Regional Infrastructure Study and the El Paso County Water Master Plan and has completed other studies specific to its own needs. In light of said studies, what has changed and what is still true or current?
- What is the organization’s most significant challenge with respect to the indirect reuse of reusable return flows?
- Any indication that the current trajectory toward build-out is going to accelerate, decelerate, or change in magnitude?
- Does the organization have organizational or legal challenges that must be surmounted in order to participate in shared or co-developed infrastructure, e.g., limitation on being a co-applicant in new water right applications?
- Is the organization in the process of acquiring or changing any current supplies that are pertinent to this study in the timeframe within this study?
- Are there any ‘in system’ water quality issues that would be exacerbated or mitigated with the import of (a) new water source(s), i.e., treated, partially treated, untreated?
- Does the organization have adequate storage currently and is there an estimate of future storage needs, either solely or cooperatively?
- Can you describe any reuse and/or storage alternatives that you have considered in the past? If so, which ones do you think hold the most promise? On your own accord or with regional partners?
- What alternatives do you think hold the most promise for your organization, whether previously evaluated or not?
- Do you have any reports or tech memos (other than what is included in the RFP References) that will help us better understand those alternatives?
- What alternatives seem most promising if your organization has to act on its own accord?

Responses to these questions were considered in development of the alternatives considered in the following chapters. The specific data requested from each entity are listed below:

- Reusable return flows to be recaptured
 - Current
 - Buildout (2050)
- Location of return flows
- Desired location for delivery
- Operational timing needs (immediate delivery vs. delayed/timed delivery)
- Reuse storage need
- Project timing need
- Secondary – Volumes, locations and rates for the collection, storage, and delivery of other water supplies

CHAPTER 3 AVAILABLE FLOWS

This chapter identifies the primary interest of this Study: quantifying participant return flows that can be recaptured from lower Fountain Creek for return and reuse. But a secondary benefit of a conceptual reuse plan would be to also allow the participants to make beneficial use (or better use) of their water rights available for diversion from lower Fountain Creek. Those potential flows are also identified in this chapter.

3.1 RETURN FLOWS

Return flows available for reuse consist of water that is “new” to the surface water system—water for which there are no ownership claims from downstream users. In El Paso County, available return flows are primarily derived from:

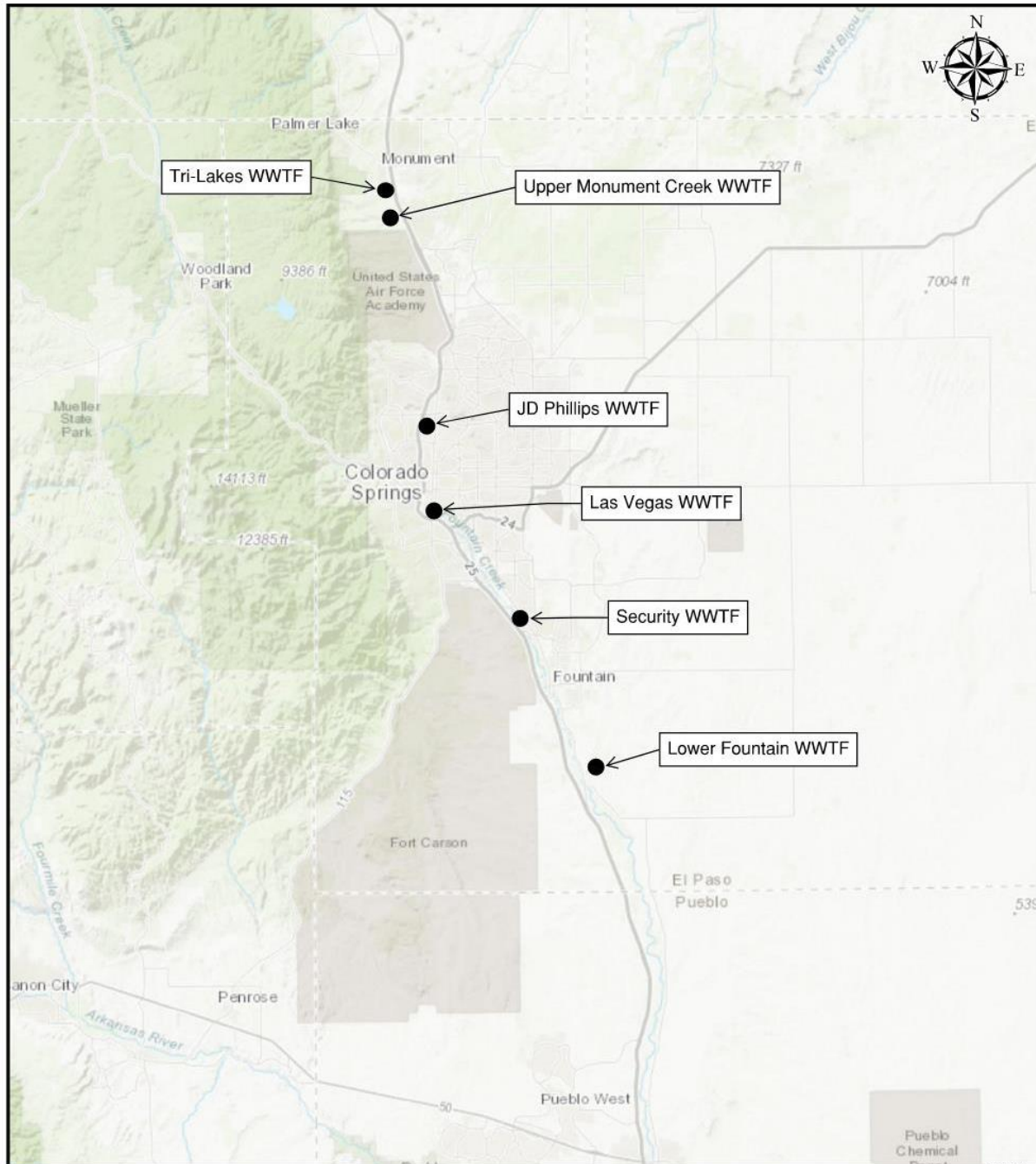
- **Nontributary Groundwater.** Several water providers in northern and eastern El Paso County rely heavily on pumping Denver Basin groundwater from bedrock aquifers having no significant influence on surface water flows.
- **Transmountain Diversions.** Springs Utilities and other water providers in southern El Paso County benefit from flows diverted into the Arkansas River basin from the West Slope.
- **Consumptive Portion of Water Rights.** Many water providers convert agricultural water rights for municipal use. The portion of agricultural water previously consumed through crop evapotranspiration may become available as a return flow.

Once water from these sources is used within a service provider’s system, a portion of it accrues to a stream such as Monument Creek or Fountain Creek primarily in the form of treated wastewater effluent. That effluent is from indoor water usage at a fairly constant rate year-round. A small share of reuse returns can be attributed to lawn irrigation return flows (LIRFs) during the irrigation season, April through October. But for purposes of this study, we will consider reuse return flows to be relatively constant year-round.

Treated wastewater return flows from five of the eight participants are currently discharged into Monument Creek from one of two treatment facilities. The Tri-Lakes WWTF in southwest Monument treats flows from Monument and WWSD (in addition to Palmer Lake, see Figure 3.1). The Upper Monument Creek WWTF treats flows from DWSD, TMD and FLMD.

In an offer for regional consolidation, Springs Utilities has proposed that those two WWTFs be decommissioned and that all flows be conveyed by a new North Monument Creek Interceptor (NMCI) to Springs Utilities’ JD Phillips WWTF. That WWTF has sufficient capacity available for consolidation, and can more readily meet increasingly stringent effluent limits for phosphorous and nitrogen. An added benefit of the interceptor would be to reduce stream losses to the return flows. Whether the five Monument-area participants join Springs Utilities in developing NMCI or not, their return flows will still be discharged into Monument Creek and available downstream of its confluence with Fountain Creek.

Figure 3-1: Area WWTFs on Monument and Fountain Creeks



In an offer for regional consolidation, Springs Utilities has proposed that those two WWTFs be decommissioned and that all flows be conveyed by a new North Monument Creek Interceptor (NMCI) to Springs Utilities' JD Phillips WWTF. That WWTF has sufficient capacity available for consolidation, and can more readily meet increasingly stringent effluent limits for phosphorous and nitrogen. An added benefit of the interceptor would be to reduce stream losses to the return flows. Whether the five Monument-area participants join Springs Utilities in developing NMCI or not, their return flows will still be discharged into Monument Creek and available downstream of its confluence with Fountain Creek.

The majority of Springs Utilities' treated wastewater flows are discharged into Monument Creek at the JD Phillips WWTF, and into Fountain Creek at its Las Vegas WWTF. SWSD's flows are treated at its own WWTF downstream of the Las Vegas WWTF for discharge to Fountain Creek. A small portion of Springs Utilities' flows are treated and discharged even further downstream at the Lower Fountain WWTF.

CMD has no current return flows discharged into the Fountain Creek basin. All treated wastewater flows from their UBSC WWTF are conveyed to recharge basins in the UBSC Basin aquifer east of Colorado Springs. A portion of that flow is pumped from a downgradient well field for indirect potable reuse within CMD's service area. CMD may consider future scenarios that would result in having return flows or water rights available from lower Fountain Creek.

Based on the background documents review and participant interviews, Table 3-1 summarizes the expected reusable return flow rates for participants. The storage volumes needed for reuse should be understood as narrative or qualitative in nature based on existing studies or participant estimates. The subsequent phase of this Study, Comparative Analysis, develops conceptual plans for operation considering the dynamics of diversion and conveyance rates, necessary storage volume, and forecast treatment capacity.

Table 3-1: Reusable Return Flows

Entity	Location / Notes	Wastewater Effluent Flow – Current Conditions		Wastewater Effluent Flow - 2050 Conditions	
		[AFY]	[cfs]	[AFY]	[cfs]
CMD	Not currently a discharger to the Fountain Creek system.	n/a	n/a	n/a	n/a
Springs Utilities	Discharge from JD Phillips and Las Vegas WWTFs (potentially Lower Fountain WRRF)	3,620	5.00	3,620 ¹	5.00
DWSD	Return flows from DBGW & Willow Creek discharged from UMCWWTF	507	0.700	507	0.700
FLMD	Return flows from DBGW & Beaver Creek /Bristlecone Reservoir discharged from UMCWWTF	53	0.073	203	0.280
TMD	Return flows from DBGW & transferred ag water rights (under development) discharged from UMCWWTF	405	0.560	688	0.950
Town of Monument	Return flows from DBGW discharged from TLWWTF	145	0.200	574	0.793
Security Water and Sanitation District	Return flows from transferred ag water rights discharged from Security WWTF	1,000	1.38	2,000	2.76
Woodmoor Water and Sanitation District	Return flows from ² DBGW & transferred ag water rights (under development) discharged from TLWWTF	652	0.900	1,160	1.60
Total		6,382	8.81	8,752	12.09

¹ Utilities expects to expand its IPR/DPR reuse significantly by 2070 up to the goal of 50-75 MGD capacity set in the 2017 IWRP. Such increase may be accomplished by a significant expansion of the system identified in this study or by a separate system

3.2 WATER RIGHTS FLOWS

As previously noted, water rights flows owned by the participants and available on lower Fountain Creek could be accessed through some upsizing of the infrastructure needed to recover and return their reuse flows. Those water rights are listed in Table 3-2. They are generally available for diversion during the irrigation season, April through October.

Table 3-2: Water Rights for Delivery

Entity	Location/Notes	Water Rights (AFY)
<i>Springs Utilities</i>	NA	NA
DWSD	Laughlin Ditch	300
FLMD	NA	NA
Monument	NA	NA
SWSD	Fountain Creek	1,000
TMD	FMIC Shares	740
WWSD	JV Ranch	2,630
TOTAL		4,670

CHAPTER 4 ALTERNATIVES

For each of the entities with return flows and water rights available within the Fountain Creek basin, we reviewed a number of conveyance and storage possibilities. After an initial screening with the participants, we developed a series of conceptual alternatives with diversions at or downstream of the Las Vegas WWTF and located on the east side of Fountain Creek and Interstate I-25, generally affording closer proximity to Springs Utilities’ SDS transmission pipeline.

Those eight alternatives vary with respect to the diversion, storage, treatment and conveyance of water from Fountain Creek into the SDS:

ALTERNATIVE	DIVERSION	STORAGE RESERVOIR	SDS CONNECTION
A-1	FMIC Canal	Big Johnson	Bailey WTP
A-2	FMIC Canal	Big Johnson	Bradley Pump Station
B-1	Chilcott Canal	Callahan	Bailey WTP
B-2	Chilcott Canal	Callahan	Williams Creek Pump Station
B-3	New Diversion & Pipeline	Callahan	Williams Creek Pump Station
B-4	Modified Owen & Hall Diversion & Pipeline	Callahan	Williams Creek Pump Station
C-1	Chilcott Canal	New Williams Creek via Callahan	SDS Transmission Line
C-2	New Diversion	New County Line	SDS Transmission Line

These initial alternatives are depicted in the figures that follow, along with a description of each. Conceptually, each alternative was thought to possibly include some level of pretreatment to assure compatibility with SDS water quality prior to connecting to the SDS. With each, the water would be treated to finished standards at the Bailey WTP, and conveyed to the participants via the Springs Utilities distribution system.

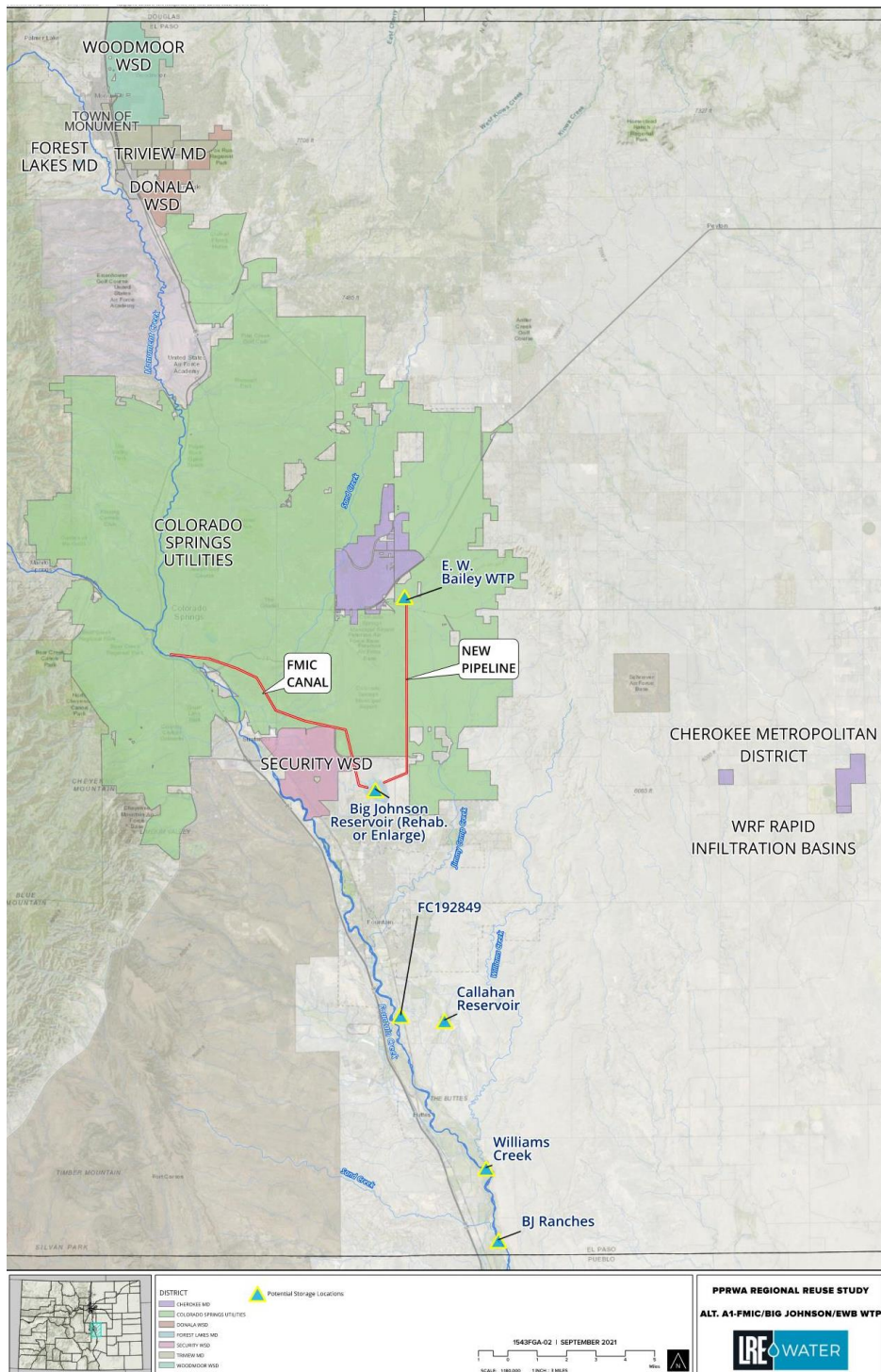


Figure 4-1: Alt A-1

Alt A-1 uses the FMIC canal to divert water from Fountain Creek to Big Johnson Reservoir. A new pipeline would be built to take water from Big Johnson Reservoir to the Bailey WTP.

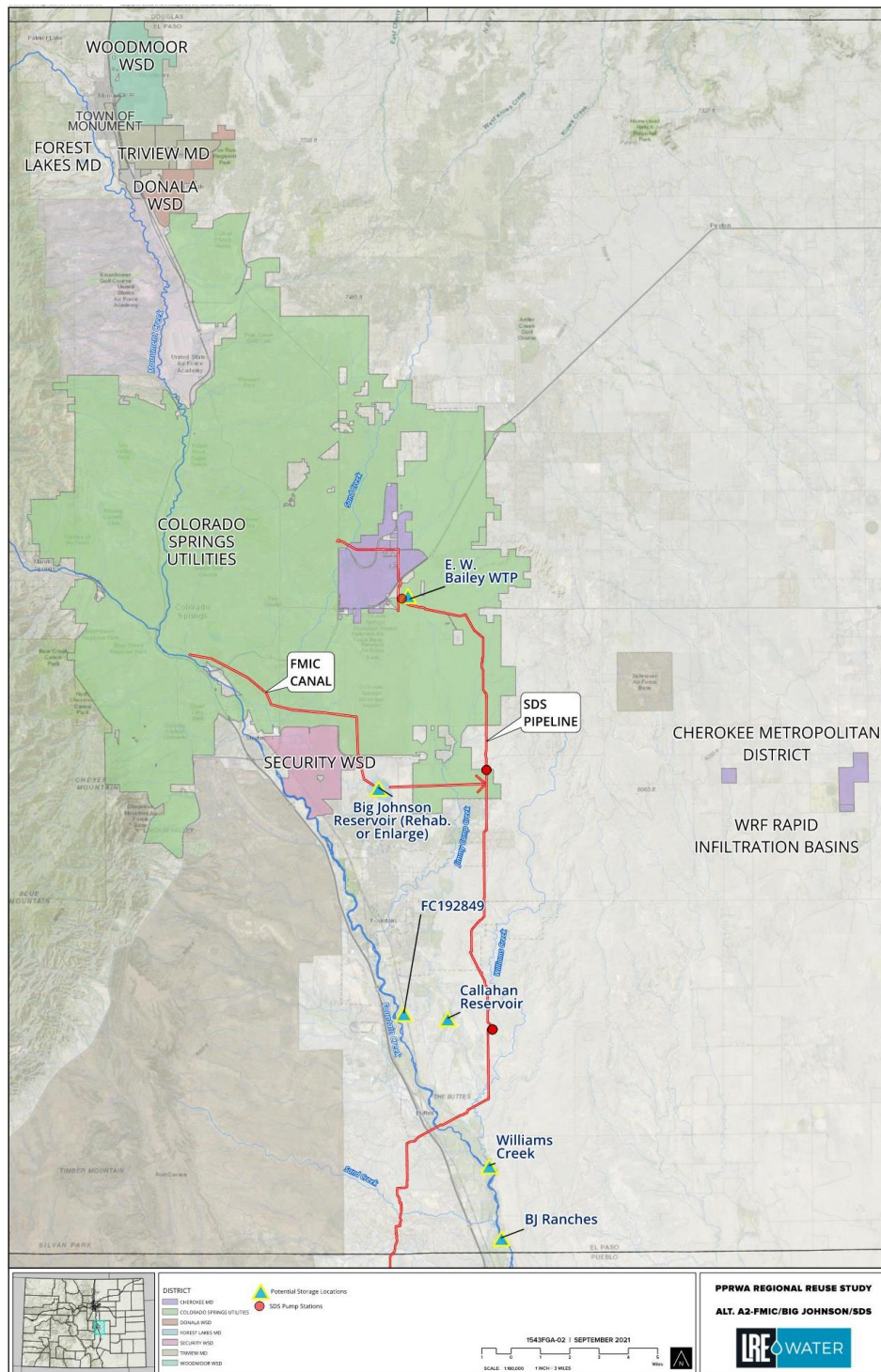


Figure 4-2: Alt A-2

Alt A-2 uses the FMIC canal to divert water from Fountain Creek into Big Johnson Reservoir. A new pipeline would convey water from Big Johnson Reservoir to the SDS Bradley Pump Station.

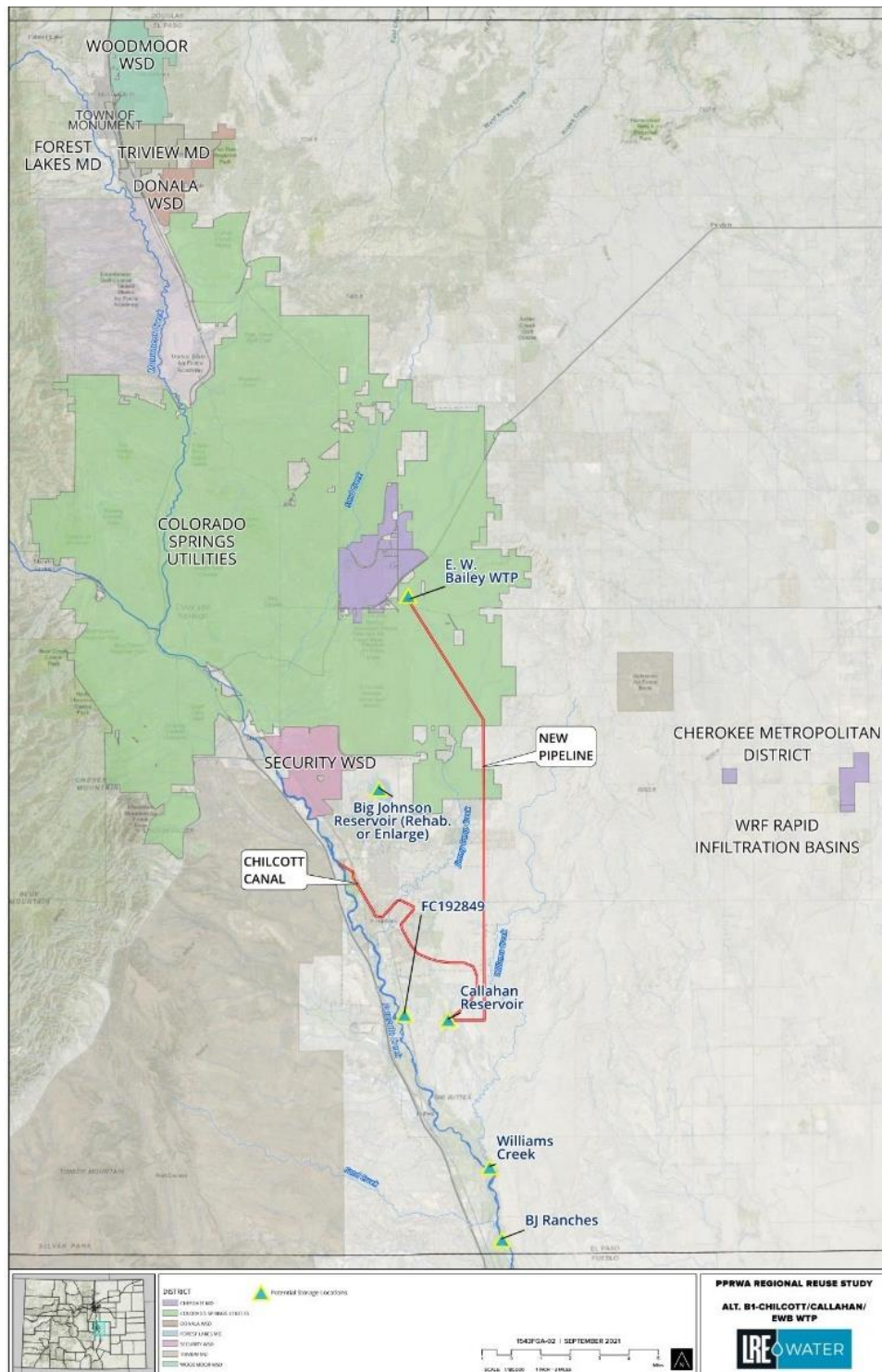


Figure 4-3: Alt B-1

Alt B-1 uses the Chilcott canal to divert water from Fountain Creek to Callahan Reservoir. A new pipeline would be constructed to convey the water from Callahan Reservoir to the Bailey WTP.

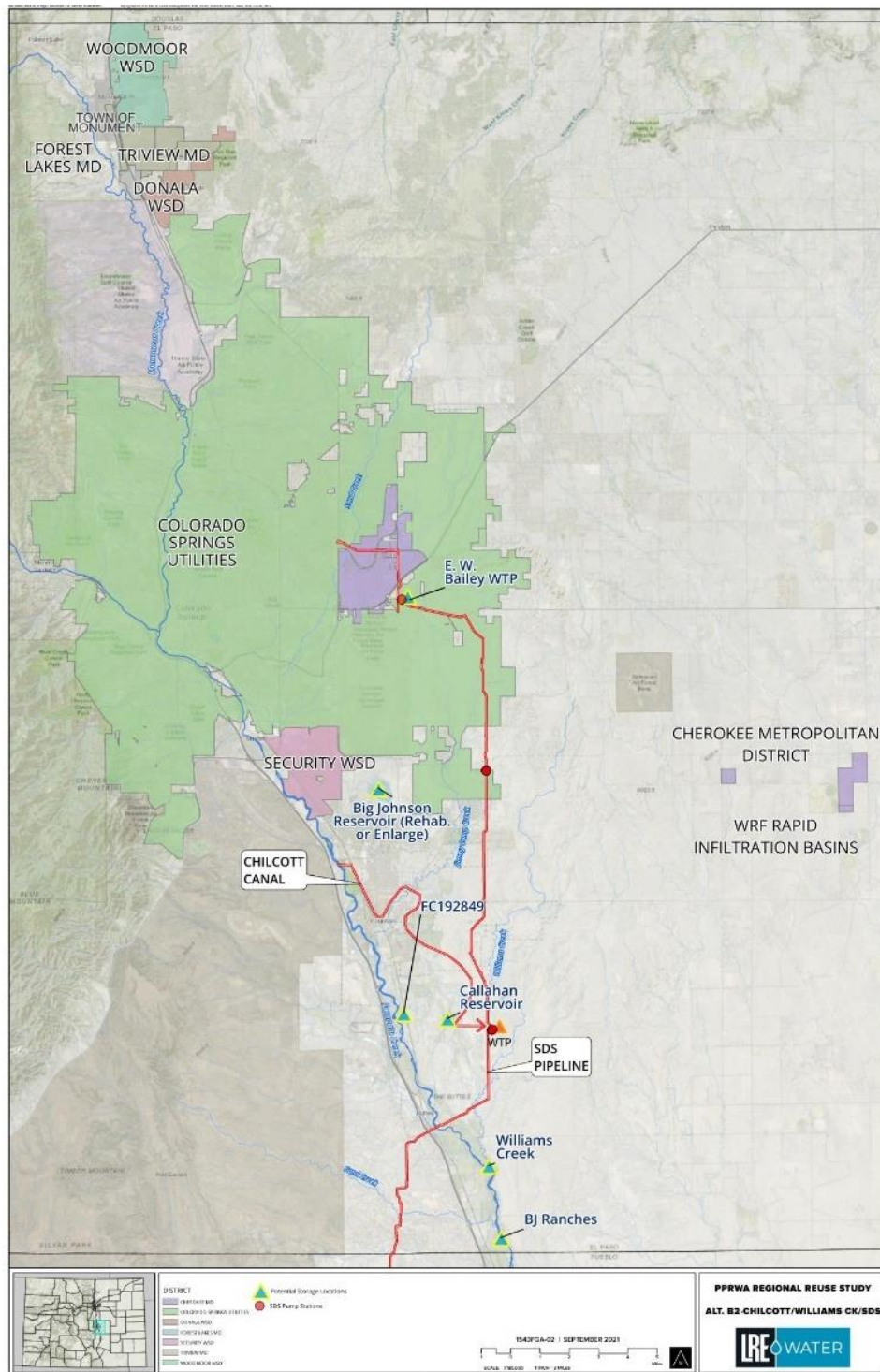


Figure 4-4: Alt B-2

Alt B-2 uses the Chilcott canal to divert water from Fountain Creek to Callahan Reservoir for storage. Water would be piped from Callahan Reservoir to the SDS Williams Creek Pump Station.

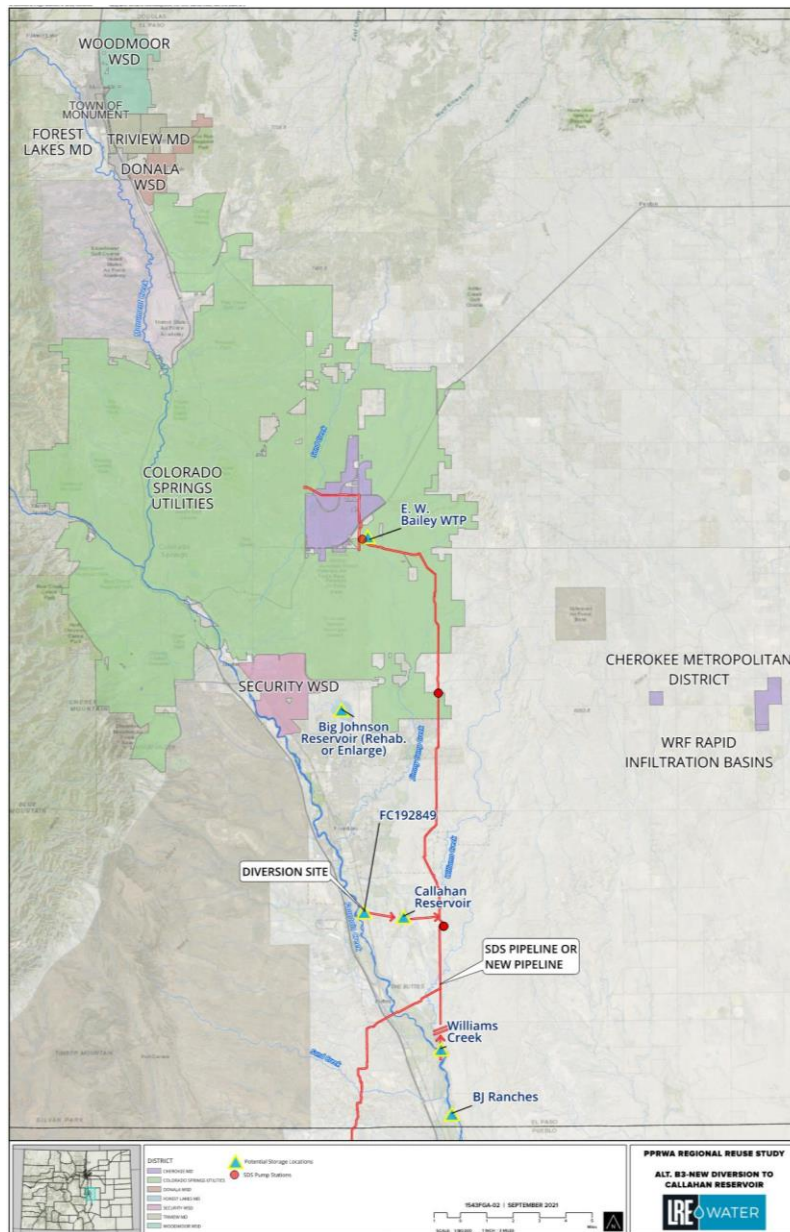


Figure 4-5: Alt B-3

*Alt B-3 would use a new diversion and pipeline from a location previously identified as a possible detention pond site by the Fountain Creek Flood Control District **R** to convey water from Fountain Creek to Callahan Reservoir. Water from Callahan Reservoir would be piped over to the SDS Williams Creek Pump Station.*

Alt B-4 would similarly use a modified diversion (close to the Alt B-3 diversion) to convey water from Fountain Creek to Callahan Reservoir. The Owen & Hall diversion structure would be modified to provide an outlet on the east side of the creek. Water from Callahan Reservoir would be piped over to the SDS Williams Creek Pump Station.

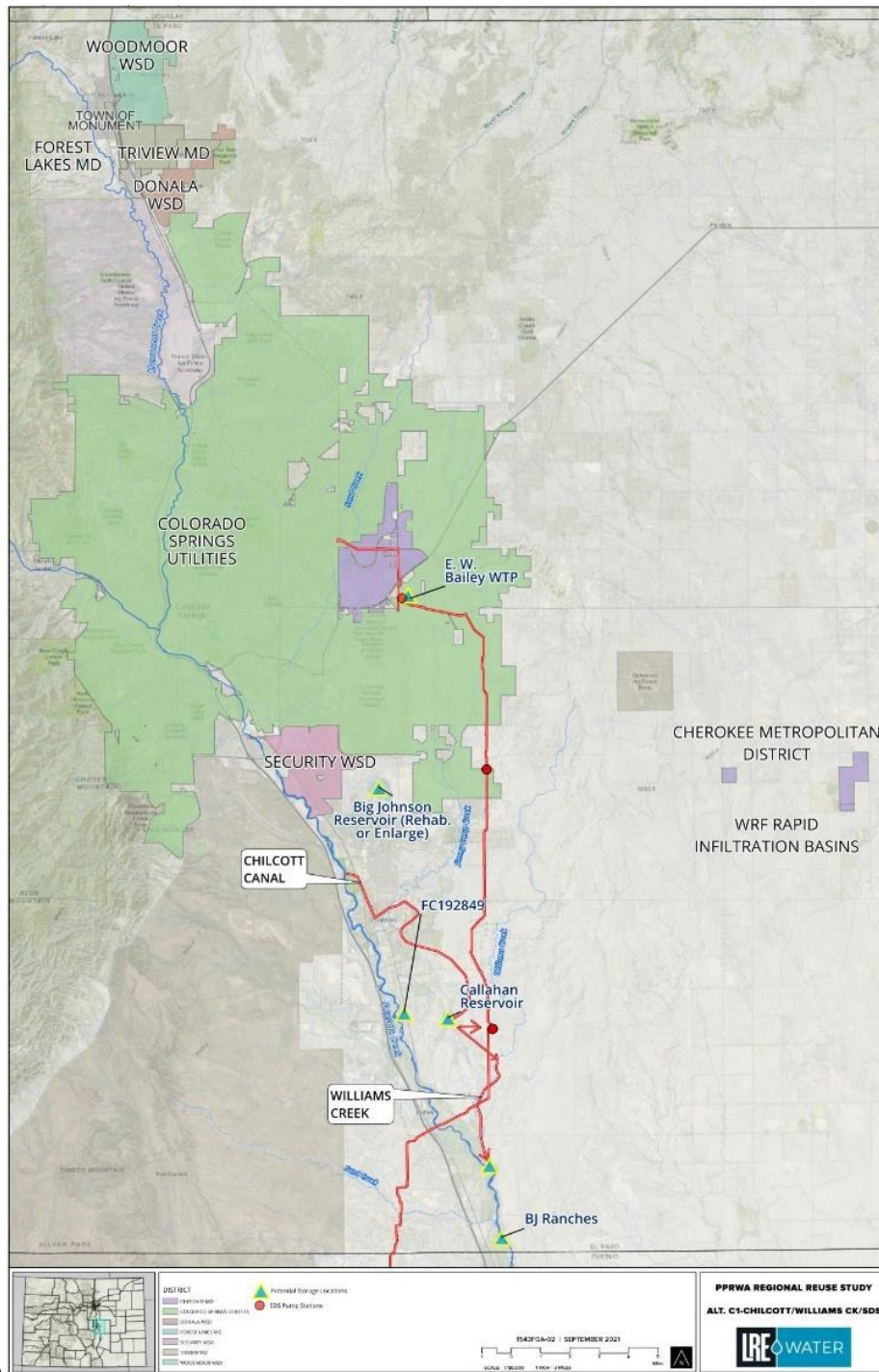


Figure 4-6: Alt C-1

Alt C-1 uses Chilcott canal to divert water from Fountain Creek to Callahan Reservoir. Water would flow past Callahan Reservoir for storage at a new Williams Creek Reservoir. The water would then be pumped to a connection with the SDS transmission pipeline.

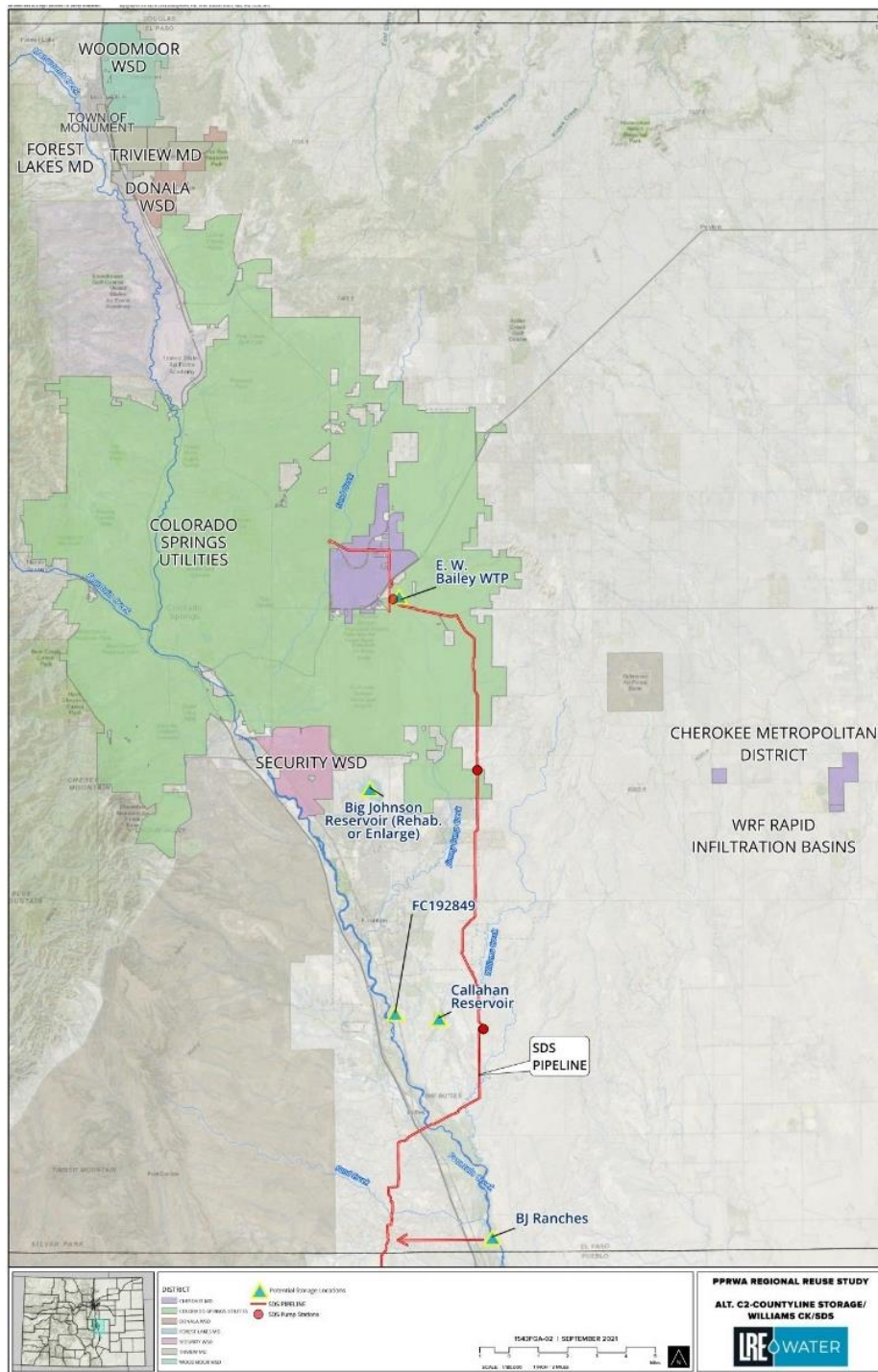


Figure 4-7: Alt C-2

Alt C-2 would include a new diversion structure and some operational storage at the BJ Ranches property located just north of the Pueblo County line. The water would be piped west to a connection with the SDS transmission pipeline.

CHAPTER 5

SCREENING OF ALTERNATIVES

In order to screen the eight conceptual alternatives for closer analysis, we developed an evaluation matrix consisting of five categories. Those categories are Selection Criteria, Site Development, Technical Criteria, and Environmental/Permitting Criteria and there are subcategories for each. The ability of each alternative to meet each criterion is quantified by a numerical score, then tallied to identify the better alternatives for closer review. The tabulated results are shown in Appendix III and summarized in this chapter.

5.1 SELECTION CRITERIA

The first category used to evaluate each alternative was Selection Criteria. This category consists of two criteria, Connection and Capacity Available. The Connection criterion scores the alternative's ability to connect to existing or reasonably foreseeable conveyance, storage and treatment facilities; it must be conceptually feasible and integrate with known or planned operations of the participants. The Capacity Available criterion scores whether minimum storage is available to meet the capacity requirements for each alternative.

Alts. A-1, A-2, B-1, and B-2 scored highest for this category.

5.2 SITE DEVELOPMENT CRITERIA

The second category used to evaluate each alternative was Site Development. This category consists of two different criteria, Property Conflicts and Road Relocation. The Property Conflicts criterion quantifies the number of parcels within each site and allocates a score based upon likelihood of property conflicts during construction of an alternative. Road Relocation considers the length of roads that would need to be relocated.

Alts. B-1 and B-2 scored highest for this category.

5.3 TECHNICAL CRITERIA – RESERVOIR STORAGE

The third category used to evaluate each alternative was Technical Criteria – Reservoir Storage. This category contains seven subcategories:

1. Return Flow Capture. This criterion considers how much of the participant return flows can be captured directly from diversion.
2. Existing or New Storage. This criterion considers whether new storage is required.
3. Average Depth. This criterion considers the average depth of the storage reservoir and its effect on potential for evaporative losses.
4. Dam Height. This criterion considers the maximum dam height needed. Higher dams are less desirable.
5. Dam Length. This criterion considers dam length, and alternatives that required longer dams are less desirable due to higher costs and permitting.

6. Site Geometry. This criterion considers site geometric efficiency. A square reservoir makes more efficient use of space than a rectangular one.
7. Drainage Basin Size. This criterion considers the drainage basin size that drains into the reservoir. A larger drainage basin is more undesirable due to an increased need to mitigate flooding with added infrastructure (such as a larger spillway).

Alts. A-1 and A-2 scored highest for this category.

5.4 TECHNICAL CRITERIA-CONVEYANCE

The fourth category used to evaluate each alternative was Technical Criteria – Conveyance. This category contains five criteria:

1. Existing or New Diversion. This criterion considers if a new diversion is required to deliver water to a reservoir.
2. Existing or New Conveyance. This criterion considered whether new conveyance is required to deliver water to the Bailey WTP.
3. Pumping to Storage. This criterion considers if pumping will be required or if gravity can convey water from Fountain Creek to the reservoir.
4. Pumping Return. This criterion considers the level of pumping required to convey water from the intake point into the reservoir.
5. Distance from Headgate. This criterion considers the distance of the reservoir from the headgate. The longer the distance from the headgate results in increased ditch losses and capacity issues.

Alts. A-1, A-2, B-1, and B-2 scored highest for this category.

5.5 ENVIRONMENTAL/PERMITTING CRITERIA

The fifth category used to evaluate each alternative was Environmental and Permitting. This category contains three criteria:

1. Environmental Permitting. This criterion considers possible environmental permitting impacts of construction of the alternative. Specifically, wetlands issues would be expected to present more difficulty in obtaining environmental permits.
2. Water Rights Issues. This criterion considers potential water rights issues with the possible need to purchase additional land for a given alternative. If the purchased land contains more senior water rights or has irrigated areas, it would be more difficult to obtain.
3. 1041 Permitting. This criterion considers the difficulty of obtaining a 1041 Permit.

Alts. A-1 and A-2 scored the highest for this category.

5.6 EVALUATION SUMMARY

The top alternatives identified were A-1 and A-2 with a tied score. Alternatives B-1 and B-2 were closely tied at the second highest score. The differentiating category among the top alternatives was Environmental/Permitting, given 1041 permitting impacts and environmental permitting. The Callahan dam would require improvements of the outlet works, while Big Johnson's dam will likely require less permitting for expansion, and its outlet was already upgraded in recent years.

Alts. B-3, B-4, C-1 and C-2 scored much lower. They would require new storage facilities further downstream than Big Johnson and Callahan Reservoirs, resulting in a more complex system with greater stream losses and requiring return flow pumping from lower elevations over greater distances. These alternatives were eliminated from further consideration.

5.7 REFINED ALTERNATIVES

Upon consideration by the project participants, the alternatives were refined for the more detailed analysis that followed. Alts. A-1 and B-1 would both require construction of a new return pipeline to the Bailey WTP, essentially paralleling the SDS transmission pipeline. But the SDS pipeline has sufficient capacity to include those return flows making Alts. A-2 and B-2 more cost effective, so Alts. A-1 and B-1 were eliminated from further consideration.

Given that the Chilcott canal is normally taken out of service during the winter, three new alternatives were added for consideration: C-3.1, C-3.2 and C-3.3. For all three, water rights flows would be conveyed by Chilcott Ditch during irrigation season, but each would have a different means for diverting and conveying year-round return flows. Alt. C-3.1 would use the reconfigured Owen & Hall diversion and pumping, C-3.2 would use the detention pond site diversion and pumping, and C-3.3 would require pumping from an alluvial well field at Fountain Creek.

It was also noted that there could be some improvement in the water quality of Fountain Creek return flows through riverbank filtration; filtering that occurs naturally in the alluvium with the use of shallow wells along the creek. That could result in added benefit for Alt. C-3.3. Similarly, an alluvial well field could be incorporated to pump return flows with the Big Johnson Reservoir option, and that became Alt. A-3. These two alluvial well field options could allow the return flows to bypass storage and some or all of the pretreatment processes for conveyance directly to one of the SDS pump stations, allowing for smaller pretreatment facilities.

We also considered three possible split combinations, Alts. D-1, D-2 and D-3 whereby the summer flows (water rights and return flows) would be conveyed by the FMIC canal for storage at Big Johnson Reservoir, and winter return flows would be conveyed from the Owen & Hall diversion (D-1), the detention pond diversion (D-2) or an alluvial well field (D-3) to Callahan Reservoir and then to the SDS Williams Creek pump station. All three were dismissed due to their complexity and the extent of infrastructure required.

CHAPTER 6 ALTERNATIVE ANALYSIS

Following reconnaissance, and identifying and screening of alternatives, this chapter documents further analysis of the six remaining alternatives listed in Table 6-1. (Please see Appendix IV for mapping and diagrams for each.) This analysis identifies the better alternatives to be considered further for implementation.

ALTERNATIVE	DIVERSION	STORAGE RESERVOIR	SDS CONNECTION
A-2	<i>FMIC Canal</i>	<i>Big Johnson</i>	<i>Bradley Pump Station</i>
A-3	<i>Water Rights-FMIC Canal; Return Flows-Alluvial Well Field</i>	<i>Big Johnson</i>	<i>Bradley Pump Station</i>
B-2	<i>Chilcott Canal</i>	<i>Callahan</i>	<i>Williams Creek Pump Station</i>
C-3.1	<i>Water Rights-Chilcott Canal; Return Flows-Owen & Hall Diversion</i>	<i>Callahan</i>	<i>Williams Creek Pump Station</i>
C-3.2	<i>Water Rights-Chilcott Canal; Return Flows-Detention Pond Diversion</i>	<i>Callahan</i>	<i>Williams Creek Pump Station</i>
C-4	<i>Water Rights-Chilcott Canal; Return Flows-Alluvial Well Field</i>	<i>Callahan</i>	<i>Williams Creek Pump Station</i>

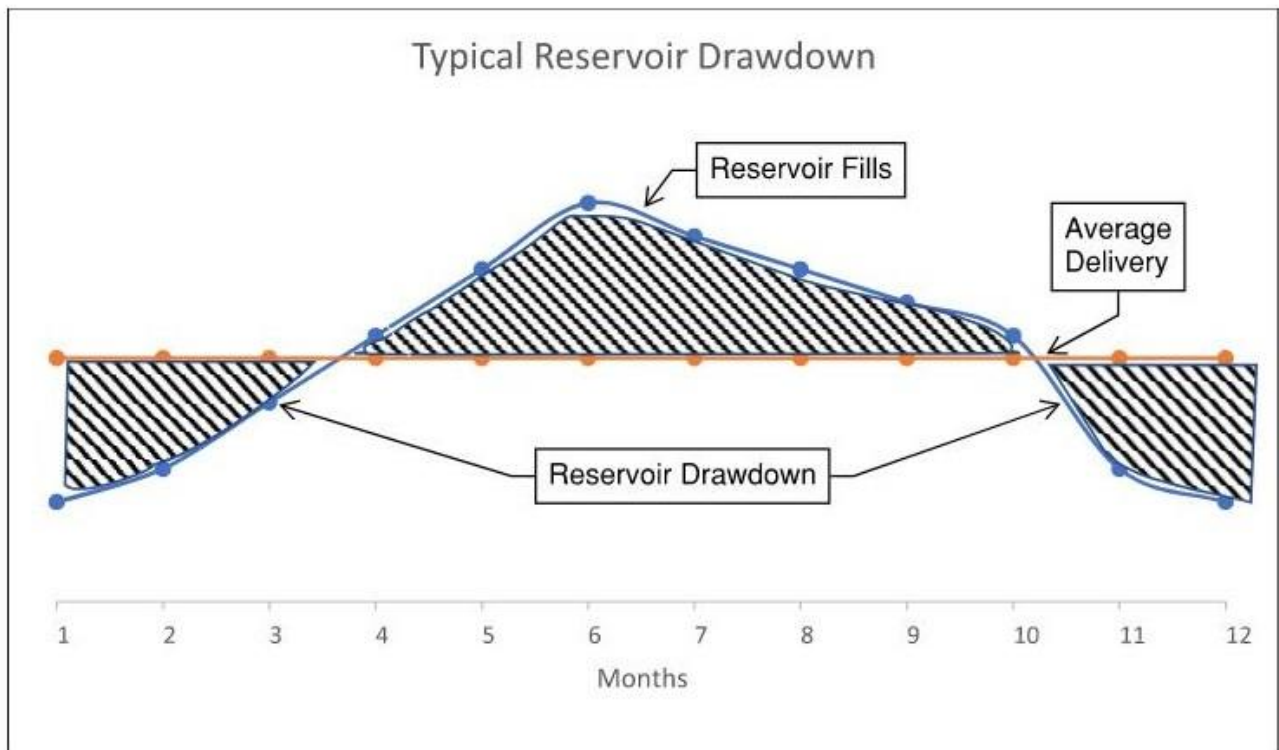
The components of each alternative are described further for comparison and contrast. First, we explain how return flows and water rights flows affect system planning differently. That leads to discussion of the diversion options, storage, treatment, and conveyance for connection to the SDS.

6.1 RETURN FLOWS VS. WATER RIGHTS FLOWS

As described in detail in Chapter 3, reuse return flows are relatively constant year-round. The return flows recaptured from Fountain Creek can then be available for use at approximately those same rates (less system losses) in respective participant water systems. Water rights diversions, however, occur primarily during the irrigation season.

An underlying condition of this study is that deliveries to suburban water providers must be at relatively constant rates year-round so as not to require Springs Utilities to reserve system capacity to deliver peak demands to those providers. Water storage is needed to dampen the water rights flows such that they fill the reservoirs during the irrigation season (when diversions exceed deliveries) and draw down the rest of the year (when deliveries exceed diversions). The reservoir would operate to discharge those flows at a fairly constant rate year-round as illustrated by Figure 6-1.

Figure 6-1: Typical Reservoir Drawdown



6.2 DIVERSION OPTIONS

All of the remaining alternatives use existing diversions and conveyances for at least a portion of their flows. Alts. A-2 and A-3 use the FMIC canal, and the others use the Chilcott canal.

6.2.1 FMIC CANAL

The FMIC canal would be used for Alts. A-2 and A-3. Interestingly, three participants in this study are members of FMIC and comprise a majority interest; TMD, Springs Utilities and SWSD. The FMIC canal is approximately 9.5 miles long from the headgate to Big Johnson Reservoir. Flow is currently restricted to 15-20 cfs in the upper portion of the canal, from the headgate to the Spring Creek augmentation station/turnout (approximately 3300 feet). Below that point, the canal has capacity to deliver at least 20 cfs to the reservoir and its capacity could be increased through ditch lining. Ditch losses from the headgate to the reservoir are estimated at 10 percent.

6.2.2 CHILCOTT CANAL

The Chilcott canal would be used for Alts. B-2, C-3.1, C-3.2 and C-4. WWSD has an ownership interest in this canal. It is slightly longer than the FMIC canal at 9.6 miles. The Chilcott canal is expected to have ample capacity available for purposes of this study, and it could also be improved in areas. Although actual losses are comparable to those of the FMIC canal, Chilcott requires that conveyance agreements account for a 15 percent loss in their accounting for delivery to Callahan Reservoir.

6.2.3 NEW/MODIFIED DIVERSIONS

Three alternatives would add a second means of diverting/conveying to (or bypassing) Callahan Reservoir for only the return flows, in addition to conveying the water rights flows in the Chilcott canal. All three would have minimal losses due to piping conveyance vs. ditches.

Alt. C-3.1 would require modifications to the existing Owen & Hall diversion structure with pumping and piping to the reservoir. Alt. C-3.2 would require acquisition of the detention pond property, along with approval and construction of a new diversion structure with pumping and piping to the reservoir. Alt. C-4 would require property acquisition and construction of an alluvial well field to pump directly to the SDS Williams Creek pump station (assuming that riverbank filtration would counter the need for pretreatment).

6.3 WATER STORAGE OPTIONS

An analysis of water rights flows vs. storage capacity indicates that 1,500 to 1,600 AF of capacity would be needed in either Big Johnson Reservoir or Callahan Reservoir to optimize year-round use of 4,670 AFY in water rights (see Chapter 3) owned by the participants in this study. Differences in how the two reservoirs are operated point to very different expansion requirements to accommodate the water rights flows considered in this study.

Because reuse flows will be diverted and returned also at fairly constant rates year-round, no storage is theoretically needed to facilitate regional reuse. The return flows diverted from lower Fountain Creek can be delivered to the entities at those same constant rates (not accounting for system losses). Some storage may be needed only to maintain operations in the event of a water transmission line break, pump station failure or some other system upset. The storage to be provided to accommodate the water rights can also function as operational storage for this purpose.

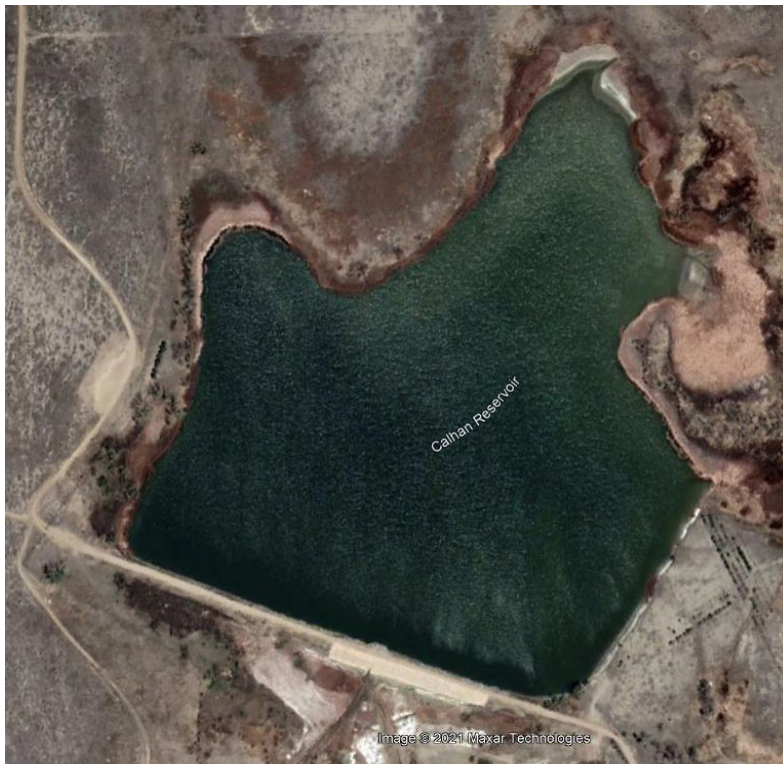
6.3.1 BIG JOHNSON RESERVOIR

Big Johnson Reservoir fills for “winter storage” throughout the non-irrigation season, typically reaching its highest level in March each year. The reservoir is then drawn down to accommodate irrigation usage throughout the summer. Because those current uses are “out of phase” with storage needs for the participants’ water rights, a large share of existing storage capacity could also accommodate those water rights. If so, a nominal expansion of 500 AF could be sufficient.



6.3.2 CALLAHAN RESERVOIR

Callahan Reservoir on the other hand, is operated for summer storage, filling seasonally at the same time as needed for diversion of the participants' water rights. Therefore, Callahan's existing capacity is not available to accommodate those water rights and an expansion of 1,500 to 1,600 AF would be required.



6.4 WATER TREATMENT

The extent and capacity of water treatment required for each of the alternatives are significant factors in comparing the capital, operation and maintenance costs. For all alternatives, the water would be conveyed to Springs Utilities' SDS-Bailey Water Treatment Plant (BWTP) prior to distribution to participant systems. It will likely be more cost effective for all participants to consolidate treatment for the Fountain Creek return flows/water rights at the BWTP, but more water quality information is needed to determine what additional treatment processes or plant modifications would be needed.

Otherwise, some level of pretreatment for the Fountain Creek water could be required to make it more compatible with SDS water quality originating in Pueblo Reservoir. Additionally, water from alluvial wells along Fountain Creek would benefit from riverbank filtration, resulting in better quality water compared to surface flows diverted from the creek. If pretreatment is required for Fountain Creek water, some or all pretreatment processes could be bypassed for the supply portion drawn from alluvial wells.

CHAPTER 7 COST COMPARISONS

This chapter provides further screening of the six remaining alternatives listed below for closer analysis and recommendations. The alternatives are compared on the bases of capital costs, operation and maintenance costs, total present worth and net production after water losses.

- Alt. A-2: FMIC Canal to Big Johnson Reservoir to SDS-Bradley Pump Station
- Alt. A-3: Similar to Alt. A-2 but includes alluvial wells pumping return flows to bypass Big Johnson Reservoir
- Alt. B-2: Chilcott Ditch to Callahan Reservoir to SDS-Williams Creek Pump Station
- Alt. C-3.1: Owen & Hall diversion to Callahan Reservoir to SDS-Williams Creek Pump Station
- Alt. C-3.2: Detention pond diversion to Callahan Reservoir to SDS-Williams Creek Pump Station
- Alt. C4: Similar to Alt. B-2 but includes alluvial wells pumping return flows to bypass Callahan Reservoir

Capital cost opinions, annual operations and maintenance costs, and total present worth in 2022 dollars to build, operate and maintain the alternative systems for 20 years are shown in the tables that follow. Table 7-1 shows the costs if no pretreatment is required and all treatment is provided at the BWTP. Table 7-2 that follows shows the costs if pretreatment is necessary prior to combining the Fountain Creek return/water rights flows with SDS sourced water.

Table 7-1: Alternative Costs Without Pretreatment

ALTERNATIVE	CAPITAL COST	ANNUAL O&M	TOTAL PRESENT WORTH
ALT A-2	\$19.3-23.3M	\$0.25M	\$27.4-31.4M
ALT A-3	\$26.0-30.0M	\$0.44M	\$37.6-41.6M
ALT B-2	\$19.7-31.9M	\$0.10M	\$24.3-36.5M
ALT C-3.1	\$27.2-39.3M	\$0.16M	\$33.5-45.6M
ALT C-3.2	\$25.4-37.6M	\$0.16M	\$31.8-44.0M
ALT C-4	\$29.5-41.6M	\$0.25M	\$37.4-49.5M

Table 7-2: Alternative Costs With Pretreatment

ALTERNATIVE	CAPITAL COST	ANNUAL O&M	TOTAL PRESENT WORTH
ALT A-2	\$61.5-65.6M	\$1.50M	\$85.6-89.6M
ALT A-3	\$46.0-50.1M	\$1.44M	\$69.7-73.6M
ALT B-2	\$68.5-80.7M	\$1.31M	\$88.0-100.2M
ALT C-3.1	\$77.5-89.7M	\$1.38M	\$98.4-110.2M
ALT C-3.2	\$75.9-88.1M	\$1.37M	\$96.4-108.5M
ALT C-4	\$56.1-68.3M	\$1.25M	\$74.7-86.8M

7.1 CAPITAL COSTS

Alts. A-2 and A-3 using the FMIC canal and Big Johnson Reservoir (with A-3 also including alluvial wells) mirror Alts. B-2 and C-4 using Chilcott canal and Callahan Reservoir (with C-4 including alluvial wells), but are expected to have lower capital costs. Because the return and water rights flows of this Study require storage off peak from current storage requirements in Big Johnson Reservoir, the reservoir need only be expanded by up to 500 AF. Current storage in Callahan Reservoir matches the seasonal needs of the flows of this study and would require expansion by more than 1,500 AF.

Alts. C-3.1 and C-3.2, the alternatives adding new or modified diversions for piping and pumping surface flows to Callahan Reservoir, would be more costly than Alt. B-2 because of the additional infrastructure needed vs. conveying flows to Callahan Reservoir via the existing Chilcott canal.

7.2 O&M COSTS

Intuitively, O&M costs for the Callahan Reservoir alternatives would be higher than for the Big Johnson Reservoir alternatives because Callahan is approximately 240 ft lower in elevation and 9 miles further downstream, requiring more pumping energy to convey the return/water rights flows to the BWTP. That pumping component is not included in this evaluation however, as it would be added to Springs Utilities operations and this Study only identifies the costs to convey the water to a point of connection to the SDS. The O&M costs shown in the tables are based on pumping flows 4.3 miles from Big Johnson Reservoir to the SDS-Bradley Pump Station vs. only 1.1 miles from Callahan Reservoir to the SDS-Williams Creek Pump Station.

7.3 TOTAL PRESENT WORTH COSTS

The total present worth costs, the funds needed in 2022 dollars to build, operate and maintain the system for 20 years, are generally lower for the FMIC canal-Big Johnson Reservoir alternatives (A-2 and A-3) than the Chilcott canal-Callahan Reservoir alternatives (B-2 and C-4). With no pretreatment required, Alt. A-2 using only FMIC canal to convey flow to Big Johnson Reservoir is more cost-effective than adding an alluvial well field for conveyance of return flows bypassing the reservoir. If pretreatment is required, the improved water quality from alluvial wells results in lower costs of treatment, offsetting the added costs of the alluvial well field and conveyance piping/pumping.

7.4 NET PRODUCTION

It is also helpful to consider the widely varying water losses of the six remaining alternatives in addition to the cost analyses. The alternatives generally have a mix of Fountain Creek transit losses, ditch losses, reservoir evaporative losses, and treatment losses. Overlaying the cost analyses with the net production after deducting the losses of each alternative, the median cost per AF delivered is determined as shown in Table 7-3 and 7-4.

Table 7-3: Alternative Costs without Pretreatment

ALTERNATIVE	AVERAGE YIELD (AFY)	TOTAL PRESENT WORTH	COST PER AFY DELIVERED
ALT A-2	10,520	\$27.4-31.4M	\$2,790
ALT A-3	11,660	\$37.6-41.6M	\$3,400
ALT B-2	9,550	\$24.3-36.5M	\$3,180
ALT C-3.1	10,040	\$33.5-45.6M	\$3,940
ALT C-3.2	10,040	\$31.8-44.0M	\$3,770
ALT C-4	11,310	\$37.4-49.5M	\$3,840

Table 7-4: Alternative Delivery Costs with Pretreatment

ALTERNATIVE	AVERAGE YIELD (AFY)	TOTAL PRESENT WORTH	COST PER AFY DELIVERED
ALT A-2	10,520	\$85.6-89.6M	\$8,330
ALT A-3	11,660	\$69.7-73.6M	\$6,140
ALT B-2	9,550	\$88.0-100.2M	\$9,850
ALT C-3.1	10,040	\$98.4-110.2M	\$10,390
ALT C-3.2	10,040	\$96.4-108.5M	\$10,200
ALT C-4	11,310	\$74.7-86.8M	\$7,140

7.5 RECOMMENDED ALTERNATIVES

When considering the yield and costs for each alternative, Alt A-2 is the lowest cost at \$2,790 per AFY delivered if no pretreatment is required. Alt A-3 is the lowest cost at \$6,140 per AFY delivered if pretreatment is required.

It is recommended that capacity in the FMIC Canal be used to convey flows for storage in an expanded Big Johnson Reservoir, then on to the SDS-Bradley Pump Station. If pretreatment is found to be necessary, an alluvial well field on Fountain Creek should be evaluated for conveying reuse return flows bypassing treatment of water rights flows from reservoir storage.

CHAPTER 8 IMPLEMENTING THE PLAN

A regional water reuse system as described in this study is feasible and could prove to be very cost effective to implement, once all costs are identified. Each participant can benefit from the “savings of scale” that a single regional system offers vs. having each entity independently develop their own system. The regional system could also provide the means for delivery of current and future water rights available from Fountain Creek.

Costs need to be confirmed (or identified) for three critical topics before the full financial picture can be known. Specifically, those areas are: (1) FMIC/Big Johnson Reservoir; (2) pretreatment vs. treatment consolidation at the Bailey WTP; and (3) Springs Utilities charges for treatment/delivery. Each is described further below.

8.1 FMIC/BIG JOHNSON RESERVOIR

As developed through this study, the alternatives making use of the FMIC canal and expanded storage in Big Johnson Reservoir are the more cost-effective options. The participants should open discussions with the rest of the FMIC ownership to explore the possibilities of how they can mutually benefit from shared use of the FMIC facilities as a key part of the regional reuse system. Sizing the possible reservoir expansion will need to be considered for joint operation of current needs with those of the study participants.

8.2 TREATMENT

It will likely be more cost effective to consolidate treatment of Fountain Creek water at the SDS-Bailey WTP rather than provide some level of pretreatment at a separate facility. To confirm, Springs Utilities will need to determine what (if any) treatment modifications would be needed at Bailey and what operational costs could be incurred.

That analysis will depend on a comparing water quality for the Fountain Creek return flows to that of the SDS raw water quality that Bailey currently treats, including seasonal variations. Additional sampling over some extended period of time may be required. Tables showing the water quality constituents currently sampled for both supplies are shown in Appendix V. If all treatment is to be provided at the Bailey WTP, Alt. A-2 would be the more cost-effective plan for the regional reuse system (vs. Alt. A-3 with an alluvial well field) as noted in Chapter 6.

8.3 SPRINGS UTILITIES

Moreover, Springs Utilities will need to charge each of the other participants for their respective share of finished water treatment and delivery costs to points of connection to those other water systems. Those cost shares will need to be factored into the overall cost determination for each participant.

8.4 OTHER CONSIDERATIONS

Two other considerations are noted as the participants move toward performing their “due diligence” with regard to a regional system: point of diversion and storage need. With regard to point of diversion, it is assumed for this study that the participants can legally obtain their return flows at the FMIC headgate (or from an alluvial well field in the area). It is assumed that the water rights flows can also be obtained at the headgate or could be transferred to that point of diversion. Each participant will need to review their water rights decrees and discuss with their water attorney to confirm.

Although allocation of costs is beyond the purposes of this study, it is helpful to again note that expanding reservoir storage would primarily accommodate the water rights flows. Some operational storage is helpful to manage return flows, but existing storage capacity in Big Johnson Reservoir could reasonably fulfill that need. Therefore, reservoir expansion costs would be funded primarily by those participants drawing water rights from Fountain Creek in excess of their return flows.

APPENDIX I: BIBLIOGRAPHY

Applegate Group, Inc., February, 2006, *Gravel Pit Reservoir Feasibility Study, Prepared for The City of Fountain*

Applegate Group, Inc., November, 2006, *Gravel Pit Reservoir Feasibility Study Addendum A, Prepared for The City of Fountain*

Applegate Group, Inc., August, 2009, *2009 Feasibility Study for Big Johnson Reservoir Enlargement, Prepared for Fountain Mutual Irrigation Company at the Request of Fountain Mutual Metropolitan District*

City of Fountain, October, 2009, *Bird Strike Hazard Assessment Design Considerations, Monitoring, and Mitigation*

Colorado Geological Survey, March, 2011, *El Paso County Groundwater Quality Study Phase 1, Prepared For El Paso County Groundwater Quality Study Committee*

Bishop, Jenny & Stewart, Neil, February 15, 2017, *Technical Memorandum: Colorado Springs Utilities*

Black & Veatch, April, 2004, *Southern Delivery System Terminal Storage and Exchange Reservoir Site Analysis Study for Colorado Springs Utilities*

Black & Veatch, September 24, 2008, *Lafarge Pit Appraisal Review, City of Fountain*

Emmons, M. Cole, October 10, 1996, *Final El Paso County Water Authority Establishing Contract*

Forsgren Associates Inc., January, 2014, *Notes on Background Documents PPRWA Regionalization Study*

Forsgren Associates Inc., April 15, 2014, *Town of Monument Water Master Plan*

Forsgren Associates Inc., April, 2015, *Pikes Peak Regional Water Authority: Regional Infrastructure Study*

Forsgren Associates Inc., October, 2016, *Town of Monument Woodmoor Water and Sanitation District No. 1 Reuse Plan*

Forsgren Associates Inc., November, 2016, *Water Supply Master Plan for Cherokee Metropolitan District*

Forsgren Associates Inc., April, 2017, *Pikes Peak Regional Water Authority: Area 3 Preliminary Engineering Report*

GMS, Inc., July, 2001, Revised August, 2001 & September, 2001, Updated December, 2002, & February, 2003, *Water System Master Plan for The Town of Monument*

Halepaska, John C. and Associates, Inc. & Knight Piesold and Co., September 6, 2002, *El Paso County Water Report Prepared for El Paso County Water Authority*

Integrated Water Resources Plan, TM #23 – Regionalization Analysis

Leonard Rice Engineers, Inc., June 20, 2011, *Phase I Investigation of National Environmental Policy Act (NEPA) and Pueblo County 1041 Issues Related to Southern Delivery System (SDS) Use, Project 1381PPR01*

MWH, January, 2017, *Fountain Creek Flood Control Study*

Rothberg, Tamburini & Winsor, Inc., October 2000, *Water Use Study Update for Town of Palmer Lake*

Stantec & Jacobs, December, 2020, *Regional Water and Wastewater Service Technical Studies: Project Summary Report for Colorado Springs Utilities*

URS Corporation, June 27, 2011, *Summary of Calhan Dam Due Diligence, Dam Inspection and Preliminary Feasibility Study, Project No. 22242330*

Utilities Policy Advisory Committee (UPAC), March 14, 2018, *White Paper Analysis and Recommendations to the Colorado Springs Utilities Board*

Water Matters!, May, 2004, *Appendix G: Previous Reports, A Water Conservation Plan for the Town of Monument, the Town of Palmer Lake and TriView Metropolitan District* and GMS, Inc. Consulting Engineers, July, 2001, Revised August, 2001 & September, 2001, Updated December, 2002, & February, 2003, *Water System Master Plan for Town of Monument*

Wheeler, W. W. & Associates, Inc., March 17, 2021, *Security Water District Water Resources Report*

April 3, 2000, *El Paso County Tables*

APPENDIX II: INTERVIEW SUMMARIES

Below are the summaries of interviews conducted with each participating entity to this study.

Cherokee Metropolitan District

Cherokee Metropolitan District (Cherokee) is generally sufficient in its current supply portfolio and is working toward decreasing its reliance on Denver Basin groundwater through ongoing development of its reuse system in the Upper Black Squirrel Creek Designated Groundwater Basin (UBSCDGB). The sustainability of its water rights and well systems will be greatly enhanced with the approval of a Replacement Plan to the UBSCDGB. At the same time, Cherokee is interested in acquiring renewable surface water supplies that might further enhance its supply portfolio and could also be used for replacement to the UBSCDGB. Cherokee has an extensive water infrastructure system for both raw and treated water that may be useful in a regional context.

Colorado Springs Utilities

Colorado Springs Utilities (CSU) is the County's largest water and wastewater service provider and serves as a central hub for the region. It is participating in this study because it may be able to optimize use of its infrastructure and improve efficiencies through regional cooperation. In recent years, CSU has considered related policy direction in the following areas:

- Regional collaboration without impairing the ability to serve existing customers;
- Leadership in regional water reuse of existing supplies;
- Ways to identify economies of scale and potential for efficiencies including use of the JD Philips Wastewater Recovery Facility (JDP), and development of the North Monument Creek interceptor (NMCI) in connection with the USAFA visitor center.

From the Water Services perspective, CSU is looking for the ability to craft contracts and water services without compromising collaborative storage and use by multiple entities. It is interested in pursuing a greater regional leadership role, and collaboratively using existing systems. CSU prefers to work with regional entities and get away from 'one off' or custom arrangements with multiple partners.

Additionally, CSU is developing a new Nonpotable Water Resource Plan with a goal of increasing nonpotable water use by 1,250 – 1,500 AF/yr., and perhaps as much as 2,500 AF/yr. They have an approved regional services plan, and will close the coal-fired Drake Power Plant in 2023 and the Nixon Power Plant in 2030. Both plants use wet cooling technologies they are currently the largest nonpotable water customers. CSU is also pursuing an Indirect Potable Reuse (IPR) demonstration project that dovetails with the NMCI and regionalization, and mitigates against limited exchange potential. Related to the IPR demonstration project, CSU is building a mobile direct potable reuse (DPR) unit with Colorado School of Mines using donated equipment and in-kind services. The unit will connect at JDP for direct reuse as a demonstration and proof of concept to gauge public support.

Utilities did not participate in the *PPRWA Regional Infrastructure Study*, but did participate in the *EPC Water Master Plan* and has completed numerous other studies including the IWRP. Their regional technical study is the most significant recent development. Going forward in CSU's master planning,

there will be a greater focus on anticipated growth in and out of the current service area where there may be opportunities to annex and coordinate with existing infrastructure. Their new Nonpotable Water Resource Plan can dovetail with the PPRWA Regional Reuse Study as both are on the same timeline for completion in 2021.

CSU's most significant challenges with respect to indirect or direct reuse of return flows are:

- Public acceptance;
- Recapture, storage and delivery mechanisms;
- Difficulty coordinating with a large group with different goals and objectives while trying to move in the same direction; and
- Administration and accounting of return flows is not merely a mathematical or engineering challenge, but also has political and socioeconomic implications.

With respect to demand growth, CSU's trajectory is tracking with the medium path identified in the IWRP with more indoor than outdoor use, resulting in a higher percentage of sewer return flows from the same demand level; a ratio of approximately 60/40 indoor/outdoor. Consumptive use is 43% over a 10-year average with 57% return flow system-wide.

CSU has numerous legal challenges associated with regionalization and reuse including the Pueblo County 1041 permit for SDS, not violating existing agreements, and non-injury to existing water rights. For example, CSU cannot deliver water outside of the Arkansas River basin. They need a lot of storage for different purposes including Restoration of Yield (ROY) storage pertaining to the Pueblo Management Program. High-level internal studies on sizes completed or underway, but not reviewed or published.

CSU recognizes that there may be better site options for the Williams Creek Reservoir as conceived in the 1990s during SDS permitting, but will maintain its interest in the selected site until a better alternative is proven. It may be best implemented in combination with storage elsewhere.

Donala Water and Sanitation District

Donala Water and Sanitation District (Donala) is a member of, and operates the Upper Monument Creek Regional Wastewater Treatment Facility. Its blended Denver Basin groundwater and transferred agricultural water supplies generate reusable return flows that accrue to Monument Creek and are either leased to downstream users or combine with native Fountain Creek and Arkansas River water uncredited to reuse by Donala. First use of its transferred surface water rights derived from lands in Lake County accrue to Pueblo Reservoir stored under a long-term Excess Capacity contract, and the water is subsequently conveyed, treated, and delivered through an arrangement with CSU using the SDS and an interconnect with CSU's treated water distribution system. Donala also owns Laughlin Ditch water that is currently unchanged for use in its service territory, but will also generate reusable return flows available for recovery. Donala continues to look for opportunities to acquire more renewable surface water supplies to decrease its reliance on nonrenewable groundwater adding redundancy and resilience to its supply portfolio.

In the context of this study, Donala is interested in identifying regional collaborative opportunities to recapture its reusable return flows for the sources described above.

Forest Lakes Metropolitan District

Forest Lakes is participating in this study due to noticeable changes in its lake volume. In 2020, the District's lake dropped about eight feet and if this continued, it could become a serious problem. The District has adequate water supplies; however, some of the water is tied up by developers. Reuse had not previously been considered as an option or pursued by the District. This year, 2021, the lake water level has been rising.

Currently, all water the District uses is reusable to extinction. The water rights were bought from CSU, and the only restriction is that the water must be used in Forest Lakes.

The District has not participated in a reuse study before, although some prior studies pointed to possible use of their reservoir as part of a reuse system. They also did not participate in the *PPRWA Regional Infrastructure Study*, but did participate in the *El Paso County Water Master Plan*. With respect to regional partnerships, the Northern Delivery System makes a lot of sense for the District.

Significant challenges for Forest Lakes are directly related to the water source and water quality. Forest Lakes must receive treated water as part of the reuse system. They are unable to receive raw water since this could create additional treatment and storage expenses.

Forest Lakes' build-out was expected to occur in 2024-2025 for residential sites; however, they now anticipate a slower trajectory. Currently, there are 262 taps connected, and the District expects to have 505 taps connected at buildout. Commercial sites are expected to be built out before the residential sites. There is currently one commercial tract that is 250 acres. Another commercial tract south of Baptist is accelerating and some services have already been extended. Sixty lots south of Bristlecone may go into a conservation easement.

Surface and groundwater rights are all held by a combination of developers and the District, however, the District has the power to move and/or change all water rights. With respect to water rights changes, Forest Lakes deeded all of the groundwater, but retained approximately 300 AF. They have also executed a warrant deed for 137 AF each in the Denver and Laramie Fox Hills aquifers.

Forest Lakes has a 1.5 MG storage tank for treated water in Bristlecone, of which 0.5 MG is licensed to Monument. There is another smaller tank on the west end. The district also has 1520 AF of raw water storage.

Town of Monument

Monument depends heavily on Denver Basin and wants to reduce the draw on its wells by making use of its reusable return flows. Participating in this study will help them figure out the most viable way to get return flows back, whether it is through a regional system or a more localized return as studied with Woodmoor WSD a few years back. If a regional system is favorable, they must consider whether it is connected to the CSU system or is an alternative possibly using Cherokee's Sundance pipeline. Capital, operational, maintenance, and carrying costs may be acceptable with enough regional partners, but that

needs to be evaluated. A flow-based allocation is preferred for infrastructure costs because the Town's demands are relatively small vs. those of some neighboring districts.

Demand is growing at 5% per year, but return flows are growing at 3% per year. Monument's demand growth is most likely to accelerate over past forecasts, and it may build out to 910 AF in as little as 10 years based on recent projections. In addition, much has changed since the Town's 2014 Water Master Plan—some projects have been completed and some developments delayed. The Town has no plans to buy additional water rights at this point, but regularly looks at such opportunities.

With respect to water quality, the long-distance delivery for a regional system may dissipate chlorine and introduce disinfection byproduct concerns. Raw water could be a bigger challenge—would either need to be treated at a new Monument water plant or regional Monument-area plant. If participating in a regional system, Monument may need terminal storage to help with meeting seasonal demands. It may also be worth reconsidering ASR.

Security Water and Sanitation District

Security Water and Sanitation District (SWSD) is a participant of the FVA and SDS systems, which puts SWSD in a good position with respect to water resources. They have some return flows accessible on Fountain Creek based on treated effluent credits and fully consumable water rights. SWSD is interested in being a part of this study to help the region succeed and seek out opportunities to work with the northern entities. SWSD is also interested in this study as a potential backup plan for water resources.

New water right acquisitions have occurred since the *PPRWA Regional Infrastructure Study* and the *El Paso County Water Master Plan*. SWSD recently completed an update to their Water Resource Report. SWSD also bought a ranch in Coaldale, on the Arkansas River. The property is a total of 200 acres and the water right is 200 AFY, which will be delivered via the FVA system. SWSD is also a SuperDitch participant and continues to look for more water rights on the Arkansas to have more resilient supplies in case of a possible Fry-Ark Project call out in the Colorado River Basin. They hold many of the FMIC shares and can use return flows for well augmentation.

CWPDA leases SWSD's return flows to farmers that allows SWSD to have 75% of that volume in Pueblo Reservoir. The trade can be 1:1 during the summer; however, there have been some changing conditions with CWPDA and the farmers. This is one of the challenges that SWSD currently faces.

SWSD is 80% built out and expects to reach full buildout by 2035. Development has leveled off, however and there is little activity.

The District does not foresee drastic challenges with the water quality from the potential new sources; however, they are aware that some type of treatment will be required. SWSD is also interested in lead and copper thus, enhanced lead and copper sampling is necessary when switching between water supplies.

Triview Metropolitan District

Triview's status is well stated in the background section of its draft Environmental Assessment in pursuit of a long-term Excess Capacity contract in Pueblo Reservoir:

Triview owns and maintains facilities that provide water, wastewater, and stormwater services to a 2,590-acre service area within the Town of Monument. Currently, this includes more than 1,900 homes and 60 commercial customers. Triview's service area is located entirely within the Arkansas River Basin. Historically, Triview's water supply has been derived from nonrenewable deep aquifers in the Denver Basin, which are being depleted and are not a sustainable resource in the long-term. In recent years, Triview has been actively acquiring renewable sources to supplement its Denver Basin groundwater, and the resources to convey such renewable resources to Triview:

- Decreed Denver Basin groundwater, representing 3,722.4 acre-feet (AF) of deliverable yield;
- 1,057 shares of the FMIC, representing an average annual yield of approximately 739.9 AF;
 - Access to water storage in Big Johnson Reservoir through its ownership of 1,057 shares of the FMIC.
- Approximately 50% share of Excelsior, representing an average annual yield of approximately 720.8 AF;
- Ownership of 2,050 AF of conditional water storage rights in the Stonewall Springs Reservoir Complex (SSRC) as filled with the Excelsior Ditch, and 19,538 shares in the Stonewall Springs Reservoir Company (SSRCo), representing approximately 19,538 AF of conditional storage capacity;
- Ownership of the AVIC representing an average annual yield of approximately 439.8 AF;
- Ownership of the Bale Ditch No.1 and 50% of the Bale Ditch No. 2 representing approximately 82.0 AF.

All of the average annual yields of historical consumptive use water from the above sources can be used and reused to extinction in accordance with their existing or anticipated decrees under Colorado water law. These water rights vary seasonally and inter-annually and the return flows resulting from Denver Basin groundwater use accrue to the Fountain Creek watershed on a continuous basis. Additional storage is needed to manage that variability and to recapture the reusable return flows resulting from their first use. Triview is requesting a contract to store up to 999 AF in Pueblo Reservoir if and when space is available for municipal purposes within Triview's service area. This contract will not be used to expand the district's service area, but instead will be used to support Triview's efforts to replace its non-renewable Denver Basin groundwater supplies with renewable surface water supplies.

In the context of this study, Triview is interested in identifying regional collaborative opportunities to recapture its reusable return flows for the sources described above that are potentially more efficient, less risky, and more cost-effective than exchanging its return flows into Pueblo Reservoir or capturing them at the Excelsior Ditch on the Arkansas River.

Woodmoor Water and Sanitation District (WWSD)

Woodmoor would like to explore the costs and alternatives associated with regional storage of recaptured reusable return flows, and the potential to capture additional water rights in the future. Knowing the Northern Monument Creek Interceptor (NMCI) Project will move return flows to the J.D. Phillips Water Resource Recovery Facility outfall, it may be cost-effective to return these flows to WWSD

facilities to meet current and future potable demands. If not, WWSD may opt for a localized reuse system previously studied with the Town of Monument.

CSU's and other entities' willingness to explore regional water use and recapture of reusable return flows has been a significant change since previous studies were performed. The costs that CSU will charge to convey, treat, and deliver water are a significant factor in whether the larger regional system can be cost effective.

WWSD must also consider how best to deliver the water rights they own at JV Ranch, south of Colorado Springs. The estimated annual consumptive use volume assumption of JV Ranch in normal years is approximately 3,500 AFY; 4,500 AFY in wet years and 2,500 AFY in dry years.

Public perception is one of the largest challenges WWSD faces in the use of direct and indirect return flows, with indirect being the less challenging of the two. In addition, under the NMCI plan, moving WWSD's return flow from the Tri-Lakes WWTF discharge site to the J.D. Phillips site could result in injury to intervening water rights holders.

Current information indicates that the District is growing at a higher than median growth rate. Tracking also indicates that this growth rate will continue for the next five to seven years. Buildout to 6557 SFEs within current boundaries is expected to occur by 2035. However, the boundaries could be expanded, increasing buildout to 7801 SFEs.

Concerns with respect to water quality have to do with blending different waters; this goes for both potable and raw water sources. Water quality has been a topic of discussion and concern that needs further evaluation once sources are known. The possible options include blending potable water from CSU's system into Woodmoor's system and blending raw water returns from Fountain Creek into CSU's SDS system. Woodmoor expects this study to identify whether any pre-treatment will be necessary for blending reuse water with CSU's raw water supplies prior to potable treatment.

Woodmoor has surface water storage of approximately 600 AF in Lake Woodmoor. However, to store all of Woodmoor's water rights so that conveyance capacities remain manageable, Woodmoor would need approximately 2,000 AF of storage.

Woodmoor has the Monument Creek Exchange System, a reuse system. The system works by exchanging reusable wastewater return flows upstream for diversions and storage in Lake Woodmoor. Woodmoor knows that this system is not 100% efficient partly due to stream flow limitations throughout the year. Historical exchange and diversion rates have indicated that Woodmoor's exchange is approximately 42% efficient, meaning that Woodmoor captures and reuses 42% of its treated wastewater flow on average. Woodmoor has also explored constructing an advanced water treatment plant at the wastewater facility, referred to as their localized IPR option. This WTP would increase Woodmoor's reuse system efficiency to near 95%. This option is feasible and would yield the largest quantity of reusable water on a net basis, meaning there would be little to no transit losses associated with conveyance down Monument and Fountain Creeks prior to recapture.

Woodmoor has considered different alternatives with respect to reuse and storage. Aside from constructing its own infrastructure, two other alternatives could be cost-effective for reuse and to

facilitate use of the District's JV Ranch surface water. One would be to contract with CSU to convey, treat, and deliver the District's surface water. The other would be to collaborate with a larger group to construct the infrastructure that was outlined in the *PPRWA Regional Infrastructure Study* that would exclude CSU. Woodmoor expects a thorough economic analysis comparing capital and O&M costs for both options to identify which is better. Both options require constructing storage infrastructure and conveyance systems that will require long-term O&M and/or service costs.

Woodmoor anticipates that the Northern Delivery System will provide average annual flow and Woodmoor will use the water directly to meet high demands from June through September, but October to May deliveries could be dechlorinated and stored in Woodmoor Lake. That water could then be re-treated and used seasonally to help meet high demands.

APPENDIX III: CHAPTER 5 TABLES

Table 5-1: Selection Criteria

Alternatives								
Criteria	Discussion	AltA1	AltA2	AltB1	AltB2	AltB3	AltC1	AltC2
		Points						
Category 2: Site Development Criteria								
Property Conflicts	This criterion considers number of parcels within each site. A higher number of parcels within a given site increases the likelihood of potential property acquisition issues.	0	0	1	1	0	0	0
Road Relocation	This criterion considers the length of county roads that would need to be relocated. Relocating county roads is not desirable because of costs, public involvement, and permitting.	1	1	1	1	1	1	1
SUBTOTAL	Max Possible Value = 2	1.0	1.0	2.0	2.0	1.0	1.0	1.0

Table 5-2: Site Development Criteria

Alternatives								
Criteria	Discussion	AltA1	AltA2	AltB1	AltB2	AltB3	AltC1	AltC2
		Points						
Category 1: Selection Criteria								
Connection	Connections to existing or reasonably foreseeable conveyance, storage, and treatment facilities must be conceptually feasible and integrate with the known or planned operations of the participants.	1	1	1	1	0	0	0
Capacity Available	Min. Storage available?	1	1	1	1	1	1	1
SUBTOTAL	Max Possible Value = 2	2.0	2.0	2.0	2.0	1.0	1.0	1.0

Table 5-3: Technical Criteria – Reservoir Storage

Alternatives								
Criteria	Discussion	AltA1	AltA2	AltB1	AltB2	AltB3	AltC1	AltC2
		Points						
Category 3: Technical Criteria - Reservoir Storage								
Return Flow Capture	This criterion considers how much of the participant return flows can be captured directly from diversion.	0.5	0.5	0.5	0.5	0.5	0.5	1
Existing or New Storage	This criterion considers whether new storage is necessary and whether rehabilitation or enlargement is necessary for existing storage.	1	1	0.5	0.5	0.5	0	0
Avg. Depth	This criterion considers avg. depth and its effect on potential for evaporative losses.	0	0	1	1	1	0	0
Dam Height	This criterion considers the maximum dam height. Taller dams are undesirable because of cost and permitting requirements.	1	1	1	1	1	1	1
Dam Length	This criterion considers the maximum dam length. Longer dams are undesirable because of cost and permitting requirements.	1	1	0	0	0	0.5	0.5
Site Geometry	This criterion considers the site geometry efficiency. A square site is desirable because it would be more efficient (i.e., less perimeter length - embankment, barrier wall, etc.) than a long, narrow site of the same size.	0	0	1	1	1	0.5	0.5
Drainage Basin Size	This criterion considers the drainage basin size that discharges to the reservoir. A larger drainage basin is undesirable because it may require a spillway and increase the likelihood of overtopping.	1	1	0	0	0	0	0.5
SUBTOTAL	Max Possible Value = 7	4.5	4.5	4.0	4.0	4.0	2.5	3.5

Table 5-4: Technical Criteria - Conveyance

Category 4: Technical Criteria - Conveyance									
Existing or New Diversion	This criterion considers whether a new diversion is necessary.	1	1	1	1	0	0.5	1	1
Existing or New Conveyance	This criterion considers whether new conveyance is necessary.	1	1	1	1	0	0	0	0
Pumping to Storage	This criterion considers if pumping will be required or if gravity conveyance can be utilized to fill the reservoir	1	1	1	1	0	0	1	0
Pumping Return	This criterion considers the level of pumping required to convey water from the intake point into the reservoir.	1	1	1	1	0	0	1	0
Distance from Headgate	This criterion considers the distance of the reservoir from the headgate. A longer distance from the headgate is undesirable because Increased losses and capacity issues.	0.5	0.5	0.5	0.5	1	1	0	1
SUBTOTAL	Max Possible Value = 5	4.5	4.5	4.5	4.5	1.0	1.5	3.0	2.0

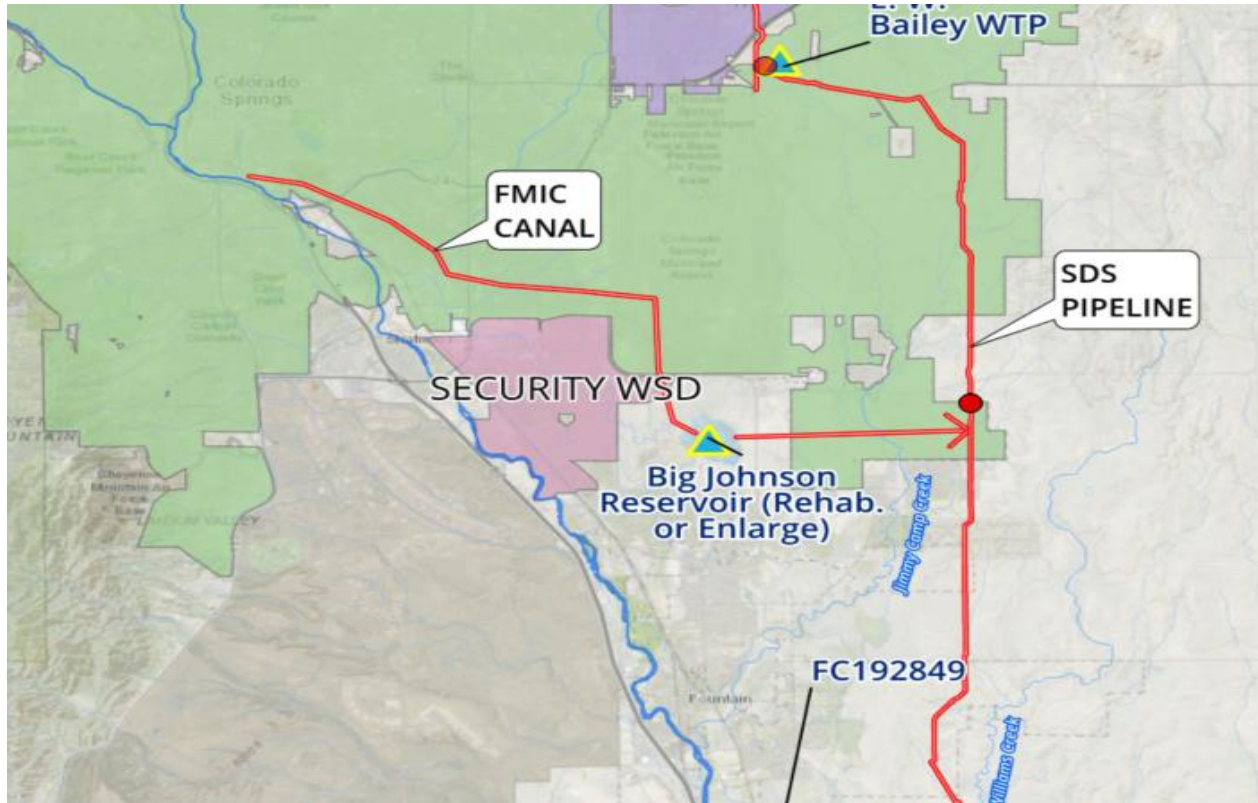
Table 5-5: Environmental/Permitting Criteria

Alternatives								
		AltA1	AltA2	AltB1	AltB2	AltB3	AltC1	AltC2
Criteria	Discussion	Points						
Category 5: Environmental/Permitting Criteria								
Environmental Permitting	This criterion considers possible environmental permitting impacts. A significant component in environmental permitting would be wetlands issues. Wetlands at a site would increase permitting complexity, time, and costs.	1	1	0	0	0	0	1
Water Rights Issues	This criterion considers potential water rights issues. Purchasing existing property with senior water rights and/or existing irrigated areas would be more difficult to obtain.	1	1	1	1	0	0.5	0.5
1041 Permitting Impacts	This criterion considers 1041 permitting issues. Some sites are located in areas that may have more 1041 permitting requirements.	1	1	0.5	0.5	0	0	0
SUBTOTAL	Max Possible Value = 3	3.0	3.0	1.5	1.5	0.0	0.5	1.5

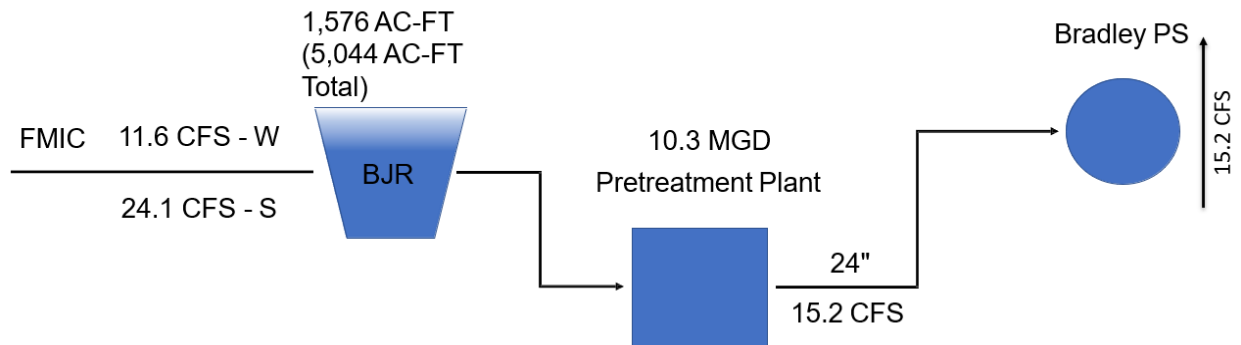
Alternatives								
		AltA1	AltA2	AltB1	AltB2	AltB3	AltC1	AltC2
		Points						
Total	Max Possible Value = 19	15.0	15.0	14.0	14.0	7.0	8.0	9.0

APPENDIX IV: CHAPTER 6 MAPS & DIAGRAMS

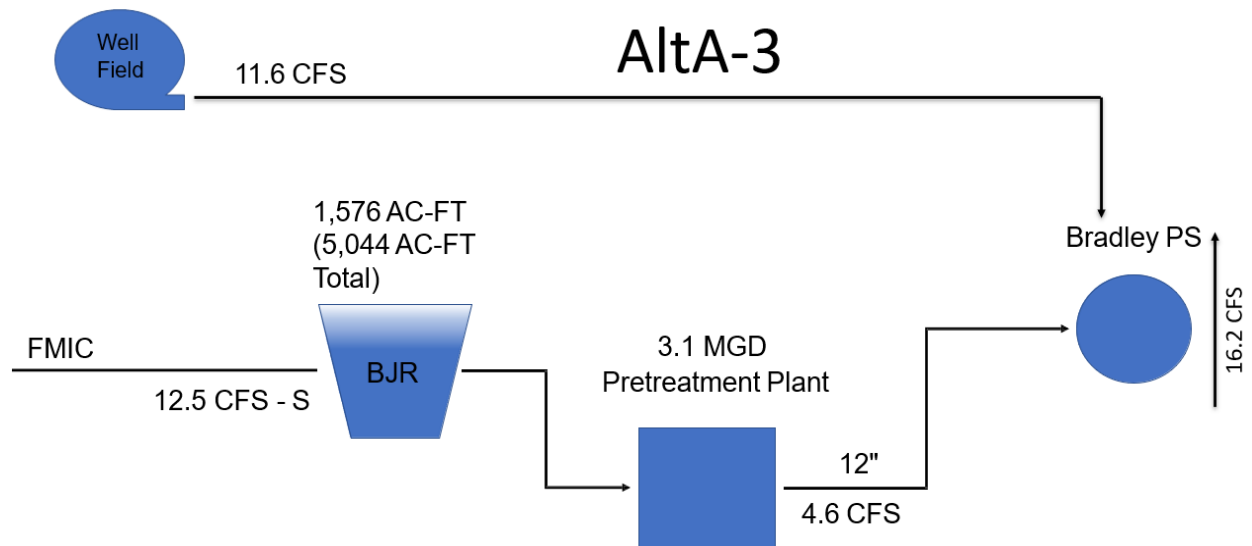
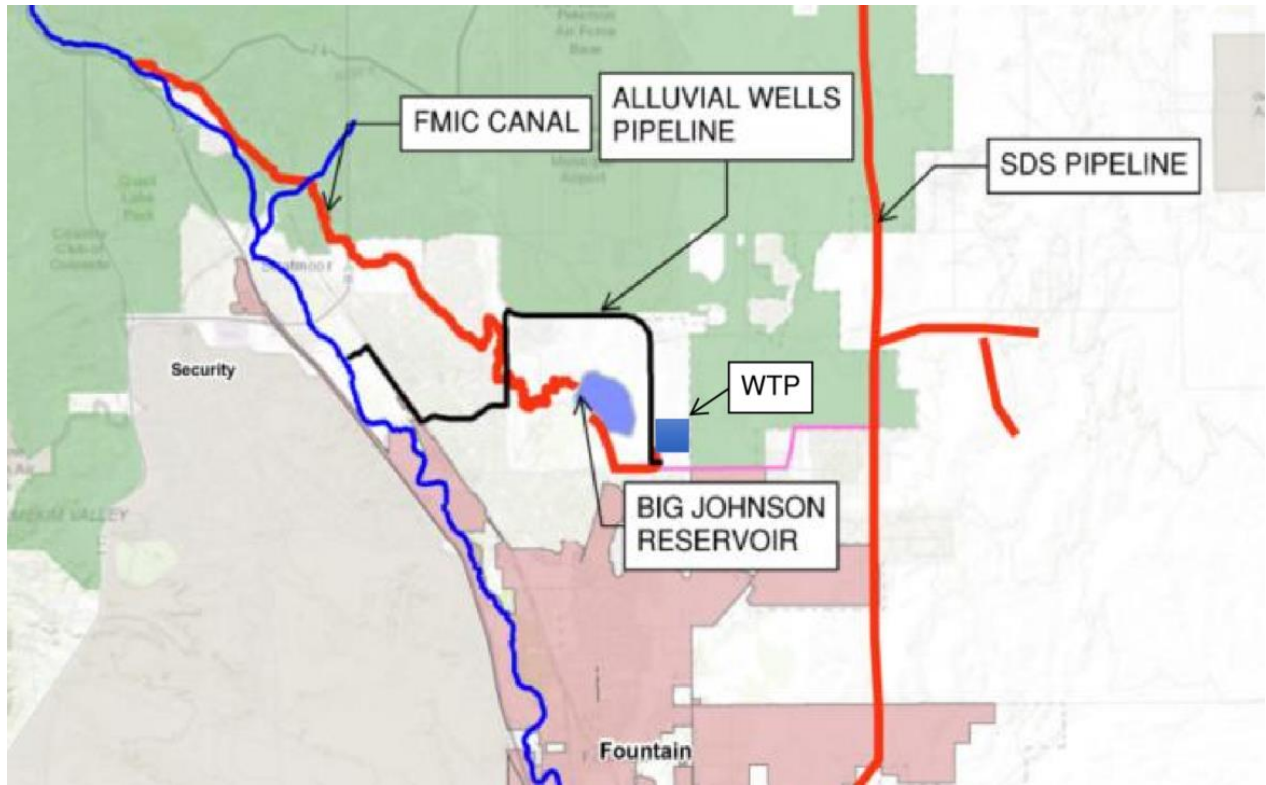
Map & Diagram AltA-2



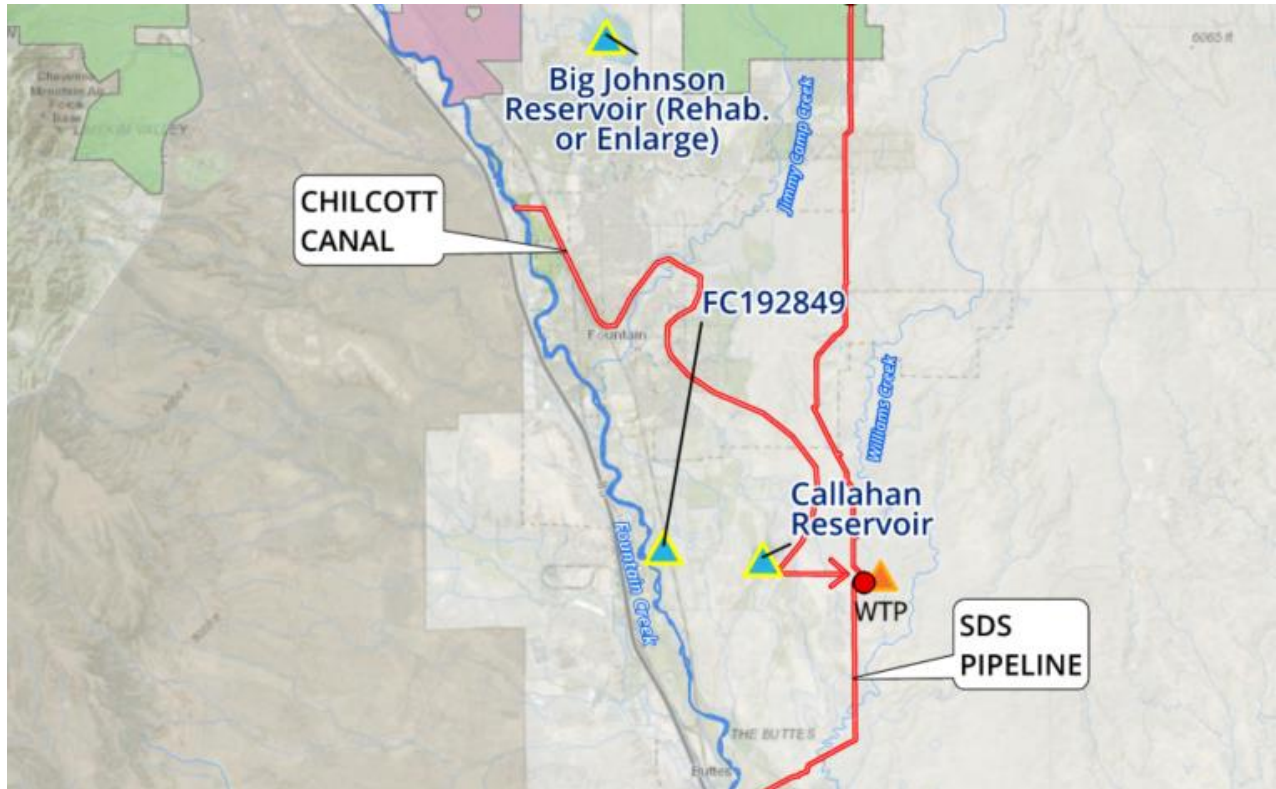
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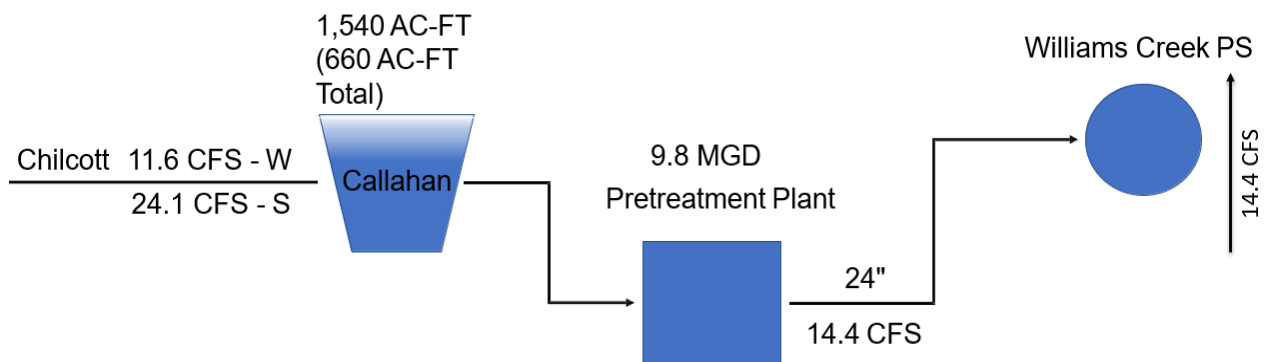
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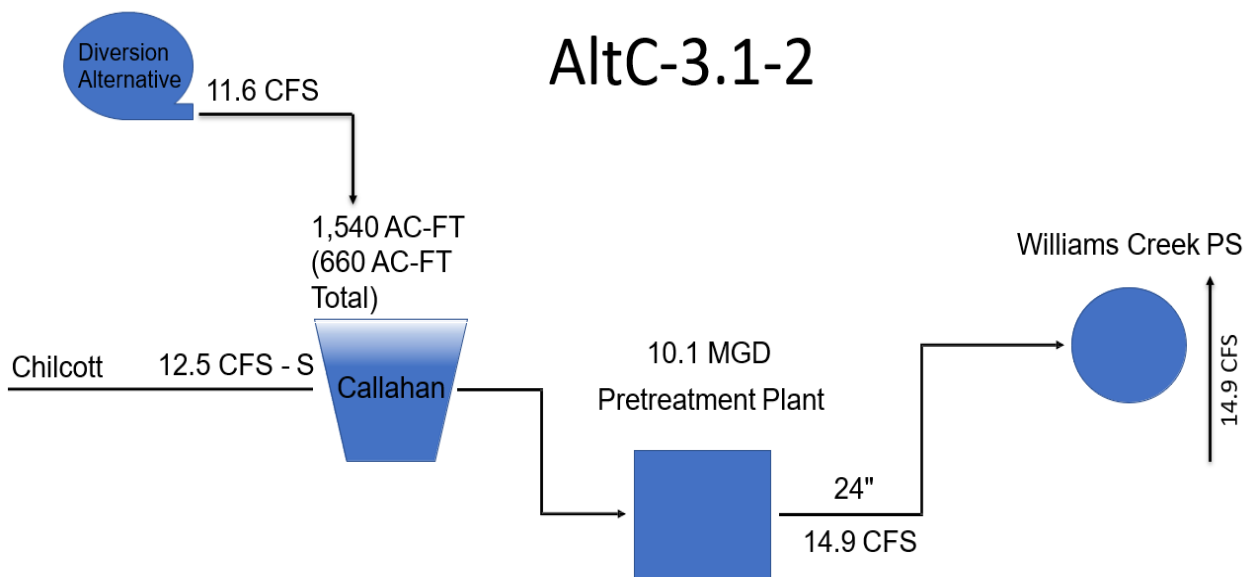
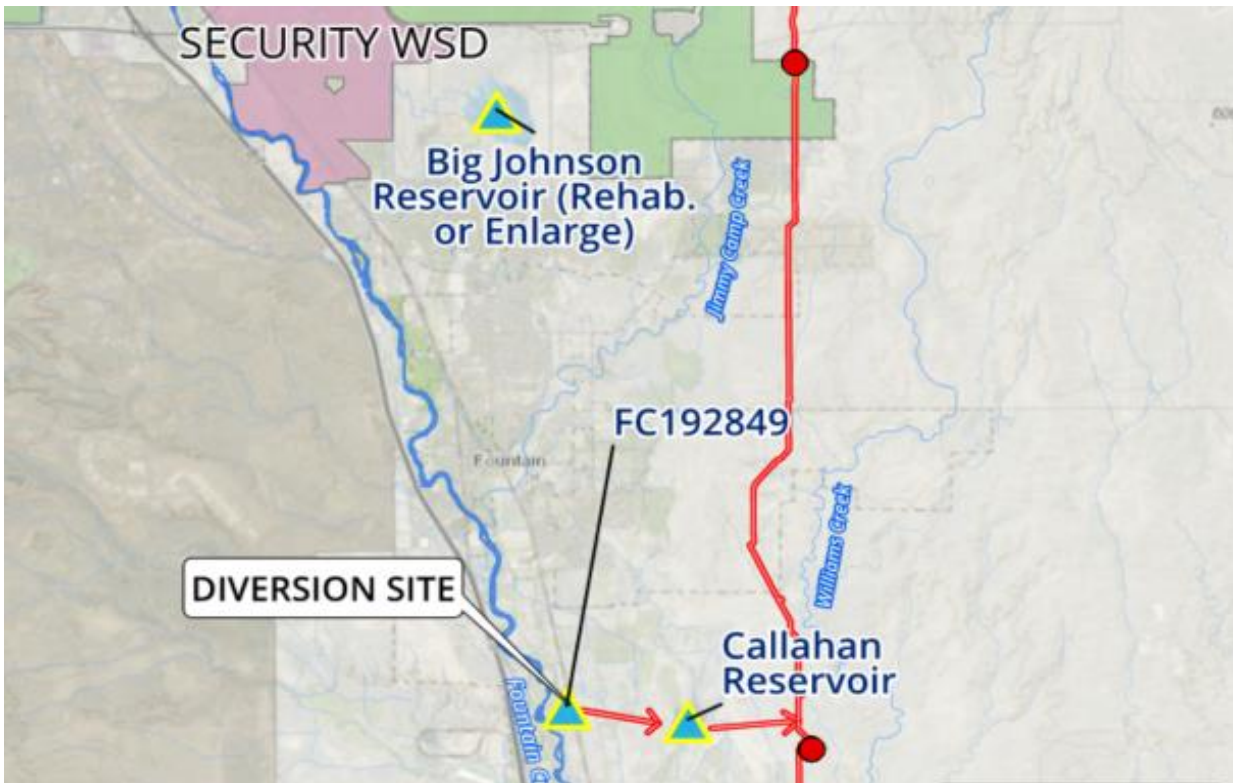
Map & Diagram AltB-2



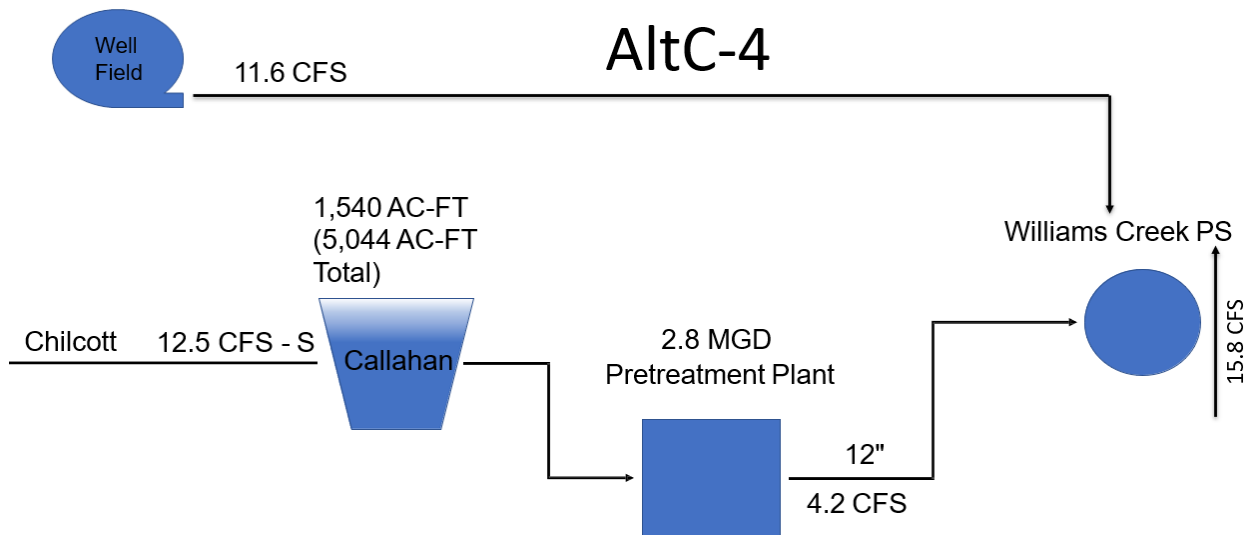
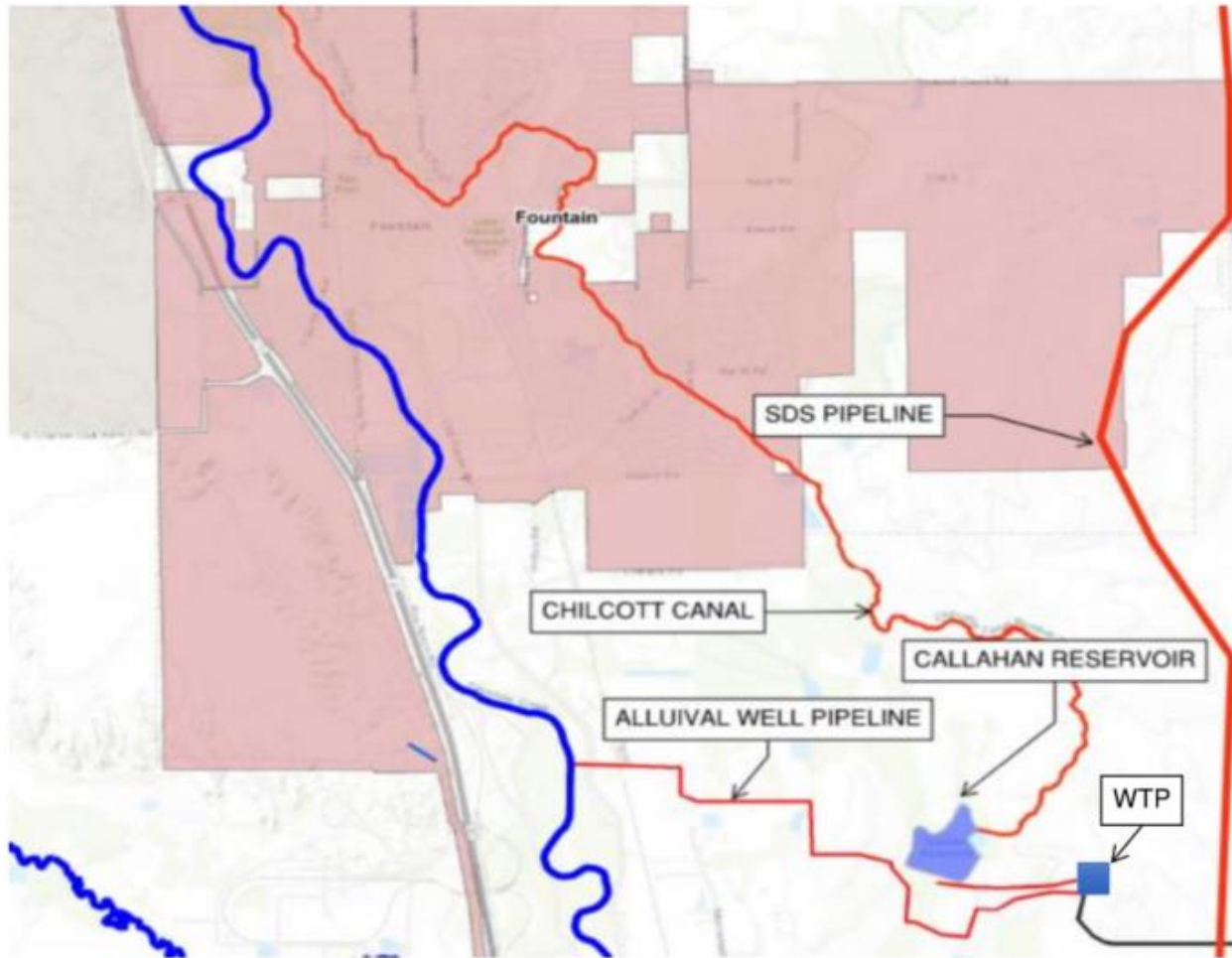
AltB-2



Map & Diagram AltC-3.1-2



Map & Diagram AltC-4



APPENDIX V: WATER QUALITY PARAMETERS

Water Quality Parameters-Bailey WTP Influent and Fountain Creek			
Parameter	Bailey WTP Influent	USGS Gauge: 07105500 Fountain at CS (Nevada)	USGS Gauge: 07105530 Fountain at Janitell
Alkalinity SM 2320 B	X		
Anions (Cl) by 300.0	X		X
Anions (SO4) by 300.0	X	X	X
Bromate, EPA 557	X		
Bromide, EPA 300.0	X		
Conductivity SM 2510 B	X	X	X
D Al EPA 200.7	X		
D Ca EPA 200.7	X	X	X
D Fe EPA 200.7	X		X
D Mg EPA 200.7	X	X	X
D Mn EPA 200.7	X	X	X
Fluoride SM 4500 FC	X		X
Hardness & Ca Hardness by 2340 B	X	X	X
Mercury EPA 1631	X		X
NO2, NO3 by EPA 353.2	X	X	X
Particles SM 10200 J	X		
Phytoplankton SM 10200 F	X		
Temperature deg C SM 2550 B	X	X	X
TOC SM 5310 B	X		
Total Coliform and E.coli SM 9223 B	X	X	X
TR Ag EPA 200.8	X		
TR Al EPA 200.7	X		
TR As EPA 200.8	X	X	X
TR Ba EPA 200.8	X		
TR Be EPA 200.8	X		
TR Ca EPA 200.7	X		
TR Cd EPA 200.8	X	X	X
TR Cr EPA 200.8	X		X
TR Cu EPA 200.8	X	X	X
TR Fe EPA 200.7	X	X	X
TR Mg EPA 200.7	X	X	X
TR Mn EPA 200.7	X	X	X
TR Na EPA 200.7	X		
TR Ni EPA 200.8	X	X	X
TR P EPA 200.7	X	X	X
TR Pb EPA 200.8	X	X	X
TR Sb EPA 200.8	X		
TR Se EPA 200.8	X	X	X
TR TI EPA 200.8	X		
TR Zn EPA 200.8	X	X	X
Turbidity Hach 10258	X	X	X

D = Dissolved

TR = Total Recoverable

Methods listed for Minimum Detection Levels (MDL)