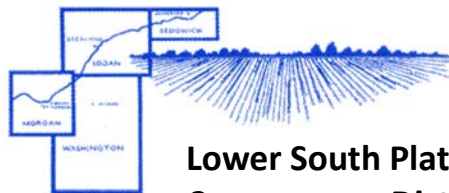


South Platte Regional Opportunities Water Group Feasibility Study Report

March 6, 2020



Prepared for:



Lower South Platte Water Conservancy District

Limitations:

This document was prepared solely for the Lower South Platte Water Conservancy District in accordance with professional standards at the time the services were performed and in accordance with the contract between the Lower South Platte Water Conservancy District and Brown and Caldwell dated March 18, 2019. This document is governed by the specific scope of work authorized by the Lower South Platte Water Conservancy District; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Lower South Platte Water Conservancy District and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List of Figures	iv
List of Tables.....	v
Executive Summary	1
SECTION 1: Introduction and Background	4
About the South Platte River Basin.....	4
Potential Future Gaps and Solutions.....	5
Feasibility Study Overview	6
Guiding Principles	7
SECTION 2: Stakeholder Outreach	8
Stakeholder Groups	8
SPROWG Task Force.....	8
Targeted Outreach Groups.....	9
Project Outreach Activities	10
Outreach Meetings	10
Outreach Feedback.....	11
Surveys	11
SECTION 3: Organizational Framework.....	14
Nonprofit Corporations (NPC).....	15
Existing State or Local Government.....	15
Water Conservancy District (WCD).....	16
Regional Water Authority (RWA).....	16
Memorandum of Understanding (MOU)	17
Intergovernmental Agreement (IGA)	17
Comparison of Organizational Frameworks	18
SECTION 4: Concept Refinement and Modeling.....	19
Initial Concept Modeling.....	19
The Point Flow Tool	20
Concept Alternatives and Modeling.....	22
Observations and Conclusions.....	26
Environmental and Recreation Considerations	27
SECTION 5: Water Treatment Strategies	28
Water Quality.....	28
Water Treatment Options	29
Nonpoint Source Treatment Options	30
Conclusions and Recommended Future Studies.....	32
SECTION 6: Cost Estimates.....	33

SECTION 7: Communications and Outreach Plan 35

 Communication Goals 35

 Stakeholder Groups 36

 Recommended Communication Activities..... 36

 Key Messages 37

 Tracking Metrics..... 37

SECTION 8: Recommendations 38

 Suggested Path Forward 43

References..... 44

Attachment A: Technical Memorandum: SPROWG Feasibility Study Outreach..... A-1

Attachment B: Technical Memorandum: Organizational Frameworks..... B-1

Attachment C: Technical Memorandum: SPROWG Concept Refinement and Alternatives Modeling C-1

Attachment D: Technical Memorandum: Water Treatment Alternatives D-1

Attachment E: Technical Memorandum: Evaluation of Nonpoint Source Treatment Options E-1

Attachment F: Technical Memorandum: Cost Estimates..... F-1

Attachment G: South Platte Regional Opportunities Work Group Communications and Outreach Plan.....G-1

List of Figures

FIGURE 1. South Platte River Basin 4

FIGURE 2. Projected municipal supply gaps..... 5

FIGURE 3. Stakeholder meetings 10

FIGURE 4. Support for type of organizational structure by stakeholder category 12

FIGURE 5. Alternative 1: Refine the Initial Concept 24

FIGURE 6. Alternative 2: Balzac First 24

FIGURE 7. Alternative 3: Add Julesburg Storage 25

FIGURE 8. Alternative 4: Additional Delivery..... 25

FIGURE 9. SPROWG alternative capital cost estimates 34

FIGURE 10. SPROWG alternative unit capital cost estimates 34

FIGURE 11. SPROWG alternative life-cycle cost estimates (50-yr planning horizon)..... 34

List of Tables

Table 1. Abbreviated Guiding Principles for the SPROWG Concept	7
Table 2. Goals of Outreach to Stakeholder Groups.....	9
Table 3. Summary of Feedback from Stakeholder Meetings	11
Table 4. After use of current supplies and supplies projected to be made available through Identified Projects and Processes (IPPs), how much water supply gap does your organization project at build out?.....	13
Table 5. If your organization received water from a regional project, what would be the intended use? (Select all that apply).....	13
Table 6. Identify your organization's preference for the type of water available through a regional project. (Select all that apply).....	13
Table 7. Amount of current or future unused reusable supplies that could be stored, conveyed, and/or treated in a regional project.....	13
Table 8. NPC Advantages and Disadvantages	15
Table 9. Existing Government Advantages and Disadvantages	15
Table 10. WCD Advantages and Disadvantages	16
Table 11. RWA Advantages and Disadvantages	16
Table 12. MOU Advantages and Disadvantages	17
Table 13. IGA Advantages and Disadvantages.....	17
Table 14. Organizational Frameworks Qualitative Assessment	18
Table 15. Sources of Water Supply Considered in SPROWG Concept Modeling	21
Table 16. Overview of Alternatives 1, 2, 3, and 4	22
Table 17. Infrastructure Necessary to Meet Delivery Goals for Each SPROWG Concept Alternative	23
Table 18. Observations and Conclusions from Modeling	26
Table 19. SPROWG Advanced Treatment Option Costs Comparison.....	30
Table 20. Summary of Recommended Communication Activities	36
Table 21. SPROWG Concept Study Key Messages	37

Executive Summary

The South Platte Regional Opportunities Water Group (SPROWG) Concept will provide water supplies to meet future municipal and agricultural water needs in the South Platte Basin. Several aspects of the SPROWG Concept were collaboratively researched in this feasibility study (Study) including identification of future water demands, strategies for incorporating environmental and recreational enhancements, needed infrastructure, water treatment strategies, potential costs, governance considerations, and communication needs.

Project Outreach

Extensive outreach was conducted and included meetings with potential future SPROWG participants and stakeholders and a survey that was sent to over 100 municipal, agricultural, environment, and recreation water users and stakeholders. The results of the outreach informed the types of governance structures that could be viable for a future SPROWG organization, the configuration and delivery goals for SPROWG infrastructure, water treatment strategies needed to provide supplies of suitable water quality, and communication and outreach needs.

Communications and outreach are an important aspect to developing the SPROWG Concept and tailoring it to fit the broadest spectrum of water users and needs. A Communications and Outreach Plan was developed that includes goals, suggested stakeholders, recommended near-term activities, recommended activities to facilitate recruitment of participants, recommended key messages, and metrics to track the success of various types of communication. **The Communications and Outreach Plan serves to:**



Educate stakeholders and create awareness needed to refine the recommended governance, operational, and infrastructure concepts.

Educate potential SPROWG Concept participants to facilitate recruitment.

Educate ratepayers/taxpayers on the need for the SPROWG Concept and funding.

Continue stakeholder engagement and transparency to build stakeholder support.

Evaluation of Governance Structures

The evaluation of governance structures was conducted in two phases. First, 13 frameworks were identified and evaluated for general allowances to assess for feasibility. The outreach efforts were then utilized to identify the governance structures most applicable to a future SPROWG project. Based on the outreach, six structures were identified for further evaluation in the second phase.

1. Nonprofit Corporations

2. Water Conservancy Districts

3. Existing Governmental Entities
4. Regional Water Authorities

5. Intergovernmental Agreements

6. Memoranda of Understanding

This Study provides an evaluation of advantages and disadvantages of six organizational structures and a qualitative comparison of the structures using seven criteria.

Concept Refinement and Modeling

Four alternative configurations of the SPROWG Concept were developed for the Study. The refinements and alternative configurations built on modeling and analysis work conducted during the preliminary discussions of the SPROWG Concept and information obtained through the project survey. Each of the four refined configurations of the SPROWG Concept met demand goals established for the Study. The alternatives explored a variety of demand goals and considered different hydrologic conditions. Modeling was used to estimate the amount of storage needed to meet demand goals. The ranges of demand goals and estimated storage needs are described below.

		Low	High
Delivery Goal	Municipal (average and wet years)	42,000 AF/year	65,000 AF/year
	Municipal (dry years)	82,000 AF/year	115,000 AF/year
	Agricultural (average and wet years)	3,000 AF/year	14,000 AF/year
	Agricultural (dry years)	10,000 AF/year	35,000 AF/year
Total Storage		215,000 AF	409,000 AF

Reservoirs are contemplated to be geographically dispersed between the Denver Metro area and the Colorado-Nebraska state line. Water deliveries from these reservoirs would be conveyed via a combination of exchanges and pipelines (depending on the alternative).

The two key objectives of the alternative evaluation were to refine the SPROWG Concept based on stakeholder feedback and evaluate four alternative configurations of the SPROWG Concept.

Water Treatment Strategies

For each of the four alternatives, this Study evaluated two treatment scenarios - riverbank filtration with a conventional treatment plant and application of advanced treatment technology in an advanced water treatment facility. Necessary water treatment will ultimately be determined by needs of the specific project participants and the water quality at diversion locations. In general terms, the South Platte River's water quality degrades as it progresses downstream to the state line. Thus, the treatment processes needed to address raw water quality will largely be determined by the location of the diversion. Nonpoint source pollution control could improve raw water quality and should be explored as a companion strategy to other treatment technologies.

Cost Estimates

Conceptual capital cost and life-cycle cost estimates were prepared for infrastructure associated with the four SPROWG Concept alternatives using a combination of unit costs and other assumptions from the previous SPROWG planning effort, the South Platte Storage Study, and the SPROWG project team’s industry experience. Cost estimates are conceptual level estimates with a range of -50% to +100%. Life-cycle costs were comprised of capital costs plus the net present worth of 50 years of operation and maintenance costs, including energy use. In summary:

	Raw Water	Treated Water	SPROWG alternatives are costly, but they compare favorably with costs of other regional water supplies.
Capital Cost	\$1.2 billion to \$1.8 billion Capital cost for all facilities to deliver raw water with a unit cost of \$18,400 to \$22,800 per acre-foot.	\$2.4 billion to \$3.4 billion Capital cost for all facilities to deliver treated water with a unit cost of \$33,600 to \$43,200 per acre-foot.	
Life-cycle Cost	\$1.8 billion to \$2.6 billion Capital cost plus 50 years of operation and maintenance (O&M) for raw water. Unit costs are \$25,800 to \$33,400 per acre-foot.	\$3.2 billion to \$4.4 billion Capital cost plus 50 years of O&M for treated water. Unit costs are \$44,100 to \$58,3000 per acre-foot.	

Alternative 4 is the most expensive and largest project, but due to economies of scale it has the lowest unit cost per acre-foot of water produced.

Recommendations

The Study validated previous findings that the SPROWG Concept is technically and financially feasible. It also revealed strong interest among water providers, water users, and other stakeholders to further examine how a regional approach to water management in the South Platte Basin designed to address a wide range of water-related needs could complement the water management and development activities already taking place or getting underway in the Basin.

This conclusion suggests that water providers, water users, and other stakeholders ought to consider how to maintain the momentum generated by this Study to further advance the SPROWG Concept. This Study report describes a variety of potential future actions and evaluations, including recommendations to:

- Consider the SPROWG Concept in the upcoming update of the South Platte Basin Implementation Plan
- Evaluate the performance of the SPROWG Concept under the five future planning scenarios in the Colorado Water Plan
- Implement the Communications and Outreach Plan and focus on identifying Concept proponents
- Continue evaluating potential organizational frameworks and eventually identify a “best-fit”
- Evaluate alternatives for financing the design, construction, and operation of the SPROWG Concept
- Continue discussions focused on Alternative Transfer Mechanisms
- Further evaluate regional water treatment strategies

SECTION 1:

Introduction and Background

This report summarizes the results of a feasibility study conducted to explore a potential future water supply strategy known as the South Platte Regional Opportunities Water Group (SPROWG) Concept. The SPROWG Concept would provide water supplies to meet future municipal and agricultural water needs in the South Platte Basin. Several aspects of the SPROWG Concept were collaboratively researched in this feasibility study (Study) including future water demands, strategies for incorporating environmental and recreational enhancements, required infrastructure, water treatment strategies, anticipated costs, governance considerations, and communication needs.

About the South Platte River Basin

The South Platte River Basin is critical to the State of Colorado.

It is currently home to approximately 70 percent of the state's population and includes the Denver Metropolitan area, large northern Colorado communities such as Loveland, Greeley, and Fort Collins, and numerous smaller but rapidly growing communities.

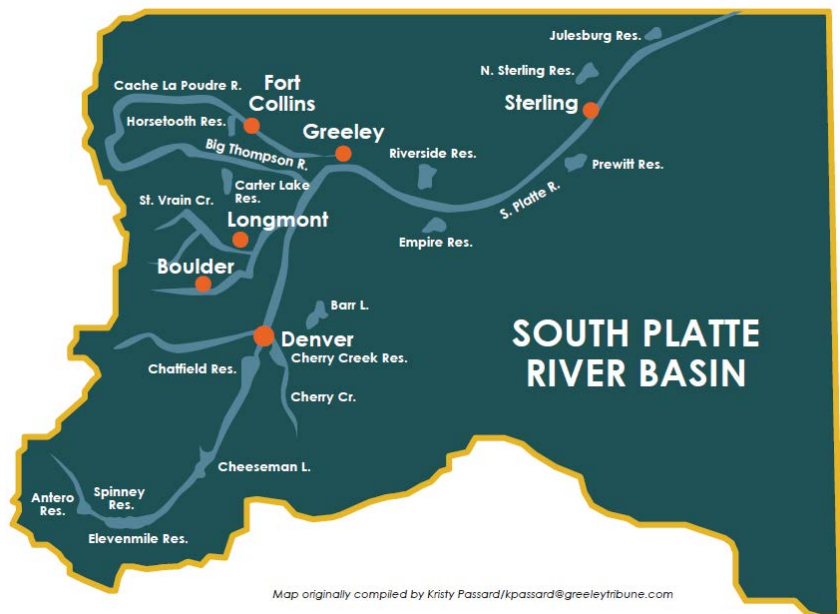


FIGURE 1. South Platte River Basin

Seven of the 10 top agricultural producing counties in Colorado are in this basin. The basin is also host to recreational amenities for fishing, hiking, boating, skiing, and state and national parks – all contributing significantly to the state's economy.

Basin water managers rely on a network of storage and conveyance infrastructure and a vast system of public and privately-owned water rights to provide water for Colorado's citizens, businesses, and recreational amenities. Limited water supplies have resulted in long standing efforts by water managers and citizens to conserve and maximize the use of water in the river. It is estimated that river water is used seven times before it flows into Nebraska.

Potential Future Gaps and Solutions

The Basin is challenged with the greatest projected water supply gap (or shortage) of any of Colorado's river basins and home to most of the state's population, which is expected to grow from 3.8 to 6 million people by 2050. The recently completed Analysis and Technical Update to Colorado's Water Plan (CWCB, 2019) projected a municipal and industrial supply gap in the Basin ranging from 185,000 to over 540,000 AF annually by the year 2050 depending on future supply and demand scenarios (see Figure 2).

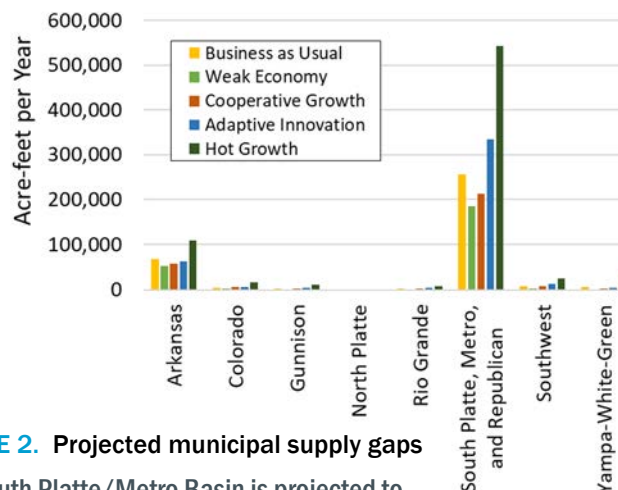


FIGURE 2. Projected municipal supply gaps

The South Platte/Metro Basin is projected to have the highest gap in the state by 2050

In 2015, several efforts exploring water supply solutions running in parallel resulted in the formation of a task force that initiated a study to explore a new water development concept to address a significant part of the projected gap.

South Platte Basin Implementation Plan (SPBIP)

The South Platte Basin and Metro Basin Roundtables evaluated various strategies to meet potential future water supply gaps, and the results of their assessments were published in the SPBIP in 2015. The SPBIP included a strategy for meeting future demands referred to as a "Conceptual Future In-Basin Multipurpose Project" that contemplated using a variety of South Platte supplies conjunctively to maximize potential benefit (SPBIP, Section 4.6.2). The conceptual project would meet future needs beyond what existing and currently contemplated water supply projects and strategies can provide.



South Platte Regional Water Development Concept (SPRWDC)

A group of South Platte municipal water providers and agricultural water managers began informally exploring strategies for advancing the "Conceptual Future In-Basin Multipurpose Project" described in the SPBIP. Their work, completed in 2018, resulted in a more refined version of the project concept with preliminary delivery goals for municipal water providers and agriculture. The refined project concept is the SPRWDC.



Foundation established for formation of the SPROWG Task Force

The SPRWDC rolled out to the Metro and South Platte basin roundtables on the heels of the SPSS. The two studies complemented one another, and the roundtables expressed enthusiasm for furthering the multipurpose, regional storage concept.

To continue the roundtable discussions, a group of interested parties consisting of roundtable members, water providers, environmental and recreational stakeholders, agricultural water users and water experts formed a stakeholder group that eventually became known as the SPROWG Task Force.

South Platte Storage Study (SPSS)

The SPSS, authorized by the Colorado General Assembly (HB 16-1256), evaluated potential storage facilities along the South Platte River between Kersey and the Nebraska state line that could help meet the future water gap identified in Colorado's Water Plan. The SPSS, published in 2017, found that water supplies for new storage projects are available but highly variable. On average, the South Platte River carries almost 300,000 acre-feet of water annually out of Colorado in excess of the amount needed to satisfy the South Platte River Compact with Nebraska, but this amount varies greatly on an annual basis.



Feasibility Study Overview

The Feasibility Study (Study), launched in March 2019, evaluated and researched a wide variety of issues related to the SPROWG Concept through collaboration that fostered education and generated interest with diverse stakeholders.

This Study's goals and key components were to:



Engage and Educate



Incorporate, Identify,
and Investigate



Develop and Describe

Engage and educate basin stakeholders and seek feedback to develop a refined understanding of specific municipal, agricultural, and environmental/recreational water demands that could be met by the SPROWG Concept, and at what cost.

Incorporate stakeholder feedback and conduct modeling analyses to refine the configuration of infrastructure components and their operations with the goal of meeting the broadest range of demands

Identify a range of suitable organizational/institutional structures to support development and eventual operation of the SPROWG Concept

Investigate water treatment strategies that meet diverse water quality needs of potential participants












Develop a plan to expand and enhance public outreach and education efforts to inform and help sustain the SPROWG Concept's continued evolution and development

Describe opportunities to foster the success of the SPROWG Concept by forming and engaging a champion group/entity/governance committee to spearhead the project as it moves forward.

Guiding Principles

Foundational Guiding Principles describing the SPROWG Concept, developed at the initiation of the Study, ensured that participants had a common understanding of the SPROWG Concept objectives, and that information was consistently communicated.

Table 1 provides a summary of the Guiding Principles that supported the initial collaboration of the SPROWG Concept.

Table 1. Abbreviated Guiding Principles for the SPROWG Concept	
Principles describing what SPROWG <i>is</i>	Principles describing what SPROWG <i>is not</i>
 SPROWG will advance the goals of the South Platte/Metro Basin Implementation Plan (BIP) and Colorado's Water Plan , and will be consistent with Colorado water law, interstate compacts/agreements.	 SPROWG is <i>not</i> intended to be a substitute for existing or planned projects .
 SPROWG intends to provide at least 50,000 acre-feet of yield to meet part of the projected municipal and industrial water supply project gap in the South Platte basin. A significant portion of this yield is targeted for smaller but rapidly growing communities between Denver and Greeley and larger communities in the Denver Metro area and northern Colorado. The project will also explore providing supplies to smaller communities east of Greeley.	 SPROWG is <i>not</i> intended to store supplies from an existing or new transmountain diversion project (though it will provide a means to utilize unused reusable return flows from transmountain diversions).
 SPROWG will utilize different sources of water available in the South Platte basin and manage them conjunctively to achieve an overall reliable yield beyond what an individual source could produce.	 SPROWG is <i>not</i> intended to be used to deliver water developed from the permanent dry up of irrigated lands in the South Platte basin.
 SPROWG will identify and incorporate strategies to address environmental and recreational needs .	
 SPROWG intends to enhance the ability to conduct alternative water transfers , thus reducing the need for traditional buy-and-dry transfers	
 SPROWG is intended to help water supply organizations and water users maximize the use of in-basin supplies .	
 SPROWG intends to improve integration of water quality and quantity planning and management activities.	
 SPROWG intends to meet a portion of the agricultural gap .	

This report describes the results of this Study and provides recommendations for next steps in furthering the development of the SPROWG Concept.

SECTION 2:

Stakeholder Outreach

Section 2 summarizes the stakeholder groups, outreach activities, and feedback from outreach. A detailed description of these aspects of the Study is included in Attachment A, the Technical Memorandum entitled “SPROWG Feasibility Study Outreach.” Stakeholder outreach was a significant part of this Study, and it informed each component of the work. A wide variety of stakeholders were engaged throughout this Study to:



Educate stakeholders and potential future participants about the SPROWG Concept

Obtain feedback from stakeholders regarding their water needs

Collaborate with stakeholders on how the SPROWG Concept can fulfill their needs

Gather information on preferences regarding organizational frameworks and communication strategies

Stakeholder Groups

A wide variety of stakeholder groups were engaged during this Study to educate them on the SPROWG Concept and to seek feedback on stakeholder preferences regarding considerations such as water supply needs and potential governance structures.

SPROWG Task Force

The SPROWG Task Force, formed in June 2018, had an initial objective of developing the scope of work for this Study. Once the Study began, the role of the Task Force shifted to providing general feedback on the Study and served as a body of interested stakeholders that could potentially be participants in a future SPROWG water supply project. Participation on the Task Force was open to any interested party, and it included 90 individuals representing municipal and agricultural water providers, environment and recreation groups, government employees, and private interests.

Stakeholder groups were collaboratively engaged to disseminate information and obtain guidance and feedback on this Study.

Targeted Outreach Groups

Outreach activities were focused on, and tailored to, three general groups of stakeholders: municipal water providers and industrial water users (M&I), agricultural water managers and users (Ag), and environmental/recreational water users and advocates (Env & Rec).

Two subsets of the Task Force provided direct feedback to the consulting team during the Study.



TABLE 2.
Outreach goals were tailored to each stakeholder group.

Table 2. Goals of Outreach to Stakeholder Groups				
Stakeholder Type	Education Educating potential participants on the SPROWG Concept	Data Acquisition Acquiring information on water needs, governance preferences, etc. from potential participants	Recruitment Gaining support and participation in the SPROWG Concept	Strategy Development Identifying potential environment and recreation benefits
Municipal/Industrial	✓	✓	✓	
Agricultural	✓	✓	✓	
Environment/Recreation	✓			✓

Project Outreach Activities

The stakeholder groups identified above were engaged in a variety of ways throughout the Study, primarily through collaborative meetings and an online survey.

A variety of tools supported outreach activities including a Fact Sheet and incorporation of SPROWG Concept details to the South Platte Basin Roundtable Website.

Outreach Meetings

A wide variety of stakeholders participated in numerous meetings as described in Figure 3. The meetings were held to educate stakeholders and potential SPROWG Concept participants and to gather information about water needs, preferences on governance, thoughts on Alternative Transfer Methods (ATMs), and strategies for effective communication. The Guiding Principles described in Section 1 were a foundational part of communicating the objectives of the SPROWG Concept during the meetings.






FIGURE 3. Stakeholder meetings

Numerous meetings kept stakeholders and potential SPROWG Concept participants informed and were a vehicle for gathering valuable stakeholder feedback.

Outreach Feedback

Table 3 provides a summary of significant stakeholder feedback provided at outreach meetings with municipal/industrial, agricultural, and environment/recreation stakeholders. Attachment A provides additional details of the feedback gathered from the meetings.

Table 3. Summary of Feedback from Stakeholder Meetings		
 Municipal/Industrial	 Agricultural	 Environment/Recreation
<p>The State Engineer should be consulted in the development of the SPROWG Concept.</p> <p>Water from the SPROWG Concept should be used as efficiently as possible.</p> <p>Development of an organizational framework will be iterative given the diversity of potential participants and the variety of water needs.</p> <p>SPROWG Concept participation costs and timelines need to be evaluated and provided to potential participants so that they can compare with other alternatives.</p>	<p>The SPROWG Concept should not convey or manage supplies from buy and dry activities.</p> <p>Water from the SPROWG Concept, as well as other sources, should be used as efficiently as possible.</p> <p>Water supplies for irrigation well augmentation would be beneficial. Long term augmentation needs could total 35,000 to 40,000 acre-feet per year (AF/yr) for some augmentation plans.</p> <p>ATMs are preferable to traditional buy-and-dry but need to provide significant value to agriculture and should only be used after development of unappropriated supplies.</p> <p>The selected governance structure should provide flexibility on water use.</p> <p>Straightforward, personal communications are preferred.</p>	<p>Additional storage in various locations along the South Platte can provide much needed habitat.</p> <p>Water from the SPROWG Concept, as well as other sources, should be used as efficiently as possible.</p> <p>Providing specific environmental and recreation strategies is difficult at this phase of concept development due to the location and operation specific nature of such opportunities.</p> <p>Strategies to improve diversion structures should be considered that allow for recreational bypass, elimination of dry-up points, and the reestablishment of hydrology and habitat at existing dry-up points.</p> <p>The selected governance structure should be capable of implementing best practices in environmental stewardship.</p> <p>Environmental and Recreational water users appreciate being included in early project development and desire to continue to be engaged.</p>

Surveys



Important findings from surveys informed key components of this Study.

A survey efficiently solicited feedback from a broad array of municipal and industrial water providers/users as well as agricultural water users and environmental and recreation stakeholders. The survey, deployed via [surveymonkey.com](https://www.surveymonkey.com), gathered information on opinions regarding governance structure, information on future water needs, thoughts on ATMs, preferences on communication methods, and feedback on the Guiding Principles.

The survey had two versions. One version was sent to municipal and industrial water providers, and it included questions regarding opinions on governance structure, information on future water needs, thoughts on ATMs, preferences on communication methods and feedback on the Guiding Principles. A similar version was sent to agricultural water users and environmental and recreation stakeholders, but it did not include questions on water needs, because this topic was covered during outreach meetings. The surveys were sent to individuals representing over 83 municipal and industrial water providers, 35 agricultural water users, and 34 environmental and recreation stakeholder entities. Attachment A provides detailed information from survey respondents.

Organizational Framework

A comparison of responses by stakeholder category of support for types of organizational structure, as shown on Figure 4, suggests there is consistent support for existing governmental entities, new non-profit private entities, and an intergovernmental agreement/cost sharing organizational structure.

None of the three stakeholder categories exhibited strong support for a new for-profit entity as the future organizational type for SPROWG.

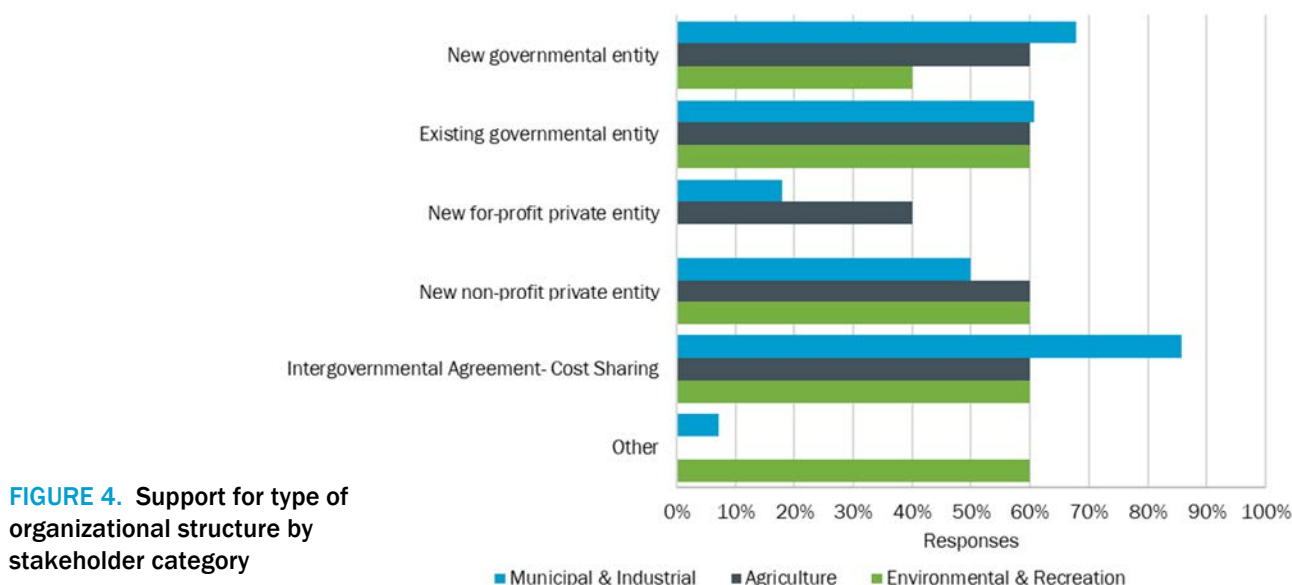


FIGURE 4. Support for type of organizational structure by stakeholder category

M&I Water Supply Gap and Water Needs

M&I water providers offered a wide variety of information regarding their future water supply needs. Responses were lumped by “planning region,” which corresponds to regional concentrations of water supply demands for modeling purposes. Tables 4 through 7 provide a summary of survey responses that informed refinements to the SPROWG Concept. Additional survey responses are included in Attachment A, “SPROWG Feasibility Study Outreach.”

The planning regions are:

Denver Metro: Communities in Denver Metropolitan area, from Castle Rock/Parker, to Westminster/Brighton.

NoCo-North: Communities generally north of Highway 56

NoCo-South: Communities generally south of Highway 56 but north of the Denver Metro area

Eastern Plains: Communities east of Greeley

Industrial Water Users: Industrial use only water providers

TABLE 4.

The amount of water supply gap that M&I survey respondents project at buildout after development and use of current and anticipated individual supplies ranges from about 30,000 AF/year to over 170,000 AF/year, for an average annual need of just over 77,000 AF/year.

Table 4. After use of current supplies and supplies projected to be made available through Identified Projects and Processes (IPPs), how much water supply gap does your organization project at build out?				
Planning Region	Total Responses	Low Estimate (AF/yr)	High Estimate (AF/yr)	Average Estimate (AF/yr)
Denver Metro	8	19,900	141,100	55,500
NoCo-North	3	4,900	21,900	13,400
NoCo-South	4	4,800	7,700	6,200
Eastern Plains	1	1,000	3,500	2,300
Industrial Water Users	1	-	-	-
Total	17	30,600	174,200	77,400

TABLE 5.

Drought year supply is the top intended use for water from a regional project. The data suggest that, for M&I survey respondents located upstream of Greeley, water received from a regional project could provide a wide range of uses. Other intended uses for water received from a regional project are aquifer recharge and supplemental supply during curtailment or demand management on the Colorado River.

Table 5. If your organization received water from a regional project, what would be the intended use? (Select all that apply)					
Planning Region	Blending Supply	Firm Yield	Drought Year Supply	Drought Recovery	Augmentation Water
Denver Metro	2	6	8	5	3
NoCo-North	2	2	4	3	2
NoCo-South	4	3	5	2	2
Eastern Plains	1	-	-	-	1
Industrial Water Users	1	-	-	-	2
Total	10	12	17	10	10

TABLE 6.

The preferred type of water for M&I users receiving water through a regional project is untreated, raw water to be treated locally by the end user, but there was also significant interest in treated water.

Table 6. Identify your organization's preference for the type of water available through a regional project. (Select all that apply)				
Planning Region	Untreated, Raw Water to be Treated by End User	Treated Water	Augmentation Supplies	Non-Potable Supply
Denver Metro	7	4	6	4
NoCo-North	5	5	2	2
NoCo-South	5	3	1	2
Eastern Plains	1	1	1	1
Industrial Water Users	2	-	3	1
Total	20	13	13	10

TABLE 7.

M&I users provided information on their reusable supplies to evaluate potential additional supplies for SPROWG, and the Denver Metro area identified the most unused reusable supplies. Responses suggested significant uncertainty and potential variability in timing of reusable supply, with greater amounts in wet and normal years, and less in dry years. The ability to legally reuse the supplies cited in the survey in the context of the SPROWG Concept has not been verified and should be done prior to incorporating this level of reusable supply into the Concept.

Table 7. Amount of current or future unused reusable supplies that could be stored, conveyed, and/or treated in a regional project	
Planning Region	Average Year Estimate (AF/yr)
Denver Metro	41,075
NoCo-North	6,340
NoCo-South	3,400
Eastern Plains	650
Industrial Water Users	9,300
Total	60,765

SECTION 3:

Organizational Framework

SPROWG is a regional concept that could include participation by a variety of municipal, agricultural, and industrial water users as well as environmental and recreational groups. Eventually, a formal organizational arrangement will be needed to finance, design, permit, construct, operate, and maintain project infrastructure. The SPROWG Study included an investigation into the potential organizational frameworks under which the Concept may form.

Each organizational framework has inherent benefits and limitations. The right organizational framework for SPROWG must meet the needs of the participants. To do so, the participants must consider a variety of criteria.

An entity is defined by many characteristics including, but not limited to how it is formed or dissolved, how it generates revenue, how it is governed, the tax status of the entity, who is allowed to participate, how it is staffed and how the budget is allocated. The purpose of this Study was not to provide a recommendation of the most applicable organizational framework, but to identify potential options and provide an appropriate level of detail on those frameworks to enable future participants to make an informed decision.

Organizational Framework Identification and Evaluation Process

A 3-phase process was used to evaluate organizational frameworks:

PHASE 1 Identify pertinent frameworks and their basic characteristics.

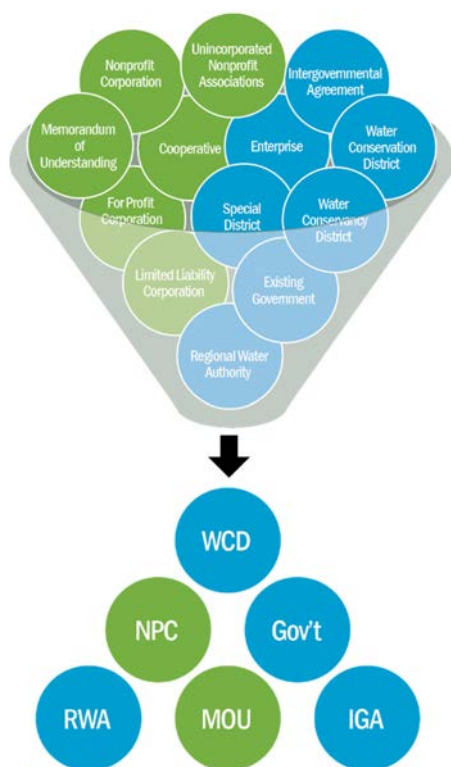
High-level evaluation of potentially applicable organizational frameworks. Of the various organizational frameworks allowed under Colorado state law, this Study evaluated thirteen for the allowed method of formation, revenue generation, governance, ownership, distribution of profits, tax status and staffing. Each organizational framework was assessed based on their characteristics under each category. The frameworks were separated by those that allowed only governmental entities to participate (blue) and those that allow for participation of non-governmental entities (green).

PHASE 2 Survey potential participants for preferences and needs.

Elements from the Phase 1 evaluation were then incorporated into the project participant survey with the purpose of identifying the characteristics of most significance to each user. As a result of the survey, six organizational frameworks were identified from the original thirteen for additional analysis.

PHASE 3 Using survey results, identify and further evaluate the six most relevant frameworks.

The six selected organizational frameworks included: nonprofit corporations, water conservancy districts, existing governmental entities, regional water authorities, intergovernmental agreements, and memoranda of understanding. Advantages and disadvantages of each option were described, along with one or more example case studies from Colorado.



Nonprofit Corporations (NPC)

As an organizational framework for water-related entities, NPCs have a strong presence in Colorado and the South Platte Basin, and an NPC would be advantageous to the SPROWG Concept. Benefits include the relative ease of creation and dissolution, the ability to apply for exemption from federal and state taxes if certain requirements are satisfied and the power to elect a board of directors and create and adopt bylaws. Incorporating as an NPC allows an entity many benefits that may not be available under other organizational frameworks.

Case Studies: Chatfield Reservoir Mitigation Company, South Platte Water Related Activities Program

Table 8. NPC Advantages and Disadvantages

Advantages	Disadvantages
Provides long-term certainty that the entity will exist in the future.	More rigorous, though not impossible, to adapt to future needs.
Provides strong legal protections for projects developed as well as participants, entity staff and elected board of directors.	Less flexible to change bylaws to add a new identified purpose.
Among the most inclusive of the organizational frameworks. Governmental and non-governmental entities alike can participate.	Formation can be time consuming, depending on complexity of participants or purpose.
Eligible for state and federal tax-exempt status.	Receiving tax-exempt status requires filing with both the state and the IRS.
Capable of growing from some organizational frameworks (IGA, MOU).	Not a great interim option due to constraints on adaptability and flexibility.

Existing State or Local Government

Under the Colorado Constitution and statutes, political subdivisions (e.g. county, city, town, water, sanitation, irrigation, drainage or other special district pursuant to law) may cooperate and contract with one another, including creating separate political entities or subdistricts to provide any function, service, or facility lawfully authorized to each of the contracting or cooperating governments. The ease with which a new subdistrict can form varies greatly depending on the type of organization from which it is created. For purposes of implementing the SPROWG Concept, there are no governmental entities other than the State of Colorado, whose geographic jurisdiction is sufficiently

encompassing to include all the prospective SPROWG participants and facilities. As a result, a subdistrict to an existing political subdivision of the State does not seem to be a viable option to plan, finance, develop, and operate the SPROWG Concept. However, this preliminary observation may change if prospective project participants are reduced in number and scope to those whose service areas are contained entirely within the jurisdiction of an existing governmental entity other than the State of Colorado. While this framework is likely not viable given the current configuration of the SPROWG Concept, it is retained on the list in the event that the SPROWG Concept is reduced in scope.

Case Study: Windy Gap Project Municipal Subdistrict of Northern Colorado Water Conservancy District

Table 9. Existing Government Advantages and Disadvantages

Advantages	Disadvantages
Once formed have strong assurances for longevity.	In certain cases, a subdistrict can be challenging to form due to statute requirements including petition signature requirements.
Depending on the parent government/district's powers or bylaws, the subdistrict may be adaptable to adjust for future needs and flexible to add new purposes or goals.	All characteristics are limited by those defined in the by-laws of the parent district.
Shared governance with the parent government/district can simplify the formation process.	
A good option for projects where specificity of participation, project allocation, and cost sharing is needed.	

Water Conservancy District (WCD)

A WCD may be created for purposes including the prevention of floods, protecting public and private property from inundation, and the conservation, development, utilization, and disposal of water for irrigation, municipal and industrial uses. Once created, WCDs remain under the jurisdiction of the state district court. They are created at the request of communities and are local instrumentalities of state government. WCDs can provide assurances of longevity, the capacity to adapt to future conditions

and changing needs, and a “tried and true” approach to levying taxes, collecting revenue, and constructing ambitious projects. These advantages notwithstanding, the requirements to form WCDs are highly prescriptive, rigid, and could be cumbersome to implement for the SPROWG Concept. Additionally, constraints with respect to the number, type, and geographic location of likely participants render the WCD structure a challenging match for the SPROWG Concept. The South Platte Basin, which the SPROWG Concept is designed to benefit, is geographically the State’s largest. It is also the State’s most populous, most urbanized, and contains the greatest number of irrigated acres. Accordingly, water users in the basin represent the greatest diversity of type and interest in the State. While probably not impossible, structuring and creating a WCD to be responsive to this diversity would be challenging.

Case Study: Northern Colorado Water Conservancy District

Table 10. WCD Advantages and Disadvantages	
Advantages	Disadvantages
Once formed provides assurance of the longevity and stability of the organization.	Requires extensive process, including public involvement and support, for formation.
Ability to levy and collect taxes as well as assess special assessments allows for security in funding of operations, maintenance, and new projects.	The number of signatures required to form is based on the estimated cost of land within all participants’ service areas. With current potential participants throughout the basin, it is anticipated that the requirements could be challenging to meet.
As a local government and a political subdivision, WCDs are not subject to state or federal taxes.	Once established, it is challenging to adapt to include additional purposes.

Regional Water Authority (RWA)

Under the Colorado Constitution and statute, two or more political subdivisions (e.g. county, city, town; water, sanitation, irrigation, drainage, or other special district pursuant to law) may form to create separate political entities such as special districts. RWAs are a type of special district created through an intergovernmental relationship. They are governed by part two of Colorado Revised Statutes Title 29, “Intergovernmental Relationships”. A regional water authority can be formed with relative ease but

must be done in accordance with Colorado law as well as each participating entities’ bylaws.

RWA, as with most other frameworks, are defined by their executed bylaws and governed by a board of directors. Limitations within the defined bylaws determine the entity’s ability to adapt to future conditions and flexibility to incorporate new goals or purposes. Therefore, while the potential participants of the SPROWG Concept could organize as a RWA, careful consideration while drafting the entity’s bylaws is recommended to avoid unintended consequences. While changing the bylaws of an RWA is possible, it is not a simple process and necessitates engaging legal counsel.

Case Study: South Metro Water Supply Authority

Table 11. RWA Advantages and Disadvantages	
Advantages	Disadvantages
Allows for a diverse group of governmental participants.	Only governmental entities may be participants.
Can incur debts and assess membership for funding needs.	May not levy a tax.
Can enter into intergovernmental agreements with other governmental entities.	Depending on the purpose and the participants, formation of a RWA can be a lengthy process.
As a governmental entity and a political subdivision, RWAs are exempt from both state and federal taxes.	

Memorandum of Understanding (MOU)

A memorandum of understanding (MOU) is generally a non-binding agreement between two or more parties. MOUs may be executed between both governmental and non-governmental entities.

Commonly thought of as a “gentleman’s agreement”, this organizational framework is often used when a binding contract is not necessary or desired but something more substantial than a handshake is needed. Of the organizational frameworks for a regional

project, MOUs are the easiest to form and dissolve. However, they also have the least power. As such, MOUs are a good option for an interim step prior to forming a more binding agreement.

While largely a non-binding agreement, MOUs may include binding elements. As such, an MOU is a viable option for the SPROWG Concept. However, if chosen it is advised that an MOU be used as an interim step only. For joint parties seeking to organize under a framework for a specific project or purpose, an MOU provides an easy, fast, and straightforward option to record the intent and responsibilities of the parties. However, the lack of structure makes MOUs challenging to provide the level of definition necessary for the planning, design, construction, and operation of a project like the SPROWG Concept.

Case Study: Eagle River Memorandum of Understanding

Table 12. MOU Advantages and Disadvantages

Advantages	Disadvantages
Easy to form with agreement between two or more parties.	Largely non-binding contracts that can include legally binding elements.
Easy to dissolve.	Does not provide long-term certainty.
A common interim framework due to the ease of formation, adaptability to future conditions, flexibility to meet additional needs and inclusive nature.	Though some elements of an MOU may be legally binding, the framework provides little if any legal protections for projects or participants.
Highly inclusive as governmental and non-governmental entities alike may participate.	Easy for participants to default due to non-binding nature.

Intergovernmental Agreement (IGA)

An IGA is a legally binding agreement between two or more existing governmental or quasi-governmental entities. In accordance with Colorado law, IGAs describe the relationship, define authority, and seek to achieve efficiencies through cooperation. An IGA may be used as a contracting mechanism for many purposes including but not limited to cooperative planning, resource sharing, joint planning commissions, and joint projects.

The ease with which an IGA is formed is dependent on the parties involved, the purpose of the project, and other potential clauses like project financing. An IGA is a viable option for the SPROWG Concept. However, it is advised that an IGA be used as an interim step only. Like MOUs, IGAs lack much of the organizational structure necessary for the planning, design, construction, and operation required for a project like the SPROWG Concept. However, the formation of an IGA can provide the structure necessary at the early stages of a project and allow participants to postpone the creation of a standalone entity to a later date.

Case Study: Water Infrastructure Supply Efficiency (“WISE”) IGA

Table 13. IGA Advantages and Disadvantages

Advantages	Disadvantages
As a legally binding contract between two or more parties, an IGA provides some legal protections for projects and participants.	While IGAs can exist into the future, protections are not solid or lasting in nature.
A good interim organizational framework as it provides project participants a binding agreement which can be superseded by a new organizational framework in the future.	An IGA is not a separate entity. All provisions must be executed by the participants in accordance to the agreement, and participation is limited to governmental entities.
Formation is relatively simple requiring negotiations between the related parties.	Formation of an IGA requires devoting resources toward legal counsel of each entity.

Comparison of Organizational Frameworks

The best framework for a project is one that meets the participants' interests and needs, as determined by the participants themselves and no one else.

The Study incorporated a qualitative assessment of the six organizational frameworks, detailed in the Technical Memorandum titled "Organizational Frameworks" (Attachment B). The qualitative assessment evaluated each organizational framework with seven criteria. Although general in nature, this allowed a qualitative comparison of the organizational frameworks.

Adaptability	Flexibility	Ease of formation	Long-term certainty	Legal protections	Inclusiveness	Interim effectiveness
Ability to adapt to future changes including but not limited to participants, project components, and project operations.	Ability to change the organization to accomplish different or additional goals.	Ability to easily form the organization.	Ability of the organization to provide confidence that it will be able to deliver its identified purpose in future years.	Ability of the organization to provide legal protections for its participants as well as for all developed projects.	Ability to accommodate a variety of types of project participants.	Ability to serve as an interim organizational framework during project development, permitting and design when project concepts and participants may still be in flux.

Table 14. Organizational Frameworks Qualitative Assessment

Organizational Framework	Adaptability	Flexibility	Ease of formation	Long-term certainty	Legal protections	Inclusiveness	Interim effectiveness
Nonprofit Corporation	Medium	Medium	Medium	High	High	High	Medium
Existing Government	Medium	Low	Medium	High	High	Medium	Medium
Water Conservancy District	Medium	Low	Low	High	High	Low	Low
Regional Water Authority	Medium	Medium	Medium	High	High	Medium	Medium
Memorandum of Understanding	High	High	High	Low	Low	High	High
Intergovernmental Agreement	High	High	High	Medium	Low	Medium	High

LEGEND: ■ Low (1-3) ■ Medium (4-7) ■ High (8-10)

The organizational frameworks were assigned a qualitative score from 1 to 10 with 1 representing a complete inability to meet the criteria and a score of 10 indicating that the criteria are completely met. The rankings reflect SPROWG as currently conceptualized and represent a broad, general interpretation of the legally allowable nature and characteristics of each organizational framework described more completely in the Technical Memorandum (Attachment B).

Each organizational framework has areas of strength and weakness. While these findings are not a recommendation, they can be used to inform later decisions on the right organizational framework for the project. For example, should the SPROWG participants desire an organizational framework in place in the near term, while not all the project components have been fully defined, the participants may be better suited to consider a memorandum of understanding or intergovernmental agreement. While a MOU or an IGA offer ease of formation and ample adaptability as well as flexibility, they may not provide the long-term certainty or robust legal protections desirable in a project like SPROWG. A WCD, while rigid and difficult to form, offers advantages in terms of long-term stability and reliability, and the ability to fund and construct ambitious projects. Thus, as the SPROWG concept becomes more developed, a more formal, or robust, organizational framework may be necessary. At which point, the participants may desire to create a more formal organization that provides additional benefits including greater long-term certainty and legal protections.

SECTION 4:

Concept Refinement and Modeling

Two key objectives for the Study were refining the SPROWG Concept based on stakeholder feedback and evaluating four alternative configurations of the SPROWG Concept. The refinements and alternative configurations were built on modeling and analysis work conducted during the preliminary discussions of the SPROWG Concept. Section 4 summarizes the concept refinements, the four alternative configurations of the SPROWG Concept, and the modeling results. A detailed description of the modeling, refinements, and conclusions is included in a Study Technical Memorandum entitled “SPROWG Concept Refinement and Alternatives Modeling” (Attachment C).

Initial Concept Modeling

Grand River Consulting and Wilson Water Group assisted early technical analyses for the SPROWG Concept collaboration. The early analyses used a tailored version of the Point Flow Tool (described below) to identify potential infrastructure that could meet preliminary yield and performance goals and to characterize a project concept to carry forward into further feasibility analysis. The tailored version of the Point Flow Tool included an expanded time period, delivery demands at various locations, reservoir and pipeline operations, and consideration of multiple sources of supply.

The initial yield and performance goals for the SPROWG Concept were to:

- ✓ **Provide 50,000 AF/yr of firm yield for future M&I demands in the South Platte Basin along the Front Range**
- ✓ **Provide up to 10,000 AF/yr of yield for agricultural water users when supplies are available**
- ✓ **Utilize exchanges to the extent possible to “move” water upstream as opposed to pumping plants and pipelines**

Initial Concept C

The team analyzed several concepts and developed a preliminary concept that met initial demand goals. The resulting concept was “Initial Concept C”, and it included storage facilities in the vicinity of Henderson, Kersey, and downstream of Fort Morgan near Balzac.

Initial Concept C sought to conjunctively utilize unappropriated water when available, reusable supplies, ATMs, and excess recharge credits to maximize the benefits of supplies, and it relied on exchanges to “move” water upstream to meet municipal demands in the South Platte Basin along the Front Range. Initial Concept C was the SPROWG Concept configuration that existed at the initiation of the Study.

The Point Flow Tool

The Point Flow Tool was initially developed by Kenny Fritzler and Brown and Caldwell to support evaluations of exchange capacity in 2011 (Colorado Corn Growers Association, et al., 2011). The original and current versions of the tool use a daily point flow analysis and daily call information to determine when and where exchanges could have historically been run and the amount of unappropriated supply historically available along the South Platte River from the Denver gage to the Colorado-Nebraska state line.

The Point Flow Tool is spreadsheet-based and is straightforward to use, update, and adapt for a variety of analyses. Since its creation, the tool has been modified and used to quantify historical unappropriated supplies and exchange capacity for several efforts including the SPBIP and the SPSS. It has also been modified and used in other studies to evaluate proposed operations of new reservoirs and recharge facilities.

For the purposes of this Study, the version of the Point Flow Tool used to analyze Initial Concept C was adopted and modified to include different delivery goals and infrastructure based on the descriptions and objectives of the alternatives. A description of the various Point Flow Tool components, assumptions and modifications is provided below:

Hydrology

The Point Flow Tool uses historical data from Hydrobase and includes daily call chronology and daily streamflow data for gaging stations and diversion points along the South Platte mainstem. The tool has estimated flows/calls for 1947 through 1996 and actual data from 1996 through 2015. While no guarantee of the future, the length of the hydrologic study period provides a wide range of flow and administrative conditions by which to model potential PROWNG operations.

Adjustments to Free River and Exchange Potential

Several considerations with respect to future supply projects and water rights were incorporated into the Point Flow Tool:

Potential depletions from future projects	The historical streamflow data described above were adjusted to reflect several future potential projects that would use unappropriated supplies including the Chatfield Re-allocation Project, conditional storage rights associated with gravel pits, and the Northern Integrated Supply Project (NISP).
South Platte Compact obligations	SPROWG Concept operations and diversions are limited by the constraints of the South Platte River Compact, which requires a flow rate of 120 cubic-feet per second (cfs) at the Colorado-Nebraska state line between April 1 and October 15 each year.
Conditional exchanges	Numerous conditional exchange rights exist along the South Platte River, and to the extent they are activated in the future, would diminish the availability of exchange capacity. The Point Flow Tool makes a 300 cfs allowance for potential future conditional exchanges whose operation is not reflected in the historical record of stream flows.

Water Sources

Table 15 describes the different sources of water supply considered by SPROWG Concept modeling.

Source	Description/Amount	Source	Description/Amount
Unappropriated supplies	Unappropriated native South Platte River flows currently available under historical free river conditions. Amount is variable.	Excess recharge credits	Up to 30,000 AF of excess recharge credits originating from recharge operations downstream of Kersey
Existing unused, reusable return flows	12,000 AF of currently unused but legally reusable return flows owned by Denver Water and Aurora Water	Alternative Transfer Methods	Up to 30,000 AF of water from ATMs downstream of the Kersey gage. Assumed to be available in driest 30% of years.
Reuse of SPROWG concept return flows	Reuse of up to 40 percent of SPROWG Concept supplies delivered for indoor use	Denver Basin supplies	Up to 5,000 AF of non-tributary Denver Basin supplies

Water Demands

For modeling purposes, demands were aggregated and assumed to occur at a limited number of locations that were conceptualized as “demand gateways”. Figures 3 through 6 show the demands and gateway locations described below.

Denver Metro Demand Gateway

The Denver Metro Demand Gateway is a representative location from which municipal water providers would receive water from the SPROWG Concept. For the Study the Denver Metro Demand Gateway was considered to be at the location of the Prairie Waters Project North Campus (PWP). The modeling assumes that, if supply could be delivered to or stored in this general location, it could be conveyed to water users such as Denver, Aurora, South Metro Water Supply Authority members, or Brighton via an expansion in the PWP or through a parallel pumping/conveyance/treatment project (for costing purposes a separate SPROWG delivery and treatment system was assumed). Delivery goals assumed that Denver Metro water providers served through this gateway have mature water portfolios and have lower needs for future firm supplies and higher needs during drought conditions when their other supplies are not as plentiful. The modeling also assumes that smaller but rapidly growing communities just north of the Denver Metro area (NoCo-S) could be served at this location and that these communities would have firm yield needs.

Northern Colorado Gateway

The Northern Colorado (NoCo-N) Gateway is the location to which water would be delivered municipal water providers in Northern Colorado. For this study, the location of the NoCo-N Gateway was considered to be on the South Platte River just downstream of its confluence of the Cache la Poudre Rivers. The NoCo-N Gateway could potentially serve water providers in the Loveland-Greeley area located roughly between US 285 and US 85 along the I-25 corridor. Delivery goals for this gateway assume that firm supplies will be required to support the needs of smaller but rapidly growing municipalities.

Eastern Plains

The modeling assumed that communities along the South Platte River downstream of Kersey would use water supplies for augmentation purposes. As a result, no specific delivery location or gateway was considered for these communities

Agriculture

Like the Eastern Plains municipal demands, the modeling assumes that agricultural water users would utilize supplies from the SPROWG Concept for augmentation purposes. Consequently, no demand gateway was considered for agricultural water users. However, specific demands were identified in Districts 2, 1, and

64, and the model sought to deliver agricultural supplies to meet the specific needs in those districts using supplies available in various storage vessels.

Other Modeling Assumptions

The SPROWG Concept Refinement and Alternatives Modeling Technical Memorandum (Attachment C) describes several assumptions that were incorporated into the modeling. Some of the more important assumptions are:

- The analysis assumes that municipal water providers would implement water conservation strategies (such as watering restrictions) to reduce demands during drought conditions. As a result, municipal/industrial delivery goals were met if supplies were adequate to meet at least 90% of the demand in each year of the analysis.
- Non-tributary Denver Basin supplies were modeled as the last supply to be accessed and are allocated only to meet Denver metro demand.
- Consistent with Initial Concept C, agricultural demands were met with available supplies after municipal demands were met, and agricultural delivery goals were not always achieved each year.
- All storage facilities are assumed to be off-channel.
- The modeling assumes that exchange bypasses will be constructed at the Jay Thomas/Hewes Cook and North Sterling diversion locations.

Concept Alternatives and Modeling

The scope of work for this Study specified the evaluation of up to four SPROWG Concept alternatives. The alternatives were developed first using Initial Concept C as a “baseline” and then refining/adding demands based on the feedback from outreach activities with stakeholders, guidance from the Advisory Committee, input from the Task Force, and consideration of other studies such as the Technical Update to Colorado’s Water Plan. The alternatives do not each have the same delivery goals. Rather, each successive alternative, in general, builds upon and adds to the delivery goals and infrastructure included in the prior alternative. Table 16 provides a list of the alternatives and a general description of how they build upon one another.

Table 16. Overview of Alternatives 1, 2, 3, and 4

<u>Initial Concept C</u> Initial Concept	<u>Alternative 1</u> Refine the Initial Concept	<u>Alternative 2</u> Balzac First	<u>Alternative 3</u> Add Julesburg Storage	<u>Alternative 4</u> Additional Delivery
Initial Concept C is a baseline. Alternatives 1, 2, 3, and 4 add infrastructure and refine/add demands based on the feedback from outreach activities.	Alternative 1 has similar overall delivery goals and infrastructure as Initial Concept C, but refinements based on feedback from outreach were incorporated.	Alternative 2 examines a scenario in which a storage facility downstream of Fort Morgan (near Balzac) is the primary facility from which deliveries are made. This alternative sets higher delivery goals for small municipalities downstream of Kersey. Denver Metro and NoCo demands are the same as Alternative 1.	Alternative 3 builds on Alternative 2 by adding another storage facility near the Colorado-Nebraska state line and increasing delivery goals for agriculture and small municipalities downstream of Kersey. Denver Metro and NoCo demands are the same as Alternative 1.	Alternative 4 builds on Alternative 3 by increasing municipal delivery goals by 25 percent, increasing agricultural delivery goals, and increasing storage facilities to meet the demands.

The Point Flow Model was used to evaluate the infrastructure and delivery goals for each alternative. Table 17 shows the size of infrastructure the modeling indicated was necessary to meet the delivery goals developed for each alternative.

Table 17. Infrastructure Necessary to Meet Delivery Goals for Each SPROWG Concept Alternative					
		<u>Alternative 1</u> Refine the Initial Concept	<u>Alternative 2</u> Balzac First	<u>Alternative 3</u> Add Julesburg Storage	<u>Alternative 4</u> Additional Delivery
Size of Infrastructure					
Henderson Storage (AF)*		45,000	40,000	40,000	85,000
Kersey Storage (AF)		150,000	100,000	100,000	200,000
Balzac Storage (AF)		25,000	75,000	75,000	95,000
Julesburg Storage (AF)		-	-	8,000	29,000
Total Storage		220,000	215,000	223,000	409,000
Balzac to Denver Pipeline Capacity (cfs)		0	30	30	30
Delivery Goals (wet and average years / dry years) – data in AF per year					
Municipal	Denver Metro Demand Gateway	20,000/60,000	20,000/60,000	20,000/60,000	25,000/75,000
	NoCo-N Demand Gateway	20,000/20,000	20,000/20,000	20,000/20,000	25,000/25,000
	Eastern Plains	2,000/2,000	5,000/5,000	10,000/10,000	15,000/15,000
	Total Municipal Delivery	42,000/82,000	45,000/85,000	50,000/90,000	65,000/115,000
Agricultural	Water District 2	750/2,500	750/2,500	1,500/5,000	2,250/7,500
	Water District 1	2,250/7,500	2,250/7,500	4,500/15,000	6,750/22,500
	Water District 64	-	-	2,000/2,000	5,000/5,000
	Total Ag Delivery	3,000/10,000	3,000/10,000	8,000/22,000	14,000/35,000

*Storage at Henderson was contemplated to be 30,000 AF of gravel pit storage with the rest being aquifer storage and recovery in the Lost Creek basin

The data in Table 17 are also in graphical format in Figures 5 through 8. The figures provide a geographic representation of each alternative and include delivery goals, size and general location of storage facilities, and conveyance facilities.

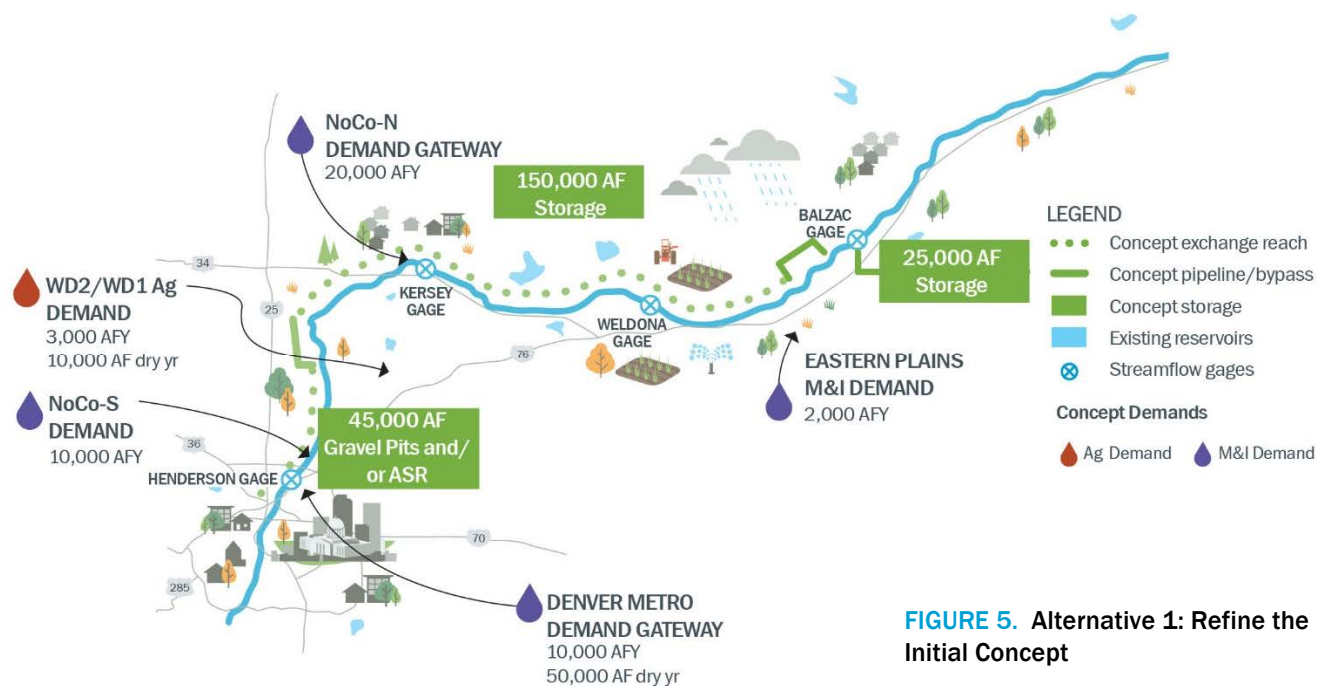


FIGURE 5. Alternative 1: Refine the Initial Concept

Schematic of Delivery Goals and Infrastructure.

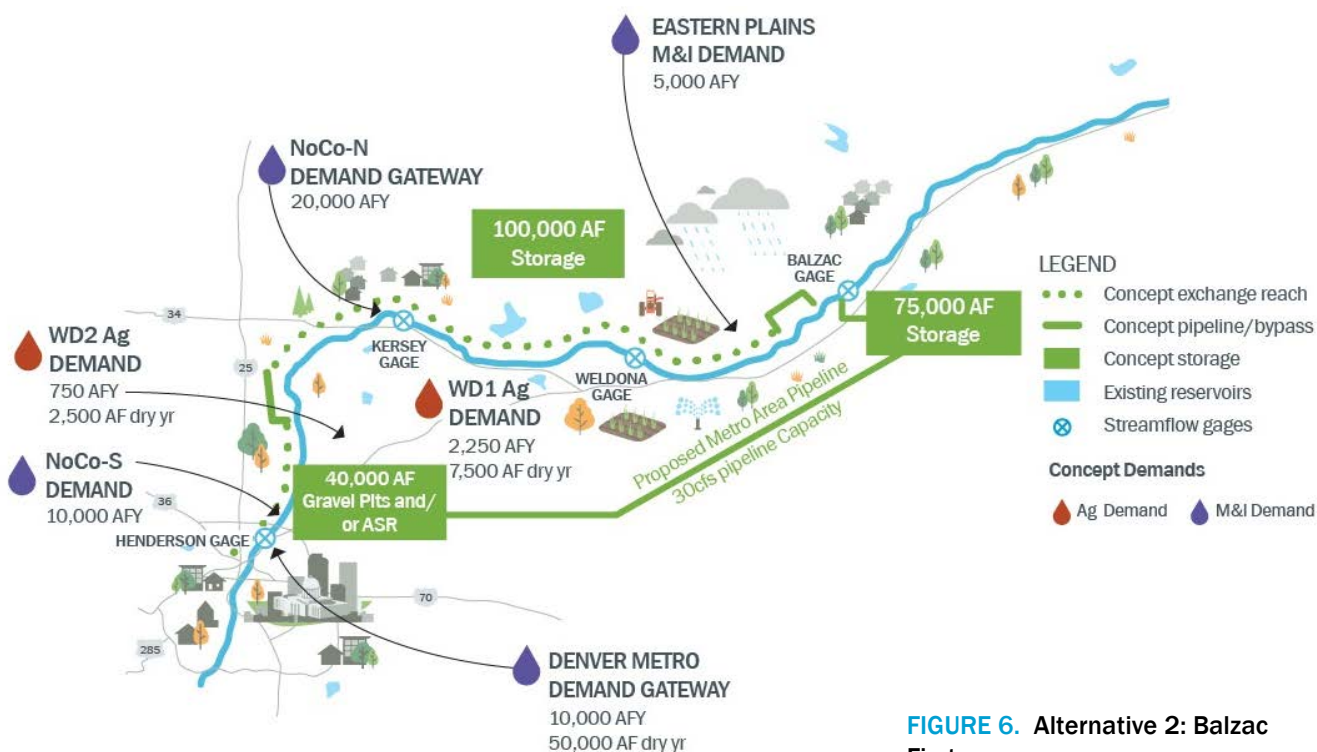


FIGURE 6. Alternative 2: Balzac First

Schematic of Delivery Goals and Infrastructure

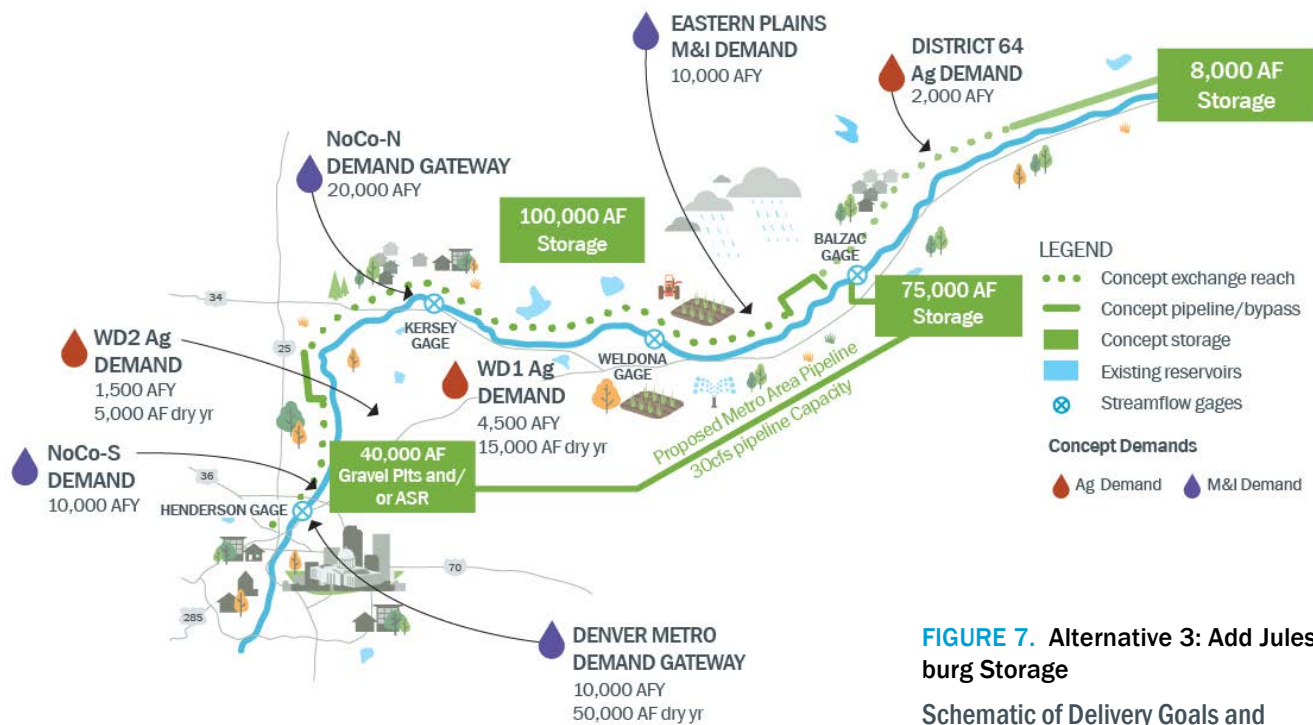


FIGURE 7. Alternative 3: Add Julesburg Storage
Schematic of Delivery Goals and Infrastructure

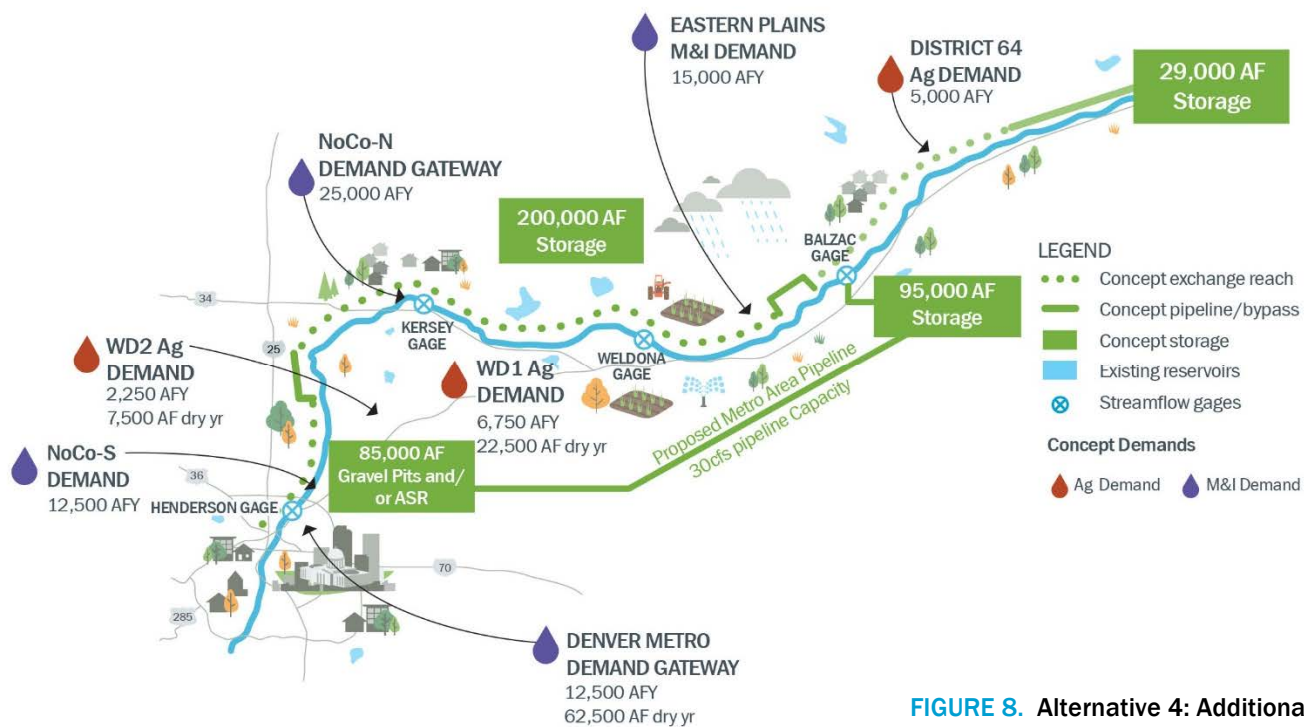


FIGURE 8. Alternative 4: Additional Delivery
Schematic of Delivery Goals and Infrastructure

Observations and Conclusions

Alternatives 1, 2, 3, and 4 are all viable options, and each Alternative provides an opportunity for the SPROWG Concept project to be successful. Table 18 describes key observations and conclusions from the modeling of each alternative. Attachment C provides a complete list of observations and conclusions.

Table 18. Observations and Conclusions from Modeling				
	<u>Alternative 1</u> Refine the Initial Concept	<u>Alternative 2</u> Balzac First	<u>Alternative 3</u> Add Julesburg Storage	<u>Alternative 4</u> Additional Delivery
Municipal	<ul style="list-style-type: none"> Projected future municipal demands were fully met in most years of the simulation. Municipal demands were not fully met in only 5 of the 69 years of simulation, and in those years, at least 90% of the municipal demand was met. 	<ul style="list-style-type: none"> Projected future municipal demands were fully met in most years of the simulation. Municipal demands were not fully met in only 3 of the 69 years of simulation, and in those years, at least 90% of the municipal demand was met. 	<ul style="list-style-type: none"> Projected future municipal demands were fully met in most years of the simulation. Municipal demands were not fully met in only 5 of the 69 years of simulation, and in those years, at least 90% of the municipal demand was met. 	<ul style="list-style-type: none"> Projected future municipal demands were higher in Alternative 4 and were fully met in most years of the simulation. Demands were not fully met in only 8 of the 69 years of simulation. In one of those years, 85% of municipal demand was met, and 90%+ was met in the rest of the years.
Agricultural	<ul style="list-style-type: none"> Agricultural demands in Water District 1 were simulated to be met nearly all the time Agricultural demands in Water District 2 were met only 9% of the time because of limitations on exchange capacity. Other alternatives performed significantly better. 	<ul style="list-style-type: none"> Agricultural demands were met nearly all of the time in Districts 1 and 2. District 2 improvements over Alternative 1 were due to releases from Henderson storage to meet agricultural demands in District 2. 	<ul style="list-style-type: none"> Agricultural demands almost always met in Districts 1 and 2. The modeling suggested that at least 2,000 AF/year of agricultural demand could be met in District 64. A variation on Alternative 3 was modeled that met more agricultural demand and had higher delivery goals in wet/average years and lower goals in dry years and assumed water would be delivered to recharge basins. 	<ul style="list-style-type: none"> Agricultural demands were met nearly all of the time in Alternative 4, even with 50 percent higher delivery goals than Alternative 3. The modeling suggested that at least 5,000 AF/year of agricultural demand could be met on a firm basis in District 64.
Infrastructure and Operations	<ul style="list-style-type: none"> Storage volumes at Henderson and Balzac were similar to Initial Concept C but larger at Kersey, because future exchange capacity limitations in Alternative 1 were greater than was assumed in Initial Concept C. A modeled variation of Alternative 1 assumed construction of a pumping station and pipeline between Kersey and Henderson to eliminate reliance on exchange between these two facilities. It resulted in lower storage needs at Henderson. Conveyance infrastructure like this can be considered in the future if adequate gravel pit storage at Henderson is unavailable, ASR in the Lost Creek basin is cost prohibitive or otherwise infeasible, or exchange capacity is severely limited. 	<ul style="list-style-type: none"> Exchange capacity limitations associated with Alternative 1 were somewhat relieved in Alternative 2, because municipal supplies can be directly delivered to Denver Metro water providers from storage at Balzac via the pipeline. Various Denver Metro pipeline capacities were simulated, and 30 cfs seemed to provide the best operational performance. Alternative 2 has less total storage than Alternative 1, but 50,000 AF of storage was shifted from Kersey to Balzac. 	<ul style="list-style-type: none"> The Julesburg-area reservoir remained full most of the simulation, because water is available due to the presence of return flows and lack of downstream calls. The Julesburg-area reservoir was primarily used to meet local (Water District 64) demands. The pipeline from the reservoir to above the Harmony Ditch played a key role in overcoming exchange capacity issues and delivering water to users. Balzac-area storage can meet more Water District 1 demands when downstream demands in District 64 are met with Julesburg-area storage. 	<ul style="list-style-type: none"> The Julesburg-area reservoir remained full most of the simulation, because water is available due to the presence of return flows and lack of downstream calls. Storage facilities at Henderson, Kersey, and Balzac were greatly drawn down in the modeling simulation during the droughts of the 1950s and 2000s.

Environmental and Recreation Considerations

Currently the modeled simulations of the SPROWG Concept do not explicitly include considerations for environmental and recreation needs and opportunities, but they could be incorporated in the future. Below are several opportunities and needs identified by environmental and recreation stakeholders that could be addressed in future modeling and design of the SPROWG Concept.

Allocation of project reservoir storage for needs such as flood control, conservation/multi-use, or sediment accumulation.

Such pools of storage are often referred to as flood control pools, conservation pools (which can meet multiple uses including environmental and recreation needs), and inactive pools, respectively. The flood control pool is intended to be empty until needed to hold floodwaters. The conservation pool contains all the water that can be used for the specified purposes of the reservoir and may include water supply, environmental flows, irrigation, hydropower, navigation, or recreation. Often, when the reservoir level is within the conservation pool, releases or withdrawals from the reservoir are only allowed for users that have permits assigned to storage within the conservation pool. The inactive pool is intended to fill with sediment over the life of the project however water in the inactive pool could be used during extreme droughts or emergencies, but only after the conservation pool has been emptied. Some examples of reservoirs in Colorado having storage pools for specific uses include: the environmental pool that is currently being created as part of the Chatfield Reservoir reallocation project to allow for strategic releases to enhance stream flows and water quality in the South Platte River below the reservoir and ancillary recreational benefits; the environmental pool in Elkhead Reservoir that is managed to provide water for augmenting summer low flows in the lower Yampa River; and Pueblo Reservoir which operates a minimum pool for fish, wildlife, and recreation purposes.

Delivery of water into project reservoirs to support specific environmental needs.

The water could meet needs such as wetland vegetation within the reservoir, wetland vegetation along sloughs or waterways supported by accretions resulting from prior delivery to and recharge from project reservoirs, and development of habitat within reservoirs for waterfowl and shore birds. Future modeling could consider the optimal timing of delivery of water into project reservoirs, and the potential for deliveries to be available (either directly or after recharge) to satisfy other project demands including potential recapture and reuse of project water.

Delivery of water from a SPROWG reservoir back to the South Platte River for the purpose of meeting water needs for specific resource values.

The voluntary flow management program (VFMP) in the Arkansas River is an example of managing reservoir releases and streamflow for specific resource values. The specific environmental and recreation resource needs recognized in the VFMP include fisheries needs, boating needs, angling needs, wildlife and riparian needs, and other needs such as the dilution to benefit water quality. Based on feedback received from environmental and recreation stakeholders, resource values to be considered in the South Platte River may include but are not limited to: maintenance of peak flows, scouring flows, and sediment transport flows; elimination of dry up points in the South Platte River or the reestablishment of hydrology and habitat at existing dry up points; habitat, incubation flows and spawning flows for small bodied plains fish; and habitat, incubation flows, and spawning flows for warm water fish.

Additional project definition is needed before the SPROWG Concept is ready for consideration from the permitting perspective.

Given the conceptual nature of the SPROWG Concept, the effects of the project cannot be fully evaluated. Additional information needed prior to consideration from a permitting perspective includes but is not limited to: the amount of water involved; the location of project components; details regarding project operation; project participants; and the time, location, and amount of project demands. If the final project proponents are able to utilize a streamlined Section 7 Endangered Species Act consultation and the template Biological Opinion through its participation in South Platte Water Related Activities Program (SPWRAP) through the Platte River Recovery Implementation Program (PRRIP), the project participants will need to be SPWRAP members. In addition, the SPROWG Concept will comply with requirements of the South Platte River Compact of 1923. Additional information will also be needed on the extent to which SPROWG may or may not affect Colorado's responsibility for mitigating the impacts of new water-related activities in Colorado through the PRRIP.

Evaluate potential effects on environmental attributes and recreation.

Development and operation of the SPROWG Concept will affect the flow of water in the South Platte River. Future SPROWG research should consider the effects of project development and operation on flows rates, water quality, water temperature, environmental resources, and recreation. Mitigation strategies can be developed to address potential negative effects.

SECTION 5:

Water Treatment Strategies

This Study identified four alternatives for capturing, storing, and delivering water to potential future SPROWG Concept participants. Municipal and industrial participants could choose to take raw or treated water. For the SPROWG Concept to reach its full benefit, delivered treated water must meet appropriate water quality standards. The necessary water treatment strategy will be determined by needs of the specific project participants and water quality at the location of the final diversion points. Simplifying assumptions provided a conceptual understanding of the treatment needs and costs for providing water to municipal and industrial customers from the SPROWG Concept. Attachment D, the “Water Treatment Alternatives” Technical Memorandum, describes the complete water treatment analysis.

Water Quality

The South Platte River’s water quality continues to degrade as it progresses downstream. The treatment processes to address raw water quality will largely be determined by the location of the diversion.

Potable water delivered by a water utility must meet health related standards set by Colorado Department of Public Health and Environment Regulation 11 Colorado Primary Drinking Water Regulations. Additional secondary or non-health related standards are also a consideration for water quality. This Study assumed that participants receiving finished water must meet primary drinking water standards, some secondary standards, and disinfection by-product standards. The governing secondary standard of concern is total dissolved solid (TDS) and the Study assumed a target TDS concentration for treated water deliveries at 400 milligrams per liter (mg/L).

This Study utilized water quality data from the 2019 Historical Analysis of the South Platte River Salinity Study conducted by Nierbo Hydrogeology (Nierbo Study) that included raw water quality for 13 parameters. The SPROWG Study utilized the Nierbo Study water quality data for raw water quality at the approximate locations of South Platte River diversions for the SPROWG Concept: near Brighton, below the Poudre River confluence, and near Fort Morgan. The SPROWG Study identified water quality issues or considerations that may necessitate various levels of treatment.

- Turbidity, iron, and manganese were found to be high.
- Total dissolved solids exceed the secondary standard of concern.
- Total organic carbon concentration is elevated, requiring 50% removal per regulations and to reduce disinfection byproduct formation.
- Bromide levels are close to the trigger for bromate formation, a parameter of concern if ozone is a desired treatment process.

Of the four alternatives, the best source water quality was found at the “near Brighton” location, which is the most upstream of the potential diversion points considered in this Study. The data indicate this location provides the lowest TDS with sulfate and chloride levels near the MCL.

Water Treatment Options

For each of the four alternatives, the Study evaluated two treatment scenarios - riverbank filtration with a conventional treatment plant, and application of advanced treatment technology in an advanced water treatment plant. Each treatment scenario provides advantages and disadvantages. Considerations for water treatment scenarios included infrastructure costs, ability to meet primary and secondary standards, land requirements, and solids handling.

After an initial assessment, riverbank filtration was considered only as a pre-treatment option to reduce turbidity and total organic carbon. Conventional treatment would meet all required primary drinking water standards.

This treatment option requires lower overall power demands relative to the advanced water treatment option. Additional advantages include ease of disposal of solids and lower water loss across the treatment processes. Disadvantages of riverbank filtration with conventional water treatment include increased chemical usage, additional polishing processes, and finished water blending to meet secondary standards for TDS. Furthermore, this option may require additional processes or modifications to meet future regulations.

The second water treatment scenario considered by the SPROWG Study was advanced water treatment. For the purpose of this study, the advanced water treatment process was assumed to consist of high-pressure membrane filtration, including reverse osmosis, with mechanical evaporators for brine treatment. This option meets all primary and secondary water standards and provides the benefit of needing a smaller physical footprint. Additionally, it is more likely to meet future regulations with fewer modifications. However, advanced water treatment has higher energy demands, more maintenance requirements, and additional source water flow to meet demands due to greater water loss across the processes.

Brine disposal represents a significant cost and permitting challenge. Mechanical evaporators with landfilling of solids were selected for evaluation in this Study.

They are the most expensive accepted practice for brine disposal but have more certainty of environmental approval than deep well injection and require significantly less land than evaporation ponds. It is possible that future regulations or specific project requirements may require a different alternative to be considered.

Capital, operation and maintenance (O&M), and life-cycle cost estimates were prepared for the treatment alternatives for each SPROWG alternative.

Table 19 presents the summary of costs for the advanced water treatment option. The total cost is the life-cycle cost, which includes capital costs plus the present worth of 20 years of O&M. Because the advanced water treatment option is more certain in terms of meeting water quality requirements, and is conservative in terms of cost, it was recommended for use in the overall SPROWG Concept cost estimates.

Table 19. SPROWG Advanced Treatment Option Costs Comparison

Alternative	Design Flow (million gallons per day (MGD))	Capital Cost ¹ (\$M)	Annual Operating Cost ² (\$M/yr)	Present Worth Operating Cost ³ (\$M)	Engineering & Permitting Costs ⁴ (\$M)	Land Acquisition Costs ⁵ (\$M)	Legal & Administrative Costs ⁶ (\$M)	Subtotal (\$M)	Total (\$B)
-------------	--	---------------------------------------	--	---	---	--	--	-------------------	----------------

Alternative 1 – Refine the Initial Concept

Metro Gateway (Metro + NoCo-S)	74	\$518	\$7.22	\$107	\$78	\$1.07	\$41	\$746	\$1.19
NoCo Gateway (NoCo-N)	44	\$308	\$4.29	\$64	\$46	\$0.64	\$25	\$444	

Alternative 2 - Balzac First

Metro Gateway: Metro	57	\$399	\$5.56	\$83	\$60	\$0.83	\$32	\$575	\$1.22
Metro Gateway: NoCo-S	20	\$140	\$1.97	\$29	\$21	\$0.29	\$11	\$202	
NoCo Gateway: NoCo-N	44	\$308	\$4.29	\$64	\$46	\$0.64	\$25	\$444	

Alternative 3 - Add Julesburg Storage

Metro Gateway: Metro	57	\$399	\$5.56	\$83	\$60	\$0.83	\$32	\$575	\$1.22
Metro Gateway: NoCo-S	20	\$140	\$1.97	\$29	\$21	\$0.29	\$11	\$202	
NoCo Gateway: NoCo-N	44	\$308	\$4.29	\$64	\$46	\$0.64	\$25	\$444	

Alternative 4 – Additional Delivery

Metro Gateway: Metro	72	\$504	\$7.02	\$104	\$76	\$1.04	\$40	\$726	\$1.48
Metro Gateway: NoCo-S	20	\$140	\$1.97	\$29	\$21	\$0.29	\$11	\$202	
NoCo Gateway: NoCo-N	55	\$385	\$5.36	\$80	\$58	\$0.80	\$31	\$555	

Assumptions: ¹ Capital (\$M/mgd) = \$7; ²Annual operating costs (chemicals, equipment replacement, labor, power and miscellaneous); ³Operating costs presented as 20yr present worth (\$M/mgd) = \$1.45; ⁴Engineering & Permitting = 15% Capital; ⁵Land Acquisition (\$10,000/ac) = 116 ac (using relative SF as the Binney WPF 80 mgd and ratio based on flow); ⁶Legal and Administrative = 8% of Capital.

Nonpoint Source Treatment Options

The SPROWG nonpoint source treatment study consisted of a conceptual assessment of possible nonpoint source approaches to water quality improvement that could be considered in the future as alternatives or companion programs to conventional water treatment measures. This was a limited evaluation of the potential for nonpoint source treatment measures to be beneficial to the SPROWG Concept and was intended only to indicate the potential feasibility of this treatment approach for further study. The nonpoint source treatment assessment is described further in the technical memorandum in Attachment E, “Evaluation of Nonpoint Source Treatment Options”.

Nonpoint source treatment best management practices (BMPs) were assumed to be applied at a watershed scale based on land use type (urban/residential, commercial/industrial, farmland, grassland, forest). Data for the type, cost, and effectiveness of a variety of BMPs was taken from published reports and data sources. Data for cost and effectiveness is highly variable for all BMPs, and strongly affects the level of accuracy for any watershed scale BMP assessment.

A range of possible nonpoint source treatment assumptions for improving South Platte River water quality in the SPROWG study area was investigated. Scenarios were developed assuming application of effective BMPs for each land use type in a buffer area within 5 miles of the South Platte River mainstem, with emphasis on areas of irrigated agriculture and those underlain by shallow groundwater aquifers (priority area) and in the area tributary to a SPROWG reservoir near Balzac. BMPs applied to each land use type were:

- **Urban/residential:** detention basins, retention basins, bioretention
- **Commercial/industrial/transportation:** detention basins, retention basins, bioretention
- **Farmland/agricultural:** grass strips and field borders, nutrient management, irrigation water management
- **Grassland:** detention basins, riparian buffer zones, streambank stabilization
- **Forest:** level terraces, riparian buffer zones, streambank stabilization

The extent of assumed BMP deployment in the priority area varied from 10% to 50% of the tributary area. BMPs for nutrient management and sediment control were also assumed for the watershed upstream of the Balzac storage facility included in SPROWG alternatives 2, 3, and 4 that include direct delivery of water from that reservoir to municipal entities. Typical BMP unit costs per acre and pollutant removal effectiveness in percentage reduction in TSS, iron, total nitrogen, total phosphorus, and TDS were estimated for four SPROWG diversion points and three BMP deployment assumptions. **Costs to implement BMPs across all land use types in the nonpoint source study area vary from \$21 to \$102 million at the Brighton diversion point and \$105 million to \$524 million at the Sterling diversion point. These are conceptual, order-of-magnitude cost estimates for 50 years of annual operation, with an accuracy of -50% to +100%. Pollutant removal percentages vary from about 5% to about 30% depending on the constituent and the location.**

The cost of nonpoint treatment on a watershed scale could be considered high compared to the level of pollutant removal that could potentially be achieved. Overall water quality improvements for watershed scale BMPs may be less than that because not all areas were assumed to be treated. However, existing agricultural and urban BMPs have already achieved some level of pollutant reduction, so estimated pollutant removal by new BMPs would be in addition to those past reductions.

The most effective BMPs relative to treatability of South Platte River water for municipal use may be those that manage irrigation practices such that irrigation tailwater return to the river from irrigated lands and recharge of shallow groundwater by excess irrigation water are minimized.

Nonpoint source treatment measures should not be viewed as a substitute for conventional water treatment of SPROWG supplies for municipal water providers, but as a companion strategy to reduce treatment costs and provide environmental benefits.

Best management practices would normally be implemented and funded by private landowners. In the case of agricultural BMPs, there are outside state and federal funding sources available in the form of grants or loans to offset many of these costs. In addition, public agencies participating in the SPROWG Concept could invest in nonpoint source management projects as a pollutant trading approach, in which pollutant reductions to receiving waters through nonpoint source measures would offset required pollutant reductions in wastewater treatment discharges or other point source discharges. In this way nonpoint source treatment would be part of a more holistic, watershed-based approach to water quality management in the SPROWG study area.

Further studies of potential nonpoint source management options related to the SPROWG Concept could include the following.

- Investigation of hot spots for particular constituents of concern (e.g., TDS, nutrients), and the benefits and costs of focusing nonpoint source measures on those areas.
- Analysis of pollutant loads in the lower South Platte River and refined estimates of pollutant reductions achievable by BMPs commonly applied on irrigated agricultural lands.
- Study of the potential reduction in water treatment costs if nonpoint source controls were applied throughout the watershed.

- Study of the relative impact of agricultural and urban land use contributions to South Platte River pollutants in the SPROWG study area to determine where nonpoint controls could have the most benefit.
- Case studies or conceptual outlines of how a pollutant trading approach could benefit SPROWG participants who contribute to implementing nonpoint source programs.

Conclusions and Recommended Future Studies

The needs of the specific project participants and water quality at the actual location of the diversions will determine the necessary water treatment for any of the alternatives. High TDS is a challenge that must be addressed for all alternatives. The Brighton location has the lowest TDS. Additionally, this location provides sulfate and chloride levels near the maximum contaminant level (MCL). Meeting as much of the Front Range municipal demand as possible from a diversion at this location could provide a relative advantage.

Additional investigations are recommended to evaluate raw water quality and treatment requirements:

Additional sampling program for better data.	The Nierbo Study is a compilation of water quality sampling data collected from multiple sample points in each reach of the South Platte River. These sampling points could be upstream or downstream of the actual proposed intake for the SPROWG Concept and represented different seasons and flow conditions. As such, the SPROWG participants are advised to perform additional analysis of currently available data as well as additional sampling at desired diversion points to determine raw water quality and associated treatment.
Evaluation of potential blending supplies.	This Study assumed that SPROWG Concept water would not be blended with other lower TDS sources. A blending supply, depending on its quality, could reduce or eliminate the need for expensive membrane treatment and brine disposal to reach a desired water quality.
Better define the desired quality of delivered water supplies from a future SPROWG Project.	The SPROWG Study assumed that treated water deliveries would meet all primary and secondary drinking water standards, including a TDS concentration of approximately 400 mg/L. However, the project could deliver supplies at lower quality if the participants are able to provide additional treatment to meet their individual needs.

SECTION 6:

Cost Estimates

Conceptual capital cost and life-cycle cost estimates were prepared for infrastructure associated with the four SPROWG Concept alternatives using a combination of unit costs and other assumptions from the previous SPROWG planning effort, the South Platte Storage Study, and experience of the SPROWG project team. The SPROWG cost estimates are useful for comparing alternatives on a relative basis and for understanding the rough order of magnitude of project development costs. Project costs and the facility layouts presented in this study should not be used for design, budgeting, or project financing.

Cost estimates are conceptual level estimates with a range of -50% to +100%. Estimates were prepared for capital costs and life-cycle costs, and are described in more detail in the technical memorandum in Attachment F, “Cost Estimates”. Wherever practical, capital cost estimates were based on prior work performed for the SPSS and SPROWG studies. This included unit costs, facility costs, and multipliers for factors such as permitting, engineering, and contingencies. In general costs for storage components (reservoirs, gravel lakes, aquifer storage and recovery) were derived from SPSS values, and costs for conveyance facilities (pipelines, pump stations) were derived from previous SPROWG values. Life-cycle costs were comprised of capital costs plus the net present worth of 50 years of operation and maintenance costs, including energy usage.

In summary:

	Raw Water	Treated Water	
Capital Cost	\$1.2 billion to \$1.8 billion Capital cost for all facilities to deliver raw water with a unit cost of \$18,400 to \$22,800 per acre-foot.	\$2.4 billion to \$3.4 billion Capital cost for all facilities to deliver treated water with a unit cost of \$33,600 to \$43,200 per acre-foot.	The costs of SPROWG alternatives compare favorably with costs of other regional water supplies.
Life-cycle Cost	\$1.8 billion to \$2.6 billion Capital cost plus 50 years of O&M for raw water. Unit costs are \$25,800 to \$33,400 per acre-foot.	\$3.2 billion to \$4.4 billion Capital cost plus 50 years of O&M for treated water. Unit costs are \$44,100 to \$58,300 per acre-foot.	

Costs of other major regional water projects in the Front Range region have typically been in the range of \$20,000 to \$30,000 per acre-ft for raw water. Units of Colorado-Big Thompson (C-BT) water are currently

selling for about \$60,000 per unit. C-BT units produce an average of about 0.7 AF/unit, based on an annual quota set by Northern Water. Therefore, the cost per acre-foot for raw water is about \$85,700/AF. This source has a high market value in part because it provides water every year, subject to the quota, and has excellent quality that does not require advanced water treatment for municipal use. SPROWG water appears to be competitive with alternate regional water sources.

Figures 9 through 11 present the total capital and life-cycle costs for the four SPROWG alternatives. Alternative 4 is the most expensive and largest project, but due to economies of scale it has the lowest unit cost per acre-foot of water produced.

FIGURE 9. SPROWG alternative capital cost estimates

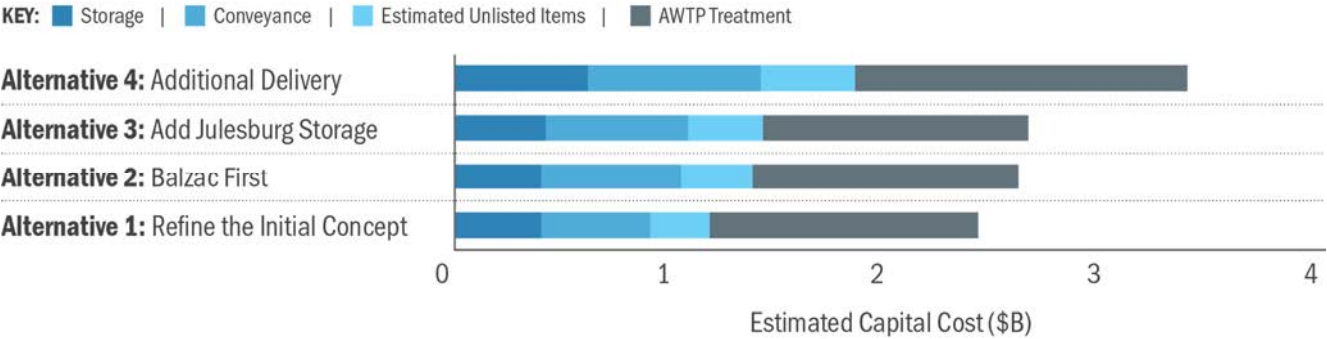


FIGURE 10. SPROWG alternative unit capital cost estimates

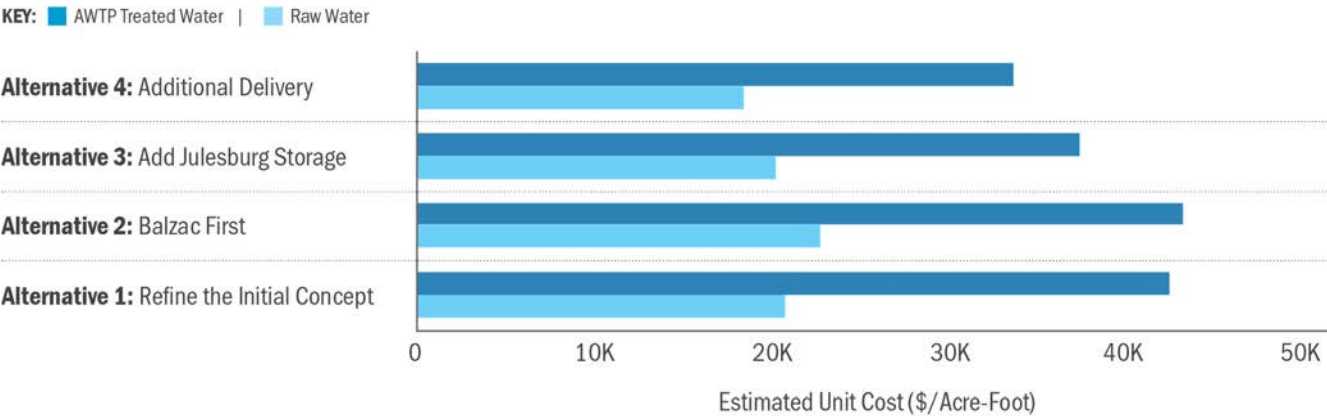
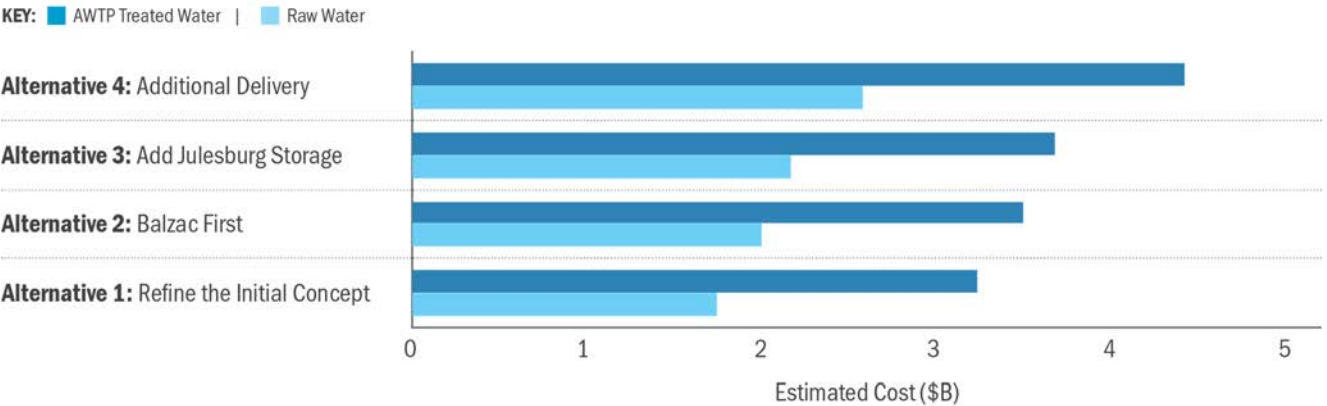


FIGURE 11. SPROWG alternative life-cycle cost estimates (50-yr planning horizon)



SECTION 7:

Communications and Outreach Plan

Communications and outreach are, and will continue to be, an important aspect to developing the SPROWG Concept and tailoring it to fit the broadest spectrum of water users and needs. This was recognized in the high degree of outreach conducted during this Study (summarized in Section 2) and in the need to develop a plan for continued communication and outreach after this Study concludes. This section summarizes the plan for future communication and outreach developed for this Study. The plan includes goals, suggested stakeholders, recommended near-term activities, recommended activities to facilitate participant recruitment, recommended key messages, and metrics to track the success of various types of communication. The South Platte Regional Opportunities Work Group Communications and Outreach Plan (Attachment G) provides additional details.

Communication Goals

Future SPROWG communication goals depend upon the audience and the degree of collaboration needed with various types of stakeholders. Proactive and collaborative communication with potential participants in the SPROWG Concept is critical to understand their needs and how the Concept can incorporate those needs. The Communications and Outreach Plan includes four general communication goals:

Educate stakeholders and create awareness to refine the recommended governance, operational strategy, and infrastructure concepts.

Educate potential SPROWG Concept participants to facilitate recruitment.

Educate ratepayers/taxpayers on the need for the SPROWG Concept and funding.

Continue stakeholder engagement and transparency to build support.

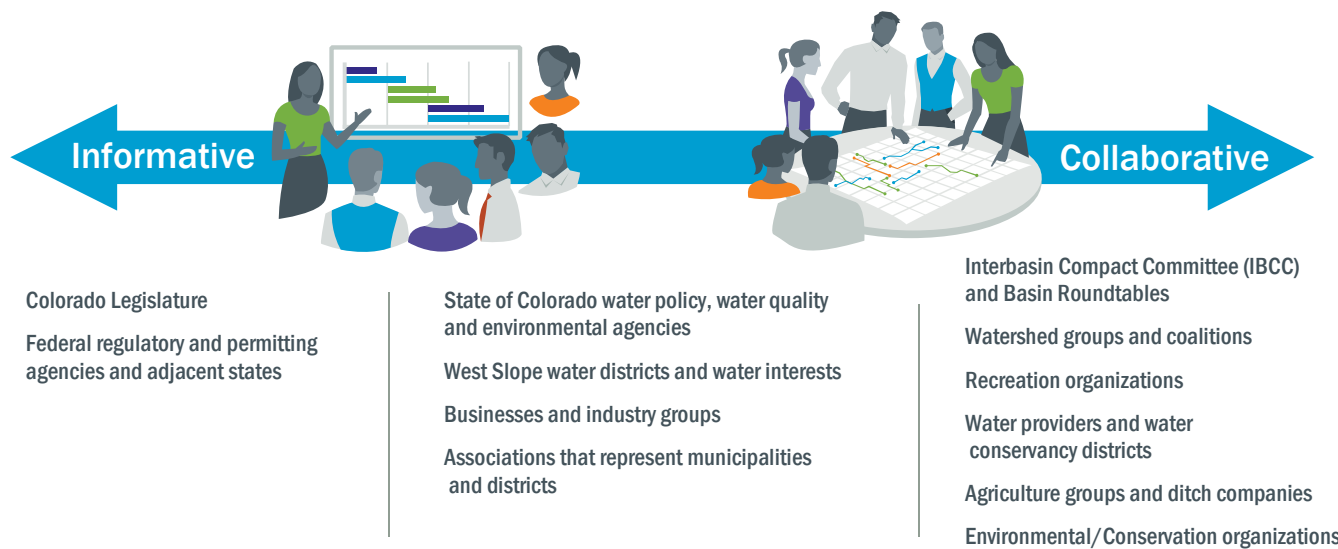
Tailored communications inform the public of the benefits and needs of the SPROWG Concept and prevent misinformation from clouding public opinion.



Stakeholder Groups

A wide variety of stakeholders will need to be engaged in the future to meet the communication goals described above. The Communications and Outreach Plan describes several stakeholder groups and also recommends numerous specific organizations that should be engaged at various levels.

Stakeholder groups require different methods of communication and engagement.







Recommended Communication Activities

The Communications and Outreach Plan describes several near-term and feasibility/recruiting phase activities. Near term activities communicate the results of this Study and support collaboration on the next steps of Concept development. Feasibility/recruiting phase activities focus on collaboratively working with potential participants to tailor the SPROWG Concept and to continue building overall public support for the Concept. Table 20 summarizes the recommended communication activities:

Table 20. Summary of Recommended Communication Activities	
Near Term	Feasibility/Recruitment
Communicate results of study to interested water stakeholders in the South Platte Basin to obtain further feedback and further refine the Concept.	Communications to potential water provider participants including one-on-one meetings, informational group meetings, developing and using a communications toolkit, and partnering with Water Education Colorado.
Communicate results of study through local news media and social media channels.	Communications to potential ATM participants including one-on-one meetings, informational group meetings, use of local radio stations, and presentation at agriculture-focused meetings.
Communicate results to the community opinion leaders/general public with emphasis on the South Platte Basin.	Outreach to recreation/environmental groups including one-on-one meetings and presentations to key groups.
	Communications to South Platte Basin residents/business outreach to ratepayers/water customers including eNewsletters, use of local and social media, and use of a communications toolkit.
	Once a single Concept is identified, establish a project name and identity.

Key Messages

Primary key messages and sub-messages were developed at the beginning of the study and updated at its conclusion. These are succinct statements used to describe the Concept. Table 21 summarizes the primary key messages, and the Communications and Outreach Plan includes additional detailed messages.

Table 21. SPROWG Concept Study Key Messages	
	Communities in the South Platte River Basin continue to make great strides in decreasing water demands through conservation, but there remains a need for additional water supplies.
	A broad and diverse group of stakeholders representing water utilities/providers, agriculture and environmental and recreational interests provided input to the SPROWG Study process and agreed to a set of Guiding Principles describing the Concept goals and defining characteristics.
	The SPROWG Study evaluated a new Concept to meet future needs by strategically managing existing supplies.
	The SPROWG Study evaluated comprehensive solutions to help meet the regional water supply gap by optimizing the use of water supplies available in the South Platte Basin.

Tracking Metrics

Web analytics, reach and sentiment of media coverage, documentation of outreach participation, and opinion surveys can track the success of various means of communication.

As various communication strategies roll out, tracking metrics should be implemented to evaluate success and identify techniques to improve communication effectiveness.



SECTION 8:

Recommendations

This Study gathered information, ideas, and critical review from a diverse set of stakeholders as it continued ongoing evaluation of a wide variety of considerations regarding the feasibility of the SPROWG Concept. The results of this study affirm there are viable organizational structures and physical configurations that could support the goals and objectives of the SPROWG Concept. This Study revealed strong interest among water providers, water users, and other stakeholders to further examine how a regional approach to water management in the South Platte Basin designed to address a wide range of water-related needs could complement the water management and development activities already taking place or getting underway in the Basin.

Water providers, water users, and other stakeholders ought to consider how momentum generated by this Study might be maintained to further advance the SPROWG Concept. Section 8 includes a wide variety of recommendations for future actions and evaluations.



Consider the SPROWG Concept in the upcoming update of the South Platte Basin Implementation Plan



Evaluate the performance of the SPROWG Concept under the five future planning scenarios in the Colorado Water Plan



Implement the Communications and Outreach Plan and focus on identifying Concept proponents



Continue evaluating potential organizational frameworks and eventually identify a “best-fit”



Evaluate alternatives for financing the design, construction, and operation of the SPROWG Concept



Continue discussions focused on ATMs



Further evaluate regional water treatment strategies



Consider the SPROWG Concept in the upcoming update of the South Platte Basin Implementation Plan

Given a high level of interest in the SPROWG Concept among water providers, water users, and other stakeholders, it is quite likely to be a prominent element of the SPBIP Update.

The SPBIP Update process is currently in its initial stages as of the publication of this report. The SPBIP Update process could advance several of the technical evaluations conducted as a part of this Study as well as implement many goals related to communications and outreach. For example:

- Several stakeholders stated during the Feasibility Study that the SPROWG Concept could be a catalyst for incentivizing adoption of “best practices” with respect to water conservation measures, including approaches to land uses and land use decision-making that could result in lower water demands than many current approaches. Basin roundtable members and other stakeholders could engage in this discussion to explore what a full range of “best practices” might consist of and how they could integrate with implementation of the SPROWG Concept.
- The basin roundtables could explore how the SPROWG Concept helps address ongoing basin issues in addition to future water demands, such as enabling ATMs or providing augmentation supplies to meet localized needs.

Available budget for technical analyses in the SPBIP will be limited. The South Platte and Metro basin roundtables will need to identify the most important questions they need to answer with the funds available.



Evaluate the performance of the SPROWG Concept under the five future planning scenarios in the Colorado Water Plan

The recently completed Analysis and Technical Update to the Colorado Water Plan (Technical Update) assessed future water supplies and demands and quantified potential future gaps under five alternative and plausible sets of future conditions (“planning scenarios”).

The planning scenarios each make different assumptions about important drivers of supply and demand including future population growth, adoption of water conservation measures, climate conditions and climate impacts on future streamflow and water demand, aquifer sustainability, and other factors. The SPROWG Concept could be evaluated and modeled through the lens of the five planning scenarios to evaluate how yields could be affected using different assumptions about the future, the potential challenges or benefits the Concept could create for environmental and recreational stakeholders under the planning scenarios, and the implications of the planning scenarios to potential costs to build and operate the Concept. Modeling the SPROWG Concept under the planning scenarios will likely require a model that is more dynamic than the Point Flow Tool used in this Study and would potentially necessitate incorporating the Concept into the StateMod model developed during the Technical Update (see Technical Update documentation on the CWCB’s website for more information on the StateMod model).



Implement the Communications and Outreach Plan and focus on identifying Concept proponents

The Communications and Outreach Plan includes several goals and strategies that, if implemented, will continue to raise awareness of the SPROWG Concept and will continue to foster collaboration necessary for advancing the Concept.

The Communications and Outreach Plan should be implemented, and the upcoming SPBIP Update provides an ideal opportunity to do so. A subset of those communication objectives could be pursued in the near term that focus on identifying and forming a group of Concept proponents. For example, municipal water providers that completed the survey (described earlier in this report) could further engage through focused individual meetings to explore their interest and ways that the SPROWG Concept could be configured to best work for them. The goal of these individual engagements is to tailor the SPROWG Concept and to invite partners that will actively participate in pursuing the Concept. Interested agricultural water users and environmental and recreational stakeholders should also be identified and invited to participate as Concept partners.



Continue evaluating potential organizational frameworks and eventually identify a “best-fit”

The most appropriate and “best-fit” organizational framework will be determined by the preferences and needs of the actual participants that coalesce to develop the SPROWG Concept into a project.

Project proponents should maintain a continued focus on the necessary characteristics of a long-term organizational framework as outreach and collaboration continue. The Study identified several potentially viable organizational frameworks under which the SPROWG Concept could be financed, designed, built, and operated. The information developed in this Study serves as a reference for future considerations of an organizational framework. In the short term, an MOU, statement of intent, or other less formal but flexible agreement among interested potential participants could serve as a temporary platform for incubating a future, permanent organizational framework (additional suggestions are included at the end of this section).



Evaluate alternatives for financing the design, construction, and operation of the SPROWG Concept

As potential participants consider their involvement in the SPROWG Concept, questions related to how much the Concept will cost and how will it be financed are commonly asked.

This Study brought potential costs into better focus and evaluated potential organizational frameworks and the allowances for financing. However, budget resources were not available to consider options related to financing the Concept. A study can be initiated that evaluates options for raising capital to finance the SPROWG Concept and the use of tools such as bonding, taxes, public-private partnerships, fees for participation or water usage, incentives for adopting water conservation practices, participation and ownership structures, loans including state and federal programs, and other measures. In addition, this study can evaluate the compatibility of various financing strategies and tools with potential organizational structures participants could adopt to design, construct, and operate the Concept over the long-term.



Continue discussions focused on ATMs

From its inception, the SPROWG Concept envisioned that water derived from ATMs would be one of several different sources of supply available to the Concept, the others being unappropriated native supplies, reusable supplies, and unused excess recharge credits.

The Study's outreach with agricultural water users and managers revealed opinions and concerns about ATMs that will be important to evaluate if ATMs are to continue to be considered as a potential source of supply for the SPROWG Concept. Focused outreach with agricultural water users on ATMs should continue and should also include Concept proponents who represent municipal and environmental/recreational interests. The SPROWG Concept provides an opportunity to advance a relatively large-scale ATM program. Therefore, it offers a distinctive opportunity to work through complicated issues that many believe may have restrained full development of ATMs in the context of a real project concept with identifiable participants as opposed to more hypothetical discussions. Issues such as the appropriate role for ATMs (e.g. firm yield vs drought recovery), rates of compensation, measurement and accounting, secondary economic impacts, and legal considerations should be further evaluated in these discussions.

The CWCB is currently launching an outreach and review process for their ATM program and their goals for the update of the Colorado Water Plan. Useful information applicable to the SPROWG Concept can be derived from the CWCB's effort, and it should be monitored.



Further evaluate regional water treatment strategies

Water treatment requirements and strategies are a significant consideration moving forward.

Regional treatment facilities should be explored due to the diversity of water providers that could benefit from the SPROWG Concept. Several recommended lines of discussion with respect to regional water treatment strategies include:

- Evaluating the feasibility of SPROWG participants to incorporate other water supplies for blending so that advanced and costly treatment methods, such as reverse osmosis (RO), are less important or not necessary. Note that the SPROWG Concept does not contemplate additional diversions of water from the West Slope to provide this blending supply. A Guiding Principle of this Feasibility Study precludes development of additional transbasin supplies. Further evaluation of water supplies that can be used for blending purposes to lessen SPROWG Concept water treatment costs should align with these Guiding Principles.
- Evaluating the feasibility of a diversion schedule that maximizes diversions in periods when TDS is low to minimize RO requirements.
- Evaluating the feasibility of a dual reservoir storage system near Balzac and potentially near Henderson. The dual storage system can include one storage facility for lower TDS water for municipal use and one for higher TDS water that would be used for releases back to the river that could provide substitute supplies for exchange or augmentation supply for agricultural or municipal water users.
- Engaging potential participants to refine estimates of the need for treated versus raw water and developing an alternative that delivers both in parallel. This Study contemplated the delivery of raw or treated water and did not consider strategies for providing these types of supply in parallel.
- Further explore options for incorporating nonpoint source control measures in combination with water treatment technologies to improve river water quality and reduce treatment requirements.

Suggested Path Forward

The SPROWG Concept has captured the attention and interest of the South Platte and Metro basin roundtables and the state as whole.

The SPROWG Concept will be a focus of the upcoming SPBIP Update, providing an opportunity for further learning and dialogue among a wide variety of stakeholders. However, while this collaboration is necessary and beneficial, the Concept will also need leadership from a group of proponents with laser focus on its continued development. This is hardly surprising: any enterprise that embodies the complexities of the SPROWG Concept, including the involvement of a wide range of private and public stakeholders, can only be sustained through capable and engaged leadership. The leadership group that emerges to sustain the SPROWG Concept will need an interim organizational framework that defines the roles of proponents, enables the proponents to collectively pursue grant funding, and creates some obligations to support the further development of the Concept (perhaps commitments of staff time or provision of cash to meet grant matching requirements).



Creating an agreement (MOU, statement of intent, or other less formal but flexible form of agreement) among a core group of motivated Concept proponents is a potential next step for continued, focused advancement of the SPROWG Concept. Participants in the agreement could conduct further studies funded by grants (likely in coordination with SPBIP update efforts). Studies could include further definition of water demands or more detailed exploration of a long-term organizational framework that meets the needs of committed participants. The agreement participants could also jointly explore potential partnerships with water providers or others who individually advance infrastructure projects that could be expanded to meet multiple uses as contemplated in the SPROWG Concept.

Collaborating with and inviting new partners to participate in the work sanctioned by the agreement with the participants in the agreement is another opportunity. If potential partners are willing to obligate themselves to the terms of the agreement, it is a strong indication of their willingness to be active participants.

Whatever path is chosen, the consulting team believes it is important for the future of the SPROWG Concept to take measured steps to maintain momentum towards a more secure water supply future for the South Platte Basin.

References

Colorado Water Conservation Board, *Analysis and Technical Update to the Colorado Water Plan*, Department of Natural Resources, September 2019.

Farnsworth, *Regional Water Transmission and Treatment Feasibility Study*, Northern Colorado Water Conservancy District, 2016.

HDR and West Sage Consultants, *South Platte Basin Implementation Plan (SPBIP)*, South Platte Basin Roundtable & Metro Basin Roundtable, April, 2015.

Nierbo Hydrogeology, *Historical Analysis of South Platte River Salinity (DRAFT)*, Colorado Water Conservation Board, 2019.

Stantec and Leonard Rice Engineers, *South Platte Storage Study (SPSS)*, Colorado General Assembly, December 2017.

Attachment A: Technical Memorandum: SPROWG Feasibility Study Outreach

Attachment B: Technical Memorandum: Organizational Frameworks

Attachment C: Technical Memorandum: SPROWG Concept Refinement and Alternatives Modeling

Attachment D: Technical Memorandum: Water Treatment Alternatives

Attachment E: Technical Memorandum: Evaluation of Nonpoint Source Treatment Options

Attachment F: Technical Memorandum: Cost Estimates

Attachment G: South Platte Regional Opportunities Work Group Communications and Outreach Plan
