TO: Colorado Water Conservation Board Members

FROM: Amy Ostdiek

DATE: July 21, 2021

SUBJECT: Agenda Item 14: Demand Management Feasibility Investigation Update

Staff recommendation:

Staff recommends that the Board adopt the Demand Management decision-making roadmap attached hereto as Exhibit A.

Background

The Upper Basin States of the Colorado River Basin are currently investigating the feasibility of a potential Demand Management program. Demand Management is the concept of temporary, voluntary, and compensated reductions in consumptive use. The conserved water would be used to ensure ongoing compliance with the 1922 Colorado River Compact. The Demand Management Storage Agreement, one element of the 2019 Drought Contingency Plan (DCP), provides the authorization for the Upper Division States to store water created pursuant to a Demand Management program in Lake Powell. The water would only be used for Compact compliance purposes at the direction of the Upper Colorado River Commission. Whether a program is established and how such a program would operate are still open questions. Each Upper Division State must make an initial determination that Demand Management is feasible before moving forward with creating a potential program.

The mission of the Colorado Water Conservation Board is to conserve, develop, protect, and manage Colorado’s water for present and future generations. In carrying out this mission, CWCB is the agency authorized to determine whether Demand Management is feasible for Colorado. Following adoption of the DCP in March 2019 and after significant discussion by the Board and key stakeholders, the CWCB Board adopted the 2019 Work Plan to help guide the initial stage of the feasibility investigation. This work was focused on identifying key threshold issues associated with a potential Demand Management program. Pursuant to the 2019 Work Plan, staff convened workgroups that met throughout the 2019-2020 Fiscal Year. Staff provided regular updates to the Board and received guidance and input throughout the implementation of the 2019 Work Plan. A summary of work completed pursuant to the 2019 Work Plan is available in the July 2020 update to the Board.
Following Board discussion through workshops and Board meetings, the Board adopted the Step II Work Plan in November 2020. In this Work Plan, the Board directed staff to develop a framework of a Demand Management program, to be used to generate discussion about potential Demand Management program design and a range of potential implementation options. Staff developed the draft framework in early 2021, then engaged a wide range of stakeholders to solicit feedback on the framework, including through workshops, updates, and other outreach as detailed in the Step II Work Plan. Staff has provided regular updates to the Board throughout implementation of the Step II Work Plan.

Additionally, during this time the literature review was completed pursuant to Board guidance both through the 2019 Work Plan and pursuant to the Step II Work Plan direction to “[a]nalize and learn from existing, ongoing, and/or new programs and projects.” The process was designed to collect as much information as possible to inform the Board’s discussion and process for the Demand Management Feasibility Investigation in July 2021 and beyond.

Status Update on Implementation of Step II Work Plan

The framework was released in March 2021, and from March - June 2021, staff conducted public outreach regarding the framework, including:

- **Six workgroup meetings:** Staff conducting meetings with six of the workgroups previously convened pursuant to the 2019 Work Plan to receive input on whether workgroup members’ input is adequately captured in the framework.
- **Nine Basin Roundtable meetings:** Staff presented to and requested input from the nine Basin Roundtables.
- **IBCC meetings and input:** Staff presented to the Interbasin Compact Committee on the framework and solicited specific input on the Framework. Staff plans to facilitate continued discussion at the October IBCC meeting.
- **Three public workshops:** Staff hosted three public workshops to receive input on the framework, each focused on specific subject matters.
- **Public listening session:** Staff hosted a public listening session to receive additional input on the framework.
- **EngageCWCB Survey:** Staff developed an informational website and a survey soliciting feedback on the framework.
- **Demand Management informational video (to be released):** Staff worked with a consultant to develop an informational video regarding Demand Management to reach those who may be interested but have been unable to attend previous meetings or may not otherwise be involved in the discussion at this time. This yet-to-be-released video directs viewers to CWCB’s website for more information and to learn how to engage.
- **Additional presentations as requested:** In addition to the above-referenced items, staff also presented the framework and provided opportunities for discussion and input upon request.
- **Written input:** Staff also invited written comments relating to the framework.

All input received on the Framework to date is provided in Exhibit B to this memo. Note that input received through workshops and public meetings is captured in summaries, as well as directly in the attached framework through comment bubbles.
Additionally, throughout this process, staff has worked with a team of consultants to achieve the following public outreach and engagement tasks, pursuant to the Step II Work Plan:

- Developed a communications toolkit designed to assist Demand Management messaging, provided electronically to the Board members previously.
- Developed strategies to make better use of various communications networks, including but not limited to social media, improved graphics and informational documents, and use of informational videos.
- Developed a database of stakeholders who have provided input, attended meetings, or otherwise shown interest in the Demand Management Feasibility Investigation, which will be used going forward to distribute information and solicit feedback on the ongoing feasibility investigation.
- Ongoing and continued engagement with Tribal Nations regarding Demand Management and the Framework on a sovereign-to-sovereign basis.

Context for Decision Making

In the Step II Work Plan, the Board adopted a lens through which to make decisions relating to Demand Management feasibility. The Work Plan breaks the feasibility question into three sub-questions:

(1) **Achievability**: The focus of this inquiry is whether it is technically possible to achieve a functioning Demand Management program within Colorado, and contemplates questions such as whether it is possible to verify and track water conservation, whether there are mechanisms available to track environmental benefits and impacts, whether it is possible to develop an appropriately robust outreach plan for a potential Demand Management program, and whether a funding source may be available.

(2) **Worthwhile for Colorado**: The focus of this inquiry is whether - even if a program is technically achievable - it is worthwhile from Colorado’s perspective. The scope of this question includes whether a Demand Management program may be established in a way that is proportional and equitable and avoids or mitigates unacceptable adverse impacts within the state.

(3) **Advisability**: The focus of this inquiry is whether it is advisable for Colorado to make a feasibility determination within the broader context of Colorado River issues and strategy. This is a determination that will likely incorporate input from other states and the Upper Colorado River Commission, and therefore will be an evolving analysis. Given the quickly changing circumstances and ongoing investigation by the Upper Colorado River Commission, this determination would likely be made at the point in time after the first two questions are considered.

Next Steps

**Roadmap for decision making**

Within this context, the purpose of this agenda item is to discuss a potential roadmap for Board decision making to assist the Board in progressing in the Demand Management feasibility investigation. Staff suggests that the Board adopt the decision-making roadmap...
attached as Exhibit A. As shown in this roadmap, staff suggests the questions relating to achievability be considered first, followed by questions relating to whether a Demand Management program may be worthwhile from Colorado’s perspective, noting that answers to the “achievability” questions may help to frame and inform the analysis of whether Demand Management may be advisable.

In considering the attached roadmap for decision making, the Board may consider the following questions:

(1) Does this roadmap adequately capture and organize the key milestones you envision in board decision making relating to Demand Management?

(2) In considering the categories of decisions to be made relating to achievability, what are some specific questions you believe need to be answered relating to each subject in order to determine whether Demand Management is achievable for Colorado?

(3) In considering the potential decisions to be made in the future, what are your thoughts on appropriate timing of decision-making?

**Resources to support decision making**

In addition to information and resources previously provided, the following items are attached hereto, designed to assist the Board in its decision-making process:

Input received to date on the Framework (Exhibit B)
Literature review completed by the consultant team (Exhibit C)
Achievability
[Tentatively to begin September 2021; subject to change]

- Monitoring & Verification: is it technically possible to monitor and verify conserved consumptive use within Colorado as required for a potential Demand Management program? - Tentatively September 2021

- Environmental Considerations: is it technically possible to track and monitor potential environmental impacts and benefits? - Tentatively September 2021

- Education & Outreach: is it possible to develop an outreach plan for a Demand Management program that would increase general water education, motivate participation in the program, and help to inform program design? - Tentatively September 2021

- Funding: given the above determinations, is it possible to secure a funding source to pay for a Demand Management program? - Pending

Worthwhile for Colorado
[Tentatively to begin November 2021; subject to change]

- Proportionality considerations: Can Colorado establish a Demand Management program that prioritizes avoidance of disproportionate negative economic or environmental impacts to any single subbasin or region within Colorado while protecting the legal rights of water rights holders, consistent with the Board’s November 2018 Support and Policy Statement? - Pending IBCC input to be received in October 2021, informing Board discussion in November 2021 and beyond

- Analyses and findings of UCRC and other states: Based on information gained from the UCRC feasibility investigation and those ongoing in the other Upper Division States, would a Demand Management program be worthwhile from Colorado’s perspective? - Investigation ongoing
EXHIBIT B

Input Received, Spring – Summer 2021

This Exhibit includes various input received on the Framework and the Demand Management Feasibility Investigation generally in Spring-Summer 2021, including meeting summaries, survey responses, letters, and other feedback received. In addition, the final document is the draft Framework with comment bubbles that correspond with specific input heard at public meetings.
Stakeholder Input

CWCB Demand Management Feasibility Investigation

Spring - Summer 2021

Contents:

Demand Management Workgroup Workshop Meeting Summaries
  Economics and Local Government Workgroup
  Funding Workgroup
  Agricultural Impacts Workgroup
  Environmental Considerations Workgroup
  Monitoring & Verification Workgroup
  Education & Outreach Workgroup

Public Workshop Meeting Summaries
  Demand Management Public Workshop #1
  Demand Management Public Workshop #2
  Demand Management Public Workshop #3

Public Listening Session Meeting Summary

EngageCWCB Survey Responses

Stakeholder Letters

Meeting summaries prepared for CWCB by Emily Zmak, CDR Associates. This document is intended to summarize stakeholder input and does not necessarily represent the views or opinions of CWCB staff or Board.
Demand Management Workgroup
Workshop Meeting Summaries

DEMAND MANAGEMENT FRAMEWORK MEETINGS
Spring 2021
Economics and Local Government Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING
April 20, 2021  |  12:00 - 1:30p

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework (“framework”) by Amy Ostdiek, CWCB, and Mark Smith, Colorado College, the Economics and Local Government Workgroup (“workgroup”) had a facilitated discussion on the content within the workgroup’s focus area.

The overall discussion focused on:
- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board’s decision-making process.

Framework Feedback

- It is difficult to present both details and an uncomplicated overview in the same framework.
- The right-hand column could be clarified with a title along the lines of “considerations” or “interconnected issues.” Issues should be captured in a consistent and accurate way.
- The A-B-C columns should better illustrate the escalation in complexity.
- “Do no harm” is a guiding principle that should be captured as fundamental to all topics / sections.
- Additional clarity around municipal participation would be helpful.
- Impacts to local government are closely connected to agriculture. The consultation category should capture that agriculture is a key component in addressing community impacts.
- Water efficiency programs may be more disruptive than currently captured in the framework.
- Green spaces are an important consideration to capture.
- Mitigation funds should be directly linked to the sector impacted.
- Iterative mitigation would allow communities to incorporate lessons-learned and/or unexpected impacts into mitigation measures.

Open Questions

- Does surplus water count as consumptive use?
- What criteria should be used to judge whether or not demand management is a good idea?
- What does proportionality mean?
- How much would other agencies be involved in a demand management program?
Funding Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING
April 21, 2021  |  10:30 - 12:00

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework (“framework”) by Amy Ostdiek, CWCB, and Brett Bovee, Westwater Research, the Funding Workgroup (“workgroup”) had a facilitated discussion on the content captured within the workgroup’s focus area.

The overall discussion focused on:

● The framework and the elements, trade-offs, and considerations captured within it; and
● Informing the CWCB Board’s decision-making process.

Framework Feedback

☐ Consider clarifying the budgets’ inclusion of one-time costs and early investments.
☐ Both fees and taxes should be considered as funding sources.
☐ Federal investments could be captured in the commentary as a potential funding source.
☐ The current presentation of costs begs the question, “Why would you pay more for the same amount of water?” The framework could articulate that the B- and C-columns fund worthwhile secondary benefits, such as consistency and mitigation. Attractive program components may have additional costs.
☐ There should be an expansive consideration of financing and funding, such as looking towards supply chains to broaden the pool of fee-payers.
☐ Costs should be considered on a perpetual basis, not solely an annual or near-term basis.
☐ Municipal participants would need to consider revenues and possible rate pressures, which would have impacts on low income communities and raise issues like bill affordability and customer assistance.
☐ Cost equity could be captured. There are different impacts and benefits to different geographies, water consumers, and economies.
☐ The framework could capture opportunity costs. Understanding opportunity costs could help clarify whether an entity should participate or not.

Open Questions

☐ How expansive are the references to “water users”? Direct users, secondary users?
☐ What is the optimum program? Defining that would be helpful in considering financing.
☐ Can the demand management model be built in a way that it is transferable to other Basins?
☐ What is the benefit for the cost and effort of the program?
Agricultural Impacts Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING
April 22, 2021  |  10:00 - 11:30a

MEETING PURPOSE: To ensure that the framework responds to workgroup members’ initial feedback, and to solicit additional input on framework elements.

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework (“framework”) by Amy Ostdiek, CWCB, and Brett Bovee, Westwater Research, the Agricultural Impacts Workgroup (“workgroup”) had a facilitated discussion on the content captured within the workgroup’s focus area.

The overall discussion focused on:
- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board’s decision-making process.

Framework Feedback

☐ Communicate the range of options’ pros and cons, as well as financial and opportunity costs
☐ Consider addressing holistic sustainability and resiliency to future impacts within the framework
☐ A demand management program should treat producers fairly
☐ Consider intra-system impacts to ensure that nonparticipants are unaffected
☐ Pre-existing procedures, operations, and governance requirements for irrigation providers are constraints that a program would work within; for example, not all systems have individual water rights
☐ System compensation is an important consideration, although is only represented in Column C
☐ Soil health is a potential secondary benefit. The state could provide optional techniques or technical services to producers for improving soil health during fallowing. This could be a participation incentive.
☐ While the framework recognizes legal damages, it does not mention inconveniences. Someone will always be inconvenienced; early engagement could mitigate non-damaging impacts.
☐ Local benefit will stem from farmer compensation. Development funds could build and support agricultural economies, although the majority of the money should go to the program participants.
☐ Not all potential participants will be appropriate participants.

Open Questions

☐ Will there be a mandatory crop type to prevent further landscape damage?
☐ How much will be paid to producers?
☐ Who pays for technical assistance offered to program participants?
**Environmental Considerations Workgroup**

**DEMAND MANAGEMENT FRAMEWORK MEETING**
April 26, 2021  |  2:00 - 3:30p

**MEETING PURPOSE:** To ensure that the framework responds to workgroup members’ initial feedback, and to solicit additional input on framework elements.

Version 1 of the draft demand management framework is available for review [here](#).

**Discussion Highlights**

Following presentations on the demand management framework (“framework”) by Amy Ostdiek, CWCB, and Jordan Dimick and Bailey Leppek, SGM Engineering, the Environmental Considerations Workgroup (“workgroup”) had a facilitated discussion on the content captured within the workgroup’s focus area.

The overall discussion focused on:
- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board’s decision-making process.

**Framework Feedback**

- The framework is a useful tool for evaluating trade-offs
- A successful program would provide resilience for the environment and recognize holistic environmental benefits
- Proportionality and fairness should be linked to discussions about water and costs
- Assessing net benefit should work within existing local environmental rules and guidance
- A long-term program will evaluate environmental benefit / impact through a different lens than a short-term program; for example, the timing of flows matters more in a long-term program
- Review language for implications or assumptions of adverse risk caused by some participants
- The value of water will factor into the proportionality discussion, and the more complicated the program, the more financially difficult it will be to launch the program

**Open Questions**

- What long-term programmatic options exist outside of the drought contingency plan timeframe?
- How can a demand management program be linked to other state programs to achieve win-win outcomes for environmental benefit?
Monitoring & Verification Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING
April 30, 2021 | 12:00 - 1:30p

MEETING PURPOSE: To ensure that the framework responds to workgroup members’ initial feedback, and to solicit additional input on framework elements.

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework (“framework”) by Amy Ostdieck, CWCB, and Jordan Dimick, SGM Engineering, the Monitoring and Verification Workgroup (“workgroup”) had a facilitated discussion on the content captured within the workgroup’s focus area.

The overall discussion focused on:
- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board’s decision-making process.

Framework Feedback

- Interconnected issues include potential environmental benefits, transmountain diversion projects, and agricultural techniques like deficit irrigation.
- The purpose of monitoring and verification is to accurately quantify what wet water has been added to the system, so functionality, accuracy, and efficacy are key themes.
- The references to time are not as accurate when referring to historical diversion rates. Consider taking out the “or” in the cell discussing bypass diversions, because of the potential disconnect between CCU on the west slope and historical diversion rates.
- Terms benefit from careful definitions. For example, conserved consumptive use may mean different things when discussing CCU in the Colorado River system or on the East Slope.
- Monitoring and verification in multiple systems is complex, and considerations include historic canal losses, potential telemetry, and field return flows.
- There are a variety of tools and resources available to potential DM participants.
- Grounding the A-B-C columns in hypotheticals would help to build more detail and illustrate a program.
- Equity considerations are less applicable to monitoring and verification than other workgroup topics.
- Consider building options for future participation from other sectors, like industry or environmental.
- Column A approaches to monitoring and verification may be too simplistic for many DM programs.

Open Questions

- How will pilot programs inform the framework?
Education & Outreach Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING
May 3, 2021 | 1:30 - 3:00p

MEETING PURPOSE: To ensure that the framework responds to workgroup members’ initial feedback, and to solicit additional input on framework elements.

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework (“framework”) by Amy Ostdiek, CWCB, and Emily Zmak, CDR Associates, the Education and Outreach Workgroup (“workgroup”) had a facilitated discussion on the content captured within the workgroup’s focus area.

The overall discussion focused on:
- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board’s decision-making process.

Framework Feedback

- Clarify messaging around purpose, motivation, and objectives.
- Outreach should give a clearer sense of the options to illustrate what implementation would look like.
- With a statewide program, messaging outside of Column C would be difficult because of the scale.
- Consider adding additional detail to capture the increasing complexities for message development. The range could capture the basic process for message development; and at a higher level, message specificity for certain geographies or target demographics.
- Education and outreach should identify target audiences for different messages. This process could include co-developing messages with the target audiences.
- A feedback loop will build trust and develop a better program.
- While the general public could benefit from general water education about curtailment and drought, targeted audiences should be DM program participants and other impacted stakeholders.
- Simplifying the framework’s presentation would assist with engagement and interpretability.
- The framework does not capture the “why” (advisability) nor climate change.
- Frame issues around shared values, such as individual agency and the program’s facilitation of choice.

Open Questions

- How are impacts being communicated? To what level of detail?
- How do messages change by audience and geography?
Demand Management Public Workshop #1

PUBLIC WORKSHOP MEETING #1
June 1, 2021 | 1:00 - 2:30p

Discussion Highlights

Following presentations on the Demand Management Framework ("Framework") by Amy Ostdiek, CWCB; the Monitoring & Verification section by Jordan Dimick, SGM; and the Environmental Considerations category by Bailey Leppek, SMG; the Public Workshop #1 had a facilitated discussion on the Framework categories Monitoring & Verification ("M&V") and Environmental Considerations.

Framework Feedback

- Participants’ priority considerations included: creating a truly voluntary program; ensuring effectiveness; balancing accuracy and implementability; and maximizing benefits to environment
- Concern that M&V is complicated enough without combining it with the issue of proportionality
- Consider clarifying the language regarding municipalities on the West and East Slopes
- Broad concern for understanding how this framework is going to inform the CWCB decision-making and implementation processes
- Shift to hypotheticals to illustrate what requirements might be for each category
- Broaden the lens to include West Slope municipalities and industrial water users
- Concern about the significant costs of issues-management
- Define what shepherding water from remote and/or rural locations to the state line looks like
- Consider other options for incentivizing environmental benefits
- The state could consider a minimum and more robust requirement for environment
- Considering equity and proportionality in M&V adds an additional, complicated layer
- Gaps in the framework include the state’s process for shepherding water; clarity on state measurement rules or mechanisms; and pilots to address transmountain projects and environmental impacts
- Incorporate relative time, accuracy, and costs into the Framework’s A-B-C options
- Concern that incentives are shifting away from compact compliance and toward environmental benefit

Open Questions

- How to connect the Framework to decision-making and implementation at the CWCB?
- How does the Demand Management program work in different locations and elevations?
- How will the Board make decisions about the A, B, and C columns? And how does the Framework inform feasibility?
- How could a program incentivize a C-column approach to the environment without or beyond money?
- What does the cost look like? Where does the funding come from?
- What is the process for shepherding water to the state line?
Demand Management Public Workshop #2

PUBLIC WORKSHOP MEETING #2
June 14, 2021 | 11:30 - 1:00p

Discussion Highlights

Following presentations on the Demand Management Framework (“Framework”) by Amy Ostdiek, CWCB; the Economic Impacts & Local Governments section by Brett Bovee, WestWater Research; and the Agricultural Impacts section by Angie Fowler, SGM; the Public Workshop #2 had a facilitated discussion on the Framework categories Economic Impacts & Local Governments and Agricultural Impacts.

Framework Feedback

- Provide technical details about what Demand Management would encompass and look like in application, specifically for farmers and ranchers in the Colorado River Basin
- Interest in exploring the legal details of Demand Management in the Framework
- Concern about how to address claims of injury and how to prevent injury
- Consider defining alternative or innovative incentives for Demand Management participants beyond money, especially for municipalities
- Define the long-term implications for rural communities and the impacts to the agricultural sector
- Consider storing water in reservoirs within the state, rather directly in Lake Powell, to provide more internal control
- Develop clear direction for next steps and approach
- If participants are going to give up water for a few years, they need assurance that the program will provide insurance from curtailment
- Desire for a program to align with growing season schedules and ranch operations
- Impacts will likely be very localized and specific, so the Framework should include a process to evaluate and resolve local impacts in a responsive manner
- Consider secondary impacts of a program, such as health care

Open Questions

- How to ensure that one sector or region doesn’t bear all the burden?
- How best to prepare water users for the new normal of water scarcity?
- What are the considerations and agreements that must be reached with the other Upper Basin states that are not encompassed by the Framework?
- Would the Demand Management program work with other state agencies?
- How is Demand Management different from existing programs like the ATM program?
- How is CWCB considering abandonment or speculation issues of water rights?
- Can other people object to an applicant’s Demand Management application?
- How will the pricing of water work?
- What does “temporary” entail (years, months)?
Demand Management Public Workshop #3

PUBLIC WORKSHOP MEETING #3
June 14, 2021 | 1:30 - 3:00p

Discussion Highlights
Following presentations on the Demand Management Framework (“Framework”) by Amy Ostdiek, CWCB; and the Education & Outreach and Process Consideration sections by Emily Zmak, CDR Associates, the Public Workshop #3 had a facilitated discussion on the Framework categories Education & Outreach and Process Considerations.

Framework Feedback

- Foster broader understanding for water providers and users about Demand Management’s purpose and goals
- Turn the Framework into action through clearly-defined next steps and process clarity, and push up the contingent decision
- Define and articulate the problem of compact curtailment as the alternative to Demand Management
- Engage actual water users to better understand problems and obstacles for potential participants, which may require making the process more clearly defined
- Be intentional in special engagement with the Ute Tribe
- Create Spanish-language newsletters and informational documents about Demand Management, and partner with Latino organizations to assist with translation and messaging
- Add specificity about the audiences that should be targeted for outreach to better define the goals
- Stakeholder education needs to be informed by a real process, data, and programmatic information
- Group consensus that Column C in Process Considerations is needed to mitigate user concerns and ensure program success
- Incorporate process transparency with the public, especially around lessons-learned and successes
- Include a technical state role or service to help water users apply and develop applications

Open Questions

- Where are the other Upper Basin States in their processes?
- What is the worst-case scenario without Demand Management?
- Who are the key audiences, and what are the messages those audiences need to hear?
- How to engage water users to inform the planning process?
- How to reach stakeholders who have not shown up to CWCB’s engagement opportunities?
- How do we communicate water and water challenges with diverse and historically underserved populations?
Public Listening Session
Meeting Summary

DEMAND MANAGEMENT FEASIBILITY INVESTIGATION
June 29, 2021

Discussion Preface

Following brief presentations on the Demand Management process by Greg Johnson, CWCB, and Emily Zmak, CDR Associates, meeting participants provided comment about the Demand Management framework; the work done to date; organizational positions pertaining to the proposed Demand Management program; and/or personal thoughts and reactions to the concept of Demand Management. Comments were limited to five minutes per participant, and were otherwise unrestricted.

Participants were encouraged to submit written comment in addition to the statements summarized below.

Comment Summaries

Aaron Citron, The Nature Conservancy
- Recognizing the ongoing bad hydrology and need for cohesive Colorado River policy, he encourages CWCB to pursue Demand Management as a critical piece in a suite of tools to address Colorado River issues
- Encourages CWCB to capture trade-offs in the framework document and to include sideboards to benefit rivers, protect communities, and ensure proportionality
- Advocates for advancing policies that would build a Demand Management program, which could include pilots and demonstrations to illustrate how a program could function

Mark Harris, Grand Valley Water Users
- He believes that the process to-date and the Demand Management framework have adequately captured the concept of Demand Management
- Now that the initial work is done, it is time to answer questions like, “So what?” and “What now?” Encourages CWCB to try a compensated, voluntary, and temporary program.
- Believes that many farmers, ranchers, and their organizations are willing to find solutions
- Supports CWCB’s identification of practical solutions, and believes that trying something new is the best way to answer the important questions
- Urges CWCB to articulate the next steps in the Demand Management process and develop a timeline

Tom Gray, Yampa/White/Green Basin Roundtable
- Are there hard parameters or sideboards about what Demand Management would look like and, if not, when will the hard parameters begin to be established? Encourages the development of hard statements for people to grapple with and respond to.
- Will staff make a recommendation to the Board about next steps?
Don West, Colorado Water Exchange
- Regarding the Monitoring and Verification section of the Framework, he advocates for a combination of the A and B Columns
- Is comfortable with the state’s Lease Fallow tool, probably in Column B
- Encourages transparency around crop coefficients; in particular, taking a statement like, “For this program, the state will use X crop coefficient with Y elevation adjustments.”
- What is the role of municipalities in conserved consumptive use? The framework focuses on the agricultural aspect.

Alden Vanden Brink, White River
- He believes that Demand Management adds to the crisis, and that it adds a target on agriculture
- The White River has depended on flood irrigation and artificial recharge for more than 100 years
- Encourages developing more reservoir space to alleviate compounding pressures on the White
- Would like a no-injury clause to protect White River users

Jeff Meyers, Yampa/White/Green Basin Roundtable
- He believes that motivation to deal with the drought is strong
- The framework document is valuable; however, the detail, complexity, and presentation means it is not the most accessible document
- Encourages CWCB to include language in the framework that defines equity as a means of ensuring all Colorado basins participate on an equitable basis
- A key issue is return flow, namely the ecosystem benefits of flood irrigation
- Feels that there is not a lot of knowledge about what Demand Management might mean or how seriously the hydrology is, so sees education and outreach as critical in this process
- Would be helpful to know from the State Engineer what curtailment might look like

Abby Burk, Audubon
- Both birds and people dependent on the Colorado River have been impacted by water supplies
- Demand Management is an alternative to curtailment and provides flexibility for Colorado
- Audubon is supportive of a Demand Management program to protect Colorado and other water users, and to yield environmental benefits; encourages CWCB to move forward and avoid delays
- Believes the framework is a good start: the next step is to evaluate the trade offs and develop a program that can be one tool in the toolbox

Austin Vincent, Colorado Farm Bureau
- Agriculture is one of the state’s largest economies, especially on the West Slope and in rural areas
- Wants to help find the solution to western water supplies and to avoid risk of curtailment
- Colorado Farm Bureau supports temporary, voluntary, and compensated programs that share the load with municipal, in-stream, environmental, and recreational flows
- Wants to have attainable goals that supports producers and creates a practical program
- Encourages CWCB to use existing programs and state agencies in a Demand Management program
- Encourages CWCB to expand education and outreach with farmers / producers on the West Slope

Orla Bannan, Western Resource Advocates
- Has submitted written comments to CWCB
- Sees the need for urgent action because of the bad hydrology
- Encourages CWCB to look for next steps and find win-win environmental benefits
Chris Treese, ret. Colorado River District, consulting with Southwest Colorado River District

- Has submitted written comments to CWCB from the Southwest Colorado River District Board
- Characterizes the Southwest guidelines as skeptical-but-constructive, and articulates a commitment by their Board to remain engaged in Demand Management discussions
- Principally concerned with protecting agriculture and ensuring that a Demand Management program not target agriculture, nor encourage speculation in Western Colorado’s agricultural waters
- Remains mindful of the consequences of both a Demand Management program and compact administration, which is not equitable, compensated, nor voluntary
EngageCWCB Survey Responses
DEMAND MANAGEMENT FEASIBILITY INVESTIGATION
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<th>Yampa-White-Green River Basin</th>
<th>Colorado River Basin</th>
<th>Arkansas River Basin</th>
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<tr>
<td>From your perspective, Demand Management (select all that apply):</td>
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<td>Would benefit agricultural water users overall?</td>
<td>X</td>
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<td>Would hurt agricultural water users overall?</td>
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<td>Would benefit urban water users overall?</td>
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<td>Would hurt urban water users overall?</td>
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<td>Is an opportunity for the state to collaborate for the benefit of the Colorado River?</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Is an opportunity for Colorado to imposes itself against mandatory water cutback in the Colorado River basin?</td>
<td>X</td>
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<td>Is an opportunity to build resilience in rural communities?</td>
<td>X</td>
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<td>Is a program that individual producers should be able to choose to participate in?</td>
<td>X</td>
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<td>Is a program that community should be able to provide feedback on?</td>
<td>X</td>
<td>X</td>
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<td>Is a program that municipalities should be able to choose to participate in?</td>
<td>X</td>
<td>X</td>
<td>X</td>
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| How might a Demand Management program potentially benefit or impact you individually? | To avoid the potentially devastating economic impacts of a Colorado River water cutback on the west slope. | Probably not much effect | Increased likelihood of low stream flows in the summer, fall, and winter months, reducing ability for irrigation (raising harvest costs), recreation (angling, canoeing, waterfowl), community water restrictions, degraded drinking water quality (water aesthetics), increased water treatment cost passed to the consumer, increased revenue for aquatic vegetation species, increased local burden due to seasonal low impacts on threatened and endangered species that live in our rivers (successes and dollars expanded), invested, (managing these species), increased concentration of wildlife to lands for available for forage, water, winter range security, private land owner wildlife impacts and conflicts, loss of productive ag lands, create great dependence upon purchasing outside livestock feed source to maintain herd, livestock herd reductions due to loss of feed, secondary economic impacts from loss of agriculture, recreation, community water conservation taxes, personal income (for ranchers, farmers, property, livestock), increased utility rates, increased to NPDES water quality standards and community wastewater treatment processes. |

| How might a Demand Management program potentially benefit or impact your community? | Avoiding the economic impacts of a cutback. | Perhaps excess water could be diverted from city supplies for compensation, protection from a flood. | | | |

1. I live in rural Colorado and open space is a very important component of my quality of life. Programs that open the door for development of agricultural lands and/or abatement of livestock would affect my community. Impacts (positive or negative) to the community MUST be taken into account in selecting participation. 2. I am an outdoors person and work hard personally and professionally to help protect rivers and watersheds. A program that results in negative impacts to rivers and watersheds would impact me directly. 3. Wildfires have devastating effects on people, communities, rivers, watersheds and the wildlife they support. The potential for participating in these programs to increase wildfire risk needs to be evaluated before projects are accepted.
<table>
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<tr>
<th>What topics or concerns would you like addressed in the next phase of the feasibility investigation?</th>
<th>Rating these six actions to determine who gets paid and how much</th>
<th>Value of water under this scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>How to maintain the Colorado River system when water resources are depleted due to continued drought and or irrigation. Impacts to alluvial storage and agriculture return flows. Impacts to basin and water users dependent upon alluvial storage and return flows from agriculture. Quantify the injury to water users when storage is depleted. Quantify how losses without storage are impacted. Why does Colorado not want to use the state’s full Colorado Compact allocation? Why is Colorado anti-water storage for compact protection purposes? What will happen if a storage is developed and people run out of water due to a Colorado Approved or Special OM program? Does “capacity” come into the DOW/OM equation?</td>
<td>We know how to create CCU, programmatic pilots investigating the administration of such CCU should be among the choices.</td>
<td>How will flows be shunted to Lake Powell (or any other storage bank)? Is storage in Lake Powell the best alternative (in light of tremendous evaporation losses) should storage in Colorado reservoirs be explored as a first alternative, with delivery to Powell on an as needed basis? These matters are not included in the framework.</td>
</tr>
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</table>
I have previously commented on the CWCB that it needs to pilot the use of auctions. Auctions are a fair and equitable means to determine who gets paid and by how much. It is also fair to who pays the bill. The attached concept paper outlines the case for auction. Attached is a water auction design document recently co-authored by Dr. Birnie Colby from the University of Arizona and the Colorado River Research Group. https://desertarizona.berkeley.edu/publication/report/water-auction-design-implementation-and-evaluation. Additionally, below are a couple of opinions that are co-authored regarding the use of auction to reduce Colorado River Water use: Fresh Water News, August 13, 2020 Opinion: Use auctions to set prices for Colorado River drought and https://www.watereducationradio.org/fresh-water-news/opinion-seeections-of-savings-from-colorado-river-drought-pass/ The Colorado Sun, September 14, 2020 Opinion: Colorado needs water markets to reduce Colorado River water use https://thecoloradosun.com/2020/09/14/colorado-river-compact-drought-water-opinion/

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<th>Survey Responses</th>
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I think the market should determine pricing. Multi-purpose storage will be the best source. Very dangerous program that puts up unintended guidances to other water users. Each basin is different and should be treated as such. “Nixing” should be implemented. Yampa/White/Evans Basin Roundtable Recommended Draft Demand Management Statement [b/w Summary Context in the face of persistent drought and anticipated longer-term growth in demand for water, Colorado and the other 6 Colorado River Basin states have prepared a drought contingency plan (DCP). One element of that plan is to investigate the feasibility of Demand Management (DM). If implemented, DM will become a future program which, on a voluntary, temporary, and connected basis, will reduce water use by individual, public, and commercial water rights holders, to avoid administration of the Colorado River Compact on the Colorado River. Statement of Principles Given the context for DCP in Colorado, the Yampa/White/Green River Basin Roundtable considers the following projects to be important in the development of a DM program:

1. Preservation of Quality of Life in the Yampa River Basin: Any DM program must preserve and enhance agricultural, local communities, and economies in our basin, while protecting municipal delivery addressing non-consumptive uses as well as recreational water use, and offering water as a source for new uses.

2. Equity of Responsibility and Opportunity: A DM program must be structured to ensure no new basin or single water user group (e.g., Ag & M) bears a disproportionate share of the DM responsibility, and to provide DM opportunities to all water users on a reasonably equitable basis. To ensure equity, some form of income-based apportionment is required.

3. Guiding Market: The State of Colorado should establish a marketplace for DM water transactions that is structured to improve the fairness and transparency of the market.

4. Recharge and Diversion: Any DM program must consider impacts on environmental and economic needs, including those resulting from changes in water supply and/or timing of flows, and must not take away impede their needs and contributions to local economies.

5. Rural Communities: Any DM program must evaluate and address all impacts that could result to rural communities, including negative economic, cultural, and social impacts.

6. Compensation for Water Use: Compensated Any DM program must provide compensation to participants who forgo use of water rights. Compensation must be based on economic impacts to the participants and not solely on the loss of income from the crop or product not produced.

7. Trans-Mountain Diversions (OMs) Basins which benefit from water diverted from the Upper Colorado River must be considered as part of the OMs, with applicable DM responsibilities and opportunities, and subject to equitable apportionment for DM purposes. Any DM program must prohibit
Stakeholder Letters Submitted to CWCB

DEMAND MANAGEMENT FEASIBILITY INVESTIGATION
I am Mark Harris General Manager of GVWUA in the Grand Valley

Thanks to all of you inside and outside the CWCB that have worked diligently to get us to this DM Framework to this point.

I am not going to make specific comments on the contents of the Framework or discuss the process by which it has been developed, but we do believe the process and the resulting document provides an adequate exploration of the appropriate issues and provides a place from which to continue the search for real time and real world solutions to the use of DM as a part of DCP and perhaps on what we call lower case dm….productive approaches to water conservation that are a part of all our futures.

What I do want to share briefly is what I am being asked by the Board I serve and the farmers and other water users we deal with every day.

What folks want to know is the “so what” and “what now”…. We hear a pretty clear concern with the state of the River, compounded by weather concerns, and by extension the fate of the GVWUA and the Grand Valley in the face of these challenges. People are asking us what we managers, the CWCB, organizations like the River District, and other organizations are doing to effectively deal with the outcomes of worsening trends and increased volatility, not just for this year and the very near term, but for the longer term as well.

They wonder how these DM explorations address the very real problems they see coming?
Our organization knows that many farmers and ranchers know how to create CCU, and even perhaps how to deal with it within their own organization or on their ditch. But the larger question I am asked is SO HOW move on and WHERE is the vehicle by which we do something productive with that water potentially made available in a voluntary, temporary, and compensated basis in several geographies by various methods.

**Who is working on that that they ask?** And when? What’s next after all this talk they ask? Can’t we try something?

Well the GVWUA submits that the time to work on answering those challenges is upon us. We recognize, acknowledge, and respect the very real differences in opinion that many of our peers and partners have regarding these difficult issues. But we also believe that many farmers, ranchers, and the organizations that serve them remain willing to find a productive way forward for agriculture and the State of Colorado, if for no other reason than it is in our best interest to do so.

*Agriculture will be as heavily impacted by the solutions to the water problems we face as we are from the problems themselves.*

Finally, we support CWCB’s identification and funding of appropriate, practical, PROGRAMMATIC PILOT PROJECTS that help understand how to administer the CCU that many people already know how to create.

I know I am not telling you anything new when I say that the only way to really raise the important questions and to identify the positive and negative consequences of our actions is to try something.

**You have heard me use his analogy before, but here it is one more time.**
You can sit in the coffee shop all winter and talk about, cuss and discuss, and second a new crop for next spring. **But sometime you just gotta take the planter to the field.....and you may get a few blanks, and you may abandon the plan in favor of another one next year, but you know you have to be trying something every year. Embracing the past too tightly does not help us deal with the future.**

There is no other way to advance the agenda without taking some well-considered risk. And all those involved in creating the FRAMEWORK have done that. We urge the CWCB to take aggressive action toward putting this time and effort to continued good use, clearly articulating the next steps in the DM process, and creating a projected schedule by which it can be accomplished.

**It doesn’t look like the water and the weather are not going to wait for us.**

Thanks for time this afternoon and good luck.
July 6, 2021

Colorado Water Conservation Board of Directors
1313 Sherman Street, Room 718
Denver, Colorado 80203

RE: Colorado Drought Contingency Plan - Demand Management

Dear Honored Member of the Colorado Water Conservation Board of Directors

The Rio Blanco Water Conservancy District (RBWCD) would like to say it is a pleasure to provide comment on Demand Management however recognizing our present state of drought and continued aridification this is proving to push a level of conversation not many are fully prepared for nor comfortable with. There is more gratifying task we all would rather be doing in our water world but here we are today in our drought-stricken region formulating a plan for a better tomorrow. Evidently all of us were chosen in one fashion or another to be part of this crucial topic in preparation for our future generation’s water security. Changing times for sure.

The winds of change are upon us, and we recognize the need for adaption to our changing environment. Being such, the RBWCD believes it is imperative for the CWCB to understand the function of the White River Basin with respect to Drought Contingency Planning (DCP) - Demand Management (DM). We believe no other Colorado water basin in our great state functions as we do nor has done so for such an extend period.

Our White River community is cultivated around areas of alluvial gravel deposits that have been washed out from the Flat Tops and high desert plains over the millennium recharged by snow, rains, and flood irrigation. The combination of these is what keeps the water available for our community needs. With the reduction in snowpack and seasonal rains not to forget increased temperatures, this has impacted our ability to put water to full beneficial use due to the lack of directly available supply from the stream or retiming of water while also reducing the alluvium storage.
Under normal years with average precipitation, flood irrigation plays an immense role “topping-off” our White River alluvial aquifers but with the loss of direct flows and seasonal precipitation less water is available to be applied shorting the alluvial aquifer storage not to forget the natural recharge occurrence which our White River basin is dependent upon. Once the alluvium is full water eventually migrates back to the stream as return flows for other later in the season beneficial water reuse. Typical return flow season is from late summer to late winter months.

For DM discussion purposes, the White River basin has: 2 municipalities, Meeker (ground water supply) and Rangely (direct diversion surface water supply) supporting a population of about 6,400 citizens; limited industry that continues to be sequestered; recreation; and agriculture. A DM program imposed upon the municipalities will have limited conserved consumptive use with the small population, industrial water use is an incredibly small quantity, recreation is non-consumptive, so that leaves agriculture to take care of the lion’s share of water for a White River DM program. As the DM program is rolling out with uncertain side boards, we must presume any Conserved Consumptive Use will be primarily sacrificed by agriculture which is the life blood of our basin hydrology. Take away or restrict flood irrigation and we eat away at the primary drought insurance policy of our community and stream ecology shorting alluvial recharge and return flows, which has been encountered during previous drought-stricken years.

Unlike other Colorado basin’s, the White River is void of any real storage for drought or contingency protections hence part of the purpose and need for RBWCD along Yellow Jacket Water Conservancy District, Town of Rangely, and Rio Blanco County to aggressively push for Wolf Creek Reservoir. Our community is progressing with our Drought Contingency Plan that includes physical storage because we understand the vulnerability to our present system and how storage provides water user flexibility. White River constituents currently face an imminent municipal, agricultural, environmental, and economic catastrophe without a resilient water supply then add DM on top of our already tasked and limited water resources? The picture is grim for our community to say the very least. What happens to our towns if there is over conservation as part of a DM program and our water supply is eliminated or injuriously reduced due to the dry up of agriculture or another DM alternative? Where do we turn to then to carry us through these water short times? Critical storage is not here yet and as DM is evolving there will become more need and reliance upon storage. We ask, what are the states
plans to carry our district water needs through when water is already past the state line as part of a state Drought Contingency Plan and basins lack critical components for drought resiliency?

By keeping water in the stream and out of our alluvium by reducing flood irrigation what affect will this have upon stream ecology or the threatened and endangers fishes that reside here later in the season with reduced alluvium storage and return flows? What happens to the considerable investments made for the protection and recovery of our threatened and endangered species or recreational fishery species? Modeling completed for the White River demonstrates low to no stream flow risk to be very real.

Proponents for a DM program express climate change as a purpose and need for such a program yet are they taking into consideration the impacts to drying areas up removing green belts from playing a roll in carbon sequestration and the associated atmospheric cooling these areas provide? Perhaps in place of drying areas up we should be wetting areas using the plants and soils for what they have to offer. How does a browned pasture or field aid or play into a warming climate? Are we treating a symptom as opposed to implementing part of a cure by not wetting and activating these carbon bioreactors?

Part of the DM discussion includes conserved water to be stored downstream in Lake Powell. The district finds this approach unique since once the water has exited Colorado the multiple beneficial uses of our precious resource are no longer possible to Colorado water users. Has the state completed a Cost/Benefit analysis quantifying the benefits to our state by keeping the conserved consumptive use within our boarders? Our analysis has shown the financial benefits keeping water within our basin with the short list detailing; increased economic diversity, healthier municipalities, greater agriculture security, more recreation, stronger healthier stream ecology, and increased carbon sequestration. The White River, while not having formal representation to the DM framework development, is unaware of any attempt by the state to quantify such an analysis. Seeing this, the RWBCD recommends the state quantify these benefits as part of the DM process in a truly representative, open, and transparent means without prejudice including entities or individuals having a truly vested stake in any DM program. This includes entities statutorily created for water conservation such as water conservancy and conservation districts who have additional concepts for DM yet not part of the conversation.
"The Colorado Water Conservation Board's mission is to conserve, develop, protect, and manage Colorado's water for present and future generations." We understand and agree with this complex mission also realizing the state has a legal obligation to meet the Colorado River Compact. Not a simple task. In the instance of DCP and DM is the state truly looking for the wellbeing of our White River community? We see DM evolving around continued or expanded trans-mountain diversions, restrict less-developed basins/regions, and benefit the lower Colorado River basin states all of which is elated to in the DM Framework.

Through a public process created by HOUSE BILL 05-1177 "COLORADO WATER FOR THE 21ST CENTURY ACT" the Yampa-White-Green Basin Round Table unanimously created seven (7) Principles specific to Demands Management. The RBWCD believes these principles are important and MUST be an essential part of any DM program. The principles are: https://drive.google.com/file/d/1YplQhFCnzzK5FgZ5mQ0EOe8Y19kmDak6/view

1. **Preservation of Quality of Life in the Y/W/G River Basin:** Any DM program must preserve and enhance all aspects of quality of life in our basin, including agriculture, local communities, and local economies, while protecting municipal delivery, addressing environmental needs as well as recreational water use, and offering locally-accepted methods to reduce consumptive use without injury.

2. **Equity of Responsibility and Opportunity:** A DM program must be structured to ensure that no river basin nor single water user group (i.e., Ag, M&I) bears a disproportionate share of DM responsibility, and to provide opportunities for all water right holders to participate on a reasonably-equitable basis. To ensure equity, some form of inter-basin apportionment is required.

3. **Guided Market:** The State of Colorado should establish a marketplace for DM water transactions that is equitable and transparent.

4. **Rural Communities:** Any DM program must evaluate and address all impacts that could result to rural communities, including negative economic, cultural, or social impacts.

5. **Recreation and Environment:** Any DM program must consider/analyze its impacts on environmental and recreational needs, including those resulting from changes in water supply and/or timing of flows. Any DM program should strive to benefit, and must not adversely impact, environmental and recreational water uses and their contributions to local economies.

6. **Compensation for Value of Water Conserved:** Any DM program must fairly compensate participants. Compensation should be based on all economic impacts to the participant and not solely on the loss of income from the crop or product not produced.
7. Trans-Mountain Diversions (TMDs): Basins which benefit from water diverted from the Upper Colorado River must be considered as part of the CRS, with applicable DM responsibilities and opportunities, and subject to equitable apportionment for DM purposes. Any DM program must prohibit trans-mountain diverters from purchasing Western Slope water to meet a DM responsibility.

The Rio Blanco Water Conservancy District unequivocally believes in water conservation and the overlaying rationale for DM but we question the looming injury such a program will have to our basin water users. We continue progressing our locally driven drought planning efforts that includes considerable water conservation imploring upon the CWCB and other state water agencies part of the DM development framework to keep the intricacies and lack of drought resiliency of our White River community in mind as the states DCP evolves. We must reiterate, significant desire to participate in a DM type program is evident in our White River basin however, we lack critical tools necessary for drought and over conservation resiliency. Basin storage is a vital component of our drought planning and must be part of any successful DM program.

Thank you for the opportunity to provide comment.

Wade Cox
Board President
Rio Blanco Water Conservancy District

[Signature]
June 30, 2021

Ms. Amy Ostdiek  
Colorado Water Conservation Board  
1313 Sherman Street, Suite 718  
Denver, Colorado 80203  

Delivered via electronic mail to amy.ostdiek@state.co.us  

Re: Comments on Demand Management Feasibility Investigation

Dear Ms. Ostdiek,

On behalf of Trout Unlimited (“TU”), I am pleased to offer these comments on the Demand Management Feasibility Investigation (the “Investigation”) and the Demand Management Framework (the “Framework”). TU appreciates the hard work of the Colorado Water Conservation Board (“CWCB”) and its staff in leading the Investigation and in developing the Framework, and we appreciate the opportunity to provide input on these important issues.

As you will recall, in August of 2020, TU sent you a letter commenting on a number of issues related to demand management and the CWCB’s Demand Management Feasibility Investigation. A copy of TU’s 2020 letter is attached for your reference. Many of the issues we discussed in our 2020 letter remain outstanding or unresolved. While we recognize that demand management is complex and while we appreciate that development of the Framework has been time-consuming for CWCB staff, as an overriding matter we would have liked to have seen more progress towards resolution of demand management issues over the past year. Going forward, as we discuss in more detail below, it is important that the CWCB increase the pace of the Investigation.

Declining Climatic Conditions Require Swift Action

As you know well, climatic conditions across the Colorado River basin are in decline. Another year of hot and dry conditions has dramatically reduced runoff into an already-low Lake Powell, which is now approaching the lowest level since its filling in the early 1960s. The U.S. Bureau of Reclamation (“Reclamation”) recently declared a Stage 1 shortage on the Colorado River, and Reclamation is projecting a further decline in water availability by 2022, which would trigger harsh curtailment measures under the 1922 Colorado River Compact. The need for action is urgent, and the CWCB must act now to advance the development of a demand management program, even if there is not 100% consensus across the state regarding the parameters of a demand management program.

Trout Unlimited: America’s Leading Coldwater Fisheries Conservation Organization
Post Office Box 770450, Steamboat Springs, Colorado 80477
(303) 204-3057 • drew.peternell@tu.org • www.tu.org
Failure to Act Could Have Devastating Consequences

Failure to take action to address the declining hydrological conditions in the Colorado River basin could lead to severe economic disruption, litigation, or federal intervention. In other words, delays make it more likely that Colorado will suffer negative consequences or lose local control over shaping how to respond to the worsening climatic conditions in the Colorado River basin. Such a loss of control is not in the state’s best interest. While there may be some hard choices in structuring a voluntary demand management program, the consequences of not acting could be significantly more disruptive to Colorado.

Demand Management is Critical

Reducing Colorado’s risks under the 1922 Colorado River Compact will require a multitude of responses, with demand management likely being the most important. The upper Colorado River basin states’ plan to release water from several upper basin reservoirs to bolster Lake Powell levels is an important tool, but it is a temporary fix that will not on its own prevent declines in Lake Powell elevations. Other solutions, including expanded water conservation and reuse, land use planning, infrastructure improvements, and investments in healthy watersheds will also be required. Demand management may be the most powerful risk-reduction response available.

A Pilot Program Would Help Advance the Investigation

The 2019 Drought Contingency Plan (“DCP”), which provided the upper basin states a seven-year opportunity to test demand management and store the conserved water in Lake Powell, expires in 2026. If the upper basin states are going to learn how a demand management program can work, it is imperative to launch a pilot program as soon as possible. Otherwise, we would be missing the opportunity to learn as much as we can during the DCP window. The CWCB should commit to initiating a new, multi-year pilot program with projects across different water use sectors and geographies as soon as possible. Given our past involvement in the System Conservation Pilot Program and other on-the-ground demonstration projects in the years since then, TU looks forward to working actively with our partners in the agricultural community to develop projects under a pilot program.

Conclusion

Trout Unlimited urges the State of Colorado to act quickly and decisively towards the development of a demand management program, and we look forward to continuing to work with the Colorado Water Conservation Board towards this goal. Thank you for the opportunity to provide these comments.

Sincerely,

Drew Peternell
June 28, 2021

Colorado Water Conservation Board
1313 Sherman St., 7th Floor
Denver, CO 80203
Via: demandmanagement@state.co.us

RE: Response to Request for Input on Demand Management Feasibility Decision

Dear Members,

The Theodore Roosevelt Conservation Partnership is a coalition of 60 hunter, angler, science and outdoor recreation groups working to ensure all Americans have quality places to hunt and fish. The TRCP has worked for most of its 20 years primarily with federal agencies but also with state governments on water issues of importance, including trying to correct the water demand-supply imbalance in the Colorado River Basin because of the importance of the Basin’s habitat for fish and wildlife. We have been following the Colorado Water Conservation Board’s efforts to determine the feasibility of a Demand Management program closely, including by serving on the Environmental Values Work Group in 2020.

Because TRCP staff will not be able to attend the Demand Management Framework Public Listening Session June 29th from 5-7 pm, we ask the Board to consider our comments below as it determines Colorado’s next steps.

Context:

As the Board is well aware, this year’s extreme drought conditions come on top of a 20 year mega-drought. The hydrology for the Basin’s rivers and reservoirs is simply dire. If the Bureau of Reclamation’s most recent 24-month study projections are true, Lake Powell may decline to elevation 3525 during the 2022 water year, triggering reductions in hydropower production at Glen Canyon Dam and putting Upper Basin cities, ranches and recreational water users at real risk for compact curtailment.

As a result, time is of the essence for the Board to identify and implement tools to help Colorado’s water users collectively, including those who value our rivers for recreational benefit. Absent state solutions, individual water users will take individual action that may not help the State, its fish and wildlife, or even downstream water users. And, while the TRCP is aware of the Upper Colorado River Commission is also evaluating the feasibility of demand
management, its process cannot answer state-specific questions, so Colorado must find answers to its own issues rather than waiting for that investigation to conclude.

Delay will make it more likely that Colorado loses control to shape the responses best for its community of water users. Without action, Colorado’s water users are at ever greater risk of severe economic disruption and potentially even litigation or federal intervention. Compared to those risks, which only grow with each dry year, it is worth the Board taking a leadership role to structure a demand management program, along with other tools (like the one-time reservoir releases current under discussion) to address the Basin’s water challenges.

Further delay of pilots and a full demand management program in Colorado will also add to the existing burdens for Latino communities in Colorado and the Colorado River Basin. One third of U.S. Latinos live within Colorado River Basin states, including ours. As a group, Latinos are more likely to face health impacts from climate change than others. And, one cannot imagine a demographic more supportive of building resilient water systems that serve people, fish and wildlife. An astonishing 96% of Latinos in the West support funding to modernize water infrastructure and restore natural areas in ways that improve drought resilience, while 93% agree that, notwithstanding state budget shortfalls, it is imperative to fund protection of states lands, water and wildlife. Without adequate responses to drought and climate change – which is primarily expressed in terms of drought and fire in the West, including Colorado – Latinos will continue to feel the disproportionate adverse health impacts and other effects of climate change and drought. It is therefore incumbent on the CWCB to act expeditiously to stand up programs like demand management and others, that can build climate and drought resiliency without delay.

The Board, with its staff of policy, technical and legal experts, and having conducted several years of public outreach regarding demand management and other tools, is best positioned to act in a way that will best serve Colorado’s people and water resources, including the fish and wildlife that resource supports. The Board must lead on demand management but also work with other agencies, water users and communities of interest to expand water conservation and reuse, promote land use plans that fosters efficient water use, fund upgrades to aging less efficient water infrastructure and invest in healthy forests and watersheds.

**Framework Comments and Next Steps**

The draft framework does a good job of laying out the many factors, and thus decisions that the Board would have to make to set up and implement an equitable, voluntary and effective demand management program. But the framework does not provide a way to evaluate the tradeoffs – costs and benefits – amongst those decisions. For example, with knowing the financial cost of choosing a simple, more complex or robust alternative for any one factor, the CWCB cannot know how that choice may constrain what other choices would be available based solely on their cost. While a more sophisticated decision support tool, along with more complete data, e.g., on the cost of various choices, would help the Board, given the need for quick action, there is not the time available to optimize a program at inception.
If the Board is going to set up a demand management program, not only the hydrology, but the seven-year timeline of the 2019 Drought Contingency Plan, demands action within the year. The States, Reclamation, and others have begun renegotiating the 2007 Interim Shortage Guidelines, which must also be completed in 2026. If the Upper Basin states are going to learn anything from a demand management program, they must launch that program and implement associated projects as soon as possible. A demand management program cannot help in a practical matter, or provide lessons useful for the renegotiation unless it is in place before the crisis, not after the horse is out of the barn.

We encourage the CWCB to be practical and focus on moving quickly beyond the Framework to seek solutions and implement a pilot program that incorporates a diverse range of pilot projects. There are too many additional complex questions that will also take time to answer. We encourage the CWCB staff to focus on identifying and answering key questions and supporting additional pilot projects, including hypothetical exercises in certain circumstances, as a good approach. A range of pilots is needed, incorporating diverse geographies and project types, including not only agricultural projects, but also transmountain diversion, industrial, and other projects. The conceptual proposal for a programmatic pilot from the Agricultural Impacts Demand Management Workgroup can be a starting point.

Because of the State’s interests in, and in some respects, responsibilities for maintaining fish and wildlife habitat, as well as the economic benefits of recreational water use, the Board’s next steps should include an analysis of potential environmental co-benefits in pilot project design or a full demand management program. Such co-benefits only become more critical in the face of changing hydrology and increasing aridification, which affect native and important non-native game species alike. Pilots as well as a full program both have the potential to impact recreational and environmental flows, either positively or negatively. We urge the state to incorporate an analysis of environmental and recreation needs and potential benefits and impacts, as well as quantitative monitoring and verification of those, in pilots and any DM program.

Thank you in advance for your consideration,

Melinda Kassen, Sr. Counsel
Jared Romero, Director of Strategic Partnerships
Feedback on the CWCB Demand Management Framework

By the Y/W/G Basin Roundtable Big River Committee

June, 2021

The Framework and Review Process

The CWCB DM Framework document contains a great deal of detailed information about DM issues and solutions, primarily gleaned from and organized around the DM Work Group discussions. The conceptual framework, based on 3 levels of solutions to address issues, is a well-thought-out approach to presenting the issues that have surface and some proposed solutions for them.

Members of the Y/W/G BRC have reviewed the Framework document in detail, and summarized their comments, suggestions, and questions in the brief that follows. The BRC chose to review the Framework document by comparing it to the Y/W/G Executive Summary of DM Principles (“Principles”) published in March of this year. For each Framework topic and subtopic, members of the BRC reviewed solutions to determine whether or not those solutions aligned with or were counter to the Principles. Note that several subtopics in the Framework document are not addressed, as they do not appear to intersect with the Principles.

Comments and questions are generally divided into 2 parts; an initial section that highlights high-level comments and suggestions, and a more detailed discussion of several important topics and sub-topics contained in the Framework.

High-Level Issue Discussion

Following is a summary of high-level comments and suggestions:

1. Purpose and Goal of DM. The DM Framework should state clearly that the overarching purpose of any DM program is to reduce consumptive water usage in order to avoid a Compact call (Y/W/G Context). Although the idea of yielding conserved consumptive use and the goal of placing 500KAF in a pool in Lake Powell are discussed in the Underlying Assumptions of the doc, these were both missed by several reviewers, and it would be helpful if they were more clearly stated at the outset.

2. Shared Responsibility/Opportunity and Apportionment. The DM Framework should also state clearly that all CRS basins and water rights holders will share in responsibility and opportunity of the DM program (Y/W/G Principles 2, 7.) Specifically, no discussion of projects from Industrial water users is provided, while Municipal subtopics emphasize ‘support’; several reviewers commented that the document is focused on Ag. While TMD projects are discussed, nowhere does the Framework indicate the requirement that TMD diverters participate in DM. Finally, no discussion of inter-basin apportionment, or some other means of ensuring shared responsibility/opportunity between and among basins, is offered.
**Detailed Issue Discussion**

Each of the topics and subtopics that intersect with the Y/W/G DM Principles was discussed to determine whether and to what degree each was aligned. Following is a summary of that review:

**Major Topic 1: Monitoring and Verification (Agricultural DM Project)**

Subtopic: Maintain Return Flows

Option A – (Y/W/G Principles 1, 4, 5): Does not align. Failure to maintain return flows will be detrimental to ag, urban/suburban water users, and recreation in our basin during the late summer/fall season.

Option B – (Y/W/G Principles 1, 4, 5): Could align, provided that adequate storage was available.

Option C – (Y/W/G Principles 1, 4, 5): Would align by providing locally-sourced return flow. However, the solution seems impossibly complex and costly.

**Major Topic 1: Monitoring and Verification (Transmountain DM Project)**

Subtopic: Measure Water Returned to Stream

Option A – (Y/W/G Principle 7): Does not align. Absent some form of accounting validation (as provided for in the next subtopic), a simple estimate provided by the TMD operator would leave room for a range of harmful outcomes. For example, the TMD operator could simply overestimate the amount of water to be diverted at that diversion point, and take credit for a greater DM impact than was actually earned.

Option B – (Y/W/G Principle 7): Does align. This approach, to which an auditable provision should be added, would help to ensure that the conserved consumptive use claimed is not simply replaced by other Western Slope waters in a ‘shell game’.

Option C – (Y/W/G Principle 7): Does align. This approach is the most thorough, but probably is impractical to implement.

Subtopic: Verify Conserved Consumptive Use Occurs on the East Slope

Option A – (Y/W/G Principle 7): Does align. An auditable provision should be added to this statement, but this approach would prevent the ‘shell game’ tactic that allows a TMD operator to simply switch one West Slope source for another while claiming a DM contribution.

Option B – (Y/W/G Principle 7): Does align, slightly better than Option A but an auditable provision should be added.

Option C – (Y/W/G Principle 7): Does align, but seems overly complicated and expensive.

** Note: This subtopic title could be considered misleading; perhaps a better name would be: ‘Verify Accuracy of Accounting for Foregoing TM Diversion and that Conserved Consumptive Use Occurs on the East Slope’.
Subtopic: Coordinate Environment and Other Benefits

Option A – (Y/W/G Principles 1, 4, 5, 7): Does align. Option A does not provide any additional benefit, but it does not involve negative impact.

Option B – (Y/W/G Principles 1, 4, 5, 7): Does align. The provision for temporary storage in a Western Slope reservoir helps to mitigate environmental and other impacts.

Option C – (Y/W/G Principles 1, 4, 5, 7): Does align (see comments for Option B) but is too complex and costly for actual implementation.

Major Topic 3: Environmental Considerations

Subtopic: Assessing Net Benefit or Impact

Option A – (Y/W/G Principles 1, 2, 4, 5): Does align, provided that benefits to Y/W/G basin and communities are part of the consideration.

Option B – (Y/W/G Principles 1, 2, 4, 5): Does align, provided that benefits to Y/W/G basin and communities are part of the consideration.

Option C – (Y/W/G Principles 1, 2, 4, 5): Does align, provided that benefits to Y/W/G basin and communities are part of the consideration.

Subtopic: Strategies to Incentivize Benefits

Option A – (Y/W/G Principles 2, 4): Does align. Ensures that all DM contributors have equal opportunity to participate.

Option B – (Y/W/G Principles 2, 3, 4): Does not align. Given hydrology, this option prioritizes participation by main stem users over tributary users.

Option C – (Y/W/G Principles 2, 3, 4): Does not align. Given hydrology, this option prioritizes participation by main stem users over tributary users.

Subtopic: Strategies to Avoid, Offset or Mitigate any Potential Negative Impacts

Option A – (Y/W/G Principles 2, 4): Does not align. Provides no benefit to Y/W/G basin users or communities.

Option B – (Y/W/G Principles 2, 4): Does align. Solutions provided would help to mitigate return flow issues and community impacts.

Option C – (Y/W/G Principles 2, 4): Does align, but seems too complex and costly.

* * Note: This subtopic is very broad; some reviewers needed more context.
Major Topic 4: Economic Impact and Local Government (All DM Projects)

Subtopic: Support for Municipal Participants

Option A – (Y/W/G Principle 2, 7): May align, depending on implementation. Accounting verification required; as many municipals have conservation plans, it will be necessary to distinguish between permanent programs and CCU for DM.

Option B – (Y/W/G Principle 2, 3, 7): Does not align. Comments under Option A apply. But beyond those accounting factors, support for municipal project development provided in addition to DM compensation would constitute a large advantage for municipal projects, resulting in inequitable solutions.

Option C – (Y/W/G Principle 2, 3, 7): Does not align. Comments under Options A and B apply. And in addition to those considerations, this Option would potentially require the state of CO to make subjective decisions regarding the applicability secondary and tertiary impacts to DM, then to fund those which are deemed applicable. Ultimately, this Option is unsustainable.

Subtopic: Municipal Sector Mitigation

Option A – (Y/W/G Principle 1, 2, 4, 7): May align, depending on implementation. While this Option does not provide DM-based funding mitigation, it does allow for locally-accepted methods and decision-making.

Option B – (Y/W/G Principle 1, 2, 3, 4, 7): Does align, but involves complexities and subjective, bureaucratic judgements that would render it non-operational.

Option C – (Y/W/G Principle 1, 2, 3, 4, 7): Does align. This Option improves on the previous one by asserting non-subjective protocols. However, it would be complex and costly to implement, and very likely would not be sustainable.

Major Topic 5: Agricultural Impacts

Subtopic: Agricultural Mitigation

Option A – (Y/W/G Principle 1, 6): Does align, provided that compensation for participation is equitable. The goals for Ag Impacts (equitability, mitigating non-farm impacts, guided market, alignment with growing seasons) can and should met through appropriate funding for participants.

Option B – (Y/W/G Principle 1, 3, 6): Does align, but involves complexities and bureaucracy that would be difficult to sustain, and are unnecessary if compensation for participants is equitable.

Option C – (Y/W/G Principle 1, 3, 6): Does align, but involves complexities and bureaucracy that would be difficult to sustain, and are unnecessary if compensation for participants is equitable. Would likely be too costly to implement.

Subtopic: Agricultural Participant Field Requirements

Option A – (Y/W/G Principle 6): Does align. The operating principle asserted here is that the individual landowner holds a property right about which he/she is entitled to make decisions.
He/she has incentive to protect the value of that property through appropriate weed and pest control.

Option B – (Y/W/G Principle 3, 6): May align, depending on implementation. Providing assistance or support at the request of the individual landowner is appropriate. Enforced regulations for private property should not be implemented.

Option C – (Y/W/G Principle 3, 6): May align, depending on implementation. Providing assistance or support at the request of the individual landowner is appropriate. Enforced regulations for private property should not be implemented. Additional staffing may add cost that is unsustainable.
Yampa/White/Green Basin Roundtable
Demand Management Statement

Executive Summary

Context
In the face of persistent drought and anticipated long-term growth in demand for water, Colorado and the other six Colorado River Basin states have prepared a Drought Contingency Plan (DCP). One element of that plan is to investigate the feasibility of Demand Management (DM). If implemented, DM will become a future program which, on a voluntary, temporary, and compensated basis, will reduce water use by individual, public, and commercial water rights holders, to avoid administration of the Colorado River Compact on the Colorado River.

Statement of Principles
Given the context for DM in Colorado, the Yampa/White/Green River Basin Roundtable considers the following concepts to be important in the development of a DM program:

1. Preservation of Quality of Life in the Y/W/G River Basin: Any DM program must preserve and enhance all aspects of quality of life in our basin, including agriculture, local communities, and local economies, while protecting municipal delivery, addressing environmental needs as well as recreational water use, and offering locally-accepted methods to reduce consumptive use without injury.

2. Equity of Responsibility and Opportunity: A DM program must be structured to ensure that no river basin nor single water user group (i.e, Ag, M&I) bears a disproportionate share of DM responsibility, and to provide opportunities for all water right holders to participate on a reasonably-equitable basis. To ensure equity, some form of inter-basin apportionment is required.

3. Guided Market: The State of Colorado should establish a marketplace for DM water transactions that is equitable and transparent.

4. Rural Communities: Any DM program must evaluate and address all impacts that could result to rural communities, including negative economic, cultural, or social impacts.

5. Recreation and Environment: Any DM program must consider/analyze its impacts on environmental and recreational needs, including those resulting from changes in water supply and/or timing of flows. Any DM program should strive to benefit, and must not adversely impact, environmental and recreational water uses and their contributions to local economies.

6. Compensation for Value of Water Conserved: Any DM program must fairly compensate participants. Compensation should be based on all economic impacts to the participant and not solely on the loss of income from the crop or product not produced.

7. Trans-Mountain Diversions (TMDs): Basins which benefit from water diverted from the Upper Colorado River must be considered as part of the CRS, with applicable DM responsibilities and opportunities, and subject to equitable apportionment for DM purposes. Any DM program must prohibit trans-mountain diverters from purchasing Western Slope water to meet a DM responsibility.
June 28, 2021

Submitted by email

RE: Demand Management Framework Comments

Dear Colorado Water Conservation Board members and staff:

The Nature Conservancy (TNC) appreciates the Colorado Water Conservation Board (CWCB) request for feedback on the Demand Management (DM) framework. We opted to send a letter rather than fill out the survey due the complexity of the issue and desire to provide more information than the survey could provide.

TNC is a global environmental nonprofit working in Colorado for over 55 years to create a world where people and nature can thrive. Our mission is to conserve the lands and waters on which all life depends. TNC has over one million members and works in all 50 states and impacts conservation in 72 countries and territories across the world.

Reservoirs in the Colorado River Basin, filled to the brim at the end of the 20th century, are at historic lows. By 2060, demand for water from the Colorado River may exceed supply by more than 3.2 million acre-feet. Coming up short could put at risk the drinking water supplies of almost 40 million people in the Southwest, agricultural production, endangered species, the health of our rivers, and future economic growth, as well as the Colorado River’s $26 billion outdoor recreation economy with its quarter-million jobs. With so much at stake, we have been following CWCB efforts to determine the feasibility of a Demand Management program closely, and four TNC staff members served on the CWCB’s demand management work groups.

Now, another year of hot and dry conditions have dramatically reduced run-off into an already low Lake Powell, which is now approaching the lowest level since its filling in the early 1960s. The U.S. Bureau of Reclamation recently projected that by early 2022, Lake Powell is likely to decline to elevation 3,525 feet—a level that would result in reduced hydropower production at Glen Canyon Dam and would put the Upper Basin at risk of triggering harsh curtailment measures under the 1922 Colorado River Compact. These unprecedented conditions require that Colorado decision-makers act swiftly and decisively to develop and implement a plan and tools to protect and manage Colorado’s water and rivers for present and future generations.

Existing conditions require a multitude of responses, and demand management is a vital tool to address the Upper Basin’s water challenges. The Upper Basin states’ plan to release water from
several Upper Basin reservoirs to bolster Lake Powell levels is one important tool, but it is a temporary fix that won’t prevent risky declines in Lake Powell on its own. Other solutions, including expanded water conservation and reuse, land use planning, infrastructure improvements, and investments to improve the health of forests and watersheds will also be required. Demand management, based on the bedrock principles of “temporary, voluntary, and compensated,” and with sideboards to avoid disproportionate impacts and ensure environmental protection, may be one of the most useful risk-reduction responses available.

With hydrology rapidly degrading, the longer we wait to develop effective tools to collectively mitigate risk the more likely we are to lose local control in shaping how Colorado will respond and what tools will be available to us.

The CWCB draft framework is a good start in laying out the many decisions needed to set up and implement an equitable, voluntary, and effective demand management program. The Framework is a good summary of the State of Colorado’s demand management feasibility evaluation, but it does not provide a way to evaluate tradeoffs and benefits to aid in decision-making. The framework is very detailed, which can be useful in understanding the State’s process to date; however, its complexity may also be confusing to many stakeholders. As is, it provides a concise high-level summary of key workgroup concepts and issues. However, it cannot be used as a decision-making tool because it lacks a way to evaluate or consider tradeoffs and benefits between the various components of one category and the implications of that component choice on other categories.

We believe that CWCB decision-makers must evaluate trade-offs, make the hard calls, and develop a demand management program that can be in place as one tool if the situation continues to decline. The state should not let the desire for the perfect be the enemy of the workable—the current and projected hydrology doesn’t allow Colorado to wait for 100% consensus. **Now is the time for the CWCB to move forward so it has a plan and a program in place before a crisis.**

**Inaction or undue delay could lead to severe economic disruption, litigation, and even federal intervention.** While there may be some hard choices in structuring a voluntary demand management program and no one wants to reduce their water use, the consequences of not having a plan to address the crisis will be severe and costly. The decision to proceed or delay needs to be made in the full context of what can happen if dry years continue. There won’t be any do-overs and curtailment without any siderails seems like a risky path for Colorado. The CWCB, with its staff and legal experts and the benefit of extensive public outreach, is positioned to make good decisions that best serve Colorado’s people and water resources.

Many states in the Upper Basin are deferring to the UCRC feasibility process. That process is important but will not answer state-specific questions. Colorado must find answers to its own issues and concerns rather than waiting for the UCRC investigation to conclude.

The 2019 Drought Contingency Plan, which provided the Upper Basin States with a seven-year opportunity to test demand management and store the water conserved in Lake Powell, expires in 2026. The States, Reclamation, and others have begun renegotiating the 2007 Interim Shortage
Guidelines, which must also be completed by 2026. If the Upper Basin states are going to learn how a demand management program can work, it seems that we are missing the opportunity to learn as much as we can during the DCP window to experiment with different approaches and pilot programs.

**We encourage the CWCB to focus on moving quickly beyond the Framework to seek solutions and implement a program that incorporates a diverse range of pilot projects.** We hope that the State will not linger on the process of finalizing or improving the Framework. We encourage the CWCB staff to focus on identifying and answering key questions and supporting additional pilot projects, including hypothetical exercises in certain circumstances, as a good approach. A range of pilots is needed, incorporating diverse geographies and project types, including not only agricultural projects, but also transmountain diversion, industrial, and other projects. The Agricultural Impacts Demand Management Workgroup shared a conceptual proposal for a programmatic pilot that offers opportunities for systematic exploration of the multiple objectives identified by the State and other interested parties.

The State has interests in and responsibilities for maintaining environmental, fish and wildlife, and recreational water uses and values. These only become more critical in the face of changing hydrology and increasing climate change driven drought. A demand management program has the potential to positively or negatively impact recreational and environmental flows, including target flows for endangered species. **We urge the state to create a demand management program that benefits rivers and that incorporates in program and project development and implementation an analysis of environmental and recreation needs and potential benefits and impacts, as well as quantitative monitoring and verification of project benefits and impacts.**

We thank the CWCB staff for their work in developing the framework and commend them on their efforts to ensure a robust and open conversation about demand management in Colorado.

Sincerely,

Carlos E. Fernandez  
Colorado State Director

Taylor Hawes  
Colorado River Program Director

CC:  
Becky Mitchell  
Lauren Ris  
Dan Gibbs  
Jonathan Asher  
Kelly Romero-Heaney
DEMAND MANAGEMENT: Preliminary Guiding Principles

Adopted June 10, 2021

The principles outlined below are intended to guide Southwestern Water Conservation District (SWCD) in its evaluation of and input to any Demand Management (DM) program the state of Colorado, in cooperation with the other three Upper Basin states, may advance.

SWCD has not adopted a position of support, opposition or neutrality on the feasibility or development, let alone implementation, of a DM program within the Upper Basin. There are simply too many unknowns at this point. DM is an evolving concept; accordingly, this is a living policy document that will be reviewed periodically to reflect changing program elements, evaluations, and goals of DM in Colorado and the Upper Basin.

SWCD was created by the General Assembly in 1941 to lead in the conservation, use and development of the water resources of the San Juan and Dolores river basins, both of which are tributary to the Colorado River. SWCD’s organic act also includes the charge “to safeguard for Colorado, all waters to which the state of Colorado is equitably entitled.” Demand management is a novel concept that, if implemented, has the potential to alter water use and administration within the Upper Basin and, on a more local level, within SWCD’s boundaries. Accordingly, SWCD will remain involved in the evaluation and potential formation and implementation of any DM program Colorado may pursue.

Colorado River Basin Drought Contingency Plans:

At least since the turn of this century, the security and sustainability of Colorado River water supply has been in question. The basin is currently experiencing one of the worst hydrologic cycles in recorded history. Continuing drought, resulting in worsening water supply and storage conditions, increases the risk of curtailment in the Upper Basin.

To reduce the risk of Lake Powell and Lake Mead declining to critically low levels, the United States Department of the Interior (Interior) and the seven Colorado River basin states agreed to develop and implement plans to overlay the 2007 Interim Guidelines addressing forecasted low reservoir elevations if the drought continued. The resulting Colorado River Drought Contingency Plans (DCP) were submitted to Congress on March 19, 2019. On April 16, 2019, then President Trump signed the Colorado River Drought Contingency Plan Authorization Act into law. This bill requires Interior to execute the Colorado River Drought Contingency Plans without delay and to operate applicable Colorado River System reservoirs accordingly.

For its part, the Upper Division states of Colorado, New Mexico, Utah and Wyoming committed to three primary strategies to address the impacts of continued drought in the basin. The first strategy, weather modification, was already being implemented across the basin and needed no federal legislation so was not included as part of the legislation passed in the Upper Basin’s Drought Contingency Plan (DCP). The other two strategies focus directly on the goal to minimize the risk of water levels at Lake Powell falling below target elevations: an immediate response and a multi-year plan. The second strategy, articulated in the Drought Response Operations Agreement of the Upper Basin’s DCP, is an immediate response measure designed to utilize operational adjustments or releases from the Colorado River Storage Project Act (CRSPA) Initial Units to bolster storage levels at Lake Powell when Lake Powell approaches a critical low elevation of 3,525’ MSL. The Drought Response Operations Agreement also provides mechanisms for recovering storage at those same CRSPA Initial Units in subsequent years.
The Upper Basin’s longer-term strategy is to explore the feasibility of developing and implementing a new demand management program that could generate water savings by either temporarily reducing existing water use within the Upper Basin or augmenting supplies with imported water. Under the Upper Basin’s DCP, up to 500,000 acre-feet of DM water savings can be stored in the CRSPA Initial Units to help assure continued compliance with the Colorado River Compact under certain circumstances.

Most of the investigations and discussions pertaining to DM to date, have been focused on generating DM “water savings” through the voluntary, compensated and temporary reduction of historically consumptively used (HCU) water within the Upper Basin in order to assist with Colorado River Compact compliance. As a result, the guiding principles set forth below are based on the assumption that DM water will be generated in this manner.

**Guiding Principles:**
The foundational elements of any DM program must be voluntary, temporary, and compensated reductions in use of water that was being beneficially used under existing rights that otherwise would have depleted Colorado River basin flows within the Upper Basin.

SWCD believes DM is not a panacea. Additional options and alternatives (e.g., forest management, groundwater storage, weather modification, non-native phreatophyte removal, importing water from outside of the Colorado River basin) should be equally and fully explored as we work towards the goal of supply security and sustainability in the Colorado River basin.

Exploration of DM must be just one part of the comprehensive, basin-wide strategy for addressing short- and long-term water supply and demand imbalance that may be included in the next set of Interim Guidelines currently in negotiations regarding the operations of Lake Mead and Lake Powell for future Colorado Compact compliance.

SWCD pledges to evaluate DM as one of many possible strategies to provide flexibility and reduce the risk of curtailment in the Upper Basin.

SWCD will participate in the exploration and potential formation of any Colorado DM program to ensure any proposed program is capable of achieving its stated objectives and that adverse consequences are avoided, minimized, or fully mitigated.

Any DM program must operate within Colorado’s Prior Appropriation Doctrine. The creation, storage, delivery and use of DM water must not injure any existing water right within Colorado.

Before deciding whether it would be feasible to adopt, let alone implement, a DM program within Colorado, the State must commit to developing the technical platform necessary to demonstrate that a program can be accomplished without injury to other users within Colorado, at a sufficient scale, and that any conserved water can be conserved, protected, and ultimately delivered for Compact compliance.

Any DM program must ensure equitable and proportional participation from all basins consuming Colorado River water as well as all regions and sectors of Colorado’s economy. SWCD acknowledges that “equity” and “proportionality” are critical but undefined terms within the context of demand management. Both are currently the subject of statewide focus.
Transmountain diverters of Colorado River water must participate in DM using water that was historically diverted and beneficially used under decreed transmountain water rights. Transmountain diverters must not be allowed to purchase or otherwise rely upon other water supplies that originate in the Colorado River Basin in order to accomplish their proportional participation in DM.

A successful DM program can help ensure the safety and economic health of all Coloradans. Accordingly, the considerable funding required for DM must not target water right holders, water users, or other specific groups.

Colorado’s DM program, if any, must be designed and implemented to support and aid sustaining Colorado’s predominantly family- and locally-owned agriculture.

Storage of DM “savings” should be in CRSPA Initial Units that are located as high in the system as practicable.

Releases of DM water from storage should only be made by the Upper Colorado River Commission for the purpose of helping the Upper Division States assure continued compliance with Article III of the Colorado River Compact without impairing the right to exercise existing Upper Basin water rights in the future. Such releases should be timed, to the extent practicable, to provide the greatest economic, environmental, and recreational benefits.

Any DM program must not encourage or reward speculation in Colorado water resources.

Any DM program must recognize there will be impacts resulting from implementation of DM, and that impacts, both positive and negative, will be neither equally nor equitably distributed. Therefore, any DM program must include adequate mitigation for those individuals, water districts and ditch and reservoir companies, and communities impacted by implementation of a DM program. Additionally, DM mitigation should be designed to provide a net benefit to participating individuals, water projects, and their communities.

The evaluation of DM’s feasibility, appropriateness, and whether DM is a timely and worthwhile pursuit must be approached without prejudice. In other words, a determination of infeasibility, inappropriateness or unworthiness must be honestly evaluated.

In order to ‘test’ DM and to allow for incremental implementation and accrual of meaningful DM savings, SWCD recognizes that initial implementation of DM may be required at a pilot or demonstration scale. However, any pilot or demonstration DM program must be conducted in conformance with Colorado water law, without injury to other water users and without prejudice regarding its conclusions or consequences.

As it continues to evaluate the appropriateness of DM, SWCD will remain mindful of the severe consequences of Compact Administration, which could force involuntary, and uncompensated water curtailments that could, in turn, result in disproportionate impacts to certain water users, economic sectors and geographic regions.

SWCD appreciates the CWCB’s outreach and inclusivity in its evaluation process to date. SWCD pledges its continued, constructive participation with the state in its DM investigations.
**Future Process:**
SWCD will continue to explore demand management, including by proactively identifying and communicating its concerns regarding disproportionate and negative impacts potentially resulting from implementation of DM.

SWCD will continue to reach out to water districts, Tribes, and other interested parties in its on-going evaluation and assessment of DM.

SWCD will continue to evaluate water supply, water rights, and water uses and their respective relationships to Compact compliance.

SWCD will collaborate closely with the Colorado River District in order to maintain, to the greatest extent possible, harmony on DM between the two districts.

SWCD will continue to engage in all appropriate Colorado River Compact discussions.
As part of Colorado’s Demand Management Feasibility Investigation (see Work Plan) led by the Colorado Water Conservation Board (CWCB), this document includes a Demand Management Framework focusing on various issues associated with a potential Demand Management program.

While reviewing, note that the following Demand Management Framework draft is:

- For a potential Demand Management program that would involve temporary, voluntary, and compensated reductions in consumptive water use pursuant to the Demand Management Storage Agreement.
- Not a Demand Management program, but rather a tool for discussion regarding a potential program, which is not a foregone conclusion.
- Designed to be iterative, and there will likely be multiple updated versions released as the discussion progresses.
- Designed to show a broad range of implementation options, without showing preference for any given option.
- Set up using a range from A to C, designed to roughly correlate with level of complexity for the various implementation options. These designations do not correlate with any value judgments about which option may be best.
- Not intended to represent any commitments or guarantees regarding viability of a program design. For example, some options presented may have budgetary or other constraints.
- Intended to be used as a tool for discussion across Colorado about what may work and what may not work in a potential Demand Management program from varying perspectives, and any information gathered throughout this process is intended to assist CWCB in determining whether Demand Management may be achievable, worthwhile, and advisable from Colorado’s perspective.
- Not intended to represent any position of the CWCB or the State of Colorado regarding the feasibility of Demand Management.

To provide feedback on this Framework document, please email demandmanagement@state.co.us or visit engagecwcb.org.
Underlying Assumptions of Demand Management (DM) Program:

DM program would be run, managed, and regulated by the State of Colorado and/or through UCRC. DM program would yield conserved consumptive use and would be compliant with all applicable law. DM program would be bound by the Demand Management Storage Agreement (500,000 AF pool in Lake Powell and all other provisions).

All projects would be reviewed to ensure compliance with applicable federal and state laws, interstate agreements, and existing programs and processes.

Ongoing coordination with the Tribal Nations would be an important element of any potential program design.

*Note that Law & Policy and Administration & Accounting elements are not included in this analysis.*
<table>
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<tr>
<th>DM Workgroup</th>
<th>Threshold Issues / Elements of Feasibility</th>
<th>Implement Option A</th>
<th>Implement Option B</th>
<th>Implement Option C</th>
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<tr>
<td>Monitoring &amp; Verification</td>
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<td>Bypass of diversions (streamflow and/or reservoir releases, if applicable) if the physical and legal availability can be easily determined; or estimate the amount of conserved consumptive use through moderate engineering estimates (such as reducing historical diversion rates) to protect downstream users.</td>
<td>Diversion of the irrigation supply (streamflow and/or reservoir releases, if applicable) into a ditch at a flume with a stage/discharge recorder, after which would be returned to the stream.</td>
<td>Diversion of the irrigation supply (streamflow and/or reservoir releases, if applicable) into a ditch with multiple real-time recording devices and a telemetry system to remotely monitor diversions and the measured returns of the irrigation supply to the stream.</td>
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<td>• As simple, easy, and flexible as possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Participation adds water to the Colorado River Basin – not solely a retiming of depletions</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Conduct a consumptive use analysis</td>
<td></td>
<td>Use the Division of Water Resources’ Lease Fallow to estimate historical consumptive use (conservatively underestimating to protect downstream users).</td>
<td>Complete a general site-specific potential consumptive use analysis, similar to a Substitute Water Supply Plan (SWSP), to estimate consumptive use, while considering the available diversions data and/or historical remote sensing data and/or aerial photographs.</td>
<td>Complete a detailed site-specific engineering analysis, similar to a water court change case, with parcel specific representative data to determine historical consumptive use and return flows.</td>
</tr>
<tr>
<td>Estimate the residual field consumptive use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintain return flows</td>
<td></td>
<td>Complete fallowing, removal of deep-rooted crops, and management practices to prevent inadvertent irrigation with visual inspections.</td>
<td>Full or split fallowing with ongoing measurement of groundwater levels and/or visual soil moisture inspections.</td>
<td>Split fallowing, irrigation of lower consumptive crops, or deficit irrigation with ongoing measurement of applied irrigation supplies, soil moisture, and remote sensing.</td>
</tr>
<tr>
<td>Monitoring &amp; Verification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmountain DM Project</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measure water returned to stream</td>
<td></td>
<td>Bypass of diversions if the physical and legal availability can be easily determined; or estimate the amount of conserved consumptive use using moderate engineering estimates (such as reducing historical diversion rates) to protect downstream users.</td>
<td>Diversion of the transmountain supply for measurement in a flume with a stage/discharge recorder, after which would be returned to the stream OR measurement of reservoir release.</td>
<td>Diversion of the transmountain supply with real-time recording devices and a telemetry system to remotely monitor measured returns/releases of the transmountain supply to the stream.</td>
</tr>
<tr>
<td>Interconnected Issues, Tradeoffs, and Equity Considerations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRAFT</td>
<td></td>
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</tbody>
</table>

*Note that implementation options A through C do not reflect the relative value or preference of any particular approach. They roughly align with varying levels of complexity, and are designed to encourage discussion about various tradeoffs relating to potential program designs.*
**DM Program Structure Matrix of Building Blocks**

| Monitoring & Verification (Process considerations for all projects) | Coordinate environmental and other benefits | Qualitatively demonstrate an increase in streamflow after bypassing a transmountain diversion and/or divert, measure, and return flows to the stream. No additional measurement structures are required above what is deemed necessary to verify measurement of water returned to the stream. | Qualitatively demonstrate that temporary storage in a West Slope reservoir for a planned release bolsters non-consumptive, environmental and flow related benefits. Impacts and benefits evaluated qualitatively only. No additional measurement structures are required above what is deemed necessary to verify measurement of water returned to the stream and reservoir operations. | Quantitatively demonstrate that temporary storage in a West Slope reservoir for multi-benefit planned releases bolsters non-consumptive, environmental, and flow related benefits. Impacts and benefits evaluated quantitatively. Measurement needs could include flumes for measuring bypass of diversions and/or return flows; additional stream gages; measurements of water quality, etc. Accounting required to monitor a project’s net effect (e.g. lagged return flow accretion timing, etc.). | Foregone agricultural and TMD diversions could provide additional benefits for non-consumptive uses and environmental flow needs both immediately after release and/or after temporary storage. Incorporating West Slope storage to manage releases of foregone agricultural and TMD diversions could maximize flexibility and bolster non-consumptive and environmental flow needs, but would result in additional evaporative losses and would reduce water generated by an individual DM project. Incorporating West Slope storage could also increase the requirements for measuring, verifying, and quantifying environmental benefits and/or impacts. |

*Note that implementation options A through C do not reflect the relative value or preference of any particular approach. They roughly align with varying levels of complexity, and are designed to encourage discussion about various tradeoffs relating to potential program designs.*
## Demand Management Framework

### Education & Outreach
- Transparent and inclusive stakeholder engagement to shape the program
- Address communication gaps with message consistency, partner networks, and virtual engagement
- Water education at the state, regional, and local levels
- Include an equity lens in all engagement and communication

<table>
<thead>
<tr>
<th>Education &amp; Outreach</th>
<th>DM Program Structure Matrix of Building Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water education (to engage broad audiences)</strong></td>
<td><strong>State creates detailed website resources, issues press releases, conducts interviews, and delegates many education tasks to PEPO, WECO, and other partners.</strong></td>
</tr>
<tr>
<td><strong>Stakeholder engagement (to inform the program)</strong></td>
<td><strong>State partners with groups such as WECO, PEPO, educators, cooperative extension or similar entity, and universities to implement a series of education activities; implements a targeted communications plan; offers webinars to partner organizations; some new audience engagement.</strong></td>
</tr>
<tr>
<td><strong>Program marketing (to ensure participation)</strong></td>
<td><strong>State brings onboard founds education to travel statewide for strategic teaching efforts rooted in drought and water shortage knowledge; partners extensively; communicates broad-scale (i.e. radio, billboards, TV) to new water audiences.</strong></td>
</tr>
</tbody>
</table>

### Stakeholder Engagement
- Leveraging the Board, Roundtables, IBCC, CWC, conservation districts, and public meetings, the State leads a public input process to inform a DM program and geography. As the program is developed, stakeholders are invited to address the CWCB Board to proactively identify and discuss how the program is working from varying perspectives and geographies.

| Stakeholder Engagement (to inform the program) | **The state engages a broad and diverse range of stakeholders over an extended period. As the program is developed and implemented, stakeholders are invited to address the CWCB Board to proactively identify and discuss how the program is working from varying perspectives and geographies.** |

### Program Marketing (to ensure participation)
- State remains active in water forums like CWC, implements marketing plan as needed to target audiences; maximizes pre-existing participants. No active solicitation. Assumes participants would approach state.

| Program Marketing (to ensure participation) | **State partners with local actors to assist with program marketing; implements proactive marketing plan to target audiences using annual allocated funds.** |
|                                           | **State opens local offices to be liaisons between the state and program participants; extensive marketing; maximizes new program participants. State has a role in co-developing applications with new participants.** |

### Environmental Considerations
- Achieve a net environmental benefit over time, and across hydrologic conditions and geographies

<table>
<thead>
<tr>
<th>Environmental Considerations</th>
<th><strong>How potential environmental benefits and impacts are considered</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Environmental benefits and impacts (flow needs, affected habitat, and/or species, alignment with other plans or efforts, etc.) considered through existing review processes and frameworks.</td>
</tr>
<tr>
<td></td>
<td>Identify potential environmental benefits and impacts and associated risks for potential projects. Evaluate possibility of realizing potential benefits and mitigating potential impacts. Coordinate with other agencies to identify and track potential benefits and impacts, including CPW and others as appropriate.</td>
</tr>
<tr>
<td></td>
<td>Consider each item in a comprehensive list of potential benefits and impacts. Public stakeholder engagement could be required for large projects. This may include consultation with local entities or with a committee of experts to assess local needs and impacts. Evaluate possibility of realizing potential benefits and mitigating potential impacts. Coordinate with other agencies and local entities to identify and track potential benefits and impacts, including CPW and others as appropriate.</td>
</tr>
</tbody>
</table>

---

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### Demand Management Framework

#### DM Program Structure Matrix of Building Blocks

<table>
<thead>
<tr>
<th>Economic Impacts &amp; Local Governments</th>
<th>Support for Municipal Participants</th>
<th>Existing programs and funding sources are used to support municipal participants.</th>
<th>State consults with and provides support for municipal participants in developing projects.</th>
<th>State identifies other programs that may be coordinated to support municipal participation and assists in facilitating more significant conservation programs. State consults with local governmental entities to identify appropriate mitigation opportunities.</th>
<th>A water efficiency program is not temporary. However, it is likely to be the least disruptive option. Municipal participant may eliminate or minimize impact on municipal water customers. However, mechanism of municipal participation and/or reliance on other water sources may impact water availability for other users.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Any program participation must be voluntary. Initial goal is to do no harm. Program should seek to create net benefits for water users. Program operations should be transparent &amp; collaborative.</td>
<td>Existing programs and funding sources are used relating to municipal sector mitigation. Municipalities may take steps to avoid secondary impacts to their customers.</td>
<td>State more actively works to identify and track potential secondary impacts to municipalities resulting from participation in the program. A portion of project compensation spent on mitigation efforts. Mitigation payments are made to municipalities or communities.</td>
<td>State sets specific protocol and mechanisms for identifying and tracking potential secondary impacts resulting from municipal participation. A larger portion of compensation spent on mitigation with a defined list of required mitigation actions dependent upon type of project activity. State partners with local governmental entities to identify appropriate mitigation opportunities.</td>
<td>Potential impacts to system reliability depending upon type of municipal participation. Mitigation measures taken by municipalities may have impacts outside their municipal boundaries. Municipalities with fewer resources may be less able to mitigate potential impacts on their own, resulting in areas of low socioeconomic status potentially having lower access to green spaces or other resources.</td>
<td></td>
</tr>
</tbody>
</table>

| Strategies to avoid, offset, or mitigate any negative impacts | No additional strategies implemented to avoid, offset, or mitigate any potential negative impacts. | Evaluate the program as a whole for opportunities for partnership(s) to add environmental value (enhance benefits or avoid, offset, and or mitigate negative impacts). Examples: potential partnerships with NGOs and/or local organizations to help in realizing benefits and mitigating potential impacts and provide additional funding, programs, or opportunities. Potential projects could include watershed restoration work, diversion structure improvements, etc. | Evaluate specific projects for opportunities for partnership(s) to add environmental value (enhance benefits or avoid, offset, and or mitigate negative impacts). Examples: Potential partnerships with NGOs and/or local organizations to help in realizing benefits and mitigating potential impacts and provide additional funding, programs, or opportunities. Potential projects could include watershed restoration work, diversion structure improvements, etc. | These are very similar to the options for monitoring and verification. Additional mitigation measures would require additional funding. Measurement and quantification of potential environmental benefits and/or impacts would have monitoring and verification components or requirements (see Monitoring & Verification). |
| provide for projects with potential environmental benefits. | No incentives provided for projects with potential environmental benefits. | Preference and/or additional monetary or program incentive given to projects with net environmental benefits. | Preference and/or additional monetary or program incentive given to projects with greater net environmental benefits. Potential partnerships with NGOs and/or local organizations to support the assessment of potential benefits. | Coordinate efforts on incentivizing benefits with local governments to streamline approval. Opportunities for collaboration on a county/local level. |

| Strategies to incentivize benefits | Preference and/or additional monetary or program incentive given to projects with net environmental benefits. | Preference and/or additional monetary or program incentive given to projects with greater net environmental benefits. Potential partnerships with NGOs and/or local organizations to support the assessment of potential benefits. | Preference and/or additional monetary or program incentive given to projects with greater net environmental benefits. Potential partnerships with NGOs and/or local organizations to support the assessment of potential benefits. | Coordinate efforts on incentivizing benefits with local governments to streamline approval. Opportunities for collaboration on a county/local level. |

| Provide opportunities for projects with net environmental benefits. | Environmental benefit or impact of a given project is assessed through existing review processes and frameworks. | List of environmental considerations evaluated quantitatively for benefits or impacts. Net benefit or impact of a project is evaluated quantitatively based on evaluation of considerations. Evaluate risks and tradeoffs. | List of environmental considerations evaluated quantitatively for benefits or impacts. Net benefit or impact of a project is evaluated quantitatively based on evaluation of considerations. Evaluate risks and tradeoffs. | More comprehensive environmental assessments could be burdensome to potential applicants as well as the State. However, greater risk of adverse impacts or lost opportunities if these assessments are not conducted. |

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## Demand Management Framework

### DRAFT

#### DM Program Structure Matrix of Building Blocks

<table>
<thead>
<tr>
<th>Ag Impacts</th>
<th>Agricultural sector mitigation</th>
<th>Agricultural participant field requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultation with local governments to track impacts and develop mitigation measures</td>
<td>General education and outreach to inform local governmental entities, water boards of DM program. State does not consult with municipal participants or local governments to identify, track, or mitigate potential impacts and identify potential benefits to local economies resulting from a DM Program.</td>
<td>Consultation with program participant and/or local governmental agencies to identify potential impacts and mitigation strategies, for all types of project activity, and to identify potential benefits to local economies and communities relating to a DM Program, as well as strategies to increase benefits.</td>
</tr>
<tr>
<td>Less consultation with local governments may result in increased impacts that are not adequately tracked and mitigated.</td>
<td>State consults with program participant and/or local governmental agencies to identify potential impacts and mitigation strategies, for all types of project activity, and to identify potential benefits to local economies and communities relating to a DM Program, as well as strategies to increase benefits.</td>
<td>Inter-governmental Agreement (IGA) or similar framework developed to facilitate robust and iterative consultation process with local governments and other entities to address local concerns and mitigate local impacts, with specific strategy and focus on mitigating or avoiding potential adverse impacts and increasing potential benefits, for all types of project activity.</td>
</tr>
<tr>
<td>Agricultural sector mitigation</td>
<td>Fund is established to provide compensation to local entity for community economic development fund. Grant program established to assist with local agricultural and economic viability.</td>
<td>State and partners make efforts to identify potential secondary impacts. Fund established that potentially provides compensation for mitigation, some of which is distributed to water management entity servicing property, while a portion is distributed to local/rural economic development or other appropriate organization. Additional staff time targeted at mitigating agricultural sector impacts to non-participants. Dependent on funding availability and identification of appropriate funding source.</td>
</tr>
<tr>
<td>Ag impacts are a varying level of resources and capacity available for local governments to facilitate coordination and mitigation efforts. This variation may affect the extent to which impacts are tracked and mitigation measures implemented across the state.</td>
<td>Limiting the community development fund to verifiable DM impacts would present additional complexity, but would perhaps lower costs or avoid reimbursement of economic impacts beyond State’s control; alternatively a community fund that supports projects regardless of verifiable impact would be easier to manage and generate positive community outcomes. State verification of potential impacts could be costly and difficult to accomplish.</td>
<td>Assess impacts to tenant farmers and land rental prices through community outreach efforts, noting it may be challenging to punish DM-related impacts.</td>
</tr>
<tr>
<td>Program should be a structured &amp; guided market</td>
<td>Ag practices</td>
<td></td>
</tr>
<tr>
<td>Program operations need to align with growing season schedules</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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## Demand Management Framework

### DRAFT

**Agricultural participant assistance**
- Existing programs and resources in place are utilized to facilitate agricultural participant assistance to help fully realize potential benefits of participation or mitigate potential impacts.

**State creates a grant or cooperative contracting program with the university cooperative extension service, conservation districts, or similar technical service providers, to offer technical assistance and help fully realize potential benefits of participation or mitigate agronomic impacts from the DM program to the participants.**

**State creates additional staff capacity responsible for assisting in fully realizing benefits of participation or mitigation of impacts from the DM program to the participants. Position manages a budget for technical assistance and mitigating impacts.**

**Participants would likely need technical assistance in both navigating any potential DM in-take process and in selecting/implementing mitigation measures (e.g., cover cropping), providing the ability to grant or contract with third parties would likely reduce programs costs and address state capacity concerns.**

**Producer participants familiar with working with agricultural service providers may be more willing to work with a trusted third party versus state staff.**

**In addition to direct technical assistance, online information regarding any DM sign-up process or agronomic impacts and best management practices would be helpful and more accessible.**

### DM Program Structure Matrix of Building Blocks

<table>
<thead>
<tr>
<th>Process Considerations</th>
<th>Soliciting projects</th>
<th>Application requirements</th>
<th>Project selection process</th>
<th>Localization and program evolution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agricultural participant assistance</strong></td>
<td>No state solicitation</td>
<td>Participants are not required to submit information regarding mitigation, monitoring, or other elements with their application. No certification program due to open enrollment process.</td>
<td>Open enrollment (first come, first serve) for projects of any duration. No certification processes. Review is done on a project-specific basis.</td>
<td>No additional protocol put in place to localize and/or evolve a program to local needs.</td>
</tr>
<tr>
<td><strong>State creates a grant or cooperative contracting program with the university cooperative extension service, conservation districts, or similar technical service providers, to offer technical assistance and help fully realize potential benefits of participation or mitigate agronomic impacts from the DM program to the participants.</strong></td>
<td>Annual grant funding for entities to identify &amp; develop project applications</td>
<td>Select mitigation &amp; monitoring elements must have been completed or substantially planned for application.</td>
<td>Annual RFP process without any certification process. Coordination with local governments, entities, others to facilitate a “guided market” approach aimed at ensuring a program aligns with specific goals and does not create unacceptable adverse impacts (see Economic Impacts and Local Governments and Agricultural Impacts sections).</td>
<td>Review of DM program put in place at specific milestone to consider successes, lessons learned, and stakeholder feedback. The review directly informs future program management across the state.</td>
</tr>
<tr>
<td><strong>State creates additional staff capacity responsible for assisting in fully realizing benefits of participation or mitigation of impacts from the DM program to the participants. Position manages a budget for technical assistance and mitigating impacts.</strong></td>
<td>State staff support &amp; grant funding for identifying &amp; developing project applications</td>
<td>Select mitigation &amp; monitoring elements must have been completed or substantially planned for application. A certification process ensures that project applications meet minimum requirements.</td>
<td>Annual RFP process with certification required. Clear protocol developed, incorporating coordination with local governments, entities, others, to establish a “guided market” approach designed to ensure the program aligns with specific goals and values and does not create unacceptable adverse impacts (see Economic Impacts and Local Governments and Agricultural Impacts sections).</td>
<td>Regular review of the DM program to consider successes, lessons learned, and stakeholder feedback. The review directly informs program management at local level. The review is public, transparent, and available for comment.</td>
</tr>
<tr>
<td><strong>Participants would likely need technical assistance in both navigating any potential DM in-take process and in selecting/implementing mitigation measures (e.g., cover cropping), providing the ability to grant or contract with third parties would likely reduce programs costs and address state capacity concerns.</strong></td>
<td></td>
<td></td>
<td></td>
<td>Depending on the level and scale at which programs evolve, there may be program differences (perceived as inequity) over time at the Basin levels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Local agencies / entities have different statutes, capacity, jurisdictions, resources, knowledge, and mobilization. Different basins can engage at different levels.</td>
</tr>
</tbody>
</table>

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Protecting Colorado Water
### Demand Management Framework

<table>
<thead>
<tr>
<th>Funding</th>
<th>Range of annual costs</th>
<th>DM Program Structure Matrix of Building Blocks</th>
<th>DRAFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Portfolio of funding sources should be considered</td>
<td>$3M - $16M</td>
<td>Example Cost Breakdown: 10% Program Costs 90% Compensation Cost</td>
<td>Payment offered may impact who is interested and able to participate, which may affect proportionality in terms of sectors and region. Compensation range reflects that some may be willing to participate at lower cost than others, and in some cases additional compensation may be available outside of state fund.</td>
</tr>
<tr>
<td>• Costs would be influenced by many factors including program design, scale, and participation</td>
<td>$5M - $20M</td>
<td>Example Cost Breakdown: 30% Program Costs 70% Compensation Cost</td>
<td></td>
</tr>
<tr>
<td>Funding Sources</td>
<td>Compensation paid by State through budget reallocation</td>
<td>Compensation paid by State through blend of multiple sources.</td>
<td></td>
</tr>
</tbody>
</table>

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EXHIBIT C

Literature Review
Demand Management Feasibility Investigation
Literature Review
July 2021

Consultant Team
CDR Associates
SGM
WestWater Research / Colorado College
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Introduction

In 2019, the consultant team was retained to conduct a literature review relating to topics that correlate with the workgroups convened pursuant to the 2019 Work Plan adopted by the Colorado Water Conservation Board. The consultant team was directed to conduct a literature review and to identify key data gaps in the literature to help inform Colorado’s Demand Management Feasibility Investigation.

The consultant team conducted the literature review, as well as additional research and interviews in some cases to inform their findings. This report summarizes the consultant team’s findings in the following topic areas:

- Agricultural Impacts
- Economic Impacts and Local Governments
- Education and Outreach
- Environmental Considerations
- Funding
- Monitoring and Verification

Each section of this report captures:

- A summary of the literature review
- A summary of work completed in addition to the literature review
- Key takeaways
- Data gaps

The Administration and Accounting and Law and Policy workgroups were not associated with the Consultant Team’s scopes and therefore not included in this report.
SECTION 1 – FEASIBILITY INVESTIGATION

BACKGROUND

Colorado is currently investigating the feasibility of a potential Demand Management (DM) program. Demand Management is the concept of temporary, voluntary, and compensated reductions in the consumptive use of water in the Upper Colorado River Basin. Each of the Upper Colorado River Basin States (also referred to as the Upper Division States) are conducting their own investigations to determine whether a potential program would be feasible from their states’ perspectives.

It is beyond the scope of this document to provide an overview of the minimum requirements to establish a Demand Management Program. However, more information relating to the Drought Contingency Plan (DCP) and associated agreements can be found at the following website: https://www.usbr.gov/dcp/index.html.

Investigation Background

The DM Feasibility Investigation (Investigation) follows direction of the CWCB Board in the Support and Policy Statements adopted in November 2018, the 2019 Work Plan (Step I), and the most recent Step II Work Plan approved in November 2020.

2019 Work Plan

The 2019 Work Plan (Step I) had three primary components:

1. Establish **workgroups** comprised of subject-matter experts and key Colorado River stakeholders, which were directed to meet publicly at least four times in Fiscal Year 2019-20, and to identify key threshold issues for board consideration
2. **Regional workshops** designed to facilitate the public discussion around DM and provide opportunities for CWCB staff updates on the Investigation; and
3. **Continued education and outreach**.

In addition, the CWCB Board directed staff to facilitate a literature review, completed by the Consultant Team.

The July 2020 Board meeting included a presentation of the summary of workgroup discussions and other work found at the following website:

https://dnrweblink.state.co.us/cweb/0/edoc/212695/8_Demand%20Management%20Update.pdf?searchid=a1d2b86a-6aab-4b53-b5dc-e3dd570b71fb

Step II Work Plan

Following the 2019 Work Plan, the Board adopted the Step II Work Plan, which contemplates exploration of potential program design options through development of a Framework. Figure 1 shows how information gained in the 2019 Work Plan has helped to inform the Framework, which shows a range of implementation options and program design options.
Figure 1. Demand Management Framework. The white highlighted tiles depict the Consultant Team’s focus workgroups.

Consultant Team
The DM Consultant Team is comprised of three consultant firms that were responsible for different tasks. Each team member reviewed information from the workgroups, conducted a comprehensive literature review, and some conducted additional analyses and interviews. A list of each team member and their specific focus-area(s) are:

- CDR
  - Education and Outreach (E&O)
- WestWater Research & Colorado College
  - Agricultural impacts
  - Economics and Local Governments
  - Funding
- SGM
  - Monitoring and Verification
  - Environmental Considerations
SECTION 2 – LITERATURE REVIEW OVERVIEW

A comprehensive list of the documents reviewed by the Consultant Team is included in Exhibit A. The following sections summarize the literature reviews and analyses of the Consultant Team. While compiling the individual components of the literature review, the Consultant Team identified interconnected issues that were relevant across specific workgroup topics. Pertinent areas of overlap were included in each applicable section.

SECTION 3 – AGRICULTURAL IMPACTS - LITERATURE REVIEW & ANALYSES

WestWater Research led the Agricultural Impacts literature review. The tasks associated with their work specifically included:

- Participation in the final meeting of the Agricultural Impacts workgroup as a listener.
- Compilation and review of past studies and research regarding the agricultural impacts of water conservation and reduced irrigation projects in the Western U.S.
- Analysis of design elements of a DM program as they relate to agricultural impacts.
- Identification of knowledge or data gaps in the ability to understand and evaluate agricultural impacts of a DM program and individual DM project activities in the agricultural sector.

This report section provides a summary of the literature review research findings.

Literature Review

There is an extensive body of knowledge and library of past research studies on the impacts of reduced irrigation activities. This section summarizes some high-level summary points from the literature review.

What we know

Demand management is the reduction of consumptive water use. The types of activities that can be undertaken in the agricultural sector to reduce consumptive water use are focused on reduced irrigation, which can take on a variety of forms such as: full-season fallowing, split-season fallowing, rotational fallowing, deficit irrigation, and crop switching. Each demand management activity will have different economic effects which depend upon the existing water use and crop and livestock production on a farm or ranch property. It is also important to distinguish demand management activities as those resulting in water conservation or conserved consumptive use, and not activities that result in greater water use efficiency which do not generally result in a reduction in consumptive use. The following two sections (below) expand upon the on-farm and off-farm impacts of agricultural demand management activities.

On-Farm Impacts

All demand management activities that may be implemented in the agricultural sector will reduce the irrigation water supply to the crop. Various types of irrigation reduction are possible for a given operation, but the primary (expected) methods are listed in the above paragraph. On-farm impacts of demand management activities are described in the points below.

- **Crop Yield.** In the Colorado agricultural sector, a reduction in consumptive water use is expected to result in a reduction of crop yield. This is the most direct impact of reduced irrigation and will result in
reduced income for the producer. The extent of yield reduction depends on the crop type, extent of water stress, and timing of water stress.

- **Crop Quality.** The quality of the harvested crop or grazed pasture is often influenced by reduced irrigation, with both positive and negative quality changes documented. Particularly for alfalfa and grass hay cut for sale, quality influences price and therefore has an impact on producer income.

- **Management Impacts.** A variety of management impacts exist for reduced irrigation activities. For hay and pasture fields, there are expected to be significant and multi-year management impacts from large-scale reduced irrigation. Hay fields and pastures can take several years to establish and reduced stand density and quality changes from reduced irrigation can result in disruptions to operations. For cattle ranchers, reduced pasture production can impact herd sizes, health, and genetics, particularly if supplemental feed is not easily acquired. These impacts are expected to scale down with reduced demand management activity and forage crops are unique in their ability to scale with various irrigation inputs. For annual crops, full-season fallowing and crop switching are the most likely activities to be implemented and disruptions to operations are expected to be less than multi-year forage crops. Also, specialty annual crops are likely to see greater operational and management impacts compared to commodity crops. One aspect that is universal is the negative impact to business relationships that comes with not producing (or producing less of) a crop or agricultural product, which forces customers (buyers) to look elsewhere. The temporary reduction in agricultural production could impact the long-term business plans for producers.

**Off-Farm Impacts**

The off-farm impacts of reduced irrigation and agricultural production that come with demand management can touch upon multiple economic sectors in a community. Additional information on off-farm impacts is provided in the Economics & Local Government section of this report. For this report section, off-farm impacts will focus only on the agricultural sector. Off-farm impacts are organized into the following three categories: (1) hydrologic, (2) economic, and (3) agronomic.

**Hydrologic Impacts**

Irrigation activities change the natural hydrologic flow patterns in a watershed. These changes are often documented in the engineering studies that accompany water right change of use applications in water court. Cessation or reduction of irrigation results in a similar but reversed change to flow patterns. For many areas in Colorado, irrigation has been occurring for well over a century, such that both natural and human reliance on the irrigation flow patterns has occurred. Reduced irrigation due to demand management may result in the following hydrologic impacts:

- Increased annual streamflow volumes due to reduced crop consumptive use and reduced losses in the conveyance and application systems. Annual volume increases are the underlying reason for conducting demand management activities.

- A shift in the timing of streamflow with increases during the spring snowmelt period and reductions during the late summer and fall seasons. This shift results from not holding back spring runoff flows through irrigation diversion and land application.

- Reduction in canal flows serving multiple producers, such as irrigation districts and mutual ditch companies, which can negatively impact canal operations. Less carriage or “push” water can create hydraulic problems on ditch systems, particularly affecting neighboring producers needing elevation head in the canals and those located at the tail-end of ditches.

- A shift in the timing and volume of streamflow may result from changes in groundwater pumping for irrigation. Aquifer water levels may also increase with reduced pumping across a large area.
**Economic Impacts**

The off-farm economic impacts are tied to the flows of money into agricultural production and out of agricultural sales. In other words, off-farm economic impacts relate to an agricultural producer’s typical spending habits and his/her modified spending habits under demand management. For production inputs, it is common to look at crop enterprise budgets developed by university extension offices to understand input types and values. The dollar value of operating costs (per acre) in the crop budget tables provide an indication of the relative economic impact resulting from reduced purchases by the producer because of demand management. For example, the 2018 budgets indicate that alfalfa hay has operating costs totaling $334 per acre or $86 per ton of hay production. Most of these operating costs will scale down with reduced production (yield) under demand management. Fixed costs identified in the crop budgets are not expected to change significantly under demand management activities.

The economic impact of modifications to spending that typically results from agricultural net income is more difficult to quantify and predict. Demand management activities will be compensated, and compensation amounts will need to be greater than the expected loss in agricultural net income to incentivize participation from agricultural producers. The off-farm economic impact from spending depends upon the source of compensation funds and whether the compensation income is spent locally or not. Limited data from two surveys indicate that approximately half to nearly all of the compensation payments will be spent locally.

The two money flows described above (inputs to and spending from agricultural production) are based on an owner-operator farm system. Many farms and ranches in Western Colorado have absentee landowners and are farmed by long-term lease tenants. An additional economic impact results to tenant farms if the landowner decides to participate in demand management activities without collaborating with the lease tenant. Demand management can disrupt the owner-tenant relationship because compensation payments to the owner may not be shared with the tenant, who will experience lost production and income. Landowners are incentivized to work with their lease tenants before participating in demand management activities to maintain a beneficial relationship with the tenant and to maintain market lease rates for the property.

**Agronomic Impacts**

The off-farm agronomic impacts relate to weeds, pests, and dust. A field that is participating in demand management can be a nuisance to neighboring fields due to these issues and therefore weed, pest, and dust management are often required as part of short-term and permanent fallowing plans. The extent of impact if such management actions are not taken is site dependent, based on field location, soil types, and localized infestation issues. Many of these agronomic impacts can be mitigated through cover crop establishment on fallowed fields and weed & pest controls on perennial forages.

The following illustration in Figure 3 provides a conceptual model for thinking about the agricultural impacts of demand management and captures many of the themes identified in the literature review.
Key Takeaways

- **Develop Educational Resources for Producers.** The CWCB may work with the Colorado Department of Agriculture, Colorado State University Extension, Natural Resource Conservation Service, and other land management groups to develop a guide for agricultural producers on how to apply for and conduct demand management activities while minimizing on-farm and off-farm impacts. The guide may be organized by crop type and demand management activity and may present best management practices (BMPs) for reduced irrigation. In addition, technical staff support may be funded and supported to assist producers in designing their demand management programs.

- **Ensure Contracting Aligns with Seasonal Cycles.** The CWCB may ensure that the application, review, and approval process is timed to align with when producers make decisions and investments each growing season. For example, project contracts by October 1 of the preceding year would be best, by January 1 of the activity year would be good, and by approximately March 1 of the activity year is
necessary. If a rolling application process is used, then a demand management program may build in sufficient time to allow the producer to adjust investments and business commitments prior to activity implementation.

- **Limit Demand Management Activity Duration.** The available research suggests that partial-season reduction in irrigation on perennial forage crops, particularly alfalfa, can be achieved without significant and lasting damage to the forage stand. Full-season falling can be conducted on perennial forages but is best suited to the latter years of a stand when re-establishment is planned. For annual crops, multiple continuous years of demand management will require diligent management of weeds and pests. In general, agricultural impacts are less if specific fields do not participate in complete full-season fallow activities for multiple consecutive years.

- **Develop a Guide for Compensation Calculations.** This review identifies multiple on-farm and off-farm elements that compensation payments may consider. The CWCB may develop a simple guidance worksheet that helps producers understand the various costs that are likely to be incurred in demand management activities. Compensation payments are expected to be customized by each producer and operation, but general guidelines may be helpful to ensure that producers do not experience unforeseen costs as part of the program.

- **Limit Concentration of Activities.** An important tool in program design to minimize significant off-farm impacts of demand management activities is to limit the geographic concentration of projects. Demand management will be structured as a voluntary program and therefore the program may place maximum limits on the number of irrigated acres approved for participation in demand management by river basin or county.

- **Mitigate Off-Farm Impacts.** This review identifies hydrologic, economic, and agronomic impacts from demand management activities that the program may be designed to minimize and/or mitigate, and the following mitigation elements may be considered by CWCB. It is difficult to quantify the off-farm impacts for each specific project such that a program may look to implement standardized policies and payments that will apply to all projects.

- **Hydrologic Impacts:** Hydrologic impacts to off-site water users can be evaluated using standard engineering techniques such as those applied in Substitute Water Supply Plan (SWSP) applications. In addition, the CWCB may consider including mitigation payments to the managing ditch company, irrigation district, or other water user association as part of project costs (as applicable) to mitigate impacts to canal operations on larger systems.

- **Economic Impacts:** The on-farm economic impacts are expected to be fully addressed through compensation payments determined by the producer. Program design may be more concerned with off-farm economic impacts, which can partly be minimized through project selection. Mitigation payments to local governments may be a consideration of a demand management program, and these payments can be used for grant or loan programs for qualifying businesses or other economic development initiatives. The need for mitigation payments to local governments has not been definitively determined based on our research. It will be difficult to customize economic impact mitigation for each project due to uncertainty and privacy concerns with producer finances, such that a program may look to develop mitigation approaches applied uniformly to certain categories of demand management projects.

- **Agronomic Impacts:** Both on-farm and off-farm agronomic impacts can be minimized with a requirement that all farms and ranches participating in demand management conduct weed and pest control measures as part of the proposed projects. For perennial forages, this is likely to consist of various integrated approaches to maintaining a healthy forage stand. For annual crops, this is likely to require the establishment of a cover crop. A program may consider a requirement for field management techniques, such as cover cropping and weed & pest controls. CWCB may consider the compilation and
development of information resources to assist producers in determining the best cover crop and weed & pest control measures for their operation.

Data Gaps

There are two types of data gaps associated with the assessment of agricultural impacts: (1) those currently present in evaluating the feasibility of a demand management program, and (2) those that are likely to be present when evaluating the impacts of specific demand management projects.

Data Gaps in Evaluating the Feasibility of Demand Management

No major data gaps concerning agricultural impacts are identified that would significantly benefit an evaluation of demand management feasibility. Significant resources have been applied in studying demand management concepts for the past 8 years. Additional studies that are presently underway or near completion will also add to our understanding of agricultural impacts. Most of the data gaps identified during our analysis were focused on other subject areas, such as quantification of consumptive use savings and facilitation of program activities. The following data gaps related to agricultural impacts were identified:

- The costs, benefits, and impacts of crop switching and deficit irrigating as demand management activities. Most of the research we reviewed focused on partial and full-season cessation of irrigation on perennial forage stands. There are several outstanding questions about how (and if) crop-switching and deficit irrigation would work as demand management activities.

- The impact of demand management activities on the availability of hay for livestock operations. Demand management activities at a small scale will result in reduced hay production locally may require local purchase of supplemental hay. At a large scale, there are uncertainties about how the hay market would respond and how hay availability would be impacted. It is possible that demand management impacts would mirror past drought periods with a similar reduction in hay production.

- Additional information on specific best management practices for managing a field that is experiencing reduced irrigation, particularly a full-season fallowing. It is well-established that cover crop establishment for annual crops and various weed and pest control measures for perennial forage crops are critical to mitigating impacts, but specific information on practices relevant to different Western Slope agricultural zones would be beneficial. This information could form the basis for guides assisting producers in project implementation.

Further research and information on the above topics would be beneficial but is not likely to significantly change the existing knowledge base on agricultural impacts of demand management activities. Agricultural impacts will often be site-specific. The CWCB may consider additional pilot projects to expand the diversity of project examples. The pilots are not expected to provide definitive findings but rather improved perspective on likely impacts.

Data Gaps in Quantifying Impacts of Specific Demand Management Projects

The agricultural impacts associated with specific demand management projects will need to be addressed as part of compensation payments and program design. On-farm impacts will be site specific and standardized impact metrics are unlikely to be useful across operations. Each producer may evaluate the expected impacts, with available information resources and technical assistance, and incorporate impacts into proposed compensation terms. Off-farm impacts are a greater concern for program design, and program design is anticipated to mitigate off-farm impacts more than information gaps addressed during the application and review process.
SECTION 4 – ECONOMICS & LOCAL GOVERNMENTS – LITERATURE REVIEW & ANALYSES

WestWater Research worked with Dr. Mark Smith from the Colorado College Economics Department to lead the Economics & Local Governments processes for the Investigation. The tasks associated with these efforts specifically included:

- Participation in the final meeting of the Economic Impacts & Local Governments workgroup as a listener.
- Compilation and review of past studies and research regarding the economic impacts of water conservation projects in the agricultural and municipal water use sectors.
- Analysis of design elements of a DM program as they relate to economic impacts.
- Identification of knowledge or data gaps in the ability to understand and evaluate economic impacts of a DM program and individual DM project activities in the agricultural and municipal sectors.
- Implementation of a survey of 19 municipal water providers in Colorado to better understand the municipal perspective on a DM program and anticipated DM activities.

Literature Review

There is an extensive body of knowledge and library of past research studies on the impacts of reduced irrigation activities, or demand management types of projects in the agricultural sector. There is also an extensive knowledge base on municipal water conservation; however, there is a general lack of information on voluntary, compensated, and temporary reduction of water use in the municipal sector. This section summarizes key points from the literature review on economic impacts.

What we know

To evaluate the economic impacts of demand management, it is necessary to consider both the direct impacts of reducing water use through demand management activities, and the indirect effects of reduced water use. These are often referred to as the primary and secondary impacts of an action or decision. An expanded discussion on the primary and secondary impacts of agricultural and municipal demand management is provided in subsequent sections. In brief they are:

- **Agricultural Demand Management.** Irrigation water is one of many inputs to crop production. Reduced water use results in less production as the primary impact of demand management. Secondary impacts reflect the other economic sectors that are affected by both reduced water use and reduced production. Backward-linked impacts result from the producer spending less on production inputs, such as seed, fertilizer, labor, and other items. Forward-linked impacts result from less harvested crop feeding into agri-businesses and other industries.

- **Municipal Demand Management.** Municipal water providers provide a service which allows their customers to live and work, enjoy a good quality of life (health, safety, and happiness), and allows businesses to function. Direct water uses in a municipal system are varied and diverse. Reduced water use results in less service, which can be reflected in various ways in a community as the primary impact depending on how both the water utility and individual customers choose to implement demand reduction. Secondary impacts reflect the nature of conservation activities and can include impacts to urban vegetation, property values, and wildlife habitat, among others. It is important to acknowledge
that there remains significant uncertainty on how demand management will be achieved in the municipal sector and if demand management activities will impact municipal water use customers.

**Economic Impacts of Reduced Agricultural Water Use**

The economic impact of reducing water use in the agricultural sector has been studied in many locations and was previously reviewed for the Colorado Water Bank Working Group and for the Colorado River District. In addition, there are active studies occurring on the West Slope that will aid in the understanding of secondary economic impacts. The secondary or regional economic impacts of demand management activities primarily depends on the type of agricultural operation (crop type, farm size, location) and the type of activity to reduce water use. This section provides a high-level summary of economic impacts from reduced agricultural water use. Additional information on agricultural impacts is provided in a separate review for the Agricultural Impacts in the preceding section of this report.

**Actions to Reduce Agricultural Water Use**

Demand management is the reduction of consumptive water use. The types of activities that can be undertaken to reduce consumptive water use are focused on reduced irrigation, which can take on a variety of forms such as: full-season fallowing, split-season fallowing, rotational fallowing, deficit irrigation, and crop switching. Each demand management activity will have different economic effects which depend upon the existing water use and crop and livestock production on a farm or ranch property. It is also important to distinguish demand management activities as those resulting in water conservation or conserved consumptive use, and not activities that result in greater water use efficiency which do not generally result in a reduction in consumptive use.

**Direct On-Farm Impacts**

All demand management activities that may be implemented in the agricultural sector will reduce the irrigation water supply to the crop and will be compensated. The net income to the producer under demand management is expected to be positive to motivate participation, with compensation payments exceeding the on-farm costs associated with demand management activities. Compensation payments need to consider the following on-farm impacts of demand management activities:

- **Reduced Crop Yield.** In the Colorado agricultural sector, a reduction in consumptive water use is expected to result in a reduction of crop yield. This is the most direct impact of reduced irrigation and will result in reduced income for the producer. The extent of yield reduction depends on the crop type, extent of water stress, and timing of water stress.

- **Modified Crop Quality.** The quality of the harvested crop or grazed pasture is often influenced by reduced irrigation, with both positive and negative quality changes documented. Particularly for alfalfa and grass hay cut for sale, quality influences price and therefore has an impact on producer income. For annual crops, reduced irrigation may result in an unmarketable product.

- **Negative Farm Management Impacts.** A variety of management impacts result from reduced irrigation and reduced production. One universal impact is the negative impact to business relationships that comes with not producing (or producing less of) a crop or agricultural product, which forces customers (buyers) to look elsewhere. The temporary reduction in agricultural production could impact the long-term business plans for producers. For hay and pasture fields, there are expected to be significant and multi-year management impacts. For cattle ranchers, reduced pasture production can impact herd sizes, health, and genetics. The on-farm impacts on cattle ranches are a function of location and scale of reduced production. In remote areas where access to supplemental hay is limited and associated replacement costs are high, the on-farm impact of reduced forage is expected to be relatively high. For areas that have access to hay for maintaining herds, a smaller on-farm impact is expected and can be estimated as the cost of acquiring supplemental hay for feed. For annual crops, full-season
fallowing and crop switching are the most likely activities to be implemented and disruptions to operations are expected to be less than multi-year forage crops.

- **Costs of Mitigation Activities.** In addition to changes in irrigation practices, the producer will likely need to invest in certain on-farm projects to reduce the off-farm impact of the demand management activities. These mitigation activities and projects are anticipated to include: (1) cover crop establishment on fallowed fields, (2) new weed and pest control measures on perennial forage stands, and (3) replacement water sources to prevent injury to downstream water users.

The positive net income to the producer results in positive on-farm economic impacts of demand management. An important point is that positive on-farm impacts will only result if the compensation paid for demand management activities exceeds the combined cost of the on-farm impacts listed above. A premium above these on-farm costs is expected to motivate participation and to address risk and uncertainty to agricultural operations.

**Off-Farm Impacts**

The off-farm impacts of reduced irrigation and agricultural production that come with demand management can touch upon multiple economic sectors in a community. Off-farm impacts can also be positive and negative depending on the economic sector and location. For this review, off-farm impacts are divided into two broad categories below.

**Costs / Negative Impacts**

Secondary economic effects of reduced irrigation involve all sectors of the regional economy that directly or indirectly transact with irrigated agriculture. Some of the secondary impacts considered likely to occur include:

- Loss in the value of output, personal income, and employment resulting from reduced spending in industries that provide inputs and support services to agriculture (referred to as backward-linked industries),
- Loss of output, personal income, and employment in sectors that use agricultural outputs as inputs to production (referred to as forward-linked industries),
- Effects caused by changes in net income spending in the region, and
- Changes in local tax revenues.

When agricultural production declines in a region, the reduced crop production results in a lower expenditure on agricultural inputs (first round effect). As a result, workers, stores, and support services directly related to agriculture reduce spending within the economy (second round effect) and the businesses that they buy from reduce their spending (third round effect), and so on. In addition, reduced agricultural production can lead to reduced activity for agri-businesses that rely on harvested crop inputs, resulting in further economic loss. These impacts are sometimes referred to as the multiplier effect.

The results of the recent 2020 economic study of demand management in Western Colorado indicate an indirect effect multiplier of approximately 0.34 and an induced effect multiplier of approximately 0.40, resulting in a total backward-linked economic impact equal to approximately 0.74, equal to 74% of reduced agricultural on-farm production. Additional forward-linked effects on the livestock industry were estimated to have a multiplier of 0.3, or 30% of direct agricultural output. In total, the secondary economic impacts of demand management were estimated to have a multiplier of 1.04 relative to the lost agricultural production value. This study indicates that secondary economic impacts of demand management are roughly equal to the primary on-farm economic impacts of lost production value.

The impact on businesses and economic sectors that utilize farm output (forward-linked industries) depends largely on the crop type and presence of food products and food processing industries in the region. For
most of the Western Slope, irrigation is practiced producing forage crops in support of the livestock industry. Hay trucking and slaughter facilities are two forward-linked industries that may be impacted by reduced forage production. The 2020 economic analysis of demand management indicated potential forward-linked impacts equal to approximately 30% of lost agricultural output.

The economic impact of modifications to spending that typically results from agricultural net income is more difficult to quantify and predict. Demand management activities will be compensated, and compensation amounts will need to be greater than the expected loss in agricultural net income to incentivize participation from agricultural producers. The off-farm economic impact from spending depends upon the source of compensation funds and whether the compensation income is spent locally or not. The 2020 economic analysis of demand management in Western Colorado indicated that compensation payments may or may not offset secondary economic impacts, depending on the extent to which payments are spent locally within the region.

The two money flows described above (inputs to and spending from agricultural production) are based on an owner-operator farm system. Many farms and ranches in Western Colorado have absentee landowners and are farmed by long-term lease tenants. An additional negative impact results to tenant farms if the landowner decides to participate in demand management activities without collaborating with the lease tenant. Demand management can disrupt the owner-tenant relationship because compensation payments to the owner may not be shared with the tenant, who will experience lost production and income. Landowners are incentivized to work with their lease tenants before participating in demand management activities to maintain a beneficial relationship with the tenant and to maintain market lease rates for the property.

In addition to the negative effects associated with changes to agricultural production, there are several environmental and recreational impacts to consider that result from a change in the timing of water flows. Irrigation, and specifically flood irrigation from surface water sources, slows the movement of water across the landscape through soil infiltration and return flows back to the stream channel. The result is that snowmelt runoff peak flows are reduced through irrigation diversion and late-summer low-flows are increased from return flows. The long-term presence of irrigated agriculture across much of the Western Slope has resulted in an environment and recreational economies that are built on this altered hydrology. Modifying the timing and magnitude of streamflow may cause additional negative economic impacts. In particular, the following are noted:

- **Wetland and Wet Meadow Habitat.** Many irrigation ditch and canal systems have wetlands and wet meadow habitat that have been formed by irrigation practices. In addition, the canals may also provide important riparian habitat. The inefficiency of surface conveyance and flood irrigation often results in habitat development down-gradient from irrigated parcels and ditch systems. A reduction in irrigation could result in negative impacts to these habitats and environmental resources. Wetland mitigation bank credits on the Western Slope have varied values depending on location and type of wetland credit.

- **Decreased Late-Season Flows for Recreational Activities.** Water-based recreation activities, and particularly fishing and boating, could be negatively impacted by a reduction in late-season streamflow. Negative effects are only anticipated to be noticeable on smaller tributary creek and river systems. The effects are also dependent on the relative scale of reduced irrigation and streamflow impact. The methods and concepts presented in previous research for recreational benefits of improved streamflow could be modified to consider the recreational costs of reduced late-season flows.

**Benefits / Positive Impacts**

The possible economic benefits of demand management activities are derived from two sources: (1) higher net income to the producer resulting in greater spending, and (2) modified hydrology resulting in greater streamflow annual volume and changes to streamflow timing. In addition, previous research on off-farm benefits identified possible salinity control benefits resulting from not leaching salts in the soil profile.
The benefit of higher net income to agricultural producers has an uncertain benefit to the surrounding economy that is largely dependent on how the additional income is spent. As stated previously, limited survey data indicate that past water conservation projects have seen half to nearly all of the compensation payments spent locally. The off-farm benefits of compensation spending may be significantly reduced if projects have absentee landowners located out of the local region. The temporary nature of demand management activities helps to ensure that project participants will maintain their properties and agricultural operations, which helps to ensure local benefit of the compensation payments.

The off-farm benefits of modified hydrology are specific to a location and project, as modified hydrology may also result in off-farm costs (see above). Downstream of the project site, annual streamflow volume will be greater based on the demand management activities. The timing and magnitude of increased streamflow is critical to understanding whether a benefit results from water conservation activities. Previous research on two System Conservation Pilot Program (SCPP) projects in Colorado and Wyoming found that these two water conservation projects resulted in nominal off-farm benefits besides salinity control. The research does indicate that off-farm benefits are expected to increase with larger volumes of water conservation activity. The following points summarize benefit concepts by various end uses:

- **Recreation.** The recreational benefit of modified hydrology is most likely to impact fishing and boating activity. The benefit can be estimated as a combination of: (1) the increase in number of visitor days, and/or (2) the increased value (enjoyment) of each visitor day. For both boating and fishing, the timing of additional streamflow needs to indicate a significant improvement to result in a measurable benefit.

- **Environment.** The environmental benefit is typically evaluated based on the presence of threatened or endangered species. The benefit may represent reduced recovery program costs or societal benefits of improved species habitat. Similar to recreation, environmental benefits are expected to be most significant if the modified hydrology represents a significant improvement in streamflow and the timing of flow increase is critical to realizing an environmental benefit.

- **Hydropower.** Run of river hydropower facilities are likely to see a direct benefit of larger streamflow volume as long as diversion capacity is not a limiting factor. Dam hydropower facilities are less likely to see a hydropower benefit unless the modified hydrology results in significant flow volume increases or the timing of flow increase occurs outside of the snowmelt period.

- **Salinity.** Reduced irrigation results in less deep percolation below the crop root zone and less leaching of salts in the soil profile into subsurface flows. In areas of the Colorado River Basin where active salinity reduction projects are in place, the benefit of reduced leaching can be significant.

- **Municipal.** Municipalities may enjoy benefits of reduced risk of Compact administration, since the goal of a potential Demand Management program would be to ensure ongoing compliance by the Upper Division States with the Colorado River Compact. This benefit is significant and is a primary driver of current efforts.

**Mitigation of Negative Economic Impacts**

Mitigation of negative economic impacts associated with water supply development projects and large water transfers is most often accomplished through federal and state environmental permits and is usually motivated by legal requirements to provide mitigation. For small and localized water transfers from agriculture to other uses, mitigation is not typically a legal requirement besides ensuring non-injury to other water right holders. Water right transfers often have negative economic impacts that are not mitigated. For a demand management program, mitigation may be evaluated and categorized based on on-farm and off-farm impacts. On-farm economic impacts are expected to be fully mitigated through compensation payments defined by the producer. Program design may be more concerned with off-farm impacts. Potential off-farm economic mitigation measures include:
• **Mitigation Payments to the Affected Community.** Mitigation payments, in addition to producer compensation, could be a component of a demand management program. The payments would be utilized for local community investments, which might take the form of grant and loan programs administered by county or other local governments, capital investment in specific economic development projects or infrastructure needs, and/or direct payments to local governments. Previous research identified three water transfer programs that provided explicit mitigation payments to local communities, ranging from 4% to 30% of producer compensation. These mitigation payments were provided primarily as a lump sum payment at the start of a multi-year water transfer program which probably would not be applicable under a demand management program. Two challenges with mitigation payments have been identified: (1) distributional challenges caused by mitigation efforts not targeting the most impacted sectors of the local economy, and (2) geographic challenges associated with dispersed project sites and impacts across the West Slope. These challenges may be addressed through a combination of mitigation payment investment rules and local oversight of mitigation payment spending.

• **Alternative Cropping & Land Uses on Participating Properties.** Creating an economic use of the participating lands during the period of demand management activities is a possible mitigation tool. Alternative cropping with a low water use requirement is a possibility but will reduce the conserved consumptive use benefits of demand management activities. Dryland grazing is a widely applicable alternative land use that may provide some limited economic activity. The types of alternative land uses are likely to be site-specific but investments could be made on properties to generate alternative economic activity, particularly if the property is intending to conduct demand management activities over multiple years.

• **Compensation Payments as Mitigation.** Most of the water transfer programs previously reviewed did not include any additional mitigation payments or policies to offset negative secondary (off-farm) impacts. Many programs may consider the compensation payments to the producer to be sufficient mitigation of local economic impacts. As stated previously, the suitability of compensation payments as mitigation for off-farm impacts is directly tied to the spending habits of producers in demand management years.

The economic effects of modified hydrology due to demand management activities are previously noted as potentially: (1) environmental impact of lost wetland and riparian habitat, and (2) recreational impact of modified streamflow for boating and fishing activities.

**Economic Impacts of Reduced Municipal Water Use**

This section first provides examples of reduced water use in the municipal sector, followed by a discussion of direct and indirect economic impacts of municipal conservation activities. There remains uncertainty as to how municipal demand management will be quantified, particularly for trans-basin diversions diverting from the Colorado River Basin to the Front Range. It is possible that a municipal utility could accomplish verifiable demand management through operations and management without requiring a modification in water use at the customer level. For this analysis, municipal demand management is evaluated assuming that water use reductions occur. The economic impacts described in this section provide context but may or may not be applicable to demand management in the municipal sector depending on how a potential program gets vetted and what demand management activities are implemented.

**Context of Municipal Water Conservation in Colorado**

Over the past 30 years both the Federal government and State of Colorado have enacted laws that have impacted both water conservation and water use efficiency for municipal water providers. These laws now guide municipal water use in three critical areas: (1) plumbing fixtures, (2) landscaping and outdoor water use, and (3) motivating municipal planning for efficient water use and effective drought response.
Context is critical in understanding the operating space for future efficiency and conservation efforts in the municipal sector. Past municipal water efficiency efforts have significantly reduced per capita water consumption. Colorado statewide municipal water use rate (per person) has declined from about 240 gallons, per-capita, per-day (gpcd) in 2000 to about 160 gpcd in 2015. In the future, these municipal water conservation savings and efficiency benefits have become “hardened” into baseline consumption, such that they will likely not be available to provide for future demand management. The greatest potential for additional conservation and demand reduction is expected to be in the following five areas: (1) further limiting water use in residential and commercial landscaping, (2) extending low-flow plumbing fixture requirements into older homes and commercial properties, (3) extending efficiency requirements to smaller water providers, (4) adopting smart metering to reduce losses and inefficiencies in the distribution system and in-home, and (5) modifying water use habits and practices.

**Actions to Reduce Municipal Water Use**

Actions to reduce municipal water use have often been divided into two categories: (1) water conservation and (2) water use efficiency. Water conservation temporarily reduces water use in response to drought or supply disruption and may be scaled back once the supply disruption ends. Water use efficiency, on the other hand, aims at maximizing the water end use benefit while minimizing waste, and efficiency practices often continue indefinitely and may be expanded. Both water conservation and water use efficiency can be achieved by policies and programs designed by municipal water providers.

Cities such as Denver, Fort Collins, and Colorado Springs, where water conservation and efficiency programs have existed for over 20 years, have seen a significant reduction in per capita water use through implementing many practices. These actions have also resulted in demand hardening. The implications for hardened water demand and past conservation efforts might be considered when establishing a baseline municipal water use for demand management. In evaluating and selecting conservation and efficiency activities, municipalities have a range of criteria that could be applied.

Municipalities also have the option to make conservation activities mandatory through policy changes. Research shows that mandatory strategies yield more water savings than those that are voluntary. However, if well implemented and tied to attractive rebates, voluntary options can be effective as well.

**Direct Economic Impacts**

Water conservation programs directly impact water providers in three ways:

- **Revenue loss from selling less water.** Water supply has high fixed costs. Dams, reservoirs, tunnels, pipelines, treatment plants and distribution systems are all major capital investments. Once these investments have been made, the variable cost of moving an added cubic foot through the system is low. Given these high capital costs, it is more cost-efficient to have one provider serving a broad geographic area to distribute these costs over a larger customer base. Therefore, water utilities are either municipally owned or regulated by a water district. Municipal water providers have several ways of recovering their fixed cost including tap fees for new construction, monthly service charges on existing customers, and the unit charge on the volume used (water rate). Where fixed costs are covered by tap fees and the monthly service charge, water conservation activities will have less impact on utility revenues. If these costs are allocated to the water rate, conservation may result in reduced operating revenue. Rates are often adjusted periodically to offset the impact of water conservation, and to respond to inflation and other cost increases associated with capital projects and operations.

- **Costs of running conservation programs.** Program costs will vary significantly with the size of the provider and the ambition of the conservation program. Water conservation programs range from public awareness and education to subsidies for turf removal and replacing landscape irrigation. Cost efficiency requires that suppliers begin with the lowest unit cost activities. Equity implies that water conservation
opportunities are not denied to low-income households that may lack the resources to adopt more efficient water use practices.

- **Impacts on wastewater treatment.** Wastewater treatment is affected when the influent flow to the treatment plant becomes more concentrated and thus more difficult to treat to the desired effluent standard. The problem is particularly acute when effluent is reused in either potable or non-potable systems.

These direct economic impacts may be a component of the compensation or benefit sought by an individual municipal water utility seeking to conduct demand management (water use reduction) activities. Like the agricultural sector, the balance of compensation (or direct benefit) versus direct economic impact will determine the overall net impact to municipal water utilities.

### Indirect Economic Impacts

Indirect impacts on urban areas are largely livability and quality of life effects. The business effects are likely to be somewhat isolated as relatively few commercial activities depend upon water. It is possible that landscaping businesses will see a decline, and heavy water use industries may struggle if pricing is used to encourage conservation. The livability impacts may be considerable and widespread, especially if conservation actions result in the die off of established trees and the desolation of parks and other urban green spaces. Unlike the indirect impacts in agriculture, these municipal impacts are not anticipated to result in reduced commercial activity and reduced profits. Nevertheless, Colorado attracts and retains both people and industry because it is a desirable place to live, both for its abundant natural beauty as well as its pleasant towns and cities with a high quality of life. These attributes that attract and retain economic activity are put at risk if significant municipal water conservation activities were to occur. A municipal water utility may incorporate some indirect impacts into its proposed compensation for conducting demand management activities, particularly those impacts that are within municipal control.

### Mitigating Negative Economic Impacts

Demand management in the municipal sector may require new levels of both conservation and efficiency, and these activities may result in economic impacts as described above. Direct economic impacts to the municipal utility are expected to be evaluated by the utility and incorporated into any requested compensation to conduct demand management. Indirect impacts may or may not be included as part of the requested compensation and are a greater concern for demand management program administration and design. The following mitigation activities are targeted at both direct and indirect impacts of municipal demand management activities.

- **Colorado’s Water Plan.** The state’s 2015 water plan, “...sets forth the measurable objectives, goals, and actions by which Colorado will address its projected future water needs and measure its progress - all built on our shared values.” The plan was developed to address supply gaps resulting from a possible doubling of the state’s population by 2050. Section 6.3 identifies many actions under (1) municipal water conservation, (2) water reuse, (3) land use, (4) agricultural conservation, efficiency, and reuse, (5) self-supplied industrial conservation and reuse, and (6) state agency conservation. The conservation and efficiency measures identified in the Plan provide a foundation for future demand management efforts.

- **Regionalization.** Front Range municipalities could examine the potential benefits of regionalizing supplies to improve reliability by taking advantage of a more diversified portfolio of water supplies. It is possible that future droughts will differentially impact streamflow conditions across the state. In addition, some metro Denver suppliers are primarily dependent upon Denver Basin groundwater. By jointly managing both surface and groundwater supplies, cooperating utilities may be able to firm up supplies under demand management.
- **Water conservation extension programs.** Current CWCB water conservation guidelines apply only to utilities that serve over 6,000 accounts. The state’s largest suppliers have already instituted a range of programs to conserve water. The state could fund extension programs that enable large utilities to provide the same programs to smaller utilities which could take advantage of conservation options that are both proven and lowest cost. For example, smart meters could be installed by small utilities who then contract for data support from a utility that has already set up a system. An extension program represents a knowledge transfer to smaller water utilities to help ensure that demand management activities are effective and cost-efficient.

- **Conservation pricing.** Raising prices and/or implementing an increasing block rate structure on customers are both used to reduce water demand. In contrast to mandatory water restrictions, the effectiveness of using higher prices to reduce demand is less certain. Conservation pricing is also utilized to respond to successful water conservation to cover fixed costs with less water sales. Raising prices has a disproportional impact on low-income households. When using conservation pricing, utilities may establish low-income assistance programs and consider rebates for additional revenue to avoid these negative impacts. Approximately 85 percent of Front Range and eastern slope water providers, and 77 percent of western slope water providers, have such tiered rate structures.

- **Xeriscape assistance programs.** Municipal demand management is expected to fall heavily on outdoor water uses by residences, businesses, and institutions. Large-scale water use reduction may involve turf removal and many indirect impacts results from the loss of tress and green spaces. Some of these indirect impacts can be mitigated by replacing turf with xeriscape plants and landscaping. Several Colorado communities provide education and financial assistance for water users to modify their landscaping to a xeriscape design.

- **Urban Forestry.** Many indirect impacts from water conservation result from loss of trees and urban green spaces that provide many community benefits that enhance the livability of towns and cities. Demand management may provide options for cities to maintain existing trees and even expand urban forests into low-income neighborhoods that often have fewer trees. Tree canopy mapping often reflects income inequality and Colorado is no exception. The tree canopy in Colorado Springs neighborhoods, for instance, ranges from less than 5% in low-income to more than 50% in high-income neighborhoods. Planting trees in low-income neighborhoods would both reduce inequality and increase air and water quality benefits for all. Targeted investments for tree health, such as direct irrigation and fertilization, is a way to reduce stress on the urban trees.

- **Turf Conversion in Parks.** Demand management may involve redesign of urban parks to reduce water use. Vast green spaces may give way to more selective green spaces, artificial turf on playing fields, and more extensive use of xeriscape. In addition, continued irrigation of trees in parks when turf is removed is an important consideration. In general, municipalities may consider maintaining parks and outdoor green spaces even if residential and commercial irrigation is reduced because of the community benefits.

- **Project vs. Programmatic Demand Management.** A demand management program may anticipate supporting both project (i.e., single entity) as well as programmatic (e.g. universal smart metering) as strategies for creating conserved consumptive use. Establishing a baseline, monitoring, and verifying savings generated over many users will be critical for any programmatic approach.

- **Water - Energy Nexus.** Colorado has 25 operating thermal power plants that all require water for cooling. Retiring these plants and replacing them with wind and solar farms will reduce both consumptive water uses and greenhouse gas emissions – a double-dividend.
Additional Work Completed

WestWater performed interviews with municipalities across the State to investigate demand management related to municipal operations. A memorandum summarizing municipal interviews is available upon request.

Key Takeaways

These key considerations are based on the literature review summarized in previous sections. The following activities and policy elements are key considerations related to the specific purpose of reducing and/or mitigating economic impacts of demand management activities.

- **Mitigation Payments in Program Design.** The feasibility investigation may consider a program that includes mitigation payments to offset indirect economic impacts, particularly for agricultural demand management projects. Mitigation funding requirements might be established as part of program design and should likely be standardized across all projects. Standard mitigation payments would avoid the process of evaluating economic impacts of each proposed project and will provide certainty to the program participants and funders. The mitigation funding might be given to local governments to make local decisions on spending the money.

- **Ensure that the Program is Voluntary.** From an economic perspective, it is important that demand management remain a voluntary program without any requirement or mandate to participate and reduce water use. In both the agricultural and municipal sectors, there is a large amount of diversity in risk, ability to pay, direct and indirect impacts, and required compensation related to demand management. A voluntary program ensures that significant direct economic impacts do not occur to specific water users and communities.

- **Include Environmental and Recreational Benefits and Impacts in Project Review.** The process of soliciting and evaluating demand management projects is not yet determined. The CWCB might consider some form of analysis and reporting on the environmental and recreational benefits of proposed demand management projects as part of the review process. It is important to distinguish that this type of analysis is not part of informing mitigation requirements but instead for supporting projects that may provide a specific benefit.

- **Leverage Other Funding Sources.** Reduced water use may result in other benefits and there may be other programs established to provide funding resources for reducing water use and/or realizing these indirect benefits. A demand management program could look to develop and publish (online) a reference list of complementary funding programs and sources for consideration by project participants. Example and possible funding sources include the Environmental Protection Agency (EPA), U.S. Bureau of Reclamation (USBR), Natural Resources Conservation Service (NRCS), and U.S. Fish and Wildlife Service (USFWS).

- **Indirect Impacts of Reduced Municipal Water Use.** Our literature review did not provide definitive findings on the scope or scale of indirect impacts related to reduced municipal water use, particularly for: (1) environmental impacts of reduced outdoor water use, (2) social and community impacts of reduced outdoor water use, and (3) equity implications of reduced water use. The CWCB may consider developing a work plan to better understand these impacts. Consider potential benefits and impacts for east slope agriculture (supplemental sources of water).
Data Gaps

This section provides a discussion of two types of data gaps: (1) those currently present in evaluating the feasibility of a demand management program, and (2) those that are likely to be present when evaluating the impacts of specific demand management projects.

Data Gaps in Evaluating the Economic Feasibility of Demand Management

The economic feasibility of demand management can be better evaluated when demand management activities are better defined, particularly for the municipal sector. Most of the data gaps identified during our analysis were focused on other subject areas, such as definition of qualifying activities and program administration. The following data gaps related to economic impacts were identified:

Agricultural Sector

- Further research may consider the definition of standard economic multipliers specific to West Slope agriculture for informing mitigation payments. Further work could be done to generate one or more standard multipliers which would be used to define mitigation payments for agricultural demand management projects. These multipliers may be used to determine the full costs of each project and make equivalent comparisons between projects. The 2020 economic analysis for Western Colorado provides an information basis to define these multipliers.
- Additional data gaps are identified in the Agricultural Impacts section of this report that should be incorporated into this economic review.

Municipal Sector

- Further research may be done to better define municipal demand management activities. The impacts of municipal demand management activities stem from a better definition of those activities, and impacts are difficult to evaluate without this definition. The municipal sector may not have to or be willing to reduce end uses of water to achieve demand management.
- Additional research could evaluate the ability to reduce municipal water use. It is expected that the municipal utilities will propose to conduct demand management activities based on system-specific analysis. In terms of understanding feasibility of demand management, the state might consider an analysis looking at the broad feasibility of additional water use reductions in the municipal sector. The following elements might be included in such an analysis:
  - Evaluating the existing water efficiency practices across the state to identify the potential water savings from: (a) retrofitting pre-compliance homes and commercial buildings with low flow fixtures; (b) extending proven water efficiency programs into smaller water providers; (c) reducing non-revenue water lost through systems leakage. Such efforts can generate consistent, long-term water savings.
  - Evaluating the effectiveness and experience of Colorado water providers with water pricing strategies. Water providers have used a range of conservation pricing strategies to reduce water use. These include tiered rates, seasonal pricing, conservation surcharges, and tap fees. These strategies could be assessed for effectiveness, revenue impact and fairness. Water managers may find the experience of other utilities, within Colorado and with which they are likely to have some familiarity, more compelling than experience from other states and countries.
  - Evaluating the impacts of reduced outdoor watering. The major savings in municipal water uses will likely come from reductions in outdoor water use. Practices to reduce outdoor water use have been widely applied, but we have limited understanding of the impacts on urban livability and options to mitigate these impacts.
Further evaluate the indirect impacts of reduced municipal water use. This literature review provides information on past research related to the indirect impacts of reduced water use in the municipal sector. Our review indicates that more information is needed on the impacts of water efficiency and conservation efforts on inequality and on environmental resources beyond urban landscaping. Academic papers and utility reports note the importance of these indirect impacts; however, studies that attempt to measure or quantify such impacts have not been identified.

Data Gaps in Evaluating Economic Impacts of Specific Demand Management Project

The economic impacts associated with specific demand management projects will need to be addressed as part of compensation payments and program design. Direct impacts will be site specific for farm operations and municipal water systems. Each demand management applicant or participant is likely to evaluate the expected direct impacts, with available information resources and technical assistance, and incorporate impacts into proposed compensation terms. Indirect impacts are a greater concern for program design, and program design is anticipated to mitigate indirect impacts more than information gaps that are addressed during the application and review process. Project-specific economic analyses will be difficult to conduct due to cost and timing.
SEC 5 – EDUCATION AND OUTREACH – LITERATURE REVIEW & ANALYSES

CDR Associates led the Education and Outreach (E&O) and Statewide Engagement processes for the Investigation. The tasks associated with these efforts specifically included:

- Participating in the Education and Outreach workgroup meetings.
- Conducting a literature review that analyzed and summarized the existing knowledge of education and outreach strategies, lessons learned, and data gaps.
- Conducting program manager interviews that collected first-hand data on education and outreach for existing water conservation and efficiency programs.
- Supporting CWCB with Statewide Engagement planning and facilitation.
- Developing a summary of the key considerations and practical education and outreach strategies relating to a potential DM program that integrates the findings from the literature review and feedback from the Education and Outreach workgroup and other key stakeholders.

The education and outreach findings detailed in this report align with the CWCB’s additional policy goal statements to work with water rights holders and stakeholders in determining the feasibility of DM in Colorado:

6. Prioritize avoidance of disproportionate negative economic or environmental impacts to any single subbasin or region within Colorado while protecting the legal rights of water rights holders. The Board will work with water rights holders and stakeholders to assess the feasibility of and promote mechanisms for obtaining roughly proportionate contributions of water consumptively used from the Colorado River System to a Demand Management program over a given timeframe from participants on each side of the Continental Divide.

8. Consider and be fully informed by the input and considerations of water rights holders and stakeholders potentially impacted by application of demand management strategies within Colorado, and institute a public review process for any such proposed demand management program.

Literature Review

CDR’s literature review aimed to:

- Identify education and outreach lessons learned from similar policy efforts.
- Develop key considerations and/or engagement toolkit (strategies and tactics) for consideration in next steps of the Investigation.
- Identify decision milestones and tradeoffs for future consideration.

The key findings informed the E&O goals and parameters for a potential DM program, as well as considerations linked to messaging, trust building, and program localization / evolution.

The literature review evaluation examined the literature through the following thematic questions:

- What would motivate people to participate in the Demand Management program?
- What components of a DM program excite potential participants? How do you build support for change? How do you build interest in a program like this?
- What disincentivizes people?
- How do you build trust in a low-trust environment? How do you build regional cooperation in a context of competition?
- Who was the target audience of the program? How familiar were people / do people need to be before adopting the program? How was the program messaged or marketed? How do you tailor messages (benefits, impacts) to different audiences?

Overall, the literature was vague in specific detail around E&O efforts, although general themes have proved to be informative for the exploration of the feasibility of a hypothetical DM framework. The literature reviewed for education and outreach themes included:

- Summary of “Lessons Learned” from UCRC’s “Final Report: Colorado River System Conservation Pilot Program in the Upper Colorado River Basin”, by UCRC & Wilson Water Group, 2018
- Lessons Learned from the System Conservation Partnership Program, by The Nature Conservancy, February 2016
- GVWUA Final Report on the Conserved Consumptive Use Pilot Projects, by GVWUA and J-U-B Engineers, 2019
- TNC Briefing Paper: Upper Basin Demand Management and Water Banking, by The Nature Conservancy, 2019
- Exploring Perceptions of a Voluntary Agricultural Water Conservation Program on the Western Slope of Colorado by MacIlroy, Colorado State University, 2019
- Towards Regional Sustainability Assessment Utilizing Community Based Participatory Research, Sustainability Indicators, and Future Scenario Modeling, by Dubinsky, CU Denver, 2019
- Urban Water Conservation in the Sacramento, California Region during the 2014-2016 Drought, by Talbot, UC Davis, 2019
- Appendix C: 2018 System Conservation Pilot Program Update, by the Upper Colorado River Commission, 2018

**What we know**

Education, outreach, and engagement is critical to the success of a program. The most perfectly designed program, without willing participants, will not accomplish the goals of a demand management program.

There is no one-size-fits-all solution: we know that each of Colorado’s distinct sub-basins will need a contextualized approach, and an approach that keeps Colorado’s residents at the heart of the solution.

Based upon the literature review and program manager interviews, the overarching E&O principles for designing and implementing a demand management program are:

- Engagement to develop and tailor the program to community needs: outreach prior to and during the exploration into the feasibility of a program to ensure it represents the potential participants.
- Motivate participation in a demand management program: following the establishment of a demand management program, marketing and outreach to program participants may align with local values, motivations to apply, and messages that resonate with community identities.
• Water education on broad policy impacts and benefits of the program: to inform and educate the broader public on the risks of inaction and the statewide benefits that justify the State’s investment in a demand management program.

Additional Work Completed

Program Manager Interviews

Program manager interviews were conducted by CDR Associates following the literature review to fill in data gaps around education and outreach. In particular, the goal was to supplement the Investigation with information about how water conservation programs undertake education, outreach, communication, and marketing efforts.

Program Managers Interviewed

Program managers were selected because of their experience designing, managing, and/or evolving water efficiency programs for agricultural or municipal audiences. Program managers were from organizations including:

• Palo Verde Irrigation District
• San Luis Valley Subdistrict 1
• Colorado River Water Conservation District
• Central Platte Natural Resource District (NRD)
• North Platte NRD
• Tri-Basin NRD
• Twin Platte NRD
• Idaho Snake River
• NRCS CREP Programs
• Metropolitan Fallowing Program
• Denver Water
• City of Westminster
• Republic River Conservation District
• Resource Central

Methodology / Interview Approach

The goal of the interviews was to better understand successes, lessons learned, and techniques linked to education and outreach on water conservation programs. Interviewees were promised that quotes and comments would not be directly attributed to them. Meetings were not recorded to encourage candidness. The interviews ran approximately 45 to 60 minutes via Zoom or telephone.

The following questions guided the interview discussions:

1. Please describe your conservation / efficiency program.
2. Was extensive outreach conducted before the program was established?
3. If the program was voluntary, what motivated participation in the demand management program?
4. What were the general outreach strategies and specific tactics implemented?
5. What would you have done differently if you had a chance?
6. Who else would you recommend we speak with for more information?

Interview Key Themes

The following description of seven key themes represent topics and sentiments heard in two or more interviews. The intent is to identify and describe themes for further discussion with stakeholders, and not to prescribe solutions or remedies. The rural designation includes agriculture and small municipal perspectives. The urban perspective captures dense areas.

Rural Themes
1. Localization and evolution of the program
2. Proactive and hardcopy outreach
3. Trust-building with stakeholders
4. Inclusion in process

Localization and evolution of the program

A program that remains reflective of community needs results in higher participation. Several of the interviewees reported that by engaging with farmers about their needs, the co-developed program led to participation that exceeded expectations. One interviewee from the San Luis Valley takes a farm-by-farm approach to ask, “What do you need? What isn’t good about the current program? What works for you?” By applying a variety of soft skills, the interviewee links input to programs. This approach is evident in the San Luis Valley’s half-usage pilot program. The program started with discussions with farmers, grew with Board input, and then our interviewee aligned the concept with timelines and budgets. The pilot was originally budgeted at $120,000; it surpassed that in the first week of enrollment, and in total a pool of $1,000,000 funded pilot participation.

Proactive and hardcopy outreach

Whereas some communities are familiar and comfortable with digital outreach and marketing, many of the agricultural-oriented interviewees emphasized that their outreach prioritizes tried-and-true methods. In part, this approach works because of the average age of producers (in some communities, interviewees estimated the average age was 50 years old). The interviewee from Nebraska’s Central Platte NRD used outreach like mailed quarterly newsletters; newspaper articles; radio advertisements in the spring and fall to target farmers on tractors listening to market updates and farm news; annual information meetings; and the development of an NRD radio jingle.

Trust-building with stakeholders

Interviewees with agricultural audiences emphasized that implementing a program in ag communities takes time. “If you’re going to do something like this, you’ve got to be in it for the long term,” said one of the NRD interviewees, “There’s no better PR than a satisfied customer.” Producers are risk averse. In the interviewee’s case, his conservation program’s first year had poor participation; the following years benefited from local talk, trust, and evidence of the program’s benefit.

Similarly, the San Luis Valley interviewee credited programmatic success to personal relationships. When communication can go both ways, particularly in getting questions answered, then individuals feel more confident in making a well-informed decision.

Inclusion in process

A theme echoed throughout the agricultural interviews was the importance of process inclusion for producers, farmers, ranchers, and rural water users. Ideally, decisions are made at a local level by local program managers or, even better, by potential program participants.

Urban Themes

5. Defining motivation for participation
6. Ease of application and program management
7. Engaging water managers and local government leaders

Defining motivation for participation

For urban residents and water providers, interviewees linked successful programs to marketing aligned with participants’ motivations. For household users, participants in water efficiency and conservation programs typically identified water savings as the primary motivator. As a Front Range interviewee said, “The target audience is people who want to do the right thing. They understand that Colorado is semi-arid and that
they’re putting too much water into their landscape.” And, in a City of Westminster survey, customers identified the top two reasons for promoting water efficiency as: “It ensures long-term water supply security” and “Water is a limited resource.”

For municipalities and water providers, motivators are efficiency, impact, and adaptation to the local context. One interviewee highlighted that “blanket solutions” for reducing consumptive use are difficult, as water providers have a strong sense of identity for their customers and organization. Additionally, most municipalities and water providers run lean organizations: few have dedicated staff to developing and implementing water efficiency programs. Programs need to be efficiently managed to align with capacity and need to have tangible impact to make the resources worthwhile.

**Ease of application and program management**

The ease of application to a program was a motivator at both the household- and water provider-levels, and the ease of program management was a motivator for water providers. Interviewees felt that complex processes would not be successful due to reasons including household attention spans, the level of effort to maintain a program, and the staff needed to run complex programs.

**Engaging water managers and local government leaders**

Two interviewees found success in implementing programs via water managers and local government leaders. Buy-in from local government leaders increases the likelihood of program implementation, because it provides visibility about a program and, often, elevates the prioritization and timeline of a program’s implementation.

**Outreach Strategies and Tactics**

Interviewees pointed to a spectrum of strategies and tactics to increase participation, raise awareness, and market a program. The tactics have been divided into two categories (municipalities / urban water users and agricultural / rural water users), because approaches varied widely depending on the local context of the interviewee.

**Municipalities / Urban Water Users**

**Messaging**

- Simplify and tailor messaging: for example, consider urban programs Cash for Grass or Slow the Flow

**Internal Communication Methods**

- Reduce barriers to marketing and program management for staff unfamiliar with outreach, such as premade marketing toolkits:
  - Flyer templates
  - Sample social media posts separated out by month, with corresponding photos
  - Editable text that can be used in micro-, medium-, or long-form media
  - Ads for local newspapers
  - Customer-service trainings for staff

**External Communication Methods**

- Create opportunities for in-person engagement and relationship-building
- For example, offer free audits to get a water expert into someone’s home, educate that customer, build relationships, and trust, and connect them to pre-existing programs
- Outreach in consistent and audience-appropriate places.
Strategies include:

- Utility bill inserts
- Direct mail
- Targeted social media promotion
- NextDoor posts and ads
- Posts in small local papers
- Joint press releases, often with a customer testimony
- E-news lists
- A customer survey asked: “What’s the best way to reach you about water efficiency programs?”
- 42% flyers and inserts in my bill
- 40% messages on my bill
- 10% social media
- 15% website
- Advertise incentives to target audiences like developers, HOAs, and hot development areas

**Leveraging Values**

- Use data-based decision-making to inform and urban programs
- Define goals around scale and geography to help program managers have an equitable, balanced, and efficient approach to simplify applications for target participants

**Agricultural / Rural Water Users**

**Messaging**

- Codefined messaging: ask potential users what they need, and what would or wouldn’t work. Then shape a message based on their input.
- Relationships are more important than words. Messaging may follow rapport and trust with the community.
- One-size won’t fit all. Farmers have diversity in operations; different crop types have different needs.

**Internal Communication Methods**

- Training program employees
- Calls with the State on possible program changes

**External Communication Methods**

- Consider timing of outreach, such as radio ads during harvest season and newsletters in off-seasons
- Having a participant-centric approach is important for long-term participation in the program
- Outreach in consistent and audience-appropriate places. These include:
  - Radio
  - Radio ads in spring and fall to correlate with the timeframe that farmers are listening to market updates on their tractors
• Customized radio jingle
• Radio interviews
• Town halls, producer meetings, symposiums, and webinars
• Have included features like guest speakers and presentations about new innovations
• Provide updates on programs, aquifer levels, hydrology changes
• Newspaper updates, articles, and newsletter postings
• Newsletters and information bulletins
• Fact sheets and flyers
• Website content
• Blog to provide narrative about key issues
• Guest writers
• Press releases
• Social media, although not as successful because of age of producers
• Board member marketing, word-of-mouth marketing
• School water education on a variety of issues; best interaction with 4th, 5th, 6th graders
• Text (SMS) communication between program managers and participants for quick updates
• Local office locations allow people to come learn about conservation programs for their area

**Leveraging Values**

• Trust and relationships between a program manager and local communities, which could look like:
• Co-learning: host opportunities for producer / farmer roundtables to inform programmatic decisions
• Upfront time commitments: state how long a pilot or program will be around, and then be consistent.
• Long-term strategy: “There’s no better PR than a satisfied customer.”

**Key Takeaways**

The following statements capture overarching takeaways from the Education and Outreach literature review and interviews conducted, and represent common considerations for establishing buy-in for a future potential DM program.

• **Motivations to participate.** Motivation to participate is connected to information, clarity, and education about the program objectives and larger economic / social / environmental issues. Addressing these motivations includes: ensuring the protection of water rights and confirming that participation in compact security is a beneficial use under Colorado Water Law; defining short- and long-term financial benefits for participants, especially to reduce risk and increase profitability; and educating potential participants on the process, goals, and program details, to provide the context needed to relate a program to personal situations.

• **Build Support for a Demand Management Program.** Develop local communication strategies and partner with local, established networks to communicate messages. Involve communities as early as possible in program design. Inclusion of trusted local and state representatives will result in a program with higher agricultural water user participation. Additionally, align a program with producer values
Demand Management Feasibility Investigation Literature Review

In addition to the literature review, CDR has helped facilitate the stakeholder engagement process relating to the Demand Management Framework and Demand Management more generally. Therefore, in lieu of an analysis of data gaps relating to Education & Outreach, the following section provides key observations relating to Colorado-specific issues and values. Further engagement can continue to inform what elements of a potential Demand Management program are acceptable to different sectors and communities, what elements or areas need further exploration or discussion, and what elements have buy-in or support.

**Coloradan Values: A Commentary**

Following the Statewide Engagement effort to engage diverse perspectives, CDR Associates provided the following anecdotal commentary to articulate Colorado-specific values. The following commentary is in no way comprehensive nor universal. However, an understanding of Colorado-specific values can help inform the advisability of a program.

**Individual Choice**

Coloradans appreciate individual choice and discourage government oversight. This value was articulated in rural and urban contexts; for example, producers participate in fallowing programs when it suits their financial objectives or personal lifestyles, and homeowners participate in municipal conservation programs to beautify yards or protect the environment.

Any potential demand management program may align with the value to participate when and where Coloradans choose to. Similarly, messaging and motivation for a demand management program might
recognize that individual choice applies to demand management but does not apply to Compact administration, which would not be voluntary or compensated.

Local Control

Colorado’s government is designed to support and empower local control, and this is a value shared by many in the state. Many Coloradans support decision-making made at the lowest level of government possible, including town councils and county commissions. This value seems especially true on the West Slope.

Any potential demand management program may incorporate the role of local government and local decision-making into its decision-making. Inclusion from the start, such as in shaping the program framework and in designing mechanisms to protect against unintended impacts, would likely build local trust and buy-in.

Agricultural Participation in Decision Making

Agricultural communities—including many who would be eligible participants for a potential demand management program—value participation in decision-making. Agricultural stakeholders want to shape the decisions that would impact their ways of life, income, community well-being, and local economies.

Any potential demand management program may proactively include agricultural communities in the process. This includes program development, program implementation, and any changes to the program after its launch. Agricultural participants would be critical to the success of a demand management program in achieving conserved consumptive use.

SECTION 6 – ENVIRONMENTAL CONSIDERATIONS – LITERATURE REVIEW

SGM led the Environmental Considerations processes for the Investigation. The tasks associated with these efforts specifically included:

- Review and develop environmental criteria for assessing impacts of potential demand management activities.
- Identify data gaps, tradeoffs, and interrelated topics relevant to the Environmental Considerations workgroup and assist in determining methods to address data gaps as directed, as identified in the literature review.
- Summarize instream flow, environmental and recreational issues relating to past water conservation programs.

Literature Review

SGM reviewed various types of water savings, water banking, pilot projects and/or water conservation reports (listed in Exhibit A) and information to understand how environmental considerations, impacts and net benefits, were considered or how they influenced projects to balance these needs. Like the Monitoring and Verification literature review, SGM reviewed this information to understand how future projects could inform the integration of environmental considerations for a potential DM program, including:

- Current methodologies, data, and information to measure environmental attributes both in the agricultural and municipal contexts.
• Details associated with consumptive use and conservation estimation and monitoring, verification methods, and related issues.
• Data gaps and methods for being able to consider and measure environmental attributes within the DM monitoring and verification process.

SGM took the direction of the Environmental Considerations workgroup and summarized key topics, criteria, and considerations relating to previous conservation projects (Exhibit B). Summary information included:

• Primarily purpose/goal of the project.
• Key takeaways.
• Project location.
• Program name, administration, structure, nature and duration of project practice.
• Tools uses to assess environmental impacts.
• Impacts to streamflow including magnitude, frequency, duration, timing, rate of change in hydrologic conditions, and return flow impacts.
• Impacts to species including critical stream reaches, critical land or riparian habitat, and list of species impacted.
• Impacts to water quality including salinity, temperature, and other constituents.
• Environmental considerations tradeoffs predicted outcome from activities, and proportionality.
• Ability to offset losses to environmental services and opportunities to incentivize environmental components for CCU projects.
• Evaluation of impacts (positive or negative) to instream flows, stream or watershed management plans, critical habitat, state species of concern, basin roundtable environmental values, conservation strategies, and other community goals and/or projects.

**What we Know**

Overall, the literature review concluded that most projects and studies did not consider nor measure how conserved consumptive use impacts or benefits environmental attributes. However, there was recognition in some studies that the environment benefits with increased streamflows due to lower diversions. In general, these streamflow impacts were correlated to better fish habitat due to higher instream flow and lower temperatures.

There was recognition that the following key elements might influence environmental impacts or benefits, and in some instances, offered suggestions for integrating potential mechanisms for measuring these benefits and impacts.

**Streamflow Impacts**

Generally, the literature found increased streamflow could benefit the environment. “Environmental Water Transactions in the Colorado River Basin: A Closer Look” (Stanford Woods Institute for the Environment, 2018, Exhibit A) reviewed instream flow projects including the SCPP projects. Notably, the report found that “although the total amount of water restored by these transactions is very small compared to the overall water budget of the basin, in certain watersheds, transactions have provided significant benefits for local streamflow.” Specifically, these were the Price River watershed in Utah and the Green River watershed in Wyoming.
Another report, “Salmon recovery in the Columbia River basin: analysis of measures affecting agriculture” (Aillery et al, 1999, Exhibit A) focused on the impact of diverted water and the impact of decreased streamflow on salmon species. Specifically, it found “flow alterations have significantly increased travel time for juvenile fish migrating to the ocean, a primary factor in reduced survival rates.” The report investigates different methods to increase streamflow in the Columbia River basin. As this relates to a DM program, increased streamflow to move water to Lake Powell could have positive impacts on fish species.

**Modeling**

The literature identified the importance of modeling to be able to fully predict changes in streamflow during a demand management program. Currently, the models do not handle extra pools of water in the reservoirs and would need to be updated to help appropriately drive reservoir operation. In “Considerations for Modeling a Water Bank at the Aspinall Unit with Current Environmental Flows,” (Hydros Consulting, 2011, Exhibit A), StateMod could be most easily reconfigured to simulate environmental flow targets (through Black Canyon and at Whitewater), including base flow and peak flow targets. However, modeling was not done in this analysis, so there are no results to share on how the water banking project would impact flows.

**Species**

Throughout the literature, different fish species are discussed with a focus on trout and salmon populations in the Western United States. One of the secondary benefits of the SCPP projects included increased streamflow in the Middle Piney Creek. As streamflow decreases, water temperature tends to rise, “often beyond ideal thresholds and also reduces available habitat.” The GV CUPP (J-U-B Engineers Inc., 2017, Exhibit A) found “increased water in the river resulted in $23,000 of estimated savings not spent on endangered fish programs.” More broadly in the United States, adding minimum flow requirements for the Snake River at Lower Granite Dam, and for the Columbia River at McNary Dam has improved salmon and steelhead populations (Aillery et al, 1999, Exhibit A).

**Water Quality**

Salinity impacts were discussed in four of the reports reviewed, mostly reviewing projects in the Grand River Valley. During the SCPP, it was estimated that the “2017 Grand Valley water conservation project is estimated to have reduced salt loading to the Colorado River by 4,960 tons.” (UCRC, 2018, Exhibit A). In the Colorado River District’s “Colorado River Water Bank Feasibility Study: Phase 2,” (MWH, 2013, Exhibit A) water quality impacts are discussed with focus on salinity and selenium. “Salinity and selenium issues may make fallowing or deficit irrigation more attractive to Project farmers, as impacted lands might be taken out of production with less impact on overall yields. In addition, reduced irrigation of these lands may have benefits in improved quality of return flows.” In this study, salinity effects (not affected or marginally affected) were a screening criterion used to select candidate systems representing a broad range of characteristics. In the “Infographic: Grand Valley Pilot Project Secondary Benefits,” (TNC, 2019, Exhibit A) reduced irrigation “on salty soils improved water quality and resulted in an estimated savings of $282,720 from money not spent on other measures to reduce salinity.” However, another review, “Research Synthesis: Agronomic Impacts of Reduction Irrigation,” (Culp and Kelly, 2019, Exhibit A) raises the concern that “salt will move to the surface of the soil during periods of fallowing.” If this occurs, “a pre-planting leaching irrigation” may be required which could “reduce the water savings from fallowing.”

**Additional Considerations**

A summary of additional project considerations from the literature suggested the following to promote the inclusion of environmental attributes. These considerations are also discussed in the M&V section.

- Using streamflow station data helps understand the impacts to streamflow from foregone diversions.
• Increasing water in the river could result in savings due to less spending on endangered fish programs in studies.
• Reducing irrigation on salt soils could improve water quality and save money on salinity reduction programs.
• Maintaining historical return flows may be a challenge and may require storage and timed releases or construction of recharge basins but could offer net environmental benefits.
• Reducing irrigation on salty soils may improve water quality and reduce costs for salinity reduction programs. However, salty soils should be monitored as extra irrigation may be needed in subsequent years to perform leaching irrigation – reducing the long-term water savings.
• Increasing streamflows keeps temperatures low, improving fish habitats.

**Key Takeaways**

The key takeaways relating to a potential DM Program that support Environmental Considerations aligns with the need to ensure ongoing Compact compliance, however, there is a strong need to fill in the data gaps to be able to measure the potential impacts or benefits associated with the streamflow impacts.

List of key things that would support measuring impacts or benefits include:

• **Local Support and Participation.** Enlist local key stakeholders and non-governmental organizations (NGOs) to partner and realize opportunities to provide a net environmental benefit.

• **Alternatives Analysis.** Initiate a high-level assessment of environmental impacts of all recommended and alternate water management strategies considered.

• **Expand Project Purpose to Consider Additional Objectives.** The literature review revealed that many of the demand management programs did not have an environmental focus.

**Data Gaps**

The following data gaps were identified in the Environmental Considerations literature review:

• **Data.** Measured data on the impacts on fallowing and deficit irrigation on downstream streamflow and environmental resources due to changes in return flows.

• **Modeling.** The actual timing and reduction in depletions will require return flow modeling

• **Instrumentation and Monitoring Equipment.** There will be a need for cost effective flow monitoring to gage the environmental benefits in specific locations

The Environmental Considerations workgroup identified specific issues of interest to be considered in the literature review. SGM looked for mentions of these items and the following issues were not addressed in the 54 documents reviewed:

• Stream Management Plan/Watershed Management Plan objectives.
• Basin Round Tables environmental values lists/mapping.
• Colorado River Cutthroat Trout conservation strategy.
• Other known community/entity project.
• Environmental specific tradeoffs.
• Other known community/entity projects.
SECTION 7 – FUNDING – LITERATURE REVIEW & ANALYSES

WestWater Research led the Funding processes for the Investigation. The tasks associated with these efforts specifically included:

- Participation in the final meeting of the Funding Workgroup as a listener.
- Compilation and review of past studies and research regarding the costs and funding structures for other water conservation programs in the Western U.S. like a DM program.
- Analysis of design elements of a DM program as they relate to costs and beneficiaries.
- Identification of knowledge or data gaps in the ability to understand and evaluate the costs and funding options for a DM program.

Literature Review

There was found to be a lack of literature and past research on the costs and funding structures for demand management types of water conservation programs. WestWater compiled data and conducted original research on other water conservation programs in the Western U.S. to support the funding analysis.

What we know

Cost Components of Example Demand Management Programs

This section provides an inventory and analysis of other “demand management” programs in the Western U.S. In identifying comparable programs, the following selection criteria and loose definition were applied: (1) voluntary, (2) compensated, (3) consumptive water use reduction that is (4) temporary for any piece of land and is distinguished from two-party transactions because it is (5) operated by a single entity as a program over multiple years, often with a (6) regulatory or policy driver. Pilot projects were included. The costs of demand management vary by the type of water use (demand) being managed and reduced. Costs are significantly different between the agricultural and municipal sectors.

Agricultural Demand Management

Most of the demand management programs identified in the Western U.S. have been programs to reduce agricultural water use in order to utilize the savings for an alternative water use, such as municipal or environmental. A total of 17 example agricultural demand management programs were identified in more than 6 different states. A range of entities have developed and administered the agricultural demand management programs, including municipal water agencies, state government agencies, local / regional water districts, and others. The following cost components were identified in reviewing the example agricultural demand management programs:

- **Water Costs.** As defined above, all example demand management programs were compensated and therefore all had a water cost associated with agricultural conservation activities. The water costs reflect various factors: (1) the foregone agricultural value, or lost net revenue, (2) the program compensation structure and term, and (3) the type of demand management activity. A more expansive discussion of agricultural economic impacts from conducting demand management activities is provided in a previous section of this report. The water costs for agricultural participants in a Colorado demand management program are likely to reflect the predominance of perennial forage crops on the Colorado West Slope.

- **Administration Costs.** All of the example demand management programs had administrative costs, with an average annual cost $40 per acre-foot. Administration costs include regulatory approvals to
initiate projects and annual monitoring and verification activities. In one example, these costs were paid by the participating landowners and were covered as part of the compensation (water cost). With the exception of the Catlin Canal Pilot Project on the Lower Arkansas River, administration costs ranged from $4 to $48 per annual acre-foot (AF) of demand reduction. The Catlin Canal Pilot Project had estimated administration costs of $167 per AF, per year which reflects the attributes of this project and relatively stringent administrative requirements found in Colorado and particularly along the Front Range.

- **Mitigation Costs.** Only 5 of the 17 example demand management programs included mitigation payments to offset economic and related secondary (indirect) impacts from reduced agricultural water use. For the 5 programs that include mitigation as part of the program, the mitigation payments ranged from $2 to $86 per annual AF of water use reduction, with an average annual payment of approximately $50 per AF.

**Municipal Demand Management**

The activities to achieve demand management in the municipal sector remain uncertain, and it is likely that municipal water providers will take different approaches to implement demand management within their systems. This funding analysis considers municipal demand management through water conservation as one potential method, but it is recognized that it may not be broadly applicable. Water conservation was selected because most Colorado municipal water providers have a water conservation program or plan of activities that can be evaluated for example costs of demand management. Unlike the agricultural examples described in the previous section, municipal programs are typically not intended to produce a transferable water supply to another use. Municipal demand management programs are typically targeted at one of the following objectives:

1. Permanently reducing individual customer water use through a variety of indoor and outdoor water conservation and efficiency activities, including public outreach, rebate programs, tiered or water budget rate structures, home water audits, and others.
2. Temporarily reducing both individual customer and municipal-scale water use in response to a potential water supply shortage due to drought, infrastructure damage, or other emergencies. Regulatory measures are often applied to achieve demand management, such as every other day outdoor watering, bans or limitations on certain water uses, and temporary increases to water billing rates.

Any potential Demand Management program in Colorado would be voluntary, temporary, and compensated. Municipal demand management examples do not necessarily align with all three characteristics. Water conservation program activities in the first category above have associated direct costs (compensation) and are voluntary actions but are often intended to result in permanent water use reduction. The second category of regulatory actions are intended to be temporary but are often not voluntary or compensated. For this analysis, the cost of municipal demand management references observed costs of permanent municipal water conservation programs, but it may be recognized that temporary demand management can be achieved in the municipal sector and historically has been more likely to occur through regulatory (policy) actions at little to no direct cost. In addition, many municipal water providers may look to implement demand management activities with no water service impact to their customers and therefore with no water conservation actions by their customers.

The costs of municipal demand management were evaluated using two approaches and datasets:

- **Municipal Conservation Activities.** Municipal demand management is achieved through a combination of activities, such as those listed above. These activities each have an estimated water demand reduction and cost. Previous research indicates that indoor residential conservation activities have costs that are roughly 50% of the outdoor conservation activities. The costs also increase with greater degrees of water demand reduction. In total, past research indicates municipal conservation
activities having total direct costs of $500 per AF or more. This cost is likely to represent a permanent water use reduction, and the annual equivalent cost is estimated at approximately $20 per AF based on a 4% discount rate over an indefinite period.

- **Municipal Conservation Programs.** Many municipal water providers have annual water conservation programs with associated budgets to achieve demand reduction. Instead of looking at the cost of individual activities, it is helpful to look at the overall costs of municipal water conservation programs to understand the administrative costs, the inefficiencies in program spending, the effects of program activities that do not have associated costs, and the impact of growth in the number of service customers. A historical analysis of municipal demand management over the period 2000-2020 was completed for 9 example municipal water providers who utilize Colorado River Basin supplies. The average unit cost was found to be approximately $1,500 per AF of demand reduction, which is considered to better reflect the total cost of achieving overall volume reductions in municipal demand, as opposed to reductions in per-person water use rates.

Municipal demand management costs in Colorado may consider two important factors:

- **Trans-Basin Diversions.** Most municipal water use in the Colorado River Basin in Colorado is sourced from trans-basin diversions to the Front Range. These trans-basin diversions have historically not had any return flows to the Colorado River system from municipal effluent, and therefore any municipal diversion demand reduction from these trans-basin diversions is effectively a reduction in consumptive use from the Colorado River Basin. This contrasts with municipal water users located in the Colorado River Basin, who would mostly realize consumptive use savings only from a reduction in outdoor watering uses.

- **Water Supply Portfolio.** Most Front Range municipal water providers, particularly the largest volume users, have a water supply portfolio that sources water from a variety of river systems and projects. The composition of municipal water supplies that are sourced from the Colorado River system as a portion of the overall supply portfolio influences how total municipal demand management activities relate to water diversion reductions in the Colorado River Basin. Available data indicates that municipal water utilities in Colorado that are reliant on the Colorado River Basin for a portion of their water supply have 50% to 60% of their water supply sourced from other water systems. Therefore, municipal water providers would need to specifically reduce Colorado River Basin sources commensurate with demand management activities, otherwise the unit costs per volume of Colorado River water use reduction would potentially double.

**Cost Factors for Demand Management Program**

Cost estimates of a DM program are inherently uncertain because the costs can vary significantly depending on the following factors (among others):

- **Funding.** The funding structure of a demand management program is expected to influence costs, and particularly the amount of state government funding required. Decisions about who pays for demand management influences who bears the costs but also impacts the cost itself.

- **Scale / Volume.** Costs are directly a function of scale, or the annual volume of demand management being implemented. At the present time and for the near term, the scale of demand management in Colorado will be limited by volume of the conservation pool in Lake Powell created by the DCP. The annual volume of demand management will depend on how much space within the conservation pool is available to Colorado and how fast that space is intended to be filled.

- **Timing.** Costs escalate under emergency action, which has long motivated planning efforts in various subject areas. Demand management activities in the agricultural and municipal sectors may be more difficult and more costly to achieve during a drought, or if activities are required due to pending water
shortages or Compact administration. A multi-year consistent demand management program is expected to carry lower costs than a program that is reacting to stressful conditions.

- **Project Selection Process & Equity Policies.** The process for selecting demand management projects may influence program costs, depending on what type of process is established, how applicants are identified and evaluated, and how projects are compared. Several of the Workgroups have had discussions supporting equity in a demand management program, including water use sector equity between agricultural and municipal water users and spatial equity to limit the concentration (and associated impacts) of demand management activities. Implementing regulatory limits to provide for equity is expected to increase costs, due to a reduction in the pool of potential projects and deviation from a lowest-cost system of project selection.

- **Administrative Process.** The process established to conduct an upfront review of each project application, and the process established for monitoring and verification of project activities are both significant factors in overall project costs. It will be important to establish a review and monitoring process for the demand management program that is not cost prohibitive. Another aspect of approval is any environmental review and mitigation that is required as part of the program.

- **Participant Requirements.** Compensation payments are expected to reflect any lost economic opportunity associated with reduced water use, and any costs associated with meeting program requirements. As described in a separate section of this report, participant requirements may include cover crops, weed and pest controls, and other elements to reduce off-farm impacts.

- **Mitigation.** In addition to compensation paid to participants, there may be mitigation payments paid to offset economic and environment impacts resulting from the projects. Example mitigation includes: (1) payments to the larger ditch company or irrigation district for operational impacts, (2) payments to the county to offset economic impacts, (3) payments to an environmental organization to offset wetland or riparian impacts.

- **Economic Factors.** The multi-year and potentially multi-decade timeline of a demand management program results in various economic factors influencing costs. Some examples include: (1) agricultural commodity market prices influencing compensation payments, (2) interest rates influencing the cost of capital outlays, (3) inflation influencing all prices & costs, (4) population and economic growth influencing water supply & demand imbalances and water transaction values. There are other factors to consider, but the underlying point is that a variety of factors outside of the program’s design and control will influence program costs.

**Key Takeaways**

The takeaways provided in this section are crafted to advance the demand management discussion and feasibility analysis in Colorado.

- **Activity & Scale.** Proactive programs that aim for annual demand management activities over a longer period of time are a more cost-effective method, as opposed to a surge of activity during a drought or other stressor. Therefore, funding sources may be structured to be reliable and consistent. Costs of demand management activities are a primary consideration if the program is publicly funded.

- **Certification Process.** Several of the time-intensive and costly aspects of project review and approval can be completed upfront and remain valid for many years. Therefore, other successful demand management programs have been designed with a certification process for projects that can allow each project to be thoroughly reviewed but also allow annual flexibility in participation.

- **Minimize Seller Costs.** To encourage participation in the demand management program, program design might avoid a significant cost burden for participants, or entities conducting demand
management activities. Monitoring and verification activities (and proving non-injury) may require the installation of equipment and annual data collection efforts. In addition, there may be mitigation costs associated with the ditch organization, local community, and environment. Upfront capital costs and mitigation costs could be incorporated into annual compensation payments. The program design may also consider state agency staff to conduct the initial reviews of applications and to assist in project administration. With these program design elements, the participant costs may be limited to developing application materials.

- **Incorporate Monitoring & Verification Costs into Project Selection.** The process of comparing and selecting project proposals requires that the full cost of the project be quantified. The compensation aspects of each proposal are expected to be defined by the participant. Monitoring and verification components of each project will be more difficult for the applicant to define. The costs of monitoring, verification, and administrative approval (to ensure non-injury) are expected to vary significantly across projects. Monitoring and verification costs could be evaluated with DNR assistance as part of a certification process and costs may be considered as a required element of each project application. An accurate evaluation of project proposals requires an “apples to apples” comparison of full project costs.

**Data Gaps**

This section provides a discussion of two types of data gaps: (1) those currently present in evaluating the feasibility of a demand management program, and (2) those that are likely to be present when structuring specific demand management funding options.

**Data Gaps in Evaluating the Feasibility of Demand Management**

The costs of demand management remain uncertain because of multiple variables and decision-points affecting the program. The preliminary estimates on cost feasibility may continue to be revisited by CWCB staff as the program design is explored. As continued analysis occurs, the following data gaps related to funding are identified:

- **Process Considerations.** Preliminary ideas on a program process are identified in the form of a single conceptual framework. The costs of a demand management program are inherently tied to the application and selection process, requirements for monitoring and verification, and project evaluation. It is expected that many of the data gaps involving process will be filled if, and as decisions are made regarding program structure.

- **Program Requirements.** Costs are also a function of program requirements, such as mitigation for local economic impacts and augmentation of stream depletions. Program costs can rise significantly depending on how program and participant requirements are defined.

**Data Gaps in Structuring Specific Funding Options**

The data gaps listed above for evaluating feasibility also apply to structuring specific funding options for demand management. Specific funding options can be developed once these data gaps are addressed.
SECTION 8 – MONITORING & VERIFICATION – LITERATURE REVIEW

SGM led the Monitoring and Verification literature review for the Investigation. The tasks associated with these efforts specifically included:

- Participation in the final two meetings of the Monitoring and Verification workgroup as a listener.
- Compilation and review of past studies and research regarding M&V considerations and practices detailed in previous CCU and ATM pilot projects, as well as western states water banking programs.
- Analysis of design elements for a potential DM program as they relate to M&V activities.
- Identification of knowledge or data gaps for consideration of the implementation of M&V requirements in a potential DM program, along with individual DM M&V project requirements.

Literature Review

SGM reviewed various types of water savings, water banking, pilot projects and/or water conservation reports and information that had similar goals and could inform the feasibility of a DM program, including:

- Current methodologies, data, and information to measure DM and water conservation both in the agricultural and municipal contexts.
- Details associated with consumptive use and conservation estimation and monitoring, verification methods, and related issues.
- Data gaps and methods for being able to continue advancing the DM monitoring and verification process.

Overall, the reports captured a summary of pilot project, such as the System Conservation Pilot Program (SCPP), and water conservation activities in Colorado and other areas across the Rocky Mountain West. The literature review considered a wide array of documents including research papers, demand-side vs supply-side municipal studies, state-mandated water conservation programs in California, crop rotations, energy-water benefits, and ATM research. The reports (shown in Exhibit A) generally analyzed off-farm benefits, conserved consumptive use, lessons learned and environmental impacts.

To better record the breadth and depth of information available in the literature, SGM summarized key topics, criteria, and takeaways relating to previously completed projects within a table. Summary information included:

- Primarily purpose/goal of the project.
- Key takeaways.
- Project location.
- Program name, administration, structure, nature and duration of project practice.
- Source and amount of water conserved.
- Monitoring and verification requirements, equipment, and processes:
  - Measurement of water returned to the stream.
  - Consumptive use analyses.
  - Estimate of residual field consumptive use.
• Return flow maintenance.
• Verification of conserved consumptive use.
• Coordination of benefits.
• Municipal considerations.

- Implications for storage, hydropower, recreation, and environmental considerations.
- Program lessons learned, successes and/or challenges, tradeoffs, proportionality, and alignment with M&V workgroup guiding principles.
- Project data gaps, keys to success, identified challenges, and overall findings and lessons learned.

See Exhibit B for the comprehensive tables documenting the overall M&V literature review findings.

What we know

Overall, few of the reports focused on the specific methods, instruments, or techniques used for monitoring and verification activities. Almost all the literature identified that projects need to be evaluated at the individual field level, as no two projects are alike. Generally speaking, the measurement devices commonly used by irrigators and municipalities are adequate to monitor and verify demand management project activities. The challenge often identified in the literature wasn’t inadequate devices, but a lack of measurement devices physically installed near the project area. At the project level, a combination of existing measurement devices and field visits were used to verify conservation projects were operating as planned. However, the literature often cited that detailed measurement and verification of the achieved conservation amount wasn’t completed, rather that the conservation practices were implemented. As an example, the Grand Valley Water Users Association Conserved Consumptive Use Pilot Project (GV CCUPP) relied on an independent contractor to perform site visits throughout the project to verify fallowed fields, give advice for weed control, as needed, and document compliance. The reports and lessons learned from the project emphasized the importance of utilizing an independent contractor to the success of the project. Ultimately, this increased trust between the participants and the program administration. The literature also identified that widespread and readily available remote sensing may help with monitoring and verification practices in the future, as well as to understand the historical irrigation practices and potential conservation benefits at a proposed site.

Consumptive Use Analysis

There are multiple computer programs available that can reasonably estimate the amount of historical consumptive use of agricultural operations. Each program is slightly different and requires a certain amount of input data. The ability to estimate the historical consumptive use is predicated on the availability of adequate climate data, water diversion records, cropping information, and soil characteristics. For instance, the CU analyses of SCPP projects focused on the specific amounts and associated cost of conserved water. Overall, the SCPP resulted in an estimated consumptive use reduction from all 45 projects in 2015 through 2017 of 22,116 acre-feet (AF). Additionally, projects complete in 2018 increased the reduction of consumptive use by 25,097 AF for a total of 47,213 AF over the entire SCPP timeframe.

The System Conservation Pilot Program also considered the difference between estimated consumptive use reduction on the applications and the reduction calculated during the subsequent analysis. Overall, the application estimates underestimated the reduction by 2,728 AF (approximately 7%). The SCPP identified that in order to accurately calculate the actual CU conserved in a project, thorough on the ground measurements are needed. In addition, the GV CCUPP pilot program analyzed the conserved consumptive use compared to the number of acres enrolled in the project. They found in 2017 with 1,069 acres enrolled in the pilot project resulted in 2,715 AF of water conserved. Similarly, in 2018, 1,252 acres were enrolled
which conserved 3,178 AF with both years yielding approximately 2.5 AF of conserved water per acre enrolled in the GV CCUUP pilot program.

It is important to note that the purpose of the System Conservation Pilot Program was not to create quantifiable water savings in Lake Powell, but rather to test the concept of a program incorporating temporary, voluntary, compensated reductions in conserved consumptive use.

Lessons Learned

Three primary lessons learned from the SCPP include:

- Outreach & communication is essential.
- Operational & legal issues must be addressed at ditch company/irrigation district level.
- Simplifying the process allows for greater efficiency.

Multiple participants voiced concerns about “broader economic impacts and social issues for” their communities – emphasizing the necessity of outreach and communication. For monitoring and verification purposes, the SCPP literature emphasized the importance of supporting efforts to estimated conserved consumptive use and the independence of verification work from the local administrators (such as ditch company/irrigation district staff). Additionally, The GV CCUUP found there was an increased interest in participation after the first year of the program and similarly indicated the importance of independent monitoring and verification-built trust within the pilot program.

Secondary Impacts

The SCPP literature described the benefits of a DM-type program increased environmental flows, decreased cost of alternative habitat flow restoration projects, improved societal benefits from habitat flows for endangered species, reduced salinity loading in the Colorado River, and increased municipal and hydropower benefits. Other pilot projects in Colorado observed that increased flows contributed minimal improvement to the overall recreational flow needs. Some documents did consider temporary water transfers and the associated impact to instream flows (ISF). These transfers without legally changing the water rights resulted in irrigators conserving water through a variety of means and leaving some portion of that water instream, which generally bolstered flows during the irrigation season, but may have reduced non-irrigation season return flows within a stream segment. The SCPP was documented to have the added effect of enhancing streamflow, and it was further determined that the availability of consistent funding would be crucial to success of long-term demand management efforts, whether for streamflow, water security or (most likely) multiple objectives.

SCPP Overview and General Findings

- Focused on the general administration and process of running a demand management system rather than the specifics of monitoring and verification.
- Attempted to streamline the process for participants (irrigators) and keep the barriers to entering a program/project minimal.
- Concluded that the size of the ditch and its governance/bylaws greatly influenced how conserved water projects could be operationally achieved and accounted (for).
- Realized that the size of the ditch company changed how water was managed.

For example, large ditch companies diverted supplies and ran through their system; medium ditch companies diverted supplies and ran through their system or reduced their river headgate diversions; and small ditches reduced their river headgate diversions or closed it.
• Systems with multiple shareholders will likely require management participation (i.e., water users association or ditch company board) for success.
• The SCPP return flow maintenance practices were considered, but generally not adequately.
• Modelling considerations will need to be updated to handle water storage for potential demand management project operations.
• Flexibility to allow for locally driven solutions can drive higher engagement.

**ATM Pilot Project Overview and Findings**

- Avoided the need to go through a water court application process. However, complex monitoring and verification requirements may require a legal process that complicate the implementation of projects (historical consumptive use, change of use cases, etc.).
- Existing legal platforms to avoid water court are limited to instream flows leases, Substitute Water Supply Plan, and Interruptible Water Supply Agreement.
- These existing options have limitations and may not apply to every case or be useful in all projects so other options may need to be developed to avoid water court.
- Protection of vested water rights along with a flexible delivery schedules for M&I stakeholders are key for agricultural producers so they can keep growing crops/livestock.
- Guaranteed supplies are paramount for M&I water providers.
- An overall pilot project goal may be to reduce costs for M&I stakeholders such that ATMs are more affordable or more beneficial than buy-and-dry.
- The cost of installing new and/or highly accurate monitoring and verification equipment may be a participation barrier, depending upon the accounting and administration requirements.

**Additional Findings**

- Integrating local issues/sentiment was critical to the successful launch of conserved consumptive use pilot projects.
- Independent verification of project compliance helped maintain a level of trust and eliminated many interpersonal issues between irrigators, districts, and ditch companies.
- Sources of funding could cause contention if irrigators perceived a Front Range entity was paying for an area to be fallowed.
- Models worked well for estimating conserved consumptive use, though without on-farm analyses, the calculation of actual water savings was difficult to determine.
- Calculated estimate consumptive use and verification of conserved consumptive use in agriculture is improved with nearby climate stations.

**Themes**

The following statements capture overarching themes from the Monitoring and Verification literature review and represent common considerations for establishing buy-in for a future potential DM program.

**Local data and input**

Local focus was identified as one of the most crucial components for obtaining buy-in, finding project participants, and addressing misconceptions or apprehensions, etc. This theme cannot be emphasized...
enough, as nearly every report highlighted this as contributing factor to the success of projects. Additional information surrounding the need for local data and input included:

- Generally, standard measurement equipment available and used by many irrigators and municipalities is adequate to monitor and verify conserved consumptive use projects. Locally, challenges may occur due to a lack of measurement devices, or with antiquated devices in poor condition.

- The availability of local data and equipment will inform the monitoring and verification needs and/or requirements for conserved consumptive use projects.

- A local presence is helpful to address any technical monitoring and verification needs. As a result, costs associated with local technical services for monitoring and verification could be significant.

- Regarding proportionality, M&I participants could more likely afford the engineering and legal costs than agricultural participants.

- Regarding proportionality, costs to support local technical services could prevent agricultural participation.

- Drought messaging can significantly influence a customer’s response to whether or not they will conserve.

For instance, the Drought Monitor could indicate conditions that are too regional and general and not reflect site-specific conditions. This develops a lack of trust in the regional information and represents an opportunity to change practices.

**Flexible program**

- Each conserved consumptive use project is different. Therefore, a flexible program structure could be more attractive to prospective applicants, especially by considering local and regional needs.

- However, a flexible program structure could require more administrative coordination and effort and could take longer to develop.

**Infrastructure**

- Potential participants in future pilot projects may need significant investment in infrastructure to accurately monitor and verify the conserved water and to ensure that return flows are maintained to avoid injury to downstream users.

**Key Takeaways**

The key takeaways relating to a potential DM Program that support M&V activities were largely based on the observed themes and may be used to fill the identified data gaps. In summary they include:

- **Utilize Local Resources.** The literature indicated obtaining local data and input to drive a monitoring and verification implementation was key to building public trust in the program, as discussed in the Education and Outreach section. Local resources were instrumental to support efforts to estimate conserved consumptive use, address any technical monitoring and verification needs for participants, as well as to provide independence for verification work from the local administrators (such as ditch company/irrigation district staff).

- **Develop a Flexible Program.** Projects in different geographic regions will require different implementation methods, project operations and local support. A project in one area will have different soil conditions, crops, ditch operations, community relations, etc. than another project. Allowing program flexibility for different implementation options increased participation in the literature reviewed.
• **Provide Funding to Support Investment in Measurement Infrastructure.** The literature highlighted it is not uncommon to have good potential projects in areas which lack the infrastructure to be able to monitor and verify the project. The initial capital costs and ongoing operations and maintenance costs required to install the measurement structures needed for accurate monitoring and verification of conservation projects needs to be addressed to promote participation in those projects.

• **Communicate with stakeholders, landowners, ditch, and reservoir companies before, during, and after projects.** The literature highlighted the importance of working directly with the program participants and those whose operations were directly impacted by participant participation (i.e. ditch companies, reservoir companies, etc.) throughout the process to future participation and trust in the monitoring and verification process.

• **Numerous takeaways from the E&O section, would support an effective M&V program implementation.** The SCPP literature highlighted the importance of a local project champion to reach out to potential project stakeholders and then work through implementation challenges, including building trust in the monitoring and verification processes.

**Data Gaps**

• More data would need to be collected to fully monitor and verify project yields and the resulting system increases, impacts to downstream water users, and ultimate benefit to Lake Powell.

• While standard irrigation and municipal measurement devices will likely be adequate, there is not detailed information regarding equipment or measurement instrumentation recommendations and/or data processing methods.

• There is a need for significant investments in infrastructure to accurately account for any conserved water and to ensure that return flows are maintained to avoid injury to downstream users.

• Fallowing projects are easier for monitoring and verification purposes, as general techniques include site visits to document that a field isn’t being irrigated, as well as to observe the growth of any vegetation along with a review of careful accounting practices.

• Verification requirements will likely be more challenging and detailed for non-fallowing projects, as producers will seek to reduce the consumptive use of plants, while still obtaining a harvest.

• Accurately assessing the CCU from deficit irrigation or alternative crops will be harder to quantify/verify, requires more monitoring and data collection, and ultimately relying on more rigorous technical analyses.

• There may be a need for improved coverage of climate stations in regions of Colorado to support M&V activities for some future pilot projects.

• ET estimation methods vary regarding the necessary data, processing techniques, and resultant accuracy. Generally, the more plentiful the data and rigorous the analyses, the greater the cost and accuracy. Future pilot projects may explore various technical options and the resultant CCU.
### ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<td>Acre-Feet</td>
</tr>
<tr>
<td>AFY</td>
<td>Acre-Feet/Year</td>
</tr>
<tr>
<td>ATM</td>
<td>Alternative Transfer Methods</td>
</tr>
<tr>
<td>Basin</td>
<td>Colorado River Basin in Colorado</td>
</tr>
<tr>
<td>BMP</td>
<td>Best Management Practice</td>
</tr>
<tr>
<td>CCU</td>
<td>Conserved Consumptive Use</td>
</tr>
<tr>
<td>CCUPP</td>
<td>Conserved Consumptive Use Pilot Program</td>
</tr>
<tr>
<td>CRWCD</td>
<td>Colorado River Water Conservation District</td>
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<td>CFS</td>
<td>Cubic Feet per Second</td>
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<td>CU</td>
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<td>Colorado Water Plan</td>
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<td>Drought Contingency Plan</td>
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<td>DMSA</td>
<td>Demand Management Storage Agreement</td>
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<td>DWR</td>
<td>Division of Water Resources</td>
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<tr>
<td>E&amp;O</td>
<td>Education and Outreach</td>
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<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
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<tr>
<td>GPCD</td>
<td>Gallons Per-Capita per-Day</td>
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<tr>
<td>IBCC</td>
<td>Interbasin Compact Committee</td>
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<td>Investigation</td>
<td>Demand Management Feasibility Investigation</td>
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<td>ISF</td>
<td>Instream Flow</td>
</tr>
<tr>
<td>MAF</td>
<td>Million Acre-Feet</td>
</tr>
<tr>
<td>M&amp;I</td>
<td>Municipal and Industrial</td>
</tr>
<tr>
<td>M&amp;V</td>
<td>Monitoring and Verification</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-governmental organization</td>
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<tr>
<td>NRCS</td>
<td>Natural Resources Conservation Service</td>
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<td>PMT</td>
<td>Project Management Team</td>
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<tr>
<td>SB</td>
<td>Senate Bill</td>
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<td>SEO</td>
<td>State Engineer’s Office</td>
</tr>
<tr>
<td>SWSP</td>
<td>Substitute Water Supply Plan</td>
</tr>
<tr>
<td>TMD</td>
<td>Transmountain Diversion</td>
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<tr>
<td>UCRC</td>
<td>Upper Colorado River Commission</td>
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<tr>
<td>USBR</td>
<td>U.S. Bureau of Reclamation</td>
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<tr>
<td>USFWS</td>
<td>U.S. Fish and Wildlife Service</td>
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Exhibit A. Summary of Literature Review Reports and Documents.

<table>
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<tr>
<th>Title</th>
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<th>Publisher/Authors</th>
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<tbody>
<tr>
<td>Infographic: Grand Valley Pilot Project Secondary Benefits</td>
<td>2019</td>
<td>TNC</td>
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<tr>
<td>Research Synthesis: Agronomic Impacts of Reduction Irrigation</td>
<td>2019</td>
<td>Culp and Kelly for TNC</td>
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<tr>
<td>Final Report: Colorado River System Conservation Pilot Program in the Upper Colorado River Basin</td>
<td>2018</td>
<td>Upper Colorado River Commission</td>
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<tr>
<td>Final Report: Appendix C: 2018 System Conservation Pilot Program Update</td>
<td>2018</td>
<td>Upper Colorado River Commission</td>
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<tr>
<td>Pilot Program Funding Agreement</td>
<td>2014</td>
<td>Bureau of Reclamation</td>
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<td>Colorado River Water Bank Feasibility Study: Phase 1</td>
<td>2012</td>
<td>Colorado River Water Conservation District</td>
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<tr>
<td>Colorado River Water Bank Feasibility Study: Phase 2</td>
<td>2013</td>
<td>For Colorado River District. By MWH.</td>
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<td>Colorado River Compact Colorado water bank feasibility study: water supply technical memorandum. (Appendix B to Colorado River Water Bank Feasibility Study: Phase 1)</td>
<td>2012</td>
<td>Natural Resources Consulting Engineers, Inc</td>
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<tr>
<td>Exploring Perceptions of a Voluntary Agricultural Water Conservation Program on the Western Slope of Colorado</td>
<td>2019</td>
<td>MacIlroy, Colorado State University</td>
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<td>GWUWA Final Report on the Conserved Consumptive Use Pilot Projects</td>
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<td>GWUWA and J-U-B Engineers</td>
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<tr>
<td>Lessons Learned from the System Conservation Partnership Program</td>
<td>2016</td>
<td>The Nature Conservancy</td>
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<tr>
<td>Title</td>
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<tr>
<td>Considerations for Modeling a Water Bank at the Aspinall Unit with Current Environmental Flows</td>
<td>2011</td>
<td>Hydro Consulting for TNC</td>
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<tr>
<td>Environmental Water Transactions in the Colorado River Basin: A Closer Look</td>
<td>2018</td>
<td>Stanford Woods Institute for the Environment</td>
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<td>Lower Colorado River Basin Pilot Program</td>
<td>NA</td>
<td>Bureau of Reclamation</td>
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<td>System Conservation: a collaborative approach to drought contingency planning the Upper Colorado River Basin</td>
<td>2017</td>
<td>Wyoming SEO Callaway, AWRA Impacts magazine</td>
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<tr>
<td>SNWA Water Resource Portfolio</td>
<td>2019</td>
<td>Southern Nevada Water Authority</td>
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<tr>
<td>Salmon recovery in the Columbia River basin: analysis of measures affecting agriculture</td>
<td>1999</td>
<td>Aillery et al, Marine Resource Economics</td>
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<tr>
<td>Temporary water transfers for urban water supply during drought</td>
<td>1992</td>
<td>Clark, CSU</td>
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<td>Flexible water allocations and rotational delivery combined adapt irrigation systems to drought</td>
<td>2018</td>
<td>Cody, K.C., Ecology and Society</td>
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<tr>
<td>Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity</td>
<td>2017</td>
<td>Colby (Ch. 3.1.4), Book eds Ziolkowska &amp; Petersen</td>
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<tr>
<td>Towards regional sustainability assessment utilizing community based participatory research, sustainability indicators, and future scenario modeling</td>
<td>2016</td>
<td>Dubinsky, CU Denver</td>
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<tr>
<td>Economic viability of deficit irrigation in the Western US</td>
<td>2018</td>
<td>Manning et al, Agricultural Water Management.</td>
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<td>The role of groundwater trading in spatial water management</td>
<td>2014</td>
<td>Palazzo and Brozovic, Agricultural Water Management.</td>
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<td>Evaluating the potentials of cropping adjustment for groundwater conservation and food production in the piedmont region of the North China Plain</td>
<td>2019</td>
<td>Ren et al, Stochastic Environmental Research &amp; Risk Assessment</td>
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<td>Opportunities for saving and reallocating agricultural water to alleviate water scarcity</td>
<td>2017</td>
<td>Richter et al., Water Policy</td>
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<td>Urban water conservation in the Sacramento, California region during the 2014-2016 drought</td>
<td>2019</td>
<td>Talbot, UC Davis</td>
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<tr>
<td>Remote sensing assessments of consumptive use of agricultural water in western slope of Colorado</td>
<td>2016</td>
<td>Vashisht, Colorado State University,</td>
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<tr>
<td>Deficit irrigation and surface residue cover effects on dry bean yield, in-season soil water content, and irrigation water use efficiency in western Nebraska high plains</td>
<td>2018</td>
<td>Yonts et al, J. of Agricultural Water Management</td>
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<td>Irrigation Efficiency and Water Balance of the Little Wind Unit on the Wind River Indian Reservation in Wyoming</td>
<td>2017</td>
<td>Rosado, U of Wyoming</td>
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<td>Use of Alternative Transfer Methods to Increase Water Supplies for Conejos Basin Agriculture, Municipal, and Environmental Purposes</td>
<td>2017</td>
<td>DiNatale Water Consultants</td>
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<tr>
<td>Development of Land Fallowing-Water Leasing in the Lower Arkansas Valley</td>
<td>2011</td>
<td>Trout, Raley, Montano, Witwer &amp; Freeman, P.C.</td>
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<tr>
<td>Little Thompson Farm ATM Grant Completion Report</td>
<td>2018</td>
<td>Larimer County Natural Resources</td>
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<td>Yampa Basin ATM Study</td>
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<td>TNC, Trout Unlimited &amp; CDM Smith</td>
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<tr>
<td>Title</td>
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<td>Completion Report: Development of Practical Alternative Agricultural Water Transfer Measures for Preservation of Colorado Irrigated Agriculture</td>
<td>May-2011</td>
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<td>Final Project Report: Implementation of Deficit Irrigation Regimes: Demonstration &amp; Outreach</td>
<td>May-2016</td>
<td>Chavez, CSU</td>
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<td>FLEX Water Market: Education and Implementation Phase</td>
<td>Dec-2015</td>
<td>Brown and Caldwell, Ducks Unlimited, Aurora Water and LJCG</td>
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<td>Alternatives to Permanent Dry Up of Formerly Irrigated Lands</td>
<td>Jun-2013</td>
<td>DiNatale Water Consultants &amp; CSU</td>
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<td>Project Report: Lake Canal alternative agricultural practices and in-stream flow demonstration project</td>
<td>Jun-2013</td>
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<td>Hansen, Chavez, Garcia &amp; Lytle</td>
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Demand Management Literature Review

EXHIBIT B
Exhibit B

This Exhibit includes 12 different tables that summarize the findings from the SGM Literature Review. There were 3 sets of documents [SCPP, Lit (General Literature), and ATM] considered across 4 different evaluation criteria (ATM, Environmental, General, and Monitoring & Verification). The following table provides a map of these exhibits.

<table>
<thead>
<tr>
<th>Exhibit</th>
<th>Document Category</th>
<th>Criteria</th>
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<td>B-1</td>
<td>SCPP</td>
<td>ATM</td>
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<td>B-2</td>
<td>Lit (General Literature)</td>
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<td>Monitoring &amp; Verification</td>
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<td>B-11</td>
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<td>B-12</td>
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This table lists the various areas considered for each criterion.

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<td>Identified Local Impacts</td>
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<td>Identified Regional Impacts</td>
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<tr>
<td>Operational Type of Project</td>
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<tr>
<td>Types of Crops</td>
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<td>Agronomic Impacts</td>
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<td>• Yield</td>
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<td>• Quality</td>
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<td>• Recovery</td>
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<td>• Water Quality Effects</td>
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<td>• Soil Health Effects</td>
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<td><strong>Environmental Criteria</strong></td>
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<td>• Magnitude</td>
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<td>• Frequency</td>
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<td>• Duration</td>
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<td>• Timing</td>
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<td>• Rate of change of hydrologic conditions</td>
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<td>• Return Flow Impacts</td>
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<td>Species Impacts</td>
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<td>• Return Flow Impacts</td>
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<td>• Temperature</td>
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<td>• Other</td>
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<td>Data Gaps, Questions for Future Projects</td>
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<td>• Tradeoffs – Resource Impacts</td>
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<td>Program Level Goals</td>
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<td>• No net loss to environmental services, recognizing tradeoffs</td>
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<td>• Build incentives for projects with net environmental benefits</td>
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<td>For Proposed Future Transactions, Need to Evaluate Impacts (Positive or Negative) to:</td>
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<td>• Stream Management Plan (SMP) or Watershed Management Plan (WMP) objectives</td>
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<td>• CRCT Conservation Strategy</td>
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<td>General</td>
<td>Monitoring and Verification</td>
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<td>Project Location Information</td>
<td>Methodologies and/or Processes</td>
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<td>- Project Location Description</td>
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<td>Demand Management Program Basics</td>
<td>- Verify Conserved Consumptive Use</td>
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<td>- DM Program/Activity Name</td>
<td>- Coordination of Benefits</td>
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<td>- DM Program Structure</td>
<td>Necessary Data and Equipment for Agricultural Participants</td>
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<tr>
<td>- Nature of DM Practices</td>
<td>- Representative Crop ET Data</td>
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<td>- Duration of DM Practices Implementation (Duration and Frequency)</td>
<td>- Verification of Conserved Consumptive Use</td>
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<td>- Source of Water Conserved</td>
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<td>- Amount of Water Conserved – Conserved Consumptive Use</td>
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<td>High Level Program Information</td>
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<td>- DM Program Administration</td>
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<td>- DM Program Monitoring and Verification Considerations</td>
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<tr>
<td>- DM Program Education and Outreach Efforts</td>
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<tr>
<td>- Tools Used to Measure General Outcomes</td>
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<td>- DM Program Funding Considerations</td>
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<td>- DM Economic Considerations</td>
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<td>- DM Agricultural Impacts Considerations</td>
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<tr>
<td>- Recreation</td>
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<tr>
<td>Program Effectiveness</td>
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<tr>
<td>- Lessons Learned</td>
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<tr>
<td>- Program Successes and/or Challenges</td>
<td></td>
</tr>
<tr>
<td>- Pros/Cons</td>
<td></td>
</tr>
</tbody>
</table>
- Sub-irrigation
- Reservoir Operations
- River Diversions & Foregone or Bypassed Diversions
- Lateral Delivery and Ditch Loss
- Irrigation and Non-irrigation Season Return Flows
- Resulting Streamflow

### Necessary Data and Equipment for Municipal Participants

- Reservoir Operations
- River Diversions
- Foregone or Bypassed Diversions
- Ditch or Pipeline Delivery
- Overall Collection Systems
- Monitor System-wide Operations to Verify Conserved Consumptive Use
- Detailed System-wide Accounting Records

### Program Level Considerations

- Tradeoffs – Value and/or Cost Implications for More Precise Data
- Proportionality

### M&V Workgroup Guiding Principles

- Honest, Accurate, and Defensible
- Protective of Other Water Users
- Simple, Easy, and Flexible
- Resulted in Added Water, rather than a Retiming of Depletions

### Lessons Learned

### Key Takeaways

- Data Gaps
- Keys to Success
- Identified Challenges
- Overall Findings and Recommendations
Exhibit B-1
SCPP Documents with ATM Criteria
Identified Local Impacts
Identified Regional Impacts
Operational Type of Project
Types of Crops
Vendor
Quality
Financing
Water Quality Effects
Soil Health Effects

**Additional ATM Specific Components**

**Title:** Additional ATM Specific Components
**Date:** 2019
**Post-Conferences:**
**Description:**

**Notes:**

**Operational Type of Project:**

**Types of Crops:**

**Vendor:**

**Quality:**

**Financing:**

**Water Quality Effects:**

**Soil Health Effects:**

---

**Additional ATM Specific Components**

**Title:** Additional ATM Specific Components
**Date:** 2019
**Post-Conferences:**
**Description:**

**Notes:**

**Operational Type of Project:**

**Types of Crops:**

**Vendor:**

**Quality:**

**Financing:**

**Water Quality Effects:**

**Soil Health Effects:**

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**Additional ATM Specific Components**

**Title:** Additional ATM Specific Components
**Date:** 2019
**Post-Conferences:**
**Description:**

**Notes:**

**Operational Type of Project:**

**Types of Crops:**

**Vendor:**

**Quality:**

**Financing:**

**Water Quality Effects:**

**Soil Health Effects:**

---

**Additional ATM Specific Components**

**Title:** Additional ATM Specific Components
**Date:** 2019
**Post-Conferences:**
**Description:**

**Notes:**

**Operational Type of Project:**

**Types of Crops:**

**Vendor:**

**Quality:**

**Financing:**

**Water Quality Effects:**

**Soil Health Effects:**

---

**Additional ATM Specific Components**

**Title:** Additional ATM Specific Components
**Date:** 2019
**Post-Conferences:**
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**Notes:**

**Operational Type of Project:**

**Types of Crops:**

**Vendor:**

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**Financing:**

**Water Quality Effects:**

**Soil Health Effects:**

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**Title:** Additional ATM Specific Components
**Date:** 2019
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**Description:**

**Notes:**

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**Types of Crops:**

**Vendor:**

**Quality:**

**Financing:**

**Water Quality Effects:**

**Soil Health Effects:**

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**Date:** 2019
**Post-Conferences:**
**Description:**

**Notes:**

**Operational Type of Project:**

**Types of Crops:**

**Vendor:**

**Quality:**

**Financing:**

**Water Quality Effects:**

**Soil Health Effects:**
Agronomic Impacts (How long does it take for a crop to fully return to pre-fallowing productivity?)

Project Types of Crops

SCPP-12

Yield Quality Recovery Water Quality Effects Soil Health Effects

Not discussed.

This briefing paper provides a general background on the DCP and demand management. It frames the key issues to address and summarizes the activities completed by the Water Bank Working Group in support of the overall DCP. This overview documents summarizes the studies completed by the Colorado River Water Bank Work Group in their effort to provide information about what types of solutions may be available to preserve communities, agriculture, power production and the river itself.

2019 TNC Addressing Risk and Creating Certainty: Exploring Options for an Upper Basin Demand Management Program

This work includes a two-phase feasibility study, an assessment of how reduced irrigation for compact purposes would work, and pilot projects to test the potential for co-benefits. The phase one of the feasibility study included an evaluation of the current and potential water-banking through two different frameworks and an assessment of the potential economic, social, and environmental impacts. Phase two focused on piloting the compact program by testing a program in the Upper Colorado River Basin.

Colorado River Water Bank Working Group: SCPP-14

Consumptive Use Pilot Projects

Top 3 lessons: outreach & communication is essential, operational & legal issues must be addressed at ditch company/irrigation district level simplify the process for efficiency.

2016 The Nature Conservancy Conserved Consumptive Use Pilot Projects

Not discussed.

2016 The Nature Conservancy Conserved Consumptive Use Pilot Projects

Not discussed.

Considerations for Modeling a Water Bank at the Aspinall Unit with Current Environmental Flows

Analysis used UCRC 2018 Final Report; no new data. 20,000ft view of ISF projects including SCPP projects.

Not discussed.

2018 NA Bureau of Reclamation Description of Wyoming SCPP, how it works, participation, and future efforts.

Lower Colorado River Basin Pilot Program

Not discussed.


This memo evaluates different framework concepts to scale up operations of the Water Bank and provides comparative costs and other factors to consider in different parts of the basin. It also provides a discussion of the potential for creating a regionalized framework concept, and provides opportunities for TNC and the Water Bank Working Group to consider and discuss in ongoing Water Bank development efforts.


"Although the Pilot Program will be ongoing until 2035, as of 2019, future announcements of funding opportunities and requests for additional project proposals are not being contemplated."

Not discussed.

2018 SNWA Water Resource Portfolio 2019

"Conservation Partnership Program approach to drought contingency to create surplus, recharge and banking, DCP, and conservation tools."

This memo evaluates different framework concepts to scale up operations of the Water Bank and provides comparative costs and other factors to consider in different parts of the basin. It also provides a discussion of the potential for creating a regionalized framework concept, and provides opportunities for TNC and the Water Bank Working Group to consider and discuss in ongoing Water Bank development efforts.
Exhibit B-2
Lit (Gen. Literature) Documents with ATM Criteria
<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
<th>Publisher/Authors</th>
<th>Description</th>
<th>Notes</th>
<th>Operational Type of Project</th>
<th>Types of Crops</th>
<th>Yield</th>
<th>Quality</th>
<th>Recovery</th>
<th>Water Quality Effects</th>
<th>End-Health Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis of ag impacts from thermal pollution related to the Columbia River</td>
<td>1999</td>
<td>Stone et al., Marine Resource Commission</td>
<td>Investigates ag impacts of thermal pollution related to the Columbia River, resulting in fish kills, impacts on human health, and the Columbia River's ecological integrity. Various models and approaches are employed to analyze the effects.</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
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</tr>
<tr>
<td>Identification of water systems to abate water quality impacts in the Columbia and Yellowstone Rivers</td>
<td>2013</td>
<td>Webster et al., Journal of Industrial Ecology</td>
<td>Identifies water systems that can abate water quality impacts in the Columbia and Yellowstone Rivers, focusing on the identification of effective and cost-effective solutions.</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
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<td>Not discussed</td>
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</tr>
<tr>
<td>Estimation of regional water quality impacts from irrigation systems and water supply studies in the Lower Colorado River</td>
<td>2015</td>
<td>Aillery et al., Marine Resource Commission</td>
<td>Estimates the regional water quality impacts from irrigation systems and water supply studies in the Lower Colorado River, providing insights into the potential effects on water quality.</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
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<td>Not discussed</td>
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</tr>
<tr>
<td>Analysis of ag impacts on water quality due to irrigation systems and water supply studies in the Lower Colorado River</td>
<td>2016</td>
<td>Dubinski et al., Water Policy</td>
<td>Analyzes the ag impacts on water quality due to irrigation systems and water supply studies in the Lower Colorado River, focusing on the impacts on water quality.</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
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<td>Not discussed</td>
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<tr>
<td>Analysis of ag impacts on water quality due to irrigation systems and water supply studies in the Lower Colorado River</td>
<td>2017</td>
<td>Dubinski et al., Water Policy</td>
<td>Analyzes the ag impacts on water quality due to irrigation systems and water supply studies in the Lower Colorado River, focusing on the impacts on water quality.</td>
<td>Not discussed</td>
<td>Not discussed</td>
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<tr>
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<td>2018</td>
<td>Dubinski et al., Water Policy</td>
<td>Analyzes the ag impacts on water quality due to irrigation systems and water supply studies in the Lower Colorado River, focusing on the impacts on water quality.</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
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<td>Not discussed</td>
<td>Not discussed</td>
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<tr>
<td>Title</td>
<td>Date</td>
<td>Publisher/Authors</td>
<td>Description</td>
<td>Notes</td>
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</tr>
<tr>
<td>Remote sensing assessments of consumptive use of agricultural water in western slope of Colorado</td>
<td>2016</td>
<td>Colorado State University, Colorado</td>
<td>Used remote sensing (e.g., remote sensing of evapotranspiration) to quantify and map water use.</td>
<td>Not discussed</td>
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</tr>
<tr>
<td>Deficit irrigation effects on corn yield and soil properties in eastern Nebraska</td>
<td>2018</td>
<td>Yonts et al., J. of Agricultural Water Management</td>
<td>Study of deficit irrigation effects on corn yield and soil properties.</td>
<td>Not discussed</td>
<td></td>
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<tr>
<td>Irrigation Efficiency and Water Balance of the Little Wind Unit on the Wind River Indian Reservation in Wyoming</td>
<td>2017</td>
<td>Rosado, U of Wyoming</td>
<td>Master’s thesis on irrigation system efficiency in a cold climate.</td>
<td>Not discussed</td>
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</table>
Exhibit B-3
ATM Documents with ATM Criteria
<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
<th>Publisher/Authors</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATM-01</td>
<td>2017</td>
<td></td>
<td>The primary objective of the TMR Study is to investigate the feasibility of a unique ATM that involves enlarging Trujillo Meadows to provide intra-year regulation of water supplies for municipal and agricultural purposes.</td>
<td></td>
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<tr>
<td>ATM-02</td>
<td>2018</td>
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<tr>
<td>ATM-03</td>
<td>2018</td>
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<tr>
<td>ATM-04</td>
<td>2018</td>
<td></td>
<td></td>
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<tr>
<td>ATM-05</td>
<td>2017</td>
<td></td>
<td>Very brief report on &quot;one potential mechanism through which water associated with CCU could be protected and returned to the Little Thompson River for use in interior basins.&quot;</td>
<td></td>
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<tr>
<td>ATM-06</td>
<td>2017</td>
<td></td>
<td></td>
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<tr>
<td>ATM-07</td>
<td>2017</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ATM-08</td>
<td>2017</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATM-09</td>
<td>2017</td>
<td></td>
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</tbody>
</table>

### Additional ATM Specific Considerations

<table>
<thead>
<tr>
<th>Type of Crop</th>
<th>Field</th>
<th>Quality</th>
<th>Recovery</th>
<th>Other Water Effects</th>
<th>Sediment Effects</th>
</tr>
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<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>Title</td>
<td>Date</td>
<td>Public/Students</td>
<td>Description</td>
<td>Additional ATM Specific Components</td>
<td></td>
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<td>-------</td>
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</tr>
<tr>
<td>Demonstration &amp; Outreach</td>
<td>May-16</td>
<td>North Poudre Irr Co, Water Supply &amp; Storage Co, New Cache La Poudre District</td>
<td>Identifies the need for developing a clear understanding of the CCU calculation methods and the potential barriers to implementation. Establishes actions for implementing demonstration and outreach activities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Water Plan and evaluation of state water sector infrastructure in the South Platte basin</td>
<td>March 15</td>
<td></td>
<td>Potential for added water throughout season to a long reach of Cache La Poudre River (Lake Canal Diversion to Greeley No. 3 Diversion).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Proposal: Alternative Agricultural Water Transfer Program and demonstration project</td>
<td>June 15</td>
<td></td>
<td>Potential for enhanced flows in the river for environmental benefits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Report of the Lower South Platte</td>
<td>Jun-14</td>
<td></td>
<td>Potential for alternative agricultural water transfer for the two case studies; findings include recommendations for best ATM practices to suit those municipalities.</td>
<td></td>
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</tr>
</tbody>
</table>

### Goals
- Develop calculation & verification of ET models
- Demonstration of the ReSET model of remote sensing. ReSET showed accuracy of 92-98% for fields under normal growing conditions and successfully detected abnormal growing conditions to accordingly adjust irrigation. Task 3. Estimate supply delivery potential. Project on Lower South Platte Irrigation Research Farm near Iliff.

### M&I
- M&I still gets water but ag gets to use more than it would during buy-and-dry
- Review of benefits and issues of buy and dry and alternatives. Potential for conversion of ag land to dry land or deficit-irrigation, economic & maintenance issues w/dry land & deficit.

### IWSA for deficit irrigation, with some fallowing
- Water market experiment, survey of municipal & industrial providers on ATM practices, leases, evaluation of shared water bank scenarios on South Platte, focused on FRICO shareholders.

### Potential for added water throughout season to a long reach of Cache La Poudre River (Lake Canal Diversion to Greeley No. 3 Diversion)
- Potential for enhanced flows in the river for environmental benefits.
Exhibit B-4
SCPP Documents with Environ. Criteria
Program level goals For proposed future transactions, need to evaluate impacts (positive or negative) to:

- Streamflow (Hydrology) Impacts
- Environmental Resources that May be Affected Data Gaps, Questions for Future Projects
- Species Impacts
- Water Quality Impacts

Title | Date | Publisher/Authors | Description | Notes
--- | --- | --- | --- | ---
Tradeoffs - Resource Impacts | CRCT conservation strategy | BRT environmental values lists/ mapping | SMP or WMP objectives / proposed projects

3 environmental flow targets below Aspinall Unit considered: - Black Canyon of the Gunnison National Park Service, - and the targets for fish screening, passage and migration at the Redlands dam about 6 miles below the... Program)), - and the targets for fish screening, passage and migration at the Redlands dam about 6 miles below

Discusses how StateMod configuration is set up to model return flows. However, modeling was not done in this analysis, so there are no results to share on how the water banking project would impact return flows.

Build incentives for projects with net env. benefits.

Discusses how StateMod configuration could be changed to simulate environmental flow targets (through the Black Canyon and at Whitewater), including base flow and peak flow targets. However, modeling was not done in this analysis, so there are no results to share on how the water banking project would impact flows.

Critical Land or Riparian Habitat Impacted
Species Impacted
Salinity Temperature Other
Rate of change of
hydrologic conditions
Return Flow Impacts
Critical Stream Reaches Impacted

Evaluation of computer models of the Gunnison River to assess their ability to simulate a potential water bank in the basin using the Aspinall Unit reservoirs and the effect on reservoir operations, including environmental flows


StateMod, Aspinall PBO/EIS Model, and CRSS are evaluated for

Considerations for Modeling a Water

Analysis used UCRC 2018 Final Report; no new data. 20,000ft view of ISF projects including SCPP projects.

"Most of the transactions have multiple benefits, including improving water security, piloting water conservation tools, ... synergy between the goals of promoting water conservation, enhancing water security and restoring streamflow. Projects

In Arizona, "TNC has been working with the Diamond S

Reviews CRB environmental transfers to track extent of activity. Examines SCPP projects by this lens, given the ISF benefits of SCPP. Found that SCPP-funded projects had the effect of enhancing streamflow.

Although the Pilot Program will be ongoing until 2035, as of 2019, future announcements of funding opportunities and requests for additional project proposals are not being contemplated.

Neither extensive nor technical, but includes some description of process & participation.

Description of Wyoming SCPP, how it works, participation, and future efforts.

"Although the Pilot Program will be ongoing until 2035, as of 2019, future announcements of funding opportunities and requests for additional project proposals are not being contemplated."
Exhibit B-5
Lit (Gen. Literature) Documents with Environmental Criteria
Exhibit B-6
ATM Documents with Environmental Criteria
Projects that involve storage have the benefit of operational flexibility for timing of releases for environmental...
**Program level goals**

For proposed future transactions, need to evaluate impacts (positive or negative) to:

- Streamflow (Hydrology)
- Impacts

**Next Steps**

- Environmental Resources that May be Affected
- Data Gaps, Questions for Future Projects

### Title Date Publisher/Authors Description

<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
<th>Publisher/Authors</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species Impacts Water Quality Impacts</td>
<td>June-13</td>
<td>Formerly Irrigated Lands</td>
<td>Impact: it was understood that return flows would be replaced in time, amount, and location, thereby causing no negative impact to streamflow.</td>
</tr>
<tr>
<td></td>
<td>March-12</td>
<td></td>
<td>In the survey of FRICO shareholders, one question asked if respondents are willing to sign a lease in which the water is used to maintain instream flows for river system recreation: 24.1% are willing, 48.3% are not willing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Review of ATMs in Colorado for Front Range Municipalities. The report conducted a screening analysis to identify ATMs and their influence on streamflow impacts and management. Findings include recommendations for best ATM practices to suit those municipalities.</td>
</tr>
</tbody>
</table>
| | | | The report identifies that a goal of ATMs in general is “to maintain or improve streamflow which support environmental and recreational activities” and that environmental interests can be involved in water transfers. Specific benefits and impacts are not discussed in this report.
| | | | The report notes the costs of storage for return flows and all downstream reaches.” Instream flow benefits of diversion reductions are only realized for the stream reach between the point of diversion and the location of return flows. Specific benefits and impacts are not discussed in this report. |

---

**Tradeoffs - Resource Impacts**

- BRT environmental values lists/mapping
- State species of concern

**Impact:** it was understood that return flows would be replaced in time, amount, and location, thereby causing no negative impact to streamflow.

**Potential benefit of Water Allocation Approach:** The return flow assumptions are conservative and additional return flows may provide benefits to rivers and downstream users.

**Mechanisms for Front Range Municipalities**

- Alternative agricultural water transfer methods in the South Platte basin.

---

**Additional Information**

- Reports exist
- ATM-18
- Irrigation Research and Demonstration
- ATM-17
Exhibit B-7
SCPP Documents with General Criteria
<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
<th>Publisher/Authors</th>
<th>Description</th>
<th>Notes</th>
<th>Identified Program Successes and/or Challenges</th>
<th>Program Pros/Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCPP-04</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td>Successes: The GV CCUPP had several off-farm benefits:</td>
<td></td>
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<tr>
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<td></td>
<td></td>
<td>- Hydropower benefits of $9,950.</td>
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<td>- Environmental benefits of $8,900.</td>
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<td>- Reduced the risk of future curtailment.</td>
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<td></td>
<td>- Reduced net consumptive use (CU) for the basin.</td>
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<td>- Central to saving water for the future.</td>
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<td>- Farmer/policy education was important.</td>
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<td>- Projects had little to no increase in the levels in Lake Powell.</td>
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<tr>
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<td>- Total water savings were between 2.2 and 4.3 million cubic feet.</td>
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<td></td>
<td>- Farmers were interested in the program.</td>
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<td></td>
<td></td>
<td></td>
<td>- Not discussed.</td>
<td></td>
</tr>
</tbody>
</table>

**Grand Valley CCUPP**

- Paid farmers to voluntarily conserve water.
- Successes:
  - Hydropower benefits of $9,950.
  - Environmental benefits of $8,900.
  - Reduced the risk of future curtailment.
  - Reduced net consumptive use (CU) for the basin.
  - Central to saving water for the future.
  - Farmer/policy education was important.
  - Projects had little to no increase in the levels in Lake Powell.

**Colorado River Water Bank**

- Derived from consumptive irrigation requirement of irrigated areas in the Basin.
- Estimated with the State of Colorado's water model.
- Cost of $1,125/acre for grass hay and alfalfa.
- Does not discuss in detail.
- Concern about secondary economic impacts and impacts to ditch companies.

**SCPP-05**

- Specific program structure was not clearly defined.
- Local outreach is critical to build trust and promote participation.
- Infographic: Grand Valley Pilot Project.

**SCPP-06**

- Varies across 45 individual project locations.
- Successes:
  - For outreach and education, involving and building relationships with those "on-the-ground".
  - "Those who understand and are affected by the water issues.
  - "Those who are impacted by the program.
  - "Those who work directly with water issues in their communities.
  - "Those who have a stake in the outcomes.

- Source was assumed to be from a "specific source".
- Does not discuss in detail.

**Ohio River Water Bank**

- Does not discuss in detail.
- Does not discuss in detail.

**Lower Colorado River Basin Projects: CA, AZ, NV, CO**

- U.S. Bureau of Reclamation (USBR), Central Arizona Project (CAP), and First-run Canal and Drainage District (FCD).
- Briefly evaluates Upper Basin risk based on drought hydrology, and discusses how to reduce that risk.
- Asks many questions, e.g. through local coordination of projects.
- Tabulates past options considered for avoiding compact curtailment.

**Upper Colorado River Basin Pilot Project (UCRP)**

- Other possible uses for the basin.
- Including potential WB uses, supply, magnitude & frequency of need, supply-use scenarios.
- SWEP & ensures that projects will coordinate with respective water rights holders.
- Includes potential WB uses, supply, magnitude & frequency of need, supply-use scenarios.
- App. D: Basic supply & use comparison scenarios for CRC WB technical memo.

**Pilot Program in the Lower Basin**

- Expected to create 175,347 acre-feet of system conservation in Lake Mead by 2035.
- 165,618 acre-feet of system conservation are expected to be conserved in Lake Mead.

**Colorado River Water Bank Feasibility Phase 1 Feasibility Study**

- To estimate the feasibility of a Colorado River Water Bank Program.
- Does not discuss in detail.
- Does not discuss in detail.
- Not discussed.
- Not discussed.
- Not discussed.
- Success: The project addressed negative externalities within the community "in a meaningful manner before any long-term and/or large-scale agricultural demand management program."
As of 2018, SNWA has more than 335,000 acre-feet of water stored in the Southern Nevada Water Bank for future use through an agreement with LVVWD. SNWA has planned to bank on a pay-as-you-go basis up to 1.25 million acre-feet. SNWA can recover up to 40,000 AFY during any water supply shortage. Review includes all of SNWA's water resources portfolio, which includes water banked under different conditions.

### DM Program Basics

<table>
<thead>
<tr>
<th>Source and Amount of Conserved Water</th>
<th>Duration of DM</th>
<th>Description Nature of DM Practices</th>
<th>Tools Used to Measure General Outcomes</th>
<th>DM Program Administration</th>
<th>DM Program Economic Considerations</th>
<th>Source of Water</th>
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</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>This is not a specific DM program but rather a review of SNWA's portfolio and the steps SNWA has taken to improve water demand and the availability of water in future years.</td>
</tr>
</tbody>
</table>

### Program Effectiveness

Success: Outreach and education across all sectors in the community helped to improve efficiency and decrease truly consumptive water uses.

### Program Lessons Learned

Not discussed. Not discussed. Not discussed. Not discussed. Not discussed. SNWA has focused for years on water used by agriculture. Remove unused turf- Change irrigation clocks to follow mandatory time-of-day and day-of-week watering restrictions.

### Program Evaluation

This paper describes Southern Nevada Water Authority (SNWA)'s water resources portfolio, including: Permanent Resources, Temporary Resources, and Future Resources. Permanent Resources include: Colorado River supplies (including return-flow credits); Tributary Conservation Intentionally Created Surplus (ICS); permitted groundwater rights in the Las Vegas Valley; and reclaimed water conservation. Groundwater, Virgin River/Colorado River Augmentation, Transfers/Exchanges. Water Conservation is also discussed.

Chapter from SNWA's water plan evaluates different framework concepts to scale up operations of the Water Bank and provides comparative costs. This analysis displays the importance of a framework to keep water leasing costs stable compared to alternative options. This framework is likely required to keep lease rates low during a drought period, when water supplies will be stressed. This was not a DM program. This analyzed 4 frameworks for leasing water - specifically the financial costs of water banking - not a project but a study. Cost analysis of each framework. Not discussed - does not describe funding sources. Relative costs are determined for the different frameworks spreadsheets based on the volume of water leases, number of associated acres, and number of farms or ranches leasing water.

This memo evaluates different framework concepts to scale up operations of the Water Bank and provides comparative costs numbers for TNC and the Water Bank Working Group to consider and discuss in ongoing Water Bank development efforts. This was not a DM program. This analyzed 4 frameworks for leasing water - specifically the financial costs of water banking - not a project but a study. Cost analysis of each framework. Not discussed - does not describe funding sources. Relative costs are determined for the different frameworks spreadsheets based on the volume of water leases, number of associated acres, and number of farms or ranches leasing water.
Exhibit B-8
Lit (Gen. Literature) Documents with General Criteria
Investigates ag impacts of fish recovery measures "such as: modified timing for dam releases, reservoir drawdown, and ... with a large reduction in irrigation diversions--would reduce producers' profits by $35 million (2.5%) annually."

"Reclamation has been purchasing water in the upper Snake River basin since 1993. More than 57,500 acre-feet in permanent ... transactions. Combined, these purchases total roughly 75% of the interim goal for flow augmentation of 0.427 maf."

Analysis of ag impacts from salmon-recovery-related flow alterations in Columbia River the 7 scenarios of reservoir drawdowns and/or flow augmentations. Decreases in producer profits for the region are as ... augmentation (low flow) and Reservoir draw down (2 month)) - 0.46%Scenario 7 (Flow augmentation (high flow) and Reservoir

Studied the levelized costs for technologies in a "replace-immediately" scheme versus a "replace-as-retire" scheme 1999 Aillery et al, Marine Resource Economics

Not discussed. Municipal demand - "Estimate the technically feasible levelized cost of water provided by seven

Not discussed. Agriculture -The results of the simulations indicate that:

Temporary water transfers for urban water supply during drought period from 2011-2014 has a documented history of regular irrigation, "regulated deficit irrigation", Seasonal (rather than year-round) suspension of irrigation locations across several states

"A comprehensive literature and internet survey was undertaken to identify well-documented studies of water-saving ... document, or could it reasonably be assumed, that crop yields would not be decreased (i.e. within 5% of original yield)?"

"Among irrigated crops in the region, dry bean (a major cash crop and critical... application (sub-surface drip)

Deficit irrigation and surface residue application (sub-surface drip)

Balance of the Little Wind Unit on the... compacts for transfers that are limited in duration. And since existing statutes nearly universally task the state

year approval would require an additional approval, which would be subject to appeal.

Although not a DM Program, this study did mention the influence on various cropping patterns and maize and wheat production.

"The study advances the literature by considering the combined effects on irrigation performance of shortage sharing and ... a wide array of crops, with different social and cultural norms, and various technological and infrastructural mixes.

"Our analysis highlights the importance of the initial distribution of permits and the institutional context in which... of groundwater pumping rights are distributed unevenly between wells, counties, and groundwater management institutions."
Exhibit B-9
ATM Documents with General Criteria
Exhibit B-10
SCPP Documents with M&V Criteria
## Research Synthesis: Agronomic Impacts

**Deficit Irrigation**

- Daily climate data required for the Penman-Monteith method were required, and include: air temperature, humidity, radiation and wind speed.

**StateCU**

- The lack of adequate measurement devices at the 8 project locations indicates the need for CU calculations based on remote sensing, meteorological data, or use of standard water requirements by crop type, elevation and irrigation type.
- Not directly discussed, but paper recommended fields for fallowing/deficit irrigating should be selected to avoid areas... to compute actual CU savings for Water Bank contributions based on the difference between diversions and return flows.

**Colorado River Water Bank Feasibility**

- Not discussed. The establishment of the SCPP was not discussed.
- Not applicable for the pilot program agreement. Not applicable for the pilot program agreement.
- Not discussed. The test case system interviews reaffirmed this understanding.
- Not applicable for the pilot program agreement.
- By withholding irrigation for one season on high-elevation grass hayfields the following conclusions were made: - ... year. - Based on limited data, it appears that yields will recover to near normal by the second year of full irrigation.
- Not directly discussed, but paper recommended fields for fallowing/deficit irrigating should be selected to avoid areas... to compute actual CU savings for Water Bank contributions based on the difference between diversions and return flows.

**StateCU**

- StateCU was used to estimate the irrigation water requirement or consumptive irrigation requirement.
- Local climate station were used within the StateCU analyses.
- Not addressed. Identified that return flow considerations and modeling were likely important.
- Alfa...
<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
<th>Publisher/Authors</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>River diversions &amp; Irrigation and non-consumptive use</td>
<td></td>
<td></td>
<td>The study includes a review of the environmental impacts study associated with irrigation and non-consumptive use, and provides a high-level assessment of environmental impacts of all recommended and alternate water management strategies for Texas.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Economic model of water cost provided by above-code water efficiency and reuse technologies, including variations &amp; uncertainty analysis.</td>
<td></td>
<td></td>
<td></td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Study of farmer response to gov't demand management, switching crops.</td>
<td></td>
<td></td>
<td></td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Response to water crisis: How do Iranian farmers respond to water crisis?</td>
<td></td>
<td></td>
<td>“Structural equation modeling showed that farmers' intention to change from rice cultivation to another crop is determined by personal norms, beliefs about their role and emotional considerations.”</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Evaluation of different cropping patterns (including fallowing) &amp; water supply scenarios.</td>
<td></td>
<td></td>
<td>Towards regional sustainability goals, the study evaluated the impacts of different cropping patterns and water supply strategies.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Rotational practice among alfalfa growers</td>
<td>2017</td>
<td>Cody, K.C., Ecology and Society</td>
<td>1) Change in rotational practice among the alfalfa growers from 7 years of alfalfa and 1 year of grain to 5 years of alfalfa and 2 years of grain; 2) Fallowing of 7,500 acres of alfalfa/grain (7 yr./1 yr.) rotation land; 3) Fallowing of 25,000 acres of land in the alfalfa/grain (7 yr./1 yr.) rotation to a potato/green manure cover crop rotation (1 yr./1 yr.); 4) Shifting of 35,000 acres of land in the potato/grain (1 yr./1 yr.) rotation to a potato/green manure cover crop rotation (1 yr./1 yr.)</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Measured by pumping and sub-surface irrigation. Crop yield was the overall focus.</td>
<td></td>
<td></td>
<td>The study evaluated the impact of rotational and fallow practices on crop yield and water use efficiency.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Sub-surface drip irrigation and planting directly in crop residue did not improve bean yield under deficit irrigation. Ample early season rainfall ensures that enough water is delivered to saturate the crop base.</td>
<td></td>
<td></td>
<td>The study evaluated the impact of deficit irrigation on bean yield and water use efficiency.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Timing of irrigation relative to the growth of the plant could be helpful when timing deficit irrigation.</td>
<td></td>
<td></td>
<td>The study evaluated the impact of irrigation timing on crop yield and water use efficiency.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Greater revenue and water-saving benefits could be realized from other crop-shifting transitions, particularly when yields of the new crop are lower. Strategies for reducing beneficial consumptive use through crop management (i.e., by temporary fallowing or shifting to a lower water requirement crop)</td>
<td></td>
<td></td>
<td>The study evaluated the impact of crop management strategies on revenue and water use efficiency.</td>
<td>Not discussed.</td>
</tr>
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<td>- Greater revenue and water-saving benefits could be realized from other crop-shifting transitions, particularly when yields of the new crop are lower. Strategies for reducing beneficial consumptive use through crop management (i.e., by temporary fallowing or shifting to a lower water requirement crop)</td>
<td></td>
<td></td>
<td>The study evaluated the impact of crop management strategies on revenue and water use efficiency.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>- Benefits of rotation are that it may generate the optimal combination of quantity and quality of crop products, and increase profitability.</td>
<td></td>
<td></td>
<td>The study evaluated the impact of rotational practices on profitability and crop quality.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>The Colorado Drought Response Plan uses the SWSI to activate the Water Availability Assessment and Management System.</td>
<td></td>
<td></td>
<td>The study evaluated the impact of drought response plans on water availability and management.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Urban water conservation in the Republican River Basin</td>
<td></td>
<td></td>
<td>The study evaluated the impact of water conservation strategies on water availability and management in the Republican River Basin.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Locally based water supply forecasting and water conservation measures.</td>
<td></td>
<td></td>
<td>The study evaluated the impact of water supply forecasting and conservation measures on water availability and management.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Professional and public outreach programs used to increase awareness and education about water conservation.</td>
<td></td>
<td></td>
<td>The study evaluated the impact of professional and public outreach on water conservation awareness and education.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Decision support systems (DSS) were used to evaluate the impact of different water management strategies.</td>
<td></td>
<td></td>
<td>The study evaluated the impact of different water management strategies on decision support system outcomes.</td>
<td>Not discussed.</td>
</tr>
<tr>
<td>Procedures in Colorado</td>
<td></td>
<td></td>
<td>The study evaluated the impact of procedures in Colorado on water management strategies.</td>
<td>Not discussed.</td>
</tr>
</tbody>
</table>
Exhibit B-12
ATM Documents with M&V Criteria
<table>
<thead>
<tr>
<th>ATM</th>
<th>Benefit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATM-02</td>
<td>Helps alleviate Rio Grande Compact obligations and distribute curtailments throughout basin</td>
<td></td>
</tr>
<tr>
<td>ATM-03</td>
<td>Recommended conveyance from Conejos River to San Antonio River</td>
<td></td>
</tr>
<tr>
<td>ATM-04</td>
<td>Reduced return flow to Little Thompson River as a result of ATM</td>
<td></td>
</tr>
<tr>
<td>ATM-05</td>
<td>Verification of conserved water for irrigation season, e.g., estimated from streamflow measurements or depletions and/or augmentation</td>
<td></td>
</tr>
</tbody>
</table>

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**Study conducted by Trout Unlimited (TU) and funded by CWCB's Alternative Agricultural Water Transfers Grant Program.** The Study seeks to improve flows in the reach between to improve flows for trout (including Colorado cutthroat trout) or warmwater fish, which is facilitated by water leasing (fallowing or fallow practices). The Study was conducted between May-15 and May-16, involving local participation through ag organizations, roundtables, conservancy districts, etc. Content not discussed:

- ATM-06
- ATM-07
- ATM-08
- ATM-09

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Programs that can address the barriers listed in the next cell:

- Personalized approach to ag about ground-based techniques (CWSI, ReSET) with similar or worse accuracy compared to industry make it tough to work out deals; customized approach for infrastructure needs on a case-by-case basis to assess needed infrastructure; Pipelines to deliver increased water in streams rather than just a retiming but it would depend on the crop type (potentially higher, if irrigation with an 83% efficiency for sprinklers and 60% for flood)
- Economic laboratory experiment to test water leasing market results: Ag users will retain more water rights and more water than in typical buy-and-dry practices and may need additional pipelines/ditches or pumping to get water to the historical patterns; may need multiple infrastructure changes to re-establish timing
- Hypothetically yes, irrigators get paid for conserving water (fallowing or deficit irrigation) and the M&I interest in environmental flows for longer reach through Fort Collins could've been achieved
- This project was not actually implemented

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**Completion Report:** Development of three ATM programs that can address the barriers listed in the next cell:

- Hypothetically, yes. This project was not actually implemented
- Not discussed
- Not discussed
- Not discussed
- Not discussed
- Not discussed
- Not discussed
- Not discussed
- Not discussed
- Not discussed
- Not discussed
- Not discussed
- Not discussed

---

**Tasks and Considerations:**

- Ground-based techniques (CWSI, ReSET) have similar or worse accuracy compared to industry make it tough to work out deals; customized approach for infrastructure needs on a case-by-case basis to assess needed infrastructure; Pipelines to deliver increased water in streams rather than just a retiming but it would depend on the crop type
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- Hypothetically yes, irrigators get paid for conserving water (fallowing or deficit irrigation) and the M&I interest in environmental flows for longer reach through Fort Collins could've been achieved
- This project was not actually implemented

---

**Discussions:**

- Ground-based techniques (CWSI, ReSET) have similar or worse accuracy compared to industry make it tough to work out deals; customized approach for infrastructure needs on a case-by-case basis to assess needed infrastructure; Pipelines to deliver increased water in streams rather than just a retiming but it would depend on the crop type
- Economic laboratory experiment to test water leasing market results: Ag users will retain more water rights and more water than in typical buy-and-dry practices and may need additional pipelines/ditches or pumping to get water to the historical patterns; may need multiple infrastructure changes to re-establish timing
- Hypothetically yes, irrigators get paid for conserving water (fallowing or deficit irrigation) and the M&I interest in environmental flows for longer reach through Fort Collins could've been achieved
- This project was not actually implemented

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**Return Flow Needs:**

- Return flow needs may require additional recharge ponds & stations; Return flows unnecessary at times due to trans-basin supply; considers monthly return flow "factors;" Most storage included - water leasing (fallowing or fallow practices)

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**Hyptothetically yes, irrigators get paid for conserving water (fallowing or deficit irrigation) and the M&I interest in environmental flows for longer reach through Fort Collins could've been achieved**

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**Allocation Method:**

- Allocation method for maintaining return flows require the availability of credits through an approved augmentation plan and/or hydrologic modeling, but no significant investment in infrastructure or equipment needed other than local weather data (could be from SCADA or other monitoring systems)

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**Yes all three ET estimates are peer-reviewed science-based methodologies**

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**Limited/Deficit Irrigating ET estimates were compared in actual test plots:**

- Stress coefficient - Crop Water Stress Index (CWSI) - ReSET mode (satellite-based method)
- Yes Yes Significant gains will have to be made in order to reach program goals by 2030 Not discussed Detailed accounting Not enough curtailment/forbearance/fallowing to reach program goals
- Allocation method for maintaining return flows require the availability of credits through an approved augmentation plan and/or hydrologic modeling, but no significant investment in infrastructure or equipment needed other than local weather data (could be from SCADA or other monitoring systems)

---

**Hypothetically yes, this project was not actually implemented**

---

**Ground-based techniques (CWSI, ReSET) have similar or worse accuracy compared to industry make it tough to work out deals; customized approach for infrastructure needs on a case-by-case basis to assess needed infrastructure; Pipelines to deliver increased water in streams rather than just a retiming but it would depend on the crop type (potentially higher, if irrigation with an 83% efficiency for sprinklers and 60% for flood).**

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**Yes all three ET estimates are peer-reviewed science-based methodologies**

---

**ATM-02:**

- Helps alleviate Rio Grande Compact obligations and distribute curtailments throughout basin
- Recommended conveyance from Conejos River to San Antonio River
- Reduced return flow to Little Thompson River as a result of ATM
- Verification of conserved water for irrigation season, e.g., estimated from streamflow measurements or depletions and/or augmentation

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**Study conducted by Trout Unlimited (TU) and funded by CWCB's Alternative Agricultural Water Transfers Grant Program.**

- The Study seeks to improve flows in the reach between to improve flows for trout (including Colorado cutthroat trout) or warmwater fish
- Local participation through ag organizations, roundtables, conservancy districts, etc.
- Content not discussed:
  - ATM-06
  - ATM-07
  - ATM-08
  - ATM-09

---

**Programs that can address the barriers listed in the next cell:**

- Personalized approach to ag about
  - Ground-based techniques (CWSI, ReSET) with similar or worse accuracy compared to industry make it tough to work out deals; customized approach for infrastructure needs on a case-by-case basis to assess needed infrastructure; Pipelines to deliver increased water in streams rather than just a retiming but it would depend on the crop type (potentially higher, if irrigation with an 83% efficiency for sprinklers and 60% for flood)
- Economic laboratory experiment to test water leasing market results: Ag users will retain more water rights and more water than in typical buy-and-dry practices and may need additional pipelines/ditches or pumping to get water to the historical patterns; may need multiple infrastructure changes to re-establish timing
- Hypothetically yes, irrigators get paid for conserving water (fallowing or deficit irrigation) and the M&I interest in environmental flows for longer reach through Fort Collins could've been achieved
- This project was not actually implemented