COLORADO
Colorado Water Conservation Board
Department of Natural Resources

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Jared Polis, Governor

Dan Gibbs, DNR Executive Director

Rebecca Mitchell, CWCB Director

TO: Colorado Water Conservation Board Members

FROM: Ben Wade
Water Supply Planning Section

DATE: September 8, 2022

AGENDA ITEM: Consent Agenda 5e Colorado Water Plan Grants – Engagement and Innovation

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Introduction
Per CWCB Policy #25, grants above $50,000 but less than $100,000 and grants not recommended for funding will be placed on the consent agenda for consideration by the Board. See attached Data Sheets and grant application for additional project details.

For the first Water Plan Grant cycle of the 2022-2023 fiscal year, the CWCB received 2 Engagement & Innovation grant applications, totaling $279,821 in requests. Of these requests, one application submitted requested under $50,000, totaling $41,721, and another application, with a request of $238,100, is not recommended for funding.

Staff Recommendation:
Staff recommends the following Board action for activities listed in the following table regarding Colorado's Water Plan Grant Program funding.

Applicant	Project Name	Grant Request Amount	Staff Recommendation
e. Roaring Fork Conservancy	Exploring Social & Environmental Controls on the Scalability of Water Conservation Program	$238,100	$0

Background:
Staff received seven applications at the July 1, 2022 deadline. Staff initially conduct a red-flag review of each application to determine whether the grant complies with all current CWCB policies and guidelines concerning grant awards.

Following the initial red-flag review, CWCB Staff scored all Engagement/Innovation applications according to the Colorado Water Plan Grant Program criteria and guidelines and Engagement/Innovation category-specific criteria, with input from a grant review committee. The grant review committee consisted of Colorado Water Conservation Board staff.

The review committee evaluates engagement/innovation grants on several criteria, including:

- whether the project achieves education, outreach and engagement measurable objectives orcritical actions identified in the Colorado Water Plan
- whether the project measures and evaluates the overall success and impact of the project
- whether the project is identified in a Basin Implementation Plan
- Concerning state budget challenges, staff also considers whether the proposed project is financially and technically feasible
- Staff also considers all letters of support included with the application.

Project Issues/Additional Needs

All funding awards are contingent upon the applicants' ability to secure match funding within a reasonable period, based on their continued efforts to secure match funding.

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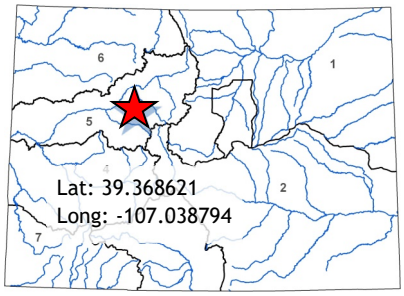
Exploring Social & Environmental Controls on the Scalability of Water Conservation Programs

Roaring Fork Conservancy

September 2022 Board Meeting

Water Plan Grant Application



LOCATION
Counties: Eagle, Garfield, Grand, Mesa, Pitkin
Drainage Basin: Colorado

DETAILS	
Total Project Cost:	$324,400
Water Plan Grant Request:	$238,100
Recommended Amount:	$0
Other CWCB Funding:	$0
Other Funding Amount:	$76,300
Applicant Match:	$10,000
Project Type(s): Study, Other	
Project Category: Engagement & Innovation	
Measurable Result: "400 Coloradoans Impacted by Engagement Activity; Project would benefit water policy development that impact thousands of Coloradoans & indirectly impacts millions".	

The applicant, the Roaring Fork Conservancy, serves residents and visitors throughout the Roaring Fork Valley through school and community-based Watershed Education programs and Watershed Science and Policy Projects including regional watershed planning, water resource policy initiatives, stream management, and restoration.

The applicant states the implementation of demand management programs across Colorado is "an important strategy proposed for reducing risks that persistent drought, growing populations, and climate change place on a finite water supply". The applicant further stated that since a limited number of pilot studies to date have aimed to implement and test outcomes of demand management efforts among agricultural producers, there is little data available to characterize demand management program participation rates at scale.

The applicant proposed this research project to provide this data by conducting a survey among 400 diverse agricultural water users on the Western Slope. Once the survey was finished, the applicant proposed to estimate the effectiveness and proposed to link the survey results to hydrological simulation models in StateMod. This included changes in the coding of StateMod.

The applicant secured funding from the Colorado River District and the American Rivers for the survey. In addition to seeking grant funds from both entities, the applicant proposed to use Water Plan grant funds for the remaining tasks.

Funding Recommendation: Staff is not recommending funding for this project. Similar outreach and surveys of Western Slope producers were conducted by CWCB Board & Staff in 2020 and 2021 and significant resources have been allocated to the Demand Management feasibility investigation to date. The Review Committee also did not see enough value in the proposed enhancements of StateMod for CWCB decision-making. Most importantly, the Committee believes it would be premature at this time to recommend any demand management proposals while the Board is still considering the feasibility of a Demand Management program.

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Water Plan

Water Project Summary

Name of Applicant	Roaring Fork Conservancy
Name of Water Project	Exploring social and environmental controls on the scalability of water conservation programs.
Grant Request Amount	**$238,100.00**
Primary Category	$238,100.00
Engagement & Innovation Activities	
Total Applicant Match	**$10,000.00**
Applicant Cash Match	$5,500.00
Applicant In-Kind Match	$4,500.00
Total Other Sources of Funding	**$76,300.00**
Colorado River Water Conservation District	$41,300.00
American Rivers	$35,000.00
Total Project Cost	**$324,400.00**

Applicant & Grantee Information

Name of Grantee: Roaring Fork Conservancy
Mailing Address: 22800 Two Rivers Road Basalt CO 81621
FEIN: 841,376,379

Organization Contact: Heather Lewin
Position/Title:
Phone: (970) 710-9023
Email: heather@roaringfork.org

Organization Contact - Alternate: Rick Lofaro
Position/Title: Executive Director
Phone: 9709271290
Email: rick@roaringfork.org

Grant Management Contact: Heather Lewin
Position/Title:
Phone: (970) 710-9023
Email: heather@roaringfork.org

Grant Management Contact - Alternate: Rick Lofaro
Position/Title: Executive Director
Phone: 9709271290
Email: rick@roaringfork.org

Description of Grantee/Applicant

Since 1996, Roaring Fork Conservancy has inspired people to explore, value, and protect the Roaring Fork Watershed. We bring people together to protect our rivers and work hard to keep water in local streams, monitor water quality, and preserve riparian habitat.

As one of the largest watershed organizations in Colorado, Roaring Fork Conservancy serves residents and visitors throughout the Roaring Fork Valley through school and community-based Watershed Education programs and Watershed Science and Policy Projects including regional watershed planning, water resource policy initiatives, stream management, and restoration.

Type of Eligible Entity

- ☐ Public (Government)
- ☐ Public (District)
- ☐ Public (Municipality)
- ☐ Ditch Company
- ☐ Private Incorporated
- ☐ Private Individual, Partnership, or Sole Proprietor
- ■ Non-governmental Organization
- ☐ Covered Entity
- ☐ Other

Category of Water Project

- ☐ Agricultural Projects
  Developing communications materials that specifically work with and educate the agricultural community on headwater restoration, identifying the state of the science of this type of work to assist agricultural users among others.
- ☐ Conservation & Land Use Planning
  Activities and projects that implement long-term strategies for conservation, land use, and drought planning.
- ■ Engagement & Innovation Activities
  Activities and projects that support water education, outreach, and innovation efforts. Please fill out the Supplemental Application on the website.
- ☐ Watershed Restoration & Recreation
  Projects that promote watershed health, environmental health, and recreation.
- ☐ Water Storage & Supply
  Projects that facilitate the development of additional storage, artificial aquifer recharge, and dredging existing reservoirs to restore the reservoirs' full decreed capacity and Multi-beneficial projects and those projects identified in basin implementation plans to address the water supply and demand gap.

Location of Water Project

Latitude	39.368621
Longitude	-107.038794
Lat Long Flag	Other: Coordinates based on other boundaries or locations
Water Source	Colorado River
Basins	Colorado
Counties	Eagle; Grand; Pitkin; Garfield; Mesa
Districts	45-Divide Creek; 50-Muddy/Troublesome Creeks; 38-Roaring Fork River Basin; 39-Rifle/Elk/Parachute Creeks; 37-Eagle River Basin; 36-Blue River Basin

Water Project Overview

Major Water Use Type	Agricultural
Type of Water Project	Planning (e.g. watershed)

Scheduled Start Date - Design 9/1/2022
Scheduled Start Date - Construction
Description
Implementation of consumptive water use reduction (i.e., water conservation) programs across the state is one important strategy proposed for reducing risks that persistent drought, growing populations, and climate change place on a finite water supply. Voluntary, temporary, and compensated water conservation programs and policies are gaining traction as the most acceptable and viable means for achieving consumptive use reduction goals. A limited number of pilot studies, to date, have endeavored to implement and test outcomes of water conservation efforts among agricultural producers. No reliable data is available to characterize water conservation program participation rates among diverse groups of water users at scale. This research project aims to fill that gap by conducting quantitative social surveys and constructing linked social and hydrological simulation models for the Colorado River Basin in Colorado. If approved, CWP funding will be used to support two of the three research Tasks that comprise the full project (see Exhibit A). The first Task will be funded entirely from match sources and will allow the project to begin prior to the release of CWP funds by CWCB. The second and third Tasks will be supported by CWP funds and will commence following completion of the first Task.

Measurable Results

New Storage Created (acre-feet)
New Annual Water Supplies Developed or Conserved (acre-feet), Consumptive or Nonconsumptive
Existing Storage Preserved or Enhanced (acre-feet)
New Storage Created (acre-feet)
Length of Stream Restored or Protected (linear feet)
Efficiency Savings (dollars/year)
Efficiency Savings (acre-feet/year)
Area of Restored or Preserved Habitat (acres)
Quantity of Water Shared through Alternative Transfer Mechanisms or water sharing agreement (acre-feet)
Number of Coloradans Impacted by Incorporating Water-Saving Actions into Land Use Planning
400 Number of Coloradans Impacted by Engagement Activity
Other
We anticipate engaging 400+ agricultural water users over the course of this project. The outcomes of this project are expected to benefit water policy development that directly impacts thousands of Coloradans and indirectly impacts millions of Coloradans.

Water Project Justification

The tasks outlined in this project further the goals and objectives laid out in the CWP and the Colorado Basin Roundtable's Basin Implementation Plan (CBRT BIP). The CWP outlines a measurable objective to "[…] share at least 50,000 acre-feet of agricultural water using voluntary alternative transfer methods by 2030." (Section 10.2, page 10-5). This objective is supported in part by the following Critical Actions:

• "Develop a collaborative water management program for the Colorado River Basin, as described in the Conceptual Framework, to maximize the use of compact water while actively avoiding a Colorado River Compact deficit" (Section 10.3, page 10-8).

• "Encourage ditch-wide and regional planning to explore system-wide conservation and efficiency opportunities and tradeoffs, the potential for water sharing, and long-term infrastructure maintenance needs" (Section 10.3, page 10-10).

• “Explore expanded grant funding that supports implementation of Alternative Transfer Method (ATM) projects, related infrastructure, or entities that would help facilitate ATMs” (Section 10.3, page 10-10).

• “Evaluate and incorporate appropriate adaptation for the potential effects of climate change on municipal, industrial, environmental, and agricultural projects and methods that address the water supply gaps” (Section 10.3, page 10-14).

Water conservation, as a value or a structured program is relevant to each of the above Critical Actions. Language included in the CBRT BIP reflects the importance of water conservation as a tool for meeting needs over the long term for users of Colorado River water. The CBRT lists as one of its major Themes, the intention to: “Encourage a high level of basinwide conservation.” (page 51). The following are included among the Plan’s listed goals:

• "Capitalize on science and data to understand gaps and risks and to inform the Basin’s priorities and decision making” (page 55).

• “Encourage and pursue alternative transfer methods (ATMs) as an alternative to permanent buy-and-dry to meet growing municipal demands, while protecting agricultural water rights” (page 55).

This research project intends to support the goals and objectives of the CWP and the CBRT BIP by providing critical information on the scalability of water conservation programs. Notably, this project hopes to illustrate how adoption rates of large-scale water conservation programs may be influenced by social networks, demographics and geography. The critical insights expected from this research will help policy-makers craft policies or conservation program attributes that maximize conservation program effectiveness and help meet conservation goals under a range of climate and development futures.

Related Studies

This effort leverages previously-funded or ongoing projects supported by CWCB grant programs. Notably, this research is a logical progression of the ATM pilot-project coordinated by Trout Unlimited and others in the Kremmling area. That ongoing project was awarded funding by CWCB under the title Evaluating Conserved Consumptive Use in the Upper Colorado River. It utilizes field measurements and remote sensing to characterize consumptive use savings under partial- and full-season fallow in high-elevation pasture. A subsequent grant request to the CWCB titled Supporting Outreach and Engagement for the “Evaluating Conserved Consumptive Use in the Upper Colorado River” Project funded work exploring the barriers and perceptions to conservation program participation in the pilot project. The interviews conducted in this regard with agricultural users in the Kremmling area will be immediately useful to the proposed research. Qualitative interview summaries produced in Kremmling can be overlaid on published findings in the academic literature (e.g., Contrad, 2017; MacIlroy, 2019; Taylor, et. al, 2019) to provide a rich set of information for developing a Discrete Choice Experiment (see Exhibit A, Task 1). The Evaluating Conserved Consumptive Use in the Upper Colorado River demonstrated the use of the OpenET platform (https://openetdata.org) to estimate consumptive water uses under various water conservation treatments. The use of OpenET will be extended under this effort (see Exhibit A, Task 2) to estimate differences consumptive water use savings affected by elevation, soil type, precipitation regime, etc. Social network information collected in Kremmling area will be useful under Task 3 (see Exhibit A) as we endeavor to construct an Agent Based Model that mimics behavior of individual irrigators, as they are affected by time varying environmental circumstances and the interactions with other agents in their network.

Conrad, Steven A., Murray B. Rutherford, and Wolfgang Haider. "Profiling farmers’ preferences about drought response policies using a choice experiment in the Okanagan Basin, Canada." Water Resources Management

31.9 (2017): 2837-2851.

MacIlroy, K. 2019. “Exploring perceptions of voluntary agricultural water conservation program on the Western Slope of Colorado.” Report published by The Nature Conservancy.

Taylor, P. L., MacIlroy, K., Waskom, R., Cabot, P. E., Smith, M., Schempp, A., & Udall, B. 2019. “Every ditch is different: Barriers and opportunities for collaboration for agricultural water conservation and security in the Colorado River Basin.” Journal of Soil and Water Conservation, 74(3), 281-295.

Skaalsveen, K., Ingram, J., & Urquhart, J. 2020. “The role of farmers' social networks in the implementation of no-till farming practices.” Agricultural Systems, 181.

Taxpayer Bill of Rights

Not applicable

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Last Updated: May 2021

ENGAGEMENT & INNOVATION GRANT FUND SUPPLEMENTAL APPLICATION

Introduction & Purpose

Colorado's Water Plan calls for an outreach, education, public engagement, and innovation grant fund in Chapter 9.5.

The overall goal of the Engagement & Innovation Grant Fund is to enhance Colorado's water communication, outreach, education, and public engagement efforts; advance Colorado's water supply planning process; and support a statewide water innovation ecosystem.

The grant fund aims to engage the public to promote well-informed community discourse regarding balanced water solutions statewide. The grant fund aims to support water innovation in Colorado. The grant fund prioritizes measuring and evaluating the success of programs, projects, and initiatives. The grant fund prioritizes efforts designed using research, data, and best practices. The grant fund prioritizes a commitment to collaboration and community engagement. The grant fund will support local and statewide efforts.

The grant fund is divided into two tracks: engagement and innovation. The Engagement Track supports education, outreach, communication, and public participation efforts related to water. The Innovation Track supports efforts that advance the water innovation ecosystem in Colorado.

Application Questions

*The grant fund request is referred to as "project" in this application.

Overview (answer for both tracks)
In a few sentences, what is the overall goal of this project? How does it achieve the stated purpose of this grant fund (above)?
The goal of this research effort is to explore the ways that linked social and environmental characteristics conspire to limit or promote the success of large-scale water conservation programs on Colorado's Western Slope. This project responds directly to the stated purpose of this grant fund. Task 1 will require extensive engagement with water users across the Colorado River basin in Colorado. The engagement with water users from diverse geographies and socio-demographic settings will help clarify important differences in the way that assorted groups perceive opportunity (or threat) in incentivized water conservation. Application of state-of-the-art quantitative social survey methods to characterize the potential willingness of these individuals to participate in water conservation as a function of different program attributes (e.g., shepherding of conserved flows, compensation levels, etc.) is a truly innovative approach that will provide critical insights to those tasked with effective water program development. Use of remote sensing data to estimate differences in conserved consumptive use across different elevation bands and soil types in Task 2 leverages new data sources to derive new knowledge about potential water conservation program effectiveness at the field scale. Linking social survey results with social network and hydrological simulation models in Task 3 brings cutting edge academic research to bear on strategic water planning efforts in Colorado.
Who is/are the target audience(s)? How will you reach them? How will you involve the community?

Last Updated: May 2021

The target audience for this project includes the Colorado Water Conservation Board, the Colorado Basin Roundtable, local conservation organizations, and other individuals and entities actively engaged in promoting, funding, or implementing water conservation programs. Specifically, target audiences include the following:

- Colorado Basin Roundtable members and participants
- Colorado Water Conservation Board Directors and staff engaged in Alternative Transfer Methods, Instream Flow Program, and Demand Management.
- Past participants in the CWCB's Demand Management Workgroups
- Colorado River Water Conservation District Board and staff
- Agricultural producers and formal agricultural groups (e.g. Colorado Ag Water Alliance, Colorado Cattleman's Association, Family Farm Alliance).
- Colorado State University Extension/Colorado Water Center
- Colorado Division of Water Resources staff, including local water commissioners
- Other stakeholders engaged in Alternative Transfer Methods, Instream Flow Program, and Demand Management.

Interim results and final findings generated by this research project will be communicated to interested parties in written reports and public presentations delivered at Roundtable meetings, at Water Congress, or at the Colorado Watershed Assembly annual meeting.

Describe how the project is collaborative or engages a diverse group of stakeholders. Who are the partners in the project? Do you have other funding partners or sources?

This project will engage agricultural water users across the Colorado River basin in Colorado. We will engage individuals from diverse geographic settings and socio-demographic backgrounds and request their participation in a Discrete Choice Experiment (see Exhibit A, Task 1). The DCE will be delivered as a web-based and/or paper survey. We hope to engage a minimum of 400 water users in this way and plan to conduct outreach primarily through engagement with water and soil conservation districts, ditch companies, and during regular meetings of the Colorado River Basin Roundtable (CBRT).

Partners in this project include the Colorado River Water Conservation District (River District) and American Rivers. Funding support is expected from both organizations and is currently pending final approval. The project team, including members of the Roaring Fork Conservancy, Lotic Hydrological, and Open Water Foundation will engage with researchers at Colorado State University and representatives from the River District and CBRT throughout the effort.

Describe how you plan to measure and evaluate the success and impact of the project?

The success of community engagement efforts will be assessed on the total number of individuals who participate in the Discrete Choice Experiment. As noted above, we hope to engaged a minimum of 400 individuals in that effort, as this number is expected to yield the greatest statistical power for reported results.

The overall success of the project will be demonstrated over the long-term as findings are incorporated into development of water conservation programs/policies or as this project is used as a model for similar research efforts extended to include other river basins in Colorado.

What research, evidence, and data support your project?

This effort leverages previously-funded or ongoing projects supported by CWCB grant programs. Notably, this research is a logical progression of the ATM pilot-project coordinated by Trout Unlimited and others in the Kremmling area. That ongoing project was awarded funding by CWCB under the title *Evaluating Conserved Consumptive Use in the Upper Colorado River*. It utilizes field measurements and remote sensing to characterize consumptive use savings under partial- and full-season fallow in high-elevation pasture. A subsequent grant request to the CWCB titled *Supporting Outreach and Engagement for the "Evaluating Conserved Consumptive Use in the Upper Colorado River" Project* funded work exploring the barriers and perceptions to conservation program participation in the pilot project. The interviews conducted in this regard with agricultural users in the Kremmling area will be immediately useful to the proposed research. Qualitative interview summaries produced in Kremmling can be overlaid on published findings in the academic literature (e.g., Conrad, 2017; MacIlroy, 2019; Taylor, et. al, 2019) to provide a rich set of information for developing a Discrete Choice Experiment (see Exhibit A, Task 1). The *Evaluating Conserved Consumptive Use in the Upper Colorado River* project demonstrated the use of the OpenET platform (https://openetdata.org) to estimate field-scale consumptive water uses under various water conservation treatments. The use of OpenET data will be extended under this effort (see Exhibit A, Task 2) to estimate differences consumptive water use savings as they are affected by elevation, soil type, precipitation regime, etc. Social network information collected in Kremmling area will be useful under Task 3 (see Exhibit A) as we endeavor to construct an Agent Based Model that mimics behavior of individual irrigators affected by time varying environmental circumstances and the interactions with other agents in their network.

Conrad, Steven A., Murray B. Rutherford, and Wolfgang Haider. "Profiling farmers' preferences about drought response policies using a choice experiment in the Okanagan Basin, Canada." Water Resources Management 31.9 (2017): 2837-2851.

MacIlroy, K. 2019. "Exploring perceptions of voluntary agricultural water conservation program on the Western Slope of Colorado." Report published by The Nature Conservancy.

Taylor, P. L., MacIlroy, K., Waskom, R., Cabot, P. E., Smith, M., Schempp, A., & Udall, B. 2019. "Every ditch is different: Barriers and opportunities for collaboration for agricultural water conservation and security in the Colorado River Basin." Journal of Soil and Water Conservation, 74(3), 281-295.

Skaalsveen, K., Ingram, J., & Urquhart, J. 2020. "The role of farmers' social networks in the implementation of no-till farming practices." Agricultural Systems, 181.

Describe potential short- and long-term challenges with this project.

Successfully engaging a large number of water users from diverse geographies under the project's somewhat constrained timeline will be the largest short-term challenge associated with the Discrete Choice Experiment portion of this project (see Exhibit A, Task 1). In recognition of this potential issue, project proponents plan to initiate outreach activities immediately after

funding approval is secured. A host of longer-term, albeit smaller, challenges are likely to manifest in the technical implementation of the modeling described in Task 3 of Exhibit A. While the detail of those potential challenges cannot be foreseen, we are confident they can be overcome thanks to the technical expertise of our project team. Finally, ongoing complications arising from COVID-19 may impact our ability to affectively engage with partners and community members at some future point.

Please fill out the applicable questions for either the Engagement Track or Innovation Track, unless your project contains elements in both tracks. If a question does not relate to your project, just leave it blank. Please answer each question that relates to your project. Please reference the relevant documents and use chapters and page numbers (Colorado's Water Plan, Basin Implementation Plan, PEPO Education Action Plan, etc.).

Engagement Track
Describe how the project achieves the education, outreach, and public engagement measurable objective set forth in Colorado's Water Plan to "significantly improve the level of public awareness and engagement regarding water issues statewide by 2020, as determined by water awareness surveys."
Describe how the project achieves the other measurable objectives and critical goals and actions laid out in Colorado's Water Plan around the supply and demand gap; conservation; land use; agriculture; storage; watershed health, environment, and recreation; funding; and additional.
The tasks outlined in this project further the goals and objectives laid out in the CWP and the Colorado Basin Roundtable's Basin Implementation Plan (CBRT BIP). The CWP outlines a measurable objective to "[…] share at least 50,000 acre-feet of agricultural water using voluntary alternative transfer methods by 2030." (Section 10.2, page 10-5). This objective is supported in part by the following Critical Actions: • "Develop a collaborative water management program for the Colorado River Basin, as described in the Conceptual Framework, to maximize the use of compact water while actively avoiding a Colorado River Compact deficit" (Section 10.3, page 10-8). • "Encourage ditch-wide and regional planning to explore system-wide conservation and efficiency opportunities and tradeoffs, the potential for water sharing, and long-term infrastructure maintenance needs" (Section 10.3, page 10-10). • "Explore expanded grant funding that supports implementation of Alternative Transfer Method (ATM) projects, related infrastructure, or entities that would help facilitate ATMs" (Section 10.3, page 10-10). • "Evaluate and incorporate appropriate adaptation for the potential effects of climate change on municipal, industrial, environmental, and agricultural projects and methods that address the water supply gaps" (Section 10.3, page 10-14). Water conservation, as a value or a structured program is relevant to each of the above Critical Actions. Language included in the CBRT BIP reflects the importance of water conservation as a tool for meeting needs over the long term for users of Colorado River water. The CBRT lists as one of its major Themes, the intention

to: "Encourage a high level of basinwide conservation." (page 51). The following are included among the Plan's listed goals:

- "Capitalize on science and data to understand gaps and risks and to inform the Basin's priorities and decision making" (page 55).
- "Encourage and pursue alternative transfer methods (ATMs) as an alternative to permanent buy-and-dry to meet growing municipal demands, while protecting agricultural water rights" (page 55).

This research project intends to support the goals and objectives of the CWP and the CBRT BIP by providing critical information on the scalability of water conservation programs. Notably, this project hopes to illustrate how adoption rates of large-scale water conservation programs may be influenced by social networks, demographics and geography. The critical insights expected from this research will help policy-makers craft policies or conservation program attributes that maximize conservation program effectiveness and help meet conservation goals under a range of climate and development futures.

Describe how the project achieves the education, outreach, and public engagement goals set forth in the applicable Basin Implementation Plan(s).

Describe how the project achieves the basin roundtable's PEPO Education Action Plans.

Innovation Track

Describe how the project enhances water innovation efforts and supports a water innovation ecosystem in Colorado.

The question of how to best connect policy makers with data and evidence that supports development of effective and scalable policies plagues many domains, including water planning in Colorado. The state relies on programmatic structures that dictate regular updates to strategic planning documents at the state, basin, and local scale (e.g., the Colorado Water Plan and Basin Implementation Plan review and update process), the support of decision support tools (e.g., CDSS), and engagement with formal stakeholder groups (e.g., Roundtables) to make those important connections between evidence and policy. Opportunities for innovation that better connect data and evidence with policy exist at all levels of the water planning process.

The proposed research is innovative in many ways. However, the contribution to Colorado's *water innovation ecosystem* is most strongly demonstrated by the adaptation of the StateMod code base. Investing in extension of the (cyber)infrastructure and decision support systems already in use by CWCB and other water planning entities across the State of Colorado under Task 3 (see Exhibit A) helps ensure that the benefits of this project are long-lived and that a new generation of engineers and planners obtain access to

and can build upon a foundational component of the CDSS. In this way, the innovation value inherit to the project is not only a function of the tangible deliverables produced at the end of the effort. That innovation value is also extended and leveraged into the future by unlocking opportunity for more innovation.

Describe how the project engages/leverages Colorado's innovation community to help solve our state's water challenges.

Colorado's academic institutions are the backbone of the state's innovation economy. This project will be led by Seth Mason from Lotic Hydrological. Seth is a Ph.D. student in Systems Engineering at Colorado State University and this project will form the basis for his dissertation. One to three peer-reviewed journal articles reporting the methods, results, and implications of this research project are expected to follow. As a student at one of Colorado's leading research institutions, Seth will continually engage with other researchers and innovators and bring their insights and knowledge to the project. RFC and Lotic will also rely on the deep expertise of their respective staff's and their working relationships with other organizations operating in the water conservation space. Solving Colorado's long-term water challenges will require ongoing collaboration between water planning agencies, thought-leaders, consulting firms, non-profits, and academic institutions.

Describe how the project helps advance or develop a solution to a water need identified through TAP-IN and other water innovation challenges. What is the problem/need/challenge?

Describe how this project impacts current or emerging trends; technologies; clusters, sectors, or groups in water innovation.

This project is highly relevant to emerging trends in computer software development and water resources simulation modeling. Task 3 of this project will endeavor to isolate the StateMod solver—the institutional standard for water rights allocation and accounting simulations in Colorado—from the remainder of the StateMod model code and then develop new routines and middleware that will allow the solver to be called from scripts developed in modern scripting languages like Python and R. The version of the StateMod solver produced by this phase of work will be published to a public Git repository to promote its use by others. This approach will leave the underlying solution algorithms intact, while making the model itself more accessible to the current generation of coders and engineers unaccustomed to working with FORTAN code. Improvements in accessibility are expected to lead to a greater number of model users. As more individuals gain access to the model, it is almost inevitable that new knowledge generation will follow. The importance of this aspect of the project to future generations of planners, policy-makers, and engineers—Colorado's future water innovators—working on Colorado water issues cannot be understated.

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Colorado Water Conservation Board
Department of Natural Resources

Last Updated: May 2021

Colorado Water Conservation Board
Water Plan Grant – Statement of Work – Exhibit A

Statement Of Work	
Date:	**July 23, 2022**
Name of Grantee:	**Roaring Fork Conservancy**
Name of Water Project:	**Exploring social and environmental controls on the scalability of water conservation programs.**
Funding Source:	**Colorado Water Plan Engagement and Innovation Grant**

Water Project Overview:

Colorado water users face ever mounting challenges. Growing populations and persistent drought place increasing demands on a system that is producing less water than in past decades. At the same time, the specter of a water management crisis on the Colorado River below Colorado is looming larger with each passing month. Discussions of doomsday scenarios once relegated to the domain of academics, policy wonks and water managers have spilled into the mainstream media as demonstrated by recent articles in the New York Times and Washington Post. The unfolding water supply and management situation in Colorado and across the greater Colorado River system highlights the need for continued development of innovative strategies to support Colorado's diverse water needs in the face of increasing uncertainty and resource scarcity.

Implementation of consumptive water use reduction (i.e., water conservation) programs across the state is one important strategy proposed for reducing risks among water users and equitably distributing a shrinking supply. Voluntary, temporary, and compensated water conservation programs and policies are gaining traction as the most acceptable and viable means for achieving consumptive use reduction goals. Unfortunately, a limited number of pilot studies, to date, have endeavored to implement and test outcomes of water conservation efforts among agricultural producers. Participation of agricultural water users is critical to the success of any large-scale conservation program since they account for ~87% of water use in Colorado. Low observed adoption rates among agricultural producers presented with incentivized water conservation opportunities in locations like the Crystal River and some negative perceptions voiced by participants in a recent water conservation pilot program in Grand County suggest that critical open questions remain regarding the factors that drive decision making and participation in water conservation programs among diverse groups of water users spread across assorted geographies.

Significant uncertainty exists in the "scaling-up" of water conservation pilot projects to the level where conservation outcomes can meaningfully contribute to the fulfillment of long-term water supply and management goals in Colorado. The high levels of sustained annual participation in water conservation programs needed to yield tangible quantities of water is not guaranteed. We suggest that developing water conservation programs and policies that lead to meaningful and sustained reductions in consumptive use at the basin scale depends on an understanding of the social conditions, policy characteristics and/or environmental circumstances that produce persistent interannual adoption levels and inspire positive opinions about prior program participation. This is a key area of focus for this innovative research project and an important line of inquiry for those tasked with planning for Colorado's water use and management in

the years to come. As such, information-driven policy-making and program-development by watershed groups, basin roundtables, and state and local government will benefit from the work proposed here.

This research directly builds on past feasibility assessments, academic literature, field studies, and small-scale pilot projects in the Colorado River Basin. Notably, this work will leverage findings from several research studies previously funded by CWCB in order advance the objectives set forth by CWCB and the State of Colorado in the Colorado Water Plan.

Project Objectives:

This research effort responds to a single overarching question: "How do linked social and environmental characteristics conspire to limit or promote the success of large-scale water conservation programs on Colorado's Western Slope?" Three linked lines of inquiry will be pursued in order to unpack several dimensions of the above question:

- What socio-economic and environmental factors help characterize the likelihood of water users' participation in water conservation programs under different policy regimes?
- What consumptive use reductions can be expected at the parcel scale by limiting irrigation water application both in timing and magnitude across geographies in the upper Colorado River basin in Colorado?
- How does the interaction of individual actors within social networks conspire to limit or encourage conservation program participation (and time-varying consumptive use reductions) under scenarios characterizing different policy regimes, drought frequencies, and initial adoption rates?

Each question will be explored using data and information collected across Colorado's upper Colorado River basin. This research is expected to deliver important information to conservation organizations looking to promote and fund water conservation efforts, and to water managers and policy makers in Colorado who need to understand the scalability and overall impact of potential water conservation programs and policies, implemented at scale under various potential climate futures. The exploration of the questions detailed above will require a robust research effort sustained over a period of 24-months, involving participation from individuals at Lotic Hydrological (Lotic), Colorado State University (CSU), and Open Water Foundation (OWF). Seth Mason from Lotic will be contracted to lead the effort and will leverage his status as a Ph.D. student in Systems Engineering at Colorado State University to bring expertise from CSU researchers to bear on the project. The body of work performed under this project will yield a dissertation and expected to produce 1-3 published, peer-reviewed academic journal articles.

This proposal is timely and highly relevant to current water planning needs. The tasks described here, individually and in aggregate, directly support recommendations or needs outlined in the Colorado Water Plan, the Colorado Basin Implementation Plan, the Colorado River Risk Study and in other local and regional planning documents. Critically, the data products and models produced here as deliverables will be formatted and conveyed in a manner that supports future updates as new information becomes available, ensuring that the value derived from this effort is long-lived and adaptable to different geographies and changing social and environmental conditions.

Tasks

Task 1 – Predicting water conservation program participation rates with quantitative social surveys.

Description of Task:

Widespread water conservation programs have yet to be implemented on Colorado's Western Slope. Therefore, neither social survey results evaluating water user opinion about water conservation program participation or quantitative characterizations of water conservation program participation rates exist. This dearth of data constrains any effort to estimate the likelihood of water user participation in a water conservation program given a set of policies, characteristics of a social network, economic conditions, or environmental setting. Thus, expectations for the effectiveness of large-scale water conservation programs remain highly-speculative.

Arriving at successful outcomes for water conservation efforts is contingent upon voluntary action across heterogeneous groups of actors. The complexities vexing this particular water management issue are not wholly dissimilar from complexities that arise elsewhere in the natural resource management domain. Context matters. Individual participation in a water conservation program in any given year is, likely, mediated by characteristics of the natural environment that each individual interacts with, the economic factors that affect evaluations of financial risk or gain, and size and type of social network that each individual is embedded within. The time-variant nature of many environmental, social, and economic attributes further complicates matters. Research efforts that probe the interactions between the social-environmental-economic context and the decision-making process employed by individuals may yield new insights and enhance the reliability of statistical models employed to predict water conservation program participation.

This task employs methods developed in social-sciences and psychology to responds to estimate the likelihood of program participation by an individual that falls into a given demographic or geographic class. The decision-making frameworks that influence water conservation program participation among diverse groups of agricultural water users will be explored using quantitative social surveys and Bayesian Belief Network (BBN) statistical models. This task aims to:

- Construct a probabilistic model that indicates the likelihood of user participation in one of three potential water conservation actions
- Explore the distributions of various social-environmental-economic context values associated with selection of each alternative action
- Explore the distributions of responses to questions linked to behavior model latent variables and associated with selection of each alternative action

Last Updated: May 2021

Method/Procedure:

The relevant decision-making variables that influence water conservation program participation among diverse groups of agricultural water users in Colorado's Upper Colorado River Basin will be explored by aggregating relevant information from existing reports and workshop proceedings, conducting one-on-one interviews with diverse groups of water users, and via consultation with professionals in the water management sector who currently or previously managed or implemented voluntary water conservation programs. This information collection exercise will inform development of a Discrete Choice Experiment (DCE), delivered as a quantitative social survey.

Surveys will be distributed in web format to agricultural water users in the Colorado River basin. Requests for survey participation will be made at meetings of regional governmental entities like the Colorado River Water Conservation District and regular meetings of the various soil and water conservation districts within the Colorado River basin. Participation by specific individuals will be solicited via phone calls, emails, and in-person meetings. The survey distribution effort will seek to generate responses from > 400 individual water users residing in different basins and characterizing different socio-economic and demographic classes. Demographic context data will be compared against similar data available from the U.S. Census, Colorado State Demographers Office, and similar data sets to determine the representativeness of the sample.

Survey results will be used to construct and parameterize a BBN. This initial structure of the BBN will be considered by an expert panel made up of self-appointed volunteers familiar with agricultural water use issues in western Colorado. A concerted effort will be made to ensure broad participation by agricultural producers representing different geographies and growing a variety of crops, agricultural researchers, water policy-makers, and water managers. This panel will endeavor to refine the directed graph model structure—the basis for the conditional probabilities represented in the BBN model—so that it better captures the expected nature of individual responses to a set of water conservation program attributes and characteristics of a social network, economic conditions or environmental setting. The conditional probability tables in the final BBN structure will be generated directly from the survey data.

The information generated by the social survey and DCE will be principally explored through the conditional probability tables that underlie the BBN. The strength of predictive relationships between any number of social-environmental-economic context variables and stated preferences for water conservation program participation (or non-participation) can be traced though the link and node structure of the BBN. The specific probabilistic relationship between a single level of any given context variable (i.e. income) can be explored by supplying the BBN with 'evidence' of a single income value and then traversing the conditional probability tables to view the associated probability of each of the three water conservation choices included in the DCE. Conversely, the distributional characteristics of a wide array of context variables associated with respondents who selected a single conservation program type (e.g. split season fallow) can be explored by supplying the BBN with 'evidence' of a single conservation choice and traversing the conditional probability tables in the opposite direction. This characteristic of BBNs allows for quantitative responses to questions like the following:

- *What is the likelihood that water users who own less than 100 acres and earn less than $60,000/year from agricultural activities will participate in a split season fallow program?*

- *What are the distributional characteristics of income and age for users who declined to participate in a water conservation program (i.e. maintained the status quo)?*

Similar questions may be posed dealing with the attributes associated with a given water conservation alternative or with specific proxy questions for the behavior model latent variables. In this manner the relative sensitivity of the model outcomes to different variable states can be directly computed. The explicit and full characterization of the joint probability distributions that exist between each linked pair of variables

in the BBN also provides opportunity to explore the uncertainty associated with any questionnaire response or DCE selection.

The results produced by this model should assist policy-makers and water managers better understand the water conservation choices that different classes of water users are likely to make when presented with different circumstances. This information can be used to tailor water conservation program characteristics to respond broadly to the largest group of water users. Alternatively, the same information can be useful in developing targeted water conservation programs for deployment in different geographies or among different user groups. Representation of specific questions from the questionnaire as proxies for latent variables in the conceptual behavior model provides a means for exploring the relative importance of social networks, awareness of 'big-picture' water management issues, etc. affect a water user's propensity for participation in water conservation programs. This information may be invaluable in the development of education and outreach campaigns design to increase awareness, for example. The inclusion of risk characteristics in the DCE portion of the model should help water managers and policy makers understand how changing environmental conditions (e.g. as driven by climate change or changes in management of Lake Powell) may influence water conservation program participation. The novel approach outlined here is expected to provide a wealth of nuanced and actionable information to water managers and policy makers. Critically, this effort is also expected to enhance understanding of the degree to which voluntary actions across diverse groups of individual actors can be predicted by behavior theory and explicit consideration of the social-environmental-economic context apparent to each actor.

Deliverable:

1. The DCE results will be analyzed using libraries in the R coding language, documented, and published to a public Git repository. This manner of publication will help ensure that the results can be used, refined, and updated by other researchers and resource managers in the future.

2. A technical report documenting the employed methodologies and results of the BBN modeling effort.

Tasks
Task 2 – Characterize distributions of potential consumptive use savings across diverse geographies
Description of Task:

Last Updated: May 2021

Understanding how different levels of individual participation in Demand Management programs under varying hydrological conditions relate to consumptive water use reductions over time is an important gap left unfilled by existing studies and reports. Research that fills this data gap will provide critical contextual information to water planers regarding the feasibility of meeting water conservation targets proposed in documents like the Upper Basin Demand Management Economic Study and the Colorado River Risk Study.

Consumptive water use at the field-scale under different climatic conditions and water conservation practices will be explored using experimental data recently collected near Kremmling, Colorado and through exploration of remotely-sensed evapotranspiration data across the upper Colorado River basin in Colorado . Draft data products from the ATM research study near Kremmling include estimations for consumptive water use reductions under split-season or full-season fallow . The provided estimates are expected to be more accurate representation of consumptive use than estimates produced by the analytical models traditionally employed by water managers and modelers in Colorado. The Kremmling research effort provides an important model for making similar estimates in other geographies with different cropping patterns, elevation distributions, precipitation rates, and other factors.

Method/Procedure:

Following the example of an ongoing CWCB-funded effort in Kremmling, the OpenET platform will be employed here as the primary means for estimating total annual evapotranspiration (ET) volumes for agricultural parcels across the Colorado River basin. Available irrigated lands mapping data layers from the Colorado Decision Support System will be used as the basis for irrigated parcel delineation. Some manual or of machine-learning based means for adjusting parcel boundaries may be employed to better match the resolution/alignment of OpenET satellite imagery. Estimates of total annual ET will be provided for each mapped parcel for the 2010-2021 period. The estimates of ET will be joined to a spatial data layer that describes the geographic attributes (e.g. watershed and elevation band), soil type, crop type, irrigation application method for each parcel in the basin. These attributes will be used as the basis for a classification scheme that stratifies the full set of parcel information into like groups. The distributional characteristics of annual ET, adjusted for precipitation and normalized by acres of irrigated land, will be computed for each class of parcels.

A search will be conducted within each of the classified parcel sets for pairs of parcels that can act as analogs for implementation of two types of water conservation: split-season fallow and full-season fallow. We expect to identify several representative parcels in each class where the behavior of individual irrigators and/or the administration of local water rights functions to limit irrigation to some parcels for the latter half of the irrigation season—analogous to split-season leasing—in some years and the full irrigation season—analogous to full-season leasing—in other years. Conversations with local Water Commissioners and a review of historical call records and observations of water diversions will inform parcel selection. Parcels where episodic irrigation reductions are evident will be considered “treatment” parcels. Each treatment parcel will be paired with a “control” parcel where application of irrigation water is relatively consistent over time. For each selected treatment parcel, the total annual ET volume computed for a year with reduced diversion activity will be compared to volumes computed on the same parcel for years with more typical diversion activity. The difference between the two conditions will be normalized by total irrigated acreage. Similar data computed on the control parcels, will be used to account for interannual variability in ET driven by other unmeasured factors. Analysis results will form the basis for estimating consumptive water use reductions that might be expected among different classes of irrigated acreage under different water conservation schemes.

Where the data supports it, the distribution of total annual ET across a class of parcels and the computations of consumptive water use reduction under the analogs for split-season and full-season fallow will be further stratified by climatic year type. For example, a review of the recent hydrological and temperature record suggests that 2018 and 2021 may provide suitable representations of hot, dry years. Conditions observed in

2017 and 2020 were closer to long term averages for both temperature and runoff, while 2016 and 2019 tended to be wetter and cooler. This line of inquiry may yield the distributional characteristics of total annual ET/acre in a class of irrigated parcels and the expected water conservation gains expected on a per acre basis for the same class in a given year type. If such a stratification of analysis results is possible, it will provide important bounds for expectations of water conservation program yields in hot and dry years versus cool and wet years.

Deliverable:

1. A technical report outlining the employed methodologies and the results

2. A fully-attributed and classified spatial layer of parcels in the Colorado River basin and a linked set of files containing the time series of OpenET data relevant to each parcel will be published to a public repository for use by others.

Tasks

Task 3 – Characterize consumptive use reductions or savings that might be expected under various policy and climate scenarios at the basin scale

Description of Task:

The principal objective of this Task is the development of a simulation framework that will support integration of the work products from Tasks 1 and 2. Successful integration will provide a means for understanding the interplay between the idiosyncrasies of human behavior, variable hydrological and climatological conditions, water rights administration, and water conservation gains at a relatively fine spatial and temporal resolution. This Task will require development of a set of enhancements for the State of Colorado's hydrology and water rights simulation model, StateMod. It will also require coupling StateMod with an implementation of the behavioral model developed in Task 1. A case study in the Colorado River basin will demonstrate the power and utility of the newly integrated tools.

Task 3 will be completed in three distinct phases. The first phase will consist of development and testing of new means for calling the FORTRAN-based StateMod solver from modern open-source coding languages. The second phase will include incorporation of the probability structures defined by the behavioral model (Task 1) into an Agent -Based Model (ABM) for simulating the actions of water users within a social network. The third phase will entail coupling the revised StateMod model with the ABM and use of the coupled modeling system to test outcomes of different conservation program frameworks and climate scenarios in the upper Colorado River basin in Colorado.

Last Updated: May 2021

Method/Procedure:

The first phase of work will endeavor to isolate the StateMod solver—the institutional standard for water rights allocation and accounting simulations in Colorado—from the remainder of the StateMod model code and then develop new routines and middleware that will allow the solver to be called from scripts developed in modern coding languages like Python and R. This work will be led by OWF and supported by Lotic. OWF has extensive working knowledge of the existing code base that provides them with unique insights into the opportunities and challenges associated with the work proposed here. OWF has also developed robust testing frameworks for extending StateMod or implementing it in a different coding language as part of their work on the OpenCDSS initiative. These testing frameworks will be relied upon to ensure a high degree of fidelity between the modified version of StateMod produced here and the official version of the model published by the State of Colorado. The version of the StateMod solver produced by this phase of work will be published to a public Git repository to promote its use by others. The importance of this work to future generations of planners, policy-makers, and engineers working on Colorado water issues cannot be understated.

The proposed adjustments made to the StateMod code base will allow a user to retrieve solver outputs on a single monthly or yearly time step, save some or all of the output to a database, update StateMod input files using an outside routine that responds to conditions in the model, run the solver for another time step, and repeat the process. This approach represents a fundamental change to the way the StateMod models are currently developed and used and opens up many new possibilities for integrating the core model code into modern hydrological simulation workflows. It also allows the StateMod solver to better support investigations of water use that are not strictly governed by the prior appropriations doctrine. This is critical to investigations of voluntary and temporary water conservation activities, especially where conserved water is shepherded downstream. Periodic and voluntary water user participation in programs is expected to produce temporary reductions in water consumption that diverge from expected patterns of water used driven solely by water rights administration—a circumstance that differs, fundamentally, from the allocation and accounting routines in StateMod and the consumptive use calculations provided by supporting software like StateCU . A secondary benefit of the development of a software and middleware stack for implementing a StateMod simulation in Python and R is that the model itself becomes more accessible to the current generation of coders and engineers. Improvements in accessibility are expected to lead to a greater number of model users. As more individuals in the academic and professional space gain access to the model, it is almost inevitable that new knowledge generation will follow.

The second phase of work in Task 3 will involve integration of the behavior modeling produced by Task 1 with the simulation tools developed here. The behavioral model will be used to predict the likelihood of water conservation program participation by different water users (i.e. “agents”) in the Colorado River basin over time. The probabilities produced by the model will be used to define the time-varying water conservation behavior of agents in an Agent-Based Model. The ABM developed here will be coded in R. Agents in the ABM will be assigned to the demand nodes present in the StateMod network . The ABM will be structured such that individual agents will select water use/conservation behaviors based on their geographic location, hydrological conditions evident in a recent StateMod simulation period (and the memory of information produced during previous time steps) and the behaviors of other agents in their social network. The structure will also dictate that when an agent elects to participate in a water conservation program, the consumptive use demands for that agent (and associated water demand node represented in StateMod) will be adjusted downward by a factor pulled from a distribution of likely values retrieved from Task 2. This phase of work is expected to require extensive software testing and optimization.

The final phase of Task 3 will be used to predict the reductions in consumptive water use across the Colorado River basin associated with at least two hypothetical water conservation programs implemented the different climate and water use scenarios presented in the Technical Update to the Colorado Water Plan. Simulation of two hypothetical water conservation programs under three climate scenarios will be carried out in a Monte Carlo simulation framework. The Colorado River basin includes a diverse mix of agricultural producers, reservoirs, transmountain diversions, and geographic settings that largely represent

characteristics found elsewhere in across Colorado's Western Slope. This suggests that a case study completed here should provide instructive results for neighboring basins.

Results from the simulations will be explored and emergent behaviors among agents in the system will be identified and characterized. Consumptive water use reductions computed on an annual basis and over a 5-year running average. The mean and variance of these calculated totals will be assessed across all runs in a given scenario. This summarization of analysis results will provide an indication of both the potential long-term average conserved consumptive use that might be achieved under a given scenario and the reliability of conservation volumes from year to year. Examination of the behavior of agents in the ABM is expected to elucidate the social and/or hydrological conditions that produce exceptionally high or exceptionally low water conservation program adoption rates.

This case study will provide a template for utilization of the tools developed by this project in other settings. We expect that the methods and deliverables generated by this project can be used by others to characterize how much water conservation might be expected over a prolonged period at a watershed outlet given different policy environments (e.g. in-basin water conservation matched by reductions in transmountain diversions vs. no east-slope participation; conserved water shepherding vs. reversion to system water), variable water conservation adoptions rates, the administration of water rights, the social and environmental constraints unique to any given socio-demographic group of water users, etc. The framework may also be extended to examine secondary economic impacts of water conservation at the basin scale and how these impacts feedback to influence the behavior of water users under different social and environmental conditions. In this way, the hypothesis testing and simulation tools produced by this project will support critical ongoing conversations about which large-scale water conservation program concepts are achievable, worthy, and advisable strategies for securing Colorado's water future.

Deliverable:

1. Revised version of the StateMod solver and relevant documentation on use of the solver will be published to a public Git repository.

2. The methodologies used to develop the ABM will be provided in a short technical report.

3. A separate and more extensive technical report will be developed discussing the case study in the Colorado River Basin.

Budget and Schedule

This Statement of Work shall be accompanied by a combined Budget and Schedule that reflects the Tasks identified in the Statement of Work and shall be submitted to CWCB in excel format.

Reporting Requirements

Progress Reports: The applicant shall provide the CWCB a progress report every 6 months, beginning from the date of issuance of a purchase order, or the execution of a contract. The progress report shall describe the status of the tasks identified in the statement of work, including a description of any major issues that have occurred and any corrective action taken to address these issues.

Last Updated: May 2021

Final Report: At completion of the project, the applicant shall provide the CWCB a Final Report on the applicant's letterhead that:

- Summarizes the project and how the project was completed.
- Describes any obstacles encountered, and how these obstacles were overcome.
- Confirms that all matching commitments have been fulfilled.
- Includes photographs, summaries of meetings and engineering reports/designs.

The CWCB will pay out the last 10% of the budget when the Final Report is completed to the satisfaction of CWCB staff. Once the Final Report has been accepted, and final payment has been issued, the purchase order or grant will be closed without any further payment.

Payment

Payment will be made based on actual expenditures and must include invoices for all work completed. The request for payment must include a description of the work accomplished by task, an estimate of the percent completion for individual tasks and the entire Project in relation to the percentage of budget spent, identification of any major issues, and proposed or implemented corrective actions.

Costs incurred prior to the effective date of this contract are not reimbursable. The last 10% of the entire grant will be paid out when the final deliverable has been received. All products, data and information developed as a result of this contract must be provided to as part of the project documentation.

Performance Measures

Performance measures for this contract shall include the following:
(a) Performance standards and evaluation: Grantee will produce detailed deliverables for each task as specified. Grantee shall maintain receipts for all project expenses and documentation of the minimum in-kind contributions (if applicable) per the budget in Exhibit C. Per Grant Guidelines, the CWCB will pay out the last 10% of the budget when the Final Report is completed to the satisfaction of CWCB staff. Once the Final Report has been accepted, and final payment has been issued, the purchase order or grant will be closed without any further payment.
(b) Accountability: Per Grant Guidelines full documentation of project progress must be submitted with each invoice for reimbursement. Grantee must confirm that all grant conditions have been complied with on each invoice. In addition, per Grant Guidelines, Progress Reports must be submitted at least once every 6 months. A Final Report must be submitted and approved before final project payment.
(c) Monitoring Requirements: Grantee is responsible for ongoing monitoring of project progress per Exhibit A. Progress shall be detailed in each invoice and in each Progress Report, as detailed above. Additional inspections or field consultations will be arranged as may be necessary.
(d) Noncompliance Resolution: Payment will be withheld if grantee is not current on all grant conditions. Flagrant disregard for grant conditions will result in a stop work order and cancellation of the Grant Agreement.

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Colorado Water Conservation Board

Water Plan Grant - Detailed Budget Estimate
Fair and Reasonable Estimate

Prepared Date: 6/27/2022
Name of Applicant: Roaring Fork Conservancy
Name of Water Project: Exploring social and environmental controls on the scalability of water conservation programs.

Detailed Budget

		Time and Materials				Subcontracts							
Task	Item	Hourly Rate	# Hours	Sub-total	Open Water Foudation	Research Inst.	Sub-total		Total Cost	CWCB Funds	Matching In-Kind Funds	Matching Cash Funds
Project Management												
-	Project management	$ 100.00	100	$ 10,000.00					$ 10,000.00	$ -	$ 4,500.00	$ 5,500.00
Quantitative Social Survey	Parcel identification/delineation							**Subtotals**	**$ 10,000.00**	**$ -**	**$ 4,500.00**	**$ 5,500.00**
1.1	Social survey development	$ 155.00	120	$ 18,600.00			$ -		$ 18,600.00	$ -		$ 18,600.00
1.2	Survey distribution	$ 155.00	160	$ 24,800.00			$ -		$ 24,800.00	$ -		$ 24,800.00
1.3	Survey results processing	$ 155.00	120	$ 18,600.00			$ -		$ 18,600.00	$ -		$ 18,600.00
1.4	Reporting and presentation	$ 155.00	60	$ 9,300.00			$ -		$ 9,300.00	$ -		$ 9,300.00
Estimate Consumptive Use	Reductions							**Subtotals**	**$ 71,300.00**	**$ -**	**$ -**	**$ 71,300.00**
2.1	Parcel identification/delineation	$ 155.00	160	$ 24,800.00			$ -		$ 24,800.00	$ 24,800.00		
2.2	Open ET technical support			$ -		$ 5,000.00	$ 5,000.00		$ 5,000.00			5000
2.3	Imagery classification and analysis	$ 155.00	160	$ 24,800.00			$ -		$ 24,800.00	$ 24,800.00		
2.4	Reporting and presentation	$ 155.00	40	$ 6,200.00			$ -		$ 6,200.00	$ 6,200.00		
Estimate Consumptive Use	Reductions							**Subtotals**	**$ 60,800.00**	**$ 55,800.00**	**$ -**	**$ 5,000.00**
3.1	Adaptation of StateMod solver	$ 155.00	180	$ 27,900.00	$ 80,000.00		$ 80,000.00		$ 107,900.00	$ 107,900.00		
3.2	Agent-based simulation model developmen	$ 155.00	200	$ 31,000.00			$ -		$ 31,000.00	$ 31,000.00		
3.3	Scenario simulations	$ 155.00	180	$ 27,900.00			$ -		$ 27,900.00	$ 27,900.00		
3.4	Reporting and presentation	$ 155.00	100	$ 15,500.00			$ -		$ 15,500.00	$ 15,500.00		
								Subtotals	**$ 182,300.00**	**$ 182,300.00**	**$ -**	**$ -**
								Total	**$ 324,400.00**	**$ 238,100.00**	**$ 4,500.00**	**$ 81,800.00**
								%		**73%**	**1%**	**25%**

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Colorado Water Conservation Board

Water Plan Grant - Schedule
Fair and Reasonable Estimate

Prepared Date: 6/23/2022
Name of Applicant: Roaring Fork Conservancy
Name of Water Project: Exploring social and environmental controls on the scalability of water conservation programs.

Detailed Budget

Task	Item	2022												2023												2024									
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep									
Project Management																																			
-	RFC project management	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x									
Quantitative Social Survey																																			
1.1	Social survey development	x	x																																
1.2	Survey distribution			x	x	x																													
1.3	Survey results processing					x	x	x																											
1.4	Reporting and presentation							x	x	x																									
Estimate Consumptive Use	Reductions																																		
2.1	Parcel identification/delineation					x	x	x																											
2.2	Open ET technical support								x	x	x																								
2.3	Imagery classification and analysis								x	x	x	x																							
2.4	Reporting and presentation											x	x	x																					
Estimate Consumptive Use	Reductions																																		
3.1	Adaptation of StateMod solver									x	x	x	x	x	x	x																			
3.2	Agent-based simulation model development															x	x	x	x																
3.3	Scenario simulations																			x	x	x	x												
3.4	Reporting and presentation																						x	x	x	x									

COLORADO RIVER DISTRICT
PROTECTING WESTERN COLORADO WATER SINCE 1937

June 30, 2022

Via electronic mail
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, CO 80203

RE: Colorado Water Plan Support Letter

Dear CWCB Board of Directors:

The Colorado River Water Conservation District ("River District") is pleased to support the Roaring Fork Conservancy's Water Plan Grant application: *Exploring Social and Environmental Controls on the Scalability of Water Conservation Programs.*

The River District recognizes that we are transitioning from an era emphasizing new supply development to an era which includes higher emphasis on wise use of our limited water resources, including higher water use efficiency and conservation. This project builds on extensive work in the Colorado River Basin supported by the CWCB and the River District. Notably, this research is expected to yield timely and critical information relevant to Drought Contingency Planning, the past efforts of the Demand Management Workgroups, and to the findings of the Colorado River Risk Study, the System Conservation Pilot Program, and the Grand Valley Conserved Consumptive Use Pilot Project. We expect that the outcome of this research project will support the development of effective water conservation programs in the future.

The River District's Community Funding Partnership was created in 2021 to fund multi-purpose water projects on the Western Slope. We are currently considering a $41,300 grant to assist in the project with a final decision expected by August 2022. We support RFC's efforts to secure additional funding for this project.

Thank you for your consideration.

Sincerely,

Andrew A. Mueller
General Manager

970.945.8522
201 Centennial Street | Suite 200
Glenwood Springs, CO 81601
ColoradoRiverDistrict.org

American Rivers
RIVERS CONNECT US®

Colorado Water Conservation Board
1313 Sherman St., Room 718
Denver, CO 80203

RE: Letter of Support

Dear Colorado Water Conservation Board Members:

I am pleased to submit this letter of commitment from American Rivers to contribute $35,000 in cash to match funds for the Colorado Water Plan Grant application: *Exploring social and environmental controls on the scalability of water conservation programs*. American Rivers is a committed partner to the project and has been engaged in projects to benefit the Upper Colorado River and the people that depend on it for more than 9 years.

This project is an important extension of the "Evaluating Conserved Consumptive Use in the Upper Colorado River" Project, previously funded by CWCB. Understanding the social controls on conserved consumptive use projects in the Colorado River basin will likely improve engagement with the agricultural community, NGO's, and water providers throughout Colorado. This project will build on and support statewide efforts to understand and investigate the feasibility of conserved consumptive use projects and programs.

Thank you for your consideration and please feel free to contact me if you have any questions or require additional specification about this commitment.

Sincerely,

Matt Rice

Senior Director, Southwest Region
American Rivers
1536 Wynkoop St.
Denver, CO 80202

The Nature Conservancy

June 28, 2022

Dear Colorado Water Conservation Board Members:

Please accept this letter of support from The Nature Conservancy (TNC) for the Roaring Fork Conservancy's Colorado Water Plan Grant application: *Exploring social and environmental controls on the scalability of water conservation programs.* TNC is a proponent of this proposed project and believes that the underlying research findings it is expected to yield will help inform water management efforts and innovation in Colorado.

This work builds on a previous social science research project in the Colorado River Basin that TNC supported titled "Evaluating Conserved Consumptive Use in the Upper Colorado River." The current proposed work endeavors to use quantitative social survey methods and simulation modeling to test how well different water conservation programs or policies "scale-up" in the face of stark differences in social attributes, cropping patterns, soil types, elevations, etc. where irrigation occurs across western Colorado.

This effort builds on the CWCB's past support of the Water Bank Work Group, the System Conservation Pilot Program, and the Grand Valley Conserved Consumptive Use Pilot Projects. We believe this project will make important contributions to efforts to increase the long-term sustainability of the Colorado River Basin.

Thank you for your consideration and please feel free to contact me if you have any questions or require additional specification about this endorsement.

Regards,

Nancy A Smith
Conservation Director, Colorado River Program
The Nature Conservancy

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THE COLORADO BASIN ROUNDTABLE
C/O P.O. BOX 1120
GLENWOOD SPRINGS, COLORADO 81602

June 29, 2022

Colorado Water Conservation Board
1313 Sherman St., Room 721
Denver, CO 80203

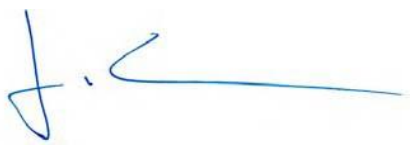
Dear Colorado Water Conservation Board Members:

I am pleased to submit this letter in support of the Colorado Water Plan Grant application: *Exploring Social and Environmental Controls on the Scalability of Water Conservation Programs.*

We face unprecedented challenges when it comes to water use in Colorado and we need to ascertain the potential role water conservation can play in addressing these challenges. The technical and legal issues related to agricultural water conservation are important to understand and we feel that work associated with various pilot projects will continue to yield important local information. However, we also acknowledge that an enhanced understanding of the social and behavioral controls on the success of water conservation programs is critically important. Understanding these controls is central to creating and implementing successful water conservation projects and policies capable of addressing Colorado's current and future water challenges.

The Colorado Basin Roundtable, through its Next Steps Committee supports this effort and is committed to engaging in this work and supporting our local partners in the design, development, and implementation of water user outreach efforts. We will also work with partners to assist in distributing findings to Basin Roundtables, the State of Colorado, agricultural producers, and other stakeholders involved in this important work.

Regards,



Jason V. Turner, Chair