COLORADO
Colorado Water Conservation Board
Department of Natural Resources

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TO: Colorado Water Conservation Board Members

FROM: Alexander Funk, Program Manager
Alternative Agricultural Water Transfer Methods Grant Program (ATM)
Interstate, Federal, and Water Information Section

DATE: March 11th, 2020

AGENDA ITEM: 15(a). Alternative Transfer Method Grant Program, Colorado River Basin Roundtable and Trout Unlimited, Evaluating Conserved Consumptive Use in the Upper Colorado River

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Staff Recommendation: Staff recommends approval of up to $500,000 from the Alternative Agricultural Water Transfer Methods Grant Program to help fund the "Evaluating Conserved Consumptive Use in the Upper Colorado River."

Background:

The Colorado Water Plan encourages alternatives to permanent dry-up of irrigated agriculture and to utilize alternative transfer methods (ATMs) to support a sustainable agricultural industry while addressing other water resource challenges. The CWCB's Alternative Water Transfer Methods Grant Program, established in 2007, provides resources to help develop and implement ATM projects, including research. The ATM grant program also provides resources for the "life cycle" costs of ATM projects, including project operations and infrastructure. The current focus of the ATM grant program is on implementing projects that will result in or facilitate actual wet-water transfers to support multiple uses, including municipal, industrial, agricultural, environmental, and recreational needs. ATM grants can also be utilized to explore voluntary, temporary, and compensated approaches to groundwater sustainability and compact compliance.

If this request is approved, it will constitute the 37th ATM Grant approved by the CWCB. Of the previous 36 projects, 12 are in-progress, and 24 have been completed or closed-out.

The current ATM balance is $892,747. If this grant request is approved and comes under contract, the remaining balance will be $392,747.

Staff's review of ATM applications involves the following steps:

1) Applications are reviewed for completeness based on the information requirements, which are primarily outlined in the ATM Grant Criteria and Guidelines (C&G).
2) Applications are reviewed to verify that the water activity meets the eligibility requirements in the C&G.
3) Staff then prepares the Water Activity Summary Sheet, which documents the outcome of the review process and contains staff's recommendations.

Staff concludes these ATM Grant applications are complete, and the proposed activity meets the eligibility requirements in the C&G. The Water Activity Summary Sheet, ATM Grant Application, Statement of Work, and Budget and Schedule are attached.

Alternative Water Transfer Methods – Competitive Grant Program
Water Activity Summary Sheet
March 11, 2020
Agenda Item 15a

Applicant & Grantee:	Colorado River Basin Roundtable, Trout Unlimited (Grantee)
Water Activity Name:	Evaluating Conserved Consumptive Use in the Upper Colorado River
Water Activity Purpose:	Demonstrate the use of alternative transfer methods and the adoption of voluntary, temporary, and compensated agricultural water conservation mechanisms in higher elevation irrigated pasture and grass systems.
Drainage Basin:	Colorado
Water Source:	Colorado River
Amount Requested:	$500,000
Matching Funds:	**$405,000** total match

Staff Recommendation
Staff recommends approval of up to $500,000 from the Alternative Water Transfer Methods Program to help fund the "Evaluating Conserved Consumptive Use in the Upper Colorado River" project.

Water Activity Summary: The purpose of the Evaluating Conserved Consumptive Use in the Upper Colorado River Project is to explore issues relating to the potential development of alternative transfer methods and other voluntary, temporary, and compensated agricultural water conservation methods to address regional water resource challenges. Despite the implementation of alternative transfer methods in other portions of the state, few alternative transfer methods have been adopted on the Western Slope given concerns about potential agronomic impacts to higher elevation irrigated grass pasture and hay production and associated regional socio-economic impacts. Multiple studies and reports, including previously funded ATM grant projects, have identified a need for additional research studies at high elevation sites to investigate the behavior of irrigated grass pasture and hay production under temporary fallowing or deficit irrigation. Various methods for verifying conserved consumptive use savings also face challenges when assessing historic consumptive use in higher elevations.

Through this project, the Colorado River Basin Roundtable ("CBRT"), Trout Unlimited, American Rivers, the Nature Conservancy, Colorado State University, and local agricultural producers will evaluate the potential for water conservation and agronomic viability for reducing irrigation on high elevation irrigated pasture in the Kremmling area. In particular, the project team will collect data on the agronomic impacts (e.g., yield, plant density, recovery time) associated with voluntary, temporary, and compensated agricultural water conservation mechanisms; assess and validate multiple methods for verifying conserved consumptive use including OpenET; develop a better understanding of operational and regional socioeconomic factors associated; and share project findings with CWCB, basin roundtables, and other stakeholders interested in utilizing alternative transfer methods on the Western Slope to address various regional water resource challenges.

Discussion: Staff supports the application based on the following considerations: the project will collect information regarding an identified data gap related to the agronomic impacts of temporary water conservation mechanisms on higher elevation irrigated grass pasture and hay production; assess the applicability of various methods to measure conserved consumptive use at higher elevations; develop methods for determining compensation for producers involved in alternative transfer methods; build on research completed through previous CWCB ATM funded projects; promote the use of voluntary, alternative transfer methods on the Western Slope; the project will help meet the Colorado River Basin Implementation Plan's goal of managing water to sustain an optimal agricultural economy while meeting growing water demands; and this effort will further Colorado's Water Plan's Measurable Objectives and Critical Goals and Actions with regard to ATMs.

Issues/Additional Needs: None at this time.

CWCB Project Manager: Alexander Funk, Amy Ostdiek

COLORADO WATER CONSERVATION BOARD

ALERNATIVE AGRICULTURAL WATER TRANSFER METHODS COMPETITIVE GRANT PROGRAM

GRANT APPLICATION FORM

Evaluating Conserved Consumptive Use in the Upper Colorado River

Program/Project Name **River Basin Name**

$500,000

Amount of Funds Requested

$405,000

Amount of Matching Funds

Instructions: This application form must be submitted in electronic format (Microsoft Word or Original PDF). The application can be emailed or a disc can be mailed to the address at the end of the application form. The Alternative Agricultural Water Transfer Methods Competitive Grant Program, Criteria and Guidelines can be found at http://cwcb.state.co.us/LoansGrants/alternative-agricultural-water-transfer-methods-grants/Pages/main.aspx. **The criteria and guidelines must be reviewed and followed when completing this application**. You may attach additional sheets as necessary to fully answer any question, or to provide additional information that you feel would be helpful in evaluating this application. Include with your application a cover letter summarizing your request for a grant. If you have difficulty with any part of the application, contact Craig Godbout of the Water Supply Planning Section (Colorado Water Conservation Board) for assistance, at (303) 866-3441 x3210 or email at craig.godbout@state.co.us.

Generally, the applicant is also the prospective owner and sponsor of the proposed program/project. If this is not the case, contact Craig before completing this application.

Alternative Agricultural Water Transfer Methods – Grant Application Form
October 2010

Part A. - Description of the Applicant(s) (Program/Project Sponsor);

1. Applicant Name(s): Colorado River Basin Roundtable
Contact: Kirsten Kurath

Mailing address: Kirsten Kurath
Williams, Turner & Holmes, PC
744 Horizon Court, Suite 115
Grand Junction, Colorado, 81506

Taxpayer ID#: n/a

Email address: kmkurath@wth-law.com

Phone Numbers: Business: (970)242.6262 ext. 236

Home: n/a

Fax:

2. **Person to contact regarding this application if different from above:**

Name: Mely Whiting

Position/Title: Trout Unlimited's Colorado Water Project Legal Counsel

3. If the Contracting Entity is different then the Applicant, please describe the Contracting Entity here.

Trout Unlimited (TU), represented by Mely Whiting, will be the Contracting Entity.

4. **Provide a brief description of your organization. The applicant may be a public or private entity. Given the diverse range of potential applicants, not all of the following information may be relevant. Where applicable and relevant the description should include the following:**

    a) **Type of organization, official name, the year formed, and the statutes under which the entity was formed, a contact person and that person's position or title, address and phone number. For private entities, a copy of the Articles of Incorporation and By-laws should be appended to the application.**

The Colorado Basin Roundtable (CBRT) is a group of water managers and stakeholders charged with water planning for the main-stem Colorado River Basin within Colorado. It is one of nine basin roundtables in Colorado created by the state legislature in 2005 in the Water for the 21st Century Act. In 2015, as part of a statewide initiative to develop the Colorado State Water Plan, the Colorado Basin Roundtable completed its own Basin Implementation Plan to address water needs within the basin. The basin roundtable also allocates grant funding to address the region's water challenges. Our members include people from agriculture, domestic water providers, environmental and recreation entities, and interested citizens. Our goals are to protect, conserve and develop water supplies within the Colorado Basin and the Western Slope of Colorado for future needs.

The CBRT has identified its priorities as 1) addressing shortages in the headwaters area; 2) looking at the impacts of transbasin firming projects; 3) looking at compact delivery impacts to existing and future in-basin water rights; 4) ensuring endangered species' needs do not negatively impact future in-basin needs; 5) identifying non-consumptive needs for environmental and recreational flow; and 6) ensuring adequate water supply for future municipal, industrial, agricultural, environmental and recreational needs. The project aligns very well with these basin wide priorities.

The CBRT contact person for this grant is Kirsten M. Kurath, Williams, Turner & Holmes, PC, 744 Horizon Court, Suite 115, Grand Junction, Colorado, 81506, 970-242-6262, CBRT Demand Management Workgroup Chair. A copy of the CBRT Bylaws is attached.

Trout Unlimited, Inc. is a 501(c)(3) non-profit organization incorporated in Lansing, Michigan on September 22, 1959. The contact person for this grant is Amelia (Mely) Whiting, Legal Counsel, Colorado Water Project, P.O. Box 1544, Pagosa Springs, CO 81147, mwhiting@tu.org, (720) 470-4758). A copy of TU's Articles of Incorporation and Bylaws are attached to this application.

    b) **For waters suppliers, information regarding the number of customers, taps, service area, and current water usage, and future growth plans, water related facilities owned or used, funding/revenue sources (existing service charges, tap fees, share assessments, etc.), the number of members or shareholders and shares of stock outstanding or a description of other means of ownership.**

N/A

    c) **For other entities, background, organizational size, staffing and budget, and funding related to water that is relevant in determining whether the applicant has the ability to accomplish the program/project for which funding is sought.**

The CBRT currently has no administrative staff and is run by Jason Turner, Chair, and Karn Stieglemeier and Paul Bruchez, Co-Vice Chairs. The CBRT has teamed with Trout Unlimited, Inc., which has agreed to be the contracting entity for the grant and to provide administrative assistance at no cost to the project.

TU currently has approximately 223 staff working in 35 offices from Alaska to North Carolina. The vast majority of TU's employees are professional conservationists that oversee watershed restoration projects, organize hunters and anglers to advocate for improved public lands management, work to systematically improve state water policy to benefit rivers and fish, or promote youth education programs. TU's 33-member board meets 3 times a year, and major committees meet quarterly.

TU is a membership organization with approximately 158,000 grassroots members organized in 385 local chapters across the country. There are approximately 12,000 members in Colorado. TU's members are community leaders, professionals, and business owners, and are among the most effective and articulate grassroots advocates for protecting our important watersheds and landscapes. In 2017, TU members volunteered more than 734,824 hours, organizing restoration projects on their local rivers and streams, educating youth in environmental stewardship, and engaging local decision makers in proactive planning.

A copy of TU's latest budget statement is attached.

d) A brief history of the Applicant(s).

Trout Unlimited: TU was founded in 1959 in Grayling, Michigan on the banks of the Au Sable River by a group of anglers who successfully sought to change the state's reliance on hatchery production of trout into a program that focused on protecting and restoring fish habitat. From the beginning, TU was guided by the principle that if we "take care of the fish, then the fishing will take care of itself." Today, TU is the nation's largest grassroots coldwater conservation organization with a mission to conserve, protect and restore North America's trout and salmon fisheries and their watersheds. TU works to achieve this mission on a local, state and national level through an extensive volunteer network and dedicated staff.

See above for a discussion of the history of the CBRT.

e) Please include any relevant Tabor issues relating to the funding request that may affect the Contracting Entity.

N/A

Part B. - Description of the Alternative Water Transfer Program/Project –

1. Purpose of the Program/Project

Please provide a summary of the proposed program/project, including a statement of what the program/project is intended to accomplish, the need for the program/project, the problems and opportunities to be addressed, the expectations of the applicant(s), and why the program/project is important to the applicant(s). The summary must include a description of the technical, institutional (i.e., how the program/project will be organized and operated), and legal elements that will and/or have been addressed by the applicant and proposed program/project. The summary should also discuss relevant project history, if applicable, and any other relevant issues.

Previous Studies: To the maximum extent possible, the results of any previous studies and investigation should be utilized and incorporated into the proposed program/project. The application for funding should include a brief summary of the results of previous studies and how they will be utilized.

PROJECT GOALS

Demand management is recognized in the Colorado State Water Plan as a mechanism to alleviate stress on a stream system during normal years and during times of shortages. This workgroup continues to explore issues related to voluntary, temporary and compensated approaches to water conservation that may be beneficial to future Colorado River compact compliance, including a potential demand management program. This same exploration will assist the CBRT in determining how to best meet its BIP goals.

Given the potential for alternative transfer method development in the Upper Colorado River region to address regional water resource challenges there is significant interest from local water users in further exploring the potential agronomic and socioeconomic impacts associated with the adoption of alternative transfer methods and water conservation programs in higher elevation systems. Through this proposed project, we will work with local water users to reduce water use through multiple methods at a scale which allows us to address the questions, including: (1) best practices for reducing irrigation on perennial irrigated pastures; (2) estimating and verifying actual water savings from those associated practices, and; (3) working with ag producers to identify multi-year strategies to create conserved consumptive use while maintaining viable agricultural operations. Collecting this information will be very valuable in formulating policies and programs encouraging ATM development on the Western Slope which has different climate, hydrologic, production types, and other factors to consider when compared to Front Range ATM projects. Even within the Western Slope, it is important to recognize and study the differences in water conservation methods viable at higher elevations compared to those at lower elevations.

This research directly builds from past work, feasibility assessments, field studies, and small-scale pilot projects, which are described in more detail below.

While this program has the potential to be informative to the statewide demand management process, it will help fill critical information gaps as to the viability of ATMs on the Western Slope and at high elevations in particular.

PROJECT NEED

The Colorado River Basin supplies water to seven U.S. states and the Republic of Mexico. The Basin provides domestic water supplies to 40 million people and irrigates more than five million acres of agricultural lands. It also fuels a multi-billion-dollar recreational economy and supports diverse wildlife and fish found nowhere else in the world. However, the Basin has experienced a severe drought since the late 1990s. While the region has had some wet years, the trend has been one of declining water supplies.

Lakes Powell and Mead, the region's principal reservoirs, have witnessed dramatic declines in the past two decades and are currently facing historically low levels. If the Colorado Basin continues to experience a dry hydrology, and if no collaborative action is taken to mitigate potential impacts, every sector is at risk. Over the past several years, multiple efforts have investigated how a program to reduce water use on a voluntary, temporary, and compensated basis can play a role in tackling these challenges. The proposed Project outlined in this grant supports the goals of both the State Water Plan and the CBRT BIP by exploring voluntary, temporary, and compensated water conservation methods. If successful, such methods may create a temporary supply that can help this basin meet its water demands in face of its ever-changing water supply due to climate change. ATMs on the Western Slope can also create mechanisms that will support the productive agriculture that is so important to this region's economy. This project will test the ATM concept at scale and in a new geography, fill in critical data gaps identified in various studies, and provide information that is essential to determining how ATMs can work on the Western Slope to address the CBRT BIP priority concerns.

PROBLEMS & OPPORTUNITIES TO BE ADDRESSED

The primary opportunity to address right now is the opportunity to work with willing water users in a priority geography to develop a project on the ground that can provide the test case for exploring multiple feasibility questions for alternative transfer method development and temporary, voluntary, and compensated reductions in consumptive use that are important to the CBRT. More specifically, the project can address the following priority issues for the CBRT:

- *Supporting Productive Agriculture:*

A potential mechanism involving the voluntary, temporary, and compensated reduction in consumptive use has to support existing and future productive agriculture and not unfairly impact rural communities, which means, among other things, not removing water permanently from the land. Avoiding permanent "buy and dry" is of paramount importance in the Colorado River basin.

- *Exploring Compensation:*

A "one price fits all" compensation plan will not work, but the question of compensation may be resolved under free market principles.

- *Providing multiple benefits:*

There can be ancillary benefits to alternative transfer methods and voluntary water conservation mechanisms that we should not lose sight of and which may play a role in implementation and funding decisions.

- *Addressing technical questions*:

Work needs to be done to address measurement, calculation methodologies and verification and the collection of data based upon spatial variability and elevation differences. More research into deficit irrigation and potential "alternative" crops may lead to solutions for some of the issues associated with the

adoption of voluntary, temporary, and compensated agricultural water conservation measures in response to regional water challenges.

APPLICANT EXPECTATIONS

The CBRT expects to work closely with our partners to implement this project and use this work on the ground to explore questions of importance to our agricultural community and other members. The CBRT will welcome the opportunity to share this work with and receive input from the CWCB, other roundtables, the demand management workgroups, and other stakeholders exploring the use of alternative transfer methods on the Western Slope, as we believe the work will be valuable in informing their efforts.

PROJECT IMPORTANCE

The CBRT is committed to being proactive in exploring the challenging issues related to Colorado River water use and potential solutions. This project provides an important opportunity to bring local leadership, agricultural expertise, and field research together to help focus and advance the conversation on the potential role of alternative transfer methods in the Upper Colorado River Basin to address regional water resource challenges..

TECHNICAL & INSTITUTIONAL ELEMENTS

The project will involve testing and evaluating these technical and institutional components.

- Developing options for producer participation in reducing water use.
- Providing estimates of conserved consumptive use for each of these options based on crop type and soil profile.
- Determining how to monitor and verify that these options are carried out in the field.
- Determining an operational mechanism to account for and manage this water with local infrastructure.
- Calculating the price per acre for participating producers.
- Determining a method for estimating actual reductions in consumptive use at the end of the irrigation season.
- Exploring how producers can incorporate payments for reduced water use in long term planning for their operations.
- Better understanding the impacts of reduced irrigation on species composition, yield, and forage quality in high elevation perennial crops.

LEGAL ELEMENTS

The legal issues associated with ATMs and voluntary, temporary, and compensated approaches to compact compliance are complex and are not the primary focus of this project. For purposes of this project, it is anticipated that the Colorado River District's Water Conservation Program will be used to provide protection to participants' water rights. Options available through current legal mechanisms for delivering water savings (e.g., muni-ag contracts, ISF program) will be explored as well as looking at potential use of water rights under conservation easements.

PREVIOUS STUDIES

A. Colorado Water Bank Feasibility Study, Phase II

This study explored if and how a water bank could work with the number of different irrigation systems on the West Slope. For Phase II of the Feasibility Study, the Colorado River Water Bank Work Group (WBWG) partnered with eight different irrigation systems on the West Slope to better understand the range of how water is used and managed. This included irrigation systems of different sizes, in different river basins, and at different elevations. It also included a range of management and ownership structures, from simple systems owned and operated by a small number of individuals, to more complex private ditch companies, to large Federal and Tribal projects. The study concluded generally that each system saw different opportunities and challenges to participating in a water bank. The study was extremely helpful in uncovering the large number of technical, legal, economic, and social questions that would need to be addressed for a water bank to become operational.

B. Agronomic Responses of Grass and Alfalfa Hayfields to No and Partial Season Irrigation

At the same time the WBWG was investigating how a water bank could work with the various irrigation systems on the West Slope, additional questions and concerns were raised about impacts to individual farm and ranch operations. Producers interested in participating needed information on how reduced irrigation would impact crops and how long it would take those crops to recover once full irrigation was restored. To address this, the WBWG partnered with Colorado State University (CSU) on a three-year study to evaluate the agronomic impacts of fallowing and split season irrigation. The study took place on seven different sites on the West Slope that included both grass and alfalfa fields. The study compared reduced irrigation and normal irrigation side by side and took measurements of yield and forage quality, as well as basic estimates of water use. The study helped quantify the

reductions in yield expected with reduced irrigation and provided critical info on how well and how long it takes fields to recover. Like the Phase II report, it also raised a number of additional questions and the WBWG chose to continue working with CSU on a longer-term, larger scale field study that is described below.

C. Water Bank Phase IIC: Agronomic Impacts and Measurements of Water Savings

Similar to the previous study, this expanded study also involved a side by side comparison of a number of different reduced irrigation practices with normal irrigation. It also included a number of the same agronomic variables, including yield and forage quality. The study also assessed issues with recovery and management factors such as weed pressure and impacts to soil moisture. This study conducted an in-depth measurement of water savings using a number of different methods. Each field was instrumented to measure a full water budget: water delivered and applied, surface runoff, soil moisture at three different depths, and influence from groundwater, if any. Each study site also has, or is in close proximity to, a full weather station allowing for robust calculations of water use. This is a highly accurate, but costly way to measure water savings. In order to address the question of how to scale up, CSU also used remote sensing data to calculate water use and water savings.

D. System Conservation Pilot Program projects

With concerns growing among water managers about declining reservoir levels in Lakes Powell and Mead, the four major municipal water providers in the Colorado River Basin partnered with the Bureau of Reclamation to implement a four-year pilot program to test emergency measures to reduce water use. The SCPP ran from 2015-2018 and completed multiple projects in each Upper Basin state. These pilots were valuable for confirming that producers can find ways to reduce water use temporarily in ways that work for their operation. The pilots also highlighted a number of challenges, including: How do you determine a fair price for both parties? How do you have a simple and transparent method for estimating and confirming water savings? How do we build a program that is large enough to address the scale of the problem? How do we administer and shepherd conserved consumptive use water within State law?

E. Research Synthesis: Agronomic Impacts of Reduction Irrigation

This report reviews research on fallowing and limited irrigation to highlight key findings related to agronomic impacts of limited irrigation or other methods to reduce consumptive use of irrigation water in the Upper Colorado River Basin. The concluding section also identifies remaining research questions and suggests potential implications and possible next steps for a demand management program. The appendix summarizes the parameters of several of the studies reviewed.

F. Colorado River Basin Roundtable Demand Management Workgroup Discussion Points

The Colorado Basin Roundtable formed a demand management workgroup at the end of January 2019. This document summarizes the issues, questions, concerns and principles the CBRT feels should be part of the demand management conversation. A copy of this document is attached to the grant application.

2. Study Area/Service Area Description

The study area/service area is generally the geographic area that is the subject of the proposed program/project (include both the source of supply and location and type of new use). The description should include the following items:

a) A narrative description of the study area/service area including: the county, the location of towns or cities, topography, and locations of major surface and ground water features.

The general area of the project is located in Grand County, Colorado near Kremmling and Parshall, Colorado. Approximately half of the project (608 acres) will occur to the north of Kremmling up the Muddy Creek drainage and its tributaries. Most of the water rights to this location are on tributaries of Muddy Creek with direct diversion rights and storage rights including three different storage facilities. Two of the project locations (307 acres) are within three miles of Kremmling on the mainstem of the Colorado River and located within the riparian corridor of the Colorado River. One additional project (235 acres) is located at a higher elevation to the south of Kremmling and Parshall up the William's Fork Valley on one of its tributaries.

b) An area map showing each of the items above, as well as the locations of existing facilities, proposed project facilities and boundaries of lands involved in the proposed program/project.

Attached.

c) Information regarding the irrigated lands that are involved in the program/project. This must include a tabulation of total irrigated acreage, description of cropping types, crop yields, and total average annual water diversions for existing agricultural lands.

Muddy Creek Tributary Project: 608 irrigated acres with an average yield of slightly over 2.5 tons grass/hay mix per acre on mechanically harvested portions of irrigated ground.

Main-Stem Colorado River Projects: 307 irrigated acres with an average yield of slightly over 2.5 tons of grass/hay mix per acre on mechanically harvested portions of irrigated land.

Williams Fork Tributary Project: 235 irrigated acres with an average yield of slightly over 2 tons of grass/hay mix per acre on mechanically harvested portions of irrigated land.

Diversions associated with these lands/areas have been documented by the Division of Water Resources and have legitimate water rights. Further information associated with water rights will be disclosed upon landowner's contracts related to this project and approval of this grant application.

d) Information regarding the location of the new water use(s) that will be served by transferred water including the estimated number of users/taps and/or uses served.

This project has the capability of providing additional water to the Colorado River and all that rely on it. More information about specific use/supply will be determined by the research team working on analysis of conserved consumptive use.

e) Socio-economic characteristics of the area such as population, employment and land use.

Kremmling Colorado has a population of approximately 1500 people. The economy is largely impacted from agriculture and recreation-based activities including fishing, hunting, and Colorado River based boating activities from Gore Canyon down river.

3. Description of the Alternative Water Transfer Method

Please describe the type(s) of water transfers that will be examined/utilized (i.e., conceived transfer methods include, but are not limited to: 1) interruptible water supply agreements; 2) long-term agricultural land fallowing; 3) water banks; 4) reduced consumptive use through efficiency or cropping changes while maintaining historic return flows; and 5) purchase by end users with leaseback under defined conditions). In addition, please describe how the transferable consumptive use will be calculated and quantified, and how return flow patterns will be addressed/maintained.

We will explore multiple options to temporarily transfer water savings from this project that can inform the potential use of alternative transfer methods to address Upper Colorado River Basin regional water priorities. We will work with the State and other partners to determine the best approach.

4. Program/Project Eligibility

Please describe how the proposed program/project meets each of the following eligibility requirements (please see Criteria and Guidelines for additional information regarding the alternative water transfer methods/strategies that qualify for funding). Note: If these requirements are addressed in other parts of the application you may simply reference the applicable section(s).

a) ***A description of how, if implemented, the proposed program/project will protect property and water rights***.

Individual property rights will be protected by working only with willing participants. Participants will apply for inclusion in the Colorado River Water Conservation District's Conservation Program, which includes various safeguards to protect the participants' water rights and prevent injury to others. C.R.S. § 37-92-103(2) provides that no intent to discontinue permanent use shall be found for purposes of determining an abandonment of a water right for the duration of the period that nonuse of a water right by its owner is a result of participation in a water conservation program approved by a water conservation district. Participants will also be protected by C.R.S. 37-92-305 (3)(c), which directs the water judge to NOT consider any decrease in water use or nonuse of water resulting from an approved water conservation program. The Colorado River Water Conservation District's Conservation Program is an approved program for purposes of these statutory protections.

b) Identified group(s) of agricultural users that are or may be willing to transfer a portion of their water and identified entity(s), group(s) or area(s) where the transferred water could or would be put to the new use and a description of the new use.

The agricultural users committed to this project understand the purpose and intent of this project. All of the agricultural users have previously contracted with Trout Unlimited and/or the CWCB. The producers involved have experience that will be critical to the feasibility analysis of conserved consumptive use in the Colorado River Basin and have previously demonstrated compliance on grants and partnership with the Colorado Basin Roundtable, the

Colorado Water Conservation Board and Trout Unlimited.

c) The program/project must at a minimum conceptually describe the technical, institutional, and legal elements of the water transfer. Grant monies may be used to address one or more of these elements. If grant monies are not requested for all three elements, the grant applicant must describe how the applicant has or intends to address the elements, which are not included in the grant request, through other efforts.

TECHNICAL/INSTITUTIONAL

- Verifying HCU and CCU
- Operational mechanism to move CCU from the field to the river
- Determining compensation
- Creating contract
- Completing monitoring & verification

LEGAL *(Note: No grant funds are requested for legal work)*

- Water rights protection
- Evaluating options for water rights administration and implementation
- Options with Conservation Easements

d) If grant monies are proposed for use for legal assistance then the use of those funds shall be oriented toward advancing the knowledge of alternative agricultural water transfer methods and techniques; not for preparation of a specific water court case. The total requested funds for legal assistance shall not exceed 40 percent of the total grant request. In addition, grant monies proposed for use for legal assistance must be used to collaboratively address issues and concerns related to agricultural water transfer. Funds shall not be used to solely advance the cause of the project proponents.

N/A

e) A minimum of a 10 percent cash match of total project cost (past expenditures and "in kind" can not be counted toward the 10 percent match).

Project partners anticipate contributing significant match for the project and have currently secured a 20% cash match for the project with additional requests pending. Project partners will provide CWCB staff with additional letters of financial commitment following submission of this proposal.

5. Program/Project Evaluation Criteria

The following grant evaluation criteria will be used by the CWCB to evaluate and make recommendations to fund, partially fund or not fund a grant application. The criteria are aimed at advancing alternative transfer methods from the literature and studies to actual on the ground projects/programs that provide reliable water supply and sustain key elements of the agricultural area from which the water is transferred. The applicant should fully address and explain in detail in the application how, and the extent to which, the proposed project/program meets each of the criteria. However, it should be noted that the project does not have to meet all of the criteria to be eligible to receive funding and the criteria below are not listed in any order of important or priority.

a. The proposed project/program builds upon the work of former alternative water transfer methods efforts and addresses key areas that have been identified. For more detailed information on this work, please refer to the draft report: *Alternative Agricultural Water Transfer Methods Grant Program Summary and Status Update*, November 2012.

As described above, the proposed project builds directly from the past feasibility studies and field research completed by the WBWG and the lessons learned described in the final report for the System Conservation Pilot Program. This includes issues such as measuring and verifying actual conserved consumptive use and understanding how reductions in water use can work in higher elevation irrigated meadows and specifically those that support cattle operations.

b. The proposed project addresses one or more key recommendation(s) in the report: *Alternative Agricultural Water Transfer Methods Grant Program Summary and Status Update*, November 2012.

This project also advances the three primary recommendations from the referenced report for the West Slope and will test mechanisms necessary for Western Slope agriculture to intentionally reduce consumptive use in a voluntary, temporary, and compensated manner and the risks associated with providing temporary sources of water for enhancing environmental flows and for municipal uses in times of shortages, and to do so in a way that works for agricultural producers and water managers.

c. Preference will be given to projects that provide additional matching resources in the form of cash, past expenditures and in-kind contributions that are in addition to the required 10% cash match.

Project partners have invested significant time on the project to date. Proposals in for additional funding that would provide up to 50% cash match and additional in-kind contributions in staff time.

d. The proposed project/program has the ability/potential to produce a reliable water supply that can be administered by the State of Colorado, Division of Water Resources.

Yes, this proposed project has the potential to produce a reliable water supply to address Colorado River issues that can be administered by the State.

There are multiple components of the project that can potentially produce a reliable water supply that can be administered by the State of Colorado. The project partners have disclosed information to the State of Colorado in a meaningful capacity. This project will advance data and science relative to conserved consumptive use on perennial crops at a high elevation that will be innovative information. All activities of water supply will be coordinated with the Division of Water Resources and the Colorado Water Conservation Board to advance science.

e. The proposed project/program produces information that is transferable and transparent to other users and other areas of the state (i.e., would provide an example "template" or roadmap to others wishing to explore alternate transfer methods).

Yes, and one of the primary goals of the project is to provide a transferrable approach to other geographies and relevant research information to the CBRT and the State. This will include both the research itself as well as the importance of having agricultural leadership and engaging multiple partners in developing a successful project.

f. The proposed project/program addresses key water needs identified in SWSI 2010 or as identified in a basin's needs assessment.

Yes, this project will provide critical information that will inform the application of ATMs on the Western Slope to address state and basin wide water needs in ways that sustain productive agriculture.

g. The proposed project/program advances the preservation of high value agricultural lands. Value can be viewed as: the value of crops produced, the value the agriculture provides to the local community, and the value the agricultural area provides for open space and wildlife habitat.

The project includes producers that have generations of experience on the land associated with the proposed project. These lands all include productive agriculture and areas of open space and wildlife habitat including a conservation easement held by Colorado Parks and Wildlife. The areas identified for this project address all the questions listed above, and more, to address research needs related to better understanding conserved consumptive use at higher elevations in Colorado.

h. The proposed project/program addresses water quality, or provides other environmental benefits to rivers, streams and wetlands.

Three trans-mountain diversion projects (TMDs) – the Colorado-Big Thompson Project, the Moffat Project, and the Windy Gap Project – divert over 60% of the native flows of the Colorado River, measured downstream of Windy Gap Reservoir, across the Continental Divide. No flows return to the area after use. The impacts of TMDs on agricultural operations and river health are well documented in several studies and research conducted by CPW and independent investigations commissioned by Grand County (Grand County Stream Management Plan (GCSMP). The means to address these impacts have also been significantly studied in the ILVK Engineering Assessment and the Windy Gap Reservoir Modification Study (Bypass Study).

Degraded Habitat for Fish, Wildlife, and Invertebrates: TMDs significantly alter stream channels and aquatic habitat in the headwaters area. Reduced stream flows have resulted in overly wide, shallow channels. Insufficient, periodic "flushing flows" have caused excess sediment to accumulate, which can suffocate and kill the fragile macroinvertebrate populations that trout depend on for food, and damage spawning grounds where trout reproduce/lay their eggs. CPW biologists have identified significant declines in trout abundance/size compared to historic norms within the watershed.

While not its primary purpose, the proposed project will benefit the reach of the Colorado River immediately in the Kremmling area, Gore Canyon and beyond.

i. The proposed project/program increases our understanding of and quantifies program/project costs. This could include: institutional, legal, technical costs, and third party impacts.

Yes, this project will advance our understanding of the costs associated with implementing voluntary, temporary, and compensated water conservation activities at scale. These costs include compensation to participants, as well as the expense of administering the program itself. The focus is on addressing institutional and technical costs, as well as evaluating success of the program and assessing any third party or community impacts. Information learned from the project will be shared with relevant stakeholders including CWCB's Demand Management Workgroups and Basin Roundtables where appropriate.

j. The proposed project/program does not adversely affect access to other sources of water (not subject to/participating in the program) where owners of these water rights may wish to pursue traditional transfer of their rights to other users.

The proposed project does not negatively affect any other sources of water or preclude any other water right holder from fully exercising their rights under Colorado law.

k. The proposed project/program provides a perpetual water supply for the new and/or alternate use and preserves agricultural production and/or helps sustain the area's economy from which the transfer is occurring.

The objective of the proposed project is to assess various issues regarding the potential of alternative transfer methods as a means to further temporary, voluntary, and compensated approaches to water conservation to increase water security, as well as, meeting other regional water demands. This approach includes preserving agricultural production and supporting associated economies. As a limited scope and duration research project however, it will only provide a temporary water supply, but it will answer many of the necessary questions identified in previous studies and reports. The project includes participation from producers that understand the potential of water scarcity into the future. The producers involved are large stakeholders to the local economy and understand the impact of the proposed project. The local community is supportive of the project to sustain its economy and understand the science relative to the project and its impacts to the community.

l. The quantity of water produced by the proposed project/program. Preference will be given to programs that can address larger water supply needs.

We estimate that the propose project could provide an estimated 1,660 AF of water savings this year with the potential for larger amounts in the future. This project includes community leaders' participation and the entire community will be watching with potential participation in the future.

m. Applicants are encouraged to develop projects demonstrating participation and/or support from a diverse set of stakeholders and interests.

This project is already supported by: The Colorado Basin Roundtable, Trout Unlimited, The Nature Conservancy, American Rivers and the agricultural producers of Grand County. The project proponents have been in communication with the Colorado River District, Denver Water, Northern Water, Colorado Parks and Wildlife, and Grand County about the project with the goal of obtaining additional support.

6. Statement of Work

Provide the proposed statement of work. On the following page there is an example format for the statement of work. You can use the example format or your own format, provided that comparable information is included. The statement of work should outline by task how the proposed program/project will be accomplished. It is important that the statement of work detail the specific steps, activities/procedures that will be followed to accomplish each individual task and the overall program/project and the specific products/deliverables that will be accomplished. The statement of work must include but not be limited to: task description, key personnel, budget, schedule and deliverables and the final report/project documentation upon completion of the water activity.

The statement of work will form the basis for the contract between the Applicant and the State of Colorado. In short, the Applicant is agreeing to undertake the work for the compensation outlined in the statement of work and budget, and in return, the State of Colorado is receiving the deliverables/products specified. Please note that costs incurred prior to execution of a contract or purchase order are not subject to reimbursement.

Please provide a detailed statement of work using the following template. Additional sections or modifications may be included as necessary. Please define all acronyms. If a grant is awarded an independent statement of work document will be required with correct page numbers.

See attached for a detailed Statement of Work, including Tasks and Deliverables.

REPORTING AND FINAL DELIVERABLE
Reporting: The applicant shall provide the CWCB a progress report every 6 months, beginning from the date of the executed contract. The progress report shall describe the completion or partial completion 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.

Final Deliverable: At completion of the project, the applicant shall provide the CWCB a final report that summarizes the project and documents how the project was completed. This report may contain photographs, summaries of meetings and engineering reports/designs.

BUDGET

COSTS					
Participant Payments					
Activity	CCU/acre	Payment/acre	Risk mitigation/acre	Participating acres	Payment
Split season (cutoff June 15)	1	$ 225	$ 56	900	$ 253,125
Full season	1.84	$ 414	$ 207	600	$ 372,600
		Subtotal		**1500**	**$ 625,725**
Research & Project Management					
Equipment					$ 75,000
Field Tech					$ 20,000
Utah State University					$ 35,000
OpenET					$ 20,000
Colorado State University					$ 55,000
Engineering					$ 35,000
Grant Admin					$ 10,000
Monitoring & Verification					$ 25,000
Project Management					
		Subtotal			**$ 275,000**
TOTAL COST					**$ 900,725**

FUNDING					
		Confirmed			
Source		In-Kind	Cash	Requested	Total
CWCB ATM				$ 500,000	$ 500,000
Private Donors				$ 150,000	$ 150,000
American Rivers			$ 30,000		$ 30,000
TNC			$ 100,000		$ 100,000
TU		$ 15,000	$ 10,000		$ 25,000
Other Requests				$ 100,000	$ 100,000
TOTAL FUNDING			**CONFIRMED**	**REQUESTED**	**TOTAL**
			$ 155,000	**$ 750,000**	**$ 905,000**

SCHEDULE

TASKS	2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1: Contract with Participants and Selection of Research Locations								
Task 2: Perform remote sensing measurement and estimation of consumptive use (CU) and conserved consumptive use (CCU) on large irrigated pastures that are characterized by various grasses, forbs and sedges under varying soil and groundwater conditions.								
Task 3: Validate several remote sensing models for CU and CCU verification that is scientific based, replicable, scalable and can be used in conjunction with broader remote sensing platforms on high elevation pastures in Western Colorado.								
Task 4: Construct water production functions for different grass, forb and sedge forages under varying soil and groundwater conditions in order to understand yields as a function of CU rates.								
Task 5: Evaluate impacts and recovery for forages subjected to different levels of irrigation curtailment.								
Task 6: Quality analysis and quality control (QA/QC).								
Task 7: Construct enterprise budgets to better understand economic considerations and to assist agricultural producers in comparing water leasing against baseline farming and ranching conditions.								
Task 8: Outreach and engage with the Colorado Water Conservation Board's Demand Management Workgroups in order to facilitate constructive dialogue on water sharing programs affecting the Colorado Basin and Western Slope overall.								
Task 9:Reporting								

PAYMENT

Payment will be made based on actual expenditures and invoicing by the applicant. Invoices from any other entity (i.e. subcontractors) cannot be processed by the State. The request for payment must include a description of the work accomplished by major task, and estimate of the percent completion for individual tasks and the entire water activity in relation to the percentage of budget spent, identification of any major issues and proposed or implemented corrective actions. The last 5 percent of the entire water activity budget will be withheld until final project/water activity documentation is completed. All products, data and information developed as a result of this grant must be provided to the CWCB in hard copy and electronic format as part of the project documentation. This information will in turn be made widely available to the public and help promote the development of alternative agricultural transfer methods.

Additional Information – If you would like to add any additional pertinent information please feel free to do so here.

The above statements are true to the best of my knowledge:

Signature of Applicant: 

Print Applicant's Name: Amelia (Mely) Whiting

Project Title: Evaluating Conserved Consumptive Use in the Upper Colorado River

Date: 2/7/2020

Return this application to:

Mr. Craig Godbout
Colorado Water Conservation Board
Water Supply Planning Section
1313 Sherman St., Room 721
Denver, CO 80203
craig.godbout@state.co.us

Scope of Work:
Evaluating Conserved Consumptive Use in the Upper Colorado River

Collaborating Investigators:
Dr. Alfonso Torres-Rua, Utah State University, Civil and Environmental Engineering
Dr. Perry Cabot, CSU, Colorado Water Center, CSU Agricultural Experiment Station, CSU Extension
Dr. Joe Brummer, CSU, Soil and Crop Sciences
Dr. Reza Keshavarz, CSU Agricultural Experiment Station, CSU Extension
Jenny Biermann, Regional Economic Specialist, CSU Extension
OpenET Partners: Robyn Grimm (Environmental Defense Fund), Dana Rollison (EDF), Justin Huntington (Desert Research Institute), Matt Bromley (DRI), and Forrest Melton (NASA/California State University, Monterey Bay)

INTRODUCTION

The Colorado River Basin Roundtable (CBRT) has identified priority questions about the feasibility of alternative transfer methods as a means to address regional water needs/priorities and to further voluntary, temporary, and compensated agricultural water conservation mechanisms. This includes evaluating the potential water conservation and agronomic viability for reducing irrigation on high altitude irrigated pasture, and better understanding the factors involved in determining cost and participant payments for reducing water use. The CBRT believes these questions are best addressed through on the ground project work and has enlisted multiple partners to develop and implement a research-based project to evaluate the feasibility of water conservation in Grand County. In addition to the CBRT, project team partners include agricultural producers in the Kremmling area, American Rivers, Colorado State University, The Nature Conservancy, Trout Unlimited, Utah State University, and OpenET (https://etdata.org/). This representative group of stakeholders and collaborators is committed to developing solutions to Colorado River water challenges that avoid the permanent dry-up of agricultural lands and balance urban, agricultural, community, and environmental needs. This project can provide a real-world laboratory for addressing important questions on integrating compensation for reduced water use with existing agricultural operations, measuring and verifying water conservation, options for delivering water downstream, potential environmental benefits, and more. This project directly builds on the past work of the Colorado River Water Bank Workgroup and the System Conservation Pilot Program, and the project team also envisions communication and outreach to share project results with stakeholders exploring the potential use of alternative transfer methods on the Western Slope to address regional water resource challenges..

GOALS & OBJECTIVES

The overarching purpose of this project is to integrate multiple facets of agricultural water management, including science-based estimations of crop water consumptive use, strategies for reduced consumption, economic considerations, forage yield and quality impact of reduced pasture irrigation, and producer involvement and feedback. This project is focused on informing the Colorado Basin Roundtable about the viability of reducing irrigation on high elevation irrigated pasture to supply water that can be used to address multiple regional priorities. . This project will provide valuable data for the use of alternative transfer methods within Colorado to enhance environmental flows and to provide temporary municipal supplies in times of shortages. In addition, the project will also help address related questions on how to best implement, manage, monitor, and determine water conservation from reduced irrigation.

Consistent with the knowledge gaps posed by producers, stakeholders and administrative partners, the main goals and objectives of this project are to:

- Use remote sensing technology to estimate consumptive use (CU) and conserved consumptive use (CCU) on large (200-1000 acres) irrigated high-elevation pastures characterized by various grasses, forbs, and sedges under varying soil and groundwater conditions. There is a need to understand CU rates in relation to these different species in order to inform estimates of water conservation.
- Validate several remote sensing based evapotranspiration estimation models for CU and CCU verification that are spatiotemporal, replicable, scalable, and can be used in conjunction with broader remote sensing data platforms. Model verification will incorporate in-field eddy covariance instrumentation, soil moisture sensors, groundwater observation wells, comparison with yield data and site visits to Grand County fields participating in this project.
- Construct water production functions for different grass, forb, and sedge forages under varying soil and groundwater conditions to better understand biomass yields and forage quality in relation to CU rates.
- Evaluate impacts and recovery for forages subjected to different levels of irrigation curtailment. This will include documentation of weed pressure and other impacts to yield, forage protein, plant carbohydrates, root depth and nutrient carryover. Additional engagement will be undertaken to assess producer interest in low water use grasses with desirable protein levels.
- Summarize ranch enterprise budgets and understand basic economic impacts to assist agricultural producers in comparing water leasing against baseline farming and ranching profitability. This evaluation will be performed for individual participating ranches as well as regionally to better understand the potential effects of water leasing programs on hay prices and supplies.
- Outreach and engage with other various stakeholders interested in alternative transfer methods and CWCB in order to facilitate constructive dialogue on water sharing programs affecting the Colorado Basin and Western Slope overall.

PROJECT OVERVIEW

Working with local community relationships in Grand County, the project team will identify willing participants and evaluate fields for the proposed project. The team will select both project fields and reference fields and enter into contracts with participating landowners. Past work concerning reduced irrigation in the Upper Colorado River Basin identified the potential impact on livestock operations and pasture yield and recovery as a top concern.

Evapotranspiration (ET) of surface vegetation is among the most critical pieces data to obtain from the pilot project as it determines the amount of water that can be conserved. Although ET can be both difficult and expensive to measure, the OpenET Research Group has made significant advances on the cost-effective operational estimation of ET using the major satellite-based ET models (METRIC, SEBAL, ALEXI, JPL Priesley-Taylor, SSEBOP, and California's CIMIS). While all methods have some limitations, we are proposing that these satellite imagery platforms be utilized to closely estimate CCU by comparing ET and yield in deficit irrigated fields against those that receive a full irrigation. Additionally, we will implement eddy covariance and ground soil moisture instrumentation to further confirm OpenET models results and increase confidence on estimations of reduced irrigation and related yield decreases. Other water conservation estimation options would either require more extensive on-the-ground field monitoring for individual parcels at very high cost, or require many assumptions to calculate decreased ET, placing remote sensing among the most desirable approaches to addressing this ongoing knowledge gap. In addition to ET monitoring, rainfall information from nearby weather stations will also be

monitored to determine the contribution of rainfall and effective precipitation during the growing season and its contribution to ET and soil moisture. Information from this project will inform larger discussions on the methodology for measuring and verifying water conservation.

In addition to the use of remotely sensed ET data, the project team will establish a transect of research plots along a corridor within the pastures. These plots will be equipped with soil moisture sensing systems and will also be used for periodic forage analysis. These field observations and data will help determine the yield impacts and cost to agricultural producers. Periodic site visits will be made to observe the conditions of the pastures and to verify that field conditions are consistent with the imposed irrigation restrictions. The installation of an eddy covariance tower will also provide comprehensive understanding of the water movement from the study site and allow strong calibration of the satellite-based ET estimation models. Furthermore, time lapse cameras will also be installed to monitor the evolution of pastures (health, biomass) under the different irrigation strategies implemented along the irrigation season.

TASKS

The proposed work includes the following main tasks in detail below:

Task 1 - Contract with Participants and Selection of Research Locations

The contract with the participants will describe the field location, irrigation management, compensation terms, and expectations for project involvement. The contracts will be between the participants and Trout Unlimited as the grant applicant.

Research sites will be established and instrumented in Year 1 (2020). A reference area on which a typical irrigation regimen is practiced will also be identified and instrumented. The purpose of the reference area will be to estimate ET under conditions that would occur on fields that do not participate in the program.

During Year 1 (2020), partial-season irrigation or non-irrigation on grass pasture will commence on the research sites using one of two options:

- Option 1. Partial-season Irrigation (shutoff June 15) and no irrigation at the end of the season
- Option 2. Full-season shutoff and no irrigation at the end of the season

Before the beginning of the field season, the research team will meet with the land managers at each participating site and confirm the plan for irrigating during the year as outlined in the contract.

<u>Deliverables:</u>

- Final table of participants (identities will be kept confidential), fields, and field characteristics.
- Annual irrigation plan for each study site.

Task 2 – Perform remote sensing measurement and estimation of consumptive use (CU) and conserved consumptive use (CCU) on large irrigated pastures that are characterized by various grasses, forbs, and sedges under varying soil and groundwater conditions.

This task will involve coordination between USU, CSU, and OpenET in evaluating the primary research questions related to the measurement and verification of CCU, including:

- Estimating and verifying water conservation from multiple irrigation practices using in-field instrumentation and remotesensing.
- Evaluate how variations in crop species, soil moisture, and depth to groundwater affect crop water use and potential water conservation.

There is a need to understand CU rates in relation to the different species of grasses, forbs, and sedges that typically comprise high elevation irrigated hay and pasture fields to inform estimates of water conservation. The project team will work with local producers in the Kremmling area to identify participating fields that have a variety of grass species and soil moisture profiles, records of previous irrigation and associated yields, and a reliable water supply. Since the proposed verification method uses Landsat 7 & 8 imagery, participating fields also need a minimum field width of approximately 1,000 feet for the statistical assessment of the study. Once the project team has identified participants and fields, we will complete a due diligence assessment of water rights and historic consumptive use for proposed project area. This information will provide a baseline to better understand potential and actual water conservation.

Consumptive water conservation under this project will come from reduced evapotranspiration (ET) in the field, which will be verified and quantified by analyzing satellite and weather station climate data, along with periodical aerial maps (from UAVs). To accomplish this, we will work in close coordination with Colorado State University (CSU), and Utah State University (USU) and OpenET. OpenET is a collaborative effort to develop an operational system for mapping ET at the scale of individual fields. The OpenET team is building a new, web-based platform and data visualization and access tools to fill a critical data gap in water management across the western U.S. OpenET's goal is to provide accurate, trusted, satellite-based data on ET and consumptive water use at a low cost to farmers and water managers. For this project, OpenET will provide access to field- and pixel-scale reduced ET estimation at monthly and annual time-steps for the participating fields. In addition, OpenET will provide access to historical evapotranspiration information for these fields to determine water use variability between dry, wet, and average years. This information will be validated with ground measurements from eddy covariance and soil moisture sensors installed as part of this project and CoAgMet stations. Water table measurements will be performed using observation wells equipped with data-logging pressure transducers at the research plots.

<u>Deliverable:</u>

- Final report addressing the two research questions described above.

Task 3 – Validate multiple remote sensing models for CU and CCU verification that is scientific based, replicable, scalable and can be used in conjunction with broader remote sensing platforms on high elevation pastures in Western Colorado.

The first year of the project (2020) will involve significant field work to establish and instrument the research sites, and the budget includes funding for both equipment and support for its installation and operation. Field instrumentation is designed to provide "real-time" measurements on energy fluxes, soil moisture conditions, soil electrical conductivity and temperature that will be used to verify the remote sensing models. Additionally,

the project team will work with participating irrigators to evaluate the need and potential to install equipment to measure the rates, totals and timing of irrigation water inputs. Details may vary by site, but the reference and research plots would each have a "sensing stations" comprised of soil moisture sensors to measure conditions in the root zone. The location of the sensing stations will be determined on the basis of soil conditions, groundwater levels, and forage composition.

Throughout the irrigation season, the project team and/or a consultant will make periodic site visits to verify that participating fields in the project are operated according to their contract and management plan. The field monitoring will only be used to ensure that no water deliveries are made to the fields after the agreed upon shut- off dates and to collect data on yield. This monitoring would not be utilized to estimate decreased consumptive use.

During and after the irrigation season, the project team will also gather field data on yield and pasture conditions. This will include a visual assessment of the crop and field conditions and grab sample yields in both project and non-participating fields. Empirical relationships that estimate ET based on water vapor, heat and energy fluxes will be employed. Vegetative indices such as NDVI, available from the OpenET platform, will also be explored as a means of estimating ET using multi-spectral satellite imagery.

Deliverables:

- Annual and summary estimates of conserved consumptive use for each study site, including comparisons of remote sensing comparisons to ground-truth.
- Revised estimates and description of the factors influencing the range potential conserved consumptive use available to meet other needs.

Task 4 – Construct water production functions for different grass, forb and sedge forages under varying soil and groundwater conditions in order to understand yields as a function of CU rates.

An additional research focus for this project is to understand the relationship between consumptive use (CU) and agronomic variables including crop yield and forage quality. To accomplish this, the project team will collect regular yield measurements (at research plot and field scale) and forage clippings and evaluate yields against local CU rates.

The project team will also install time-lapse cameras and process daily photographs to assess potential factors affecting pasture conditions during the irrigation season. In addition, UAV imagery will also provide a detailed

characterization of potential factors affecting pasture growth, such as soil variability, spatial differences plant growth, and topography/slope.

Dr. Cabot and Prof. Brummer will take the lead on this task, with additional input from Dr. Keshavarz and Dr. Torres-Rua to develop the CU/CCU relationship with agronomic variables. Field visits will be regularly scheduled during the summer in order to collect data at the sites.

Deliverables:

- Summary agronomic data for each field site, including yield, plant density, relative feed value, weed pressure, species changes.

Task 5 – Evaluate impacts and recovery for forages subjected to different levels of irrigation curtailment.

Determinations of the agronomic and biophysical impacts of reduced irrigation versus irrigation to maximize yield or irrigation to fully utilize water throughout the season (i.e., "typical" irrigation) will be made. Understanding how variations in crop species, soil moisture, and depth to groundwater impacts yield, forage quality, and species composition under reduced irrigation and recovery with full irrigation is an important research goal for this project. Therefore, this task will involve collecting data from both reference and treated fields on yield, plant count and density, forage protein, plant carbohydrates, nutrient carryover, and weed pressure. The project team will then analyze this data to assess the recovery period and pattern of vegetation on fields that have undergone a period of reduced irrigation. Agronomic data collection will follow a similar pattern to previous research supervised by Prof. Brummer.

Additionally, the project team will collect anecdotal data from local producers about any previous experience with reduced irrigation that may have occurred in drought or low water years. The project team will also work with producers to explore possibilities for low water use grasses with desirable protein levels.

Deliverables:

- Summary report on the agronomic impacts of reduced irrigation.

Task 6 – Quality analysis and quality control (QA/QC).

In order to maintain data quality and address problems as they are encountered a Quality Analysis and Quality Control (QA/QC) protocol will be established. This will involve regular compiling of data, formatting spreadsheets and generating appropriate charts in order to determine any issues arising with the data collection system. Additionally, regular interactions with the land managers will allow any unplanned changes to the irrigation schedules to be understood and reflected in the data.

Task 7 – Construct enterprise budgets to better understand economic considerations and to assist agricultural producers in comparing water leasing against baseline farming and ranching conditions.

A better understanding of economic factors is needed for ag producers to evaluate how compensation for reduced water use fits into their operational planning. The CBRT has discussed economic considerations for mechanisms necessary for Western Slope agriculture to intentionally reduce consumptive use in a voluntary and compensated manner, including the need to utilize a market-based approach that supports productive agriculture and considers the full range of costs and benefits for participants and their communities.

This evaluation will be performed for individual participating ranches as well as regionally to learn the effects of water leasing programs on hay prices and supplies. This information will help determine the impact on yield and the value of the water to the ranching enterprise. We will also do a general assessment of the impact that deficit

irrigation or no irrigation has on future yield in the project fields. This information will help complete an economic assessment of impacts of water conservation programs.

Deliverables:

- Annual and summary crop enterprise budgets for each field site.
- Economic evaluation for the region to explore how hay supply affects price in the local market.

Task 8 – Outreach and engage with the Colorado Water Conservation Board and other stakeholders interested in alternative transfer methods in order to facilitate constructive dialogue on water sharing programs affecting the Colorado Basin and Western Slope overall.

The project team will work with the CWCB to share information on the project and explore opportunities to leverage this field work to address additional questions. Furthermore, at the request of the CWCB, an extension and outreach program can be developed for the project, consisting perhaps of such approaches as field tours, video materials, and fact sheets. The project team will work with the CWCB to determine a schedule and structure for extension and outreach.

Potential Deliverables:

- Annual or semi-annual field tours.
- Fact sheets/summary sheets for outreach and education.
- Summary document of participant experiences with reduced irrigation practices.

Task 9 – Reporting

Results from the project will be compiled and reported to the funding entity on a timely basis that is scheduled at the outset of the project. All of the Principal Investigators will be involved in the reporting and presentation of data.

Deliverables:

- Progress reports.
- Final report summarizing study, key findings, and recommendations.
- Update to the Colorado Basin Roundtable

Last Update: December 17, 2019

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Colorado Water Conservation Board

Alternative Agricultural Water Transfer Methods Grants

EXHIBIT B - BUDGET AND SCHEDULE - Direct & Indirect (Administrative) Costs

Date:

Water Activity Name:

Grantee Name:

Task No.[1]	Description	Start Date[2]	End Date	Matching Funds (cash & in-kind)[3]	ATM Grant Funds	Total
1	Participant contract/Research locations	4/1/2020	6/31/2021	$282,025.75	$348,199.25	$630,225.00
2	CU/CCU remote sensing	4/1/2020	3/31/2022	$56,610.50	$69,889.50	$126,500.00
3	Validation	6/1/2020	6/1/2021	$43,073.20	$53,176.80	$96,250.00
4	Water production functions	4/1/2020	6/1/2021	$3,356.35	$4,143.65	$7,500.00
5	Impact/recovery evaluation	4/1/2020	3/31/2022	$3,356.35	$4,143.65	$7,500.00
6	QA/QC	4/1/2020	3/31/2022	$2,013.81	$2,486.19	$4,500.00
7	Construct enterprise budgets	6/1/2020	3/31/2022	$1,230.66	$1,519.34	$2,750.00
8	Outreach	4/1/2020	3/31/2022	$2,013.81	$2,486.19	$4,500.00
9	Reporting (includes Admin Costs)	9/1/2020	3/31/2022	$11,310.85	$13,964.00	$25,274.85
			Total	**$404,991**	**$500,009**	**$905,000**

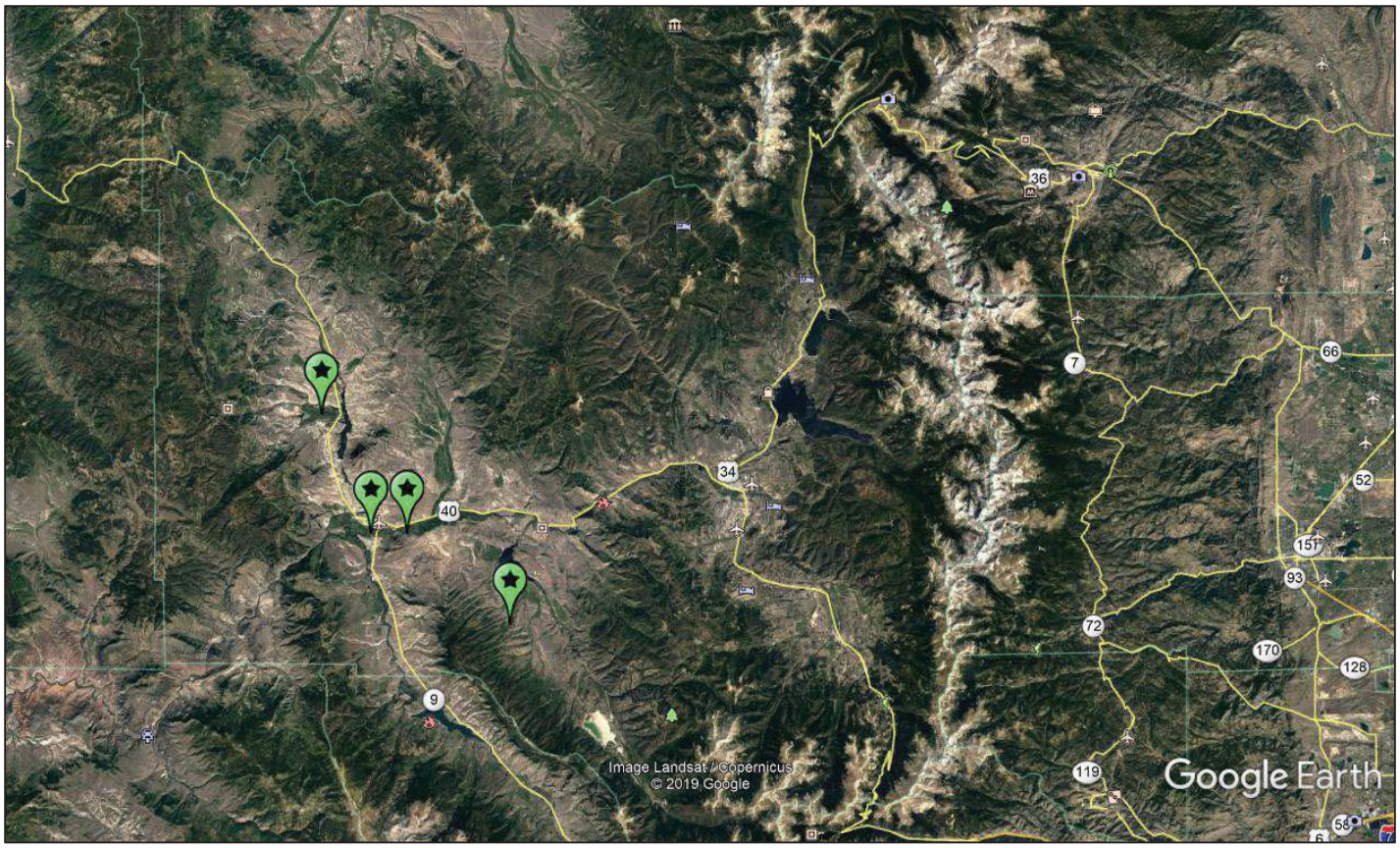
(1) The single task that include costs for Grant Administration must provide a labor breakdown (see Indirect Costs tab below) where the total WSRF Grant contribution towards that task does not exceed 15% of the total WSRF Grant amount.

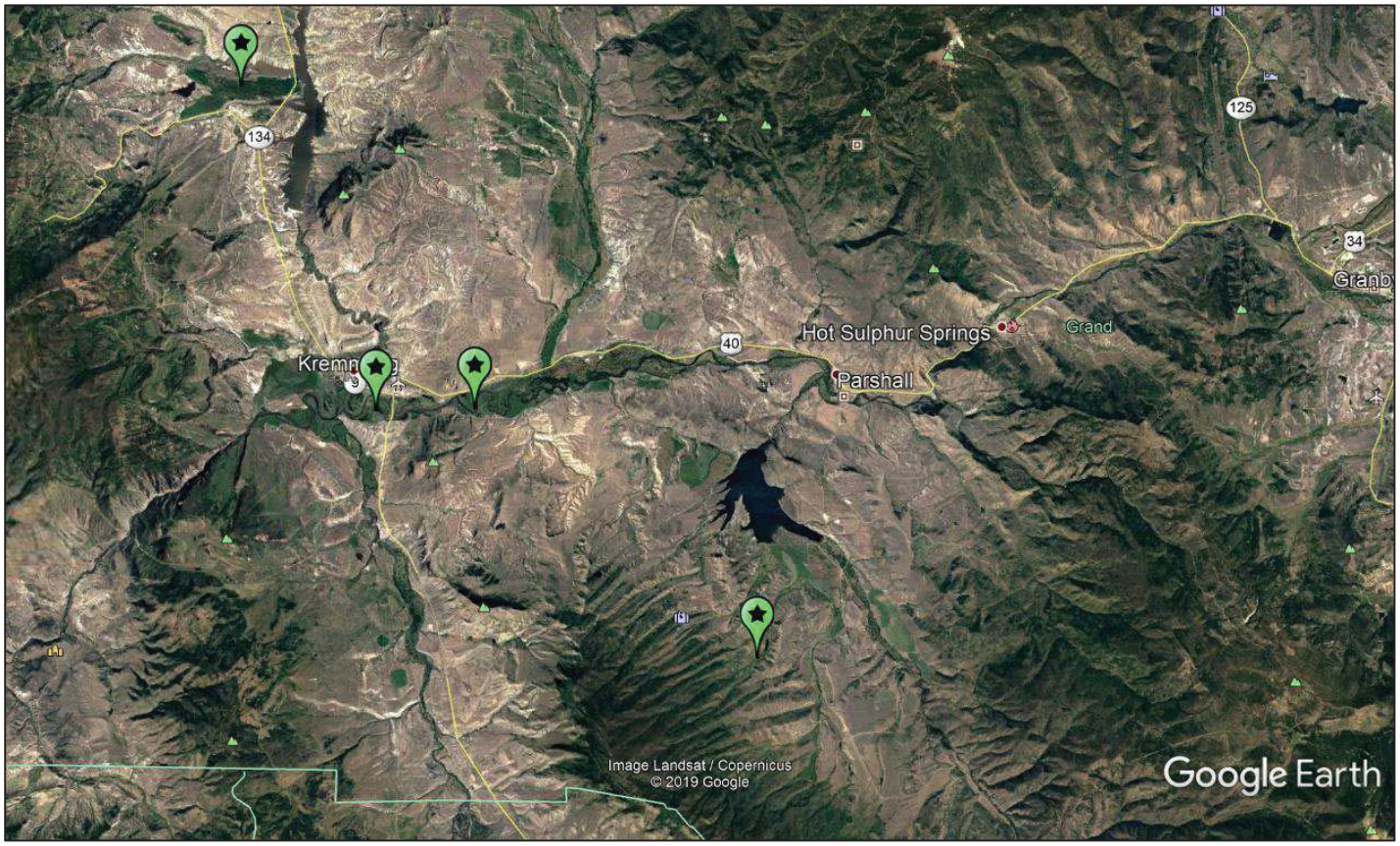
(2) Round values up to the nearest hundred dollars.

• Additional documentation providing a Detailed/Itemized Budget may be required for contracting. Applicants are encouraged to coordinate with the CWCB Project Manager to determine specifics.

STUDY AREA MAP

The maps below show the four proposed study areas located in Grand County.





February 7, 2020

Alex Funk
Colorado Water Conservation Board
Water Supply Planning Section
1313 Sherman St., Room 721
Denver, CO 80203
Via email: alex.funk@state.co.us

Re: Evaluating Conserved Consumptive Use in the Upper Colorado River ATM Grant Application – Letter of Commitment

Dear Alex,

Trout Unlimited (TU) is proud to be a partner in this Colorado River Basin Roundtable effort. I am writing to express our support for the project and confirm our commitment of $10,000 in cash and $15,000 worth of in-kind contributions in the form of staff time and expenses as part of the match for the grant.

Do not hesitate to contact me if you have any questions.

Sincerely,

Scott Yates – Director
TU Western Water and Habitat Program

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

February 7, 2020

Alex Funk
Agricultural Water Resource Specialist
Colorado Water Conservation Board
1313 Sherman Street, Room 718
Denver CO, 80203

Re: Colorado River Basin Round Table Alternative Agriculture Water Transfer Methods Competitive Grant Application for Evaluating Conserved Consumptive Use in the Upper Colorado River

Dear Alex:

On January 27, 2020, by a vote of its members the Colorado River Basin Round Table approved proceeding with the application for a CWCB ATM grant to evaluate agricultural conserved consumptive use in the Upper Colorado River in the Kremmling area. The Round Table is the applicant for the grant and its Demand Management Workgroup will serve as the primary contact for the grant. Trout Unlimited has agreed to serve as the contracting entity for the grant. If you require further information from the Round Table, please let me know. Thank you.

Sincerely,

Jason V. Turner, Chair

American Rivers
RIVERS CONNECT US®

February 5, 2020

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

Re: American Rivers' commitment of financial support for the Colorado River Basin Roundtable's Evaluating Conserved Consumptive Use in the Upper Colorado River project proposal

Dear Board of Directors,

I am writing this letter to express American Rivers' enthusiastic support for the Colorado River Basin Roundtable's project proposal titled *Evaluating Conserved Consumptive Use in the Upper Colorado River.* American Rivers will commit $30,000 in cash and at least $10,000 in-kind match through staff time, travel, and other costs to the match CWCB funds for the project.

American Rivers is committed to supporting local partners in the design, development, implementation of collaborative environmental, recreational, and agricultural water conservation projects throughout the state of Colorado. This project will provide critically important data and information that will the help the Colorado River Basin Roundtable, the State of Colorado, agricultural producers, and other stakeholders better understand the feasibility of potential conserved consumptive use programs such as Demand Management.

Thank you for your consideration. Please feel free to contact me with any questions at 303-454-3395.

Sincerely,

Matt Rice
Director, Colorado River Basin Program
American Rivers
mrice@americanrivers.org
303-454-3395

The Nature Conservancy
Colorado River Program
2424 Spruce St.
Boulder, CO 80302

nature.org/coloradoriver

February 7, 2020

Colorado Water Conservation Board
Attn: Alex Funk
1313 Sherman St., Room 721
Denver, CO 80203

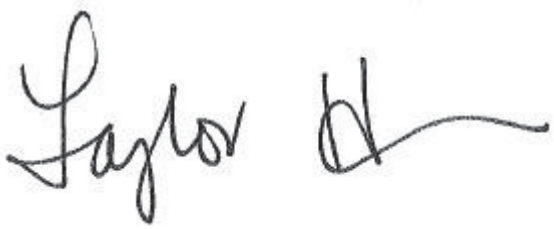
Dear Colorado Water Conservation Board Members:

Please accept this letter of commitment from The Nature Conservancy to contribute $100,000 in cash and contributions to support the *Evaluating Conserved Consumptive Use in the Upper Colorado River* grant application. This commitment will be effective upon finalization of the grant agreement and contribute towards the total project cost.

This important research-based field project builds on our past efforts in the Water Bank Work Group, the System Conservation Pilot Program, and the Grand Valley Conserved Consumptive Use Pilot Projects, which have all received previous support from the Colorado Water Conservation Board. Under the guidance of the Colorado Basin Roundtable, we believe this project is tremendously important to the sustainability of the Colorado River Basin. It will help advance our understanding of the science related to measuring and verifying water conservation and assess how a locally created solution can help address basin wide challenges.

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

Sincerely,



Taylor Hawes
Director, Colorado River Program

cc: Carlos Fernandez, State Director, The Nature Conservancy of Colorado
Jason Turner, Colorado Basin Roundtable & Colorado River District