COLORADO
Colorado Water Conservation Board
Department of Natural Resources

1313 Sherman Street, Room 721
Denver, CO 80203

Memorandum

To: Colorado Water Conservation Board Members

From: Craig Godbout, Program Manager
Alternative Agricultural Water Transfer Methods Grant Program (ATM)

Date: May 7, 2014

Subject: Agenda Item 16, May 21-22, 2014 Board Meeting
No Chico Brush ATM Grant Application

Staff Recommendation – Action Items
Please refer to the ATM grant program summary sheet for staff recommendations for grant applications.

Background
Of the approximately $4,000,000 in ATM Grant appropriations, approximately $366,000 remains available for qualifying applicants and their respective projects. If approved, the attached ATM Grant application for $173,080.17 will result in a reduced balance of approximately $193,000.

If approved, the No Chico Brush Project will constitute the 22nd ATM Grant approved by the CWCB. Of the previuos 21 projects, 11 are In-progress, and 10 have been completed or closed-out.

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

1) Applications are reviewed for completeness based on the information requirements, which are primarily outlined inthe 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.

Alternative Agricultural Water Transfer Methods Project Status Report
To provide the Board updates on the status of specific ATM grant applications and projects, staff provides the following list of funded projects.

Alternative Agricultural Water Transfer Methods – Competitive Grant Program
Water Activity Summary Sheet
May 21-22, 2014
Agenda Item 16

Applicant: Colorado River Water Conservation District

Water Activity Name: No Chico Brush Agricultural Water Research Project

Water Activity Purpose: Demonstrate the feasibility of different methods of deficit irrigation

Drainage Basin: Gunnison

Water Source: Uncompahgre Valley Water Users Association

Amount Requested: $173,080.17

Matching Funds: $65,000 total cash match – 37.6% of total grant request ($35,000 from the Gunnison Basin Account, & $30,000 cash match by 3rd party participants)

Staff Recommendation
Staff recommends approval of up to $173,080.17 from the Alternative Agricultural Water Transfer Methods Program to help fund the "No Chico Brush Agricultural Water Research Project."

Water Activity Summary:
This project seeks to demonstrate the feasibility of different methods of deficit irrigation. The applicant believes that transferring technology and educating water users and regulators is an important step in the adoption of deficit irrigation as a viable ATM.

The specific goals of the proposed demonstration and outreach project are:

- To demonstrate the feasibility (technical and economic) and resource-requirement of using selected water management techniques to quantify the water balance components and consumptive use under different deficit irrigation levels, on crops such as corn and sunflower, on clayey to sandy soil types, with pressurized and surface irrigation methods, and under different agronomic practices. Technical feasibility involves a practical, cost-effective monitoring approach and economic feasibility involves understanding and demonstrating crop water productivity, production costs and farmer incentives. Numerous sensors and their related equipment (e.g., infra-red thermometers, data-loggers, neutron probe, multispectral scanner, etc.) required to achieve this goal will be provided by CSU.
- To educate and train water users and regulators about using these techniques and their advantages and disadvantages (including limitations) through a variety of outreach and extension activities, such as publishing online and printed manuals including user-friendly spreadsheets, fact sheets, newsletters, and magazine articles; holding field days and a training workshop (video recordings to be made available online); and, creating a YouTube channel to upload short informational video clips.

This project will build upon the results of previous studies to demonstrate, transfer technology and educate on how some of the most promising techniques can be used, with minimal instrumentation, to document water balance components under deficit irrigation regimes.

Discussion:
Staff believes that this project, if implemented, could help meet the water supply needs for a variety of sectors (agricultural, environmental and municipal) and prevent the dry-up of irrigated lands in this area. The CWCB, the IBCC and Basin Roundtables have all indicated that Alternative Agricultural Water Transfer are a necessary component for helping meet Colorado's future water needs and this approach which seeks multiple partners, interests and purposes is directly in line with these policy statements. The CWCB has also indicated that they desire for the ATM program to help fund projects that are facilitating projects, agreements and

pilot/demonstrations. While this request is for a feasibility analysis, it is focused on a real problem with the objective of finding solutions.

The No Chico Brush group, via the Colorado River Water Conservation District, received a WSRA Gunnison Basin Account grant for $35,000 from the CWCB during the March 2014 meeting. The group, due to Statewide Account funding shortfall, was unable to proceed with a $50,000 WSRA Statewide Account request during the March 2014 CWCB meeting, and has opted to submit an ATM application in its place. However, if the CWCB does not approve this ATM Grant request, the No Chico Brush group requests that the CWCB consider their $50,000 Statewide Account request at a later date.

Issues/Additional Needs:
No issues or additional needs have been identified.

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 Basin Roundtables and the general public and will help promote the development of a common technical platform.

In accordance with the Criteria and Guidelines of the Alternative Agricultural Water Transfer Methods Competitive Grant Program, staff would like to highlight additional reporting and final deliverable requirements. The specific requirements are provided below.

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 scope 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.

Engineering: All engineering work (as defined in the Engineers Practice Act (§12-25-102(10) C.R.S.)) performed under this grant shall be performed by or under the responsible charge of professional engineer licensed by the State of Colorado to practice Engineering.

COLORADO WATER CONSERVATION BOARD

ALERNATIVE AGRICULTURAL WATER TRANSFER METHODS COMPETITIVE GRANT PROGRAM

GRANT APPLICATION FORM

NoChicoBrush Group: A farmer-led initiative to quantify and demonstrate irrigation efficiencies at farm-scales through instrumented water budgeting

Program/Project Name

River Basin Name

$173,080.17

Amount of Funds Requested

$30,000

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 Todd Doherty of the Water Supply Planning Section (Colorado Water Conservation Board) for assistance, at (303) 866-3441 x3210 or email at todd.doherty@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 Todd 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): NoChicoBrush
Colorado River Water Conservation District

Mailing address: 408 1740 Rd.
Delta, CO. 81416

Taxpayer ID#: Email address: stephendschrock@yahoo.com

Phone Numbers: Business: 970.216.7204
Home:
Fax:

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

Name: Stephen Schrock

Position/Title Project Manager, NoChicoBrush

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

For the purpose of this grant No-ChicoBrush intends to use the Colorado River Water Conservation District as its fiscal agent.

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.

    No-ChicoBrush is an ad-hoc farmer led group dedicated to finding solutions to water supply, quality and management issues in the lower Gunnison Basin. The group consists of members of the local farming community, local county government leaders, municipal water suppliers, agricultural water supply managers, as well as members of the conservation organizations Trout Unlimited and The Nature Conservancy.

    No-ChicoBrush is coordinated by Steve Schrock ,a local consultant with years of experience directing and managing collaborative efforts. The NoChico Brush executive committee consists of Tom Kay a farmer from Hotchkiss, John Harold committee chair a farmer from Olathe, Randy Meaker a farmer from Montrose, Dan McClendon former manager of Delta Montrose Electric Association, Marc Catlin local farmer and water expert, Aaron Derwingson Agricultural Coordinator The Nature Conservancy, Dr. Perry Cabot Colorado Water Institute, and Cary Denison Gunnison Basin Coordinator Trout Unlimited.

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

No-Chico Brush was created in 2013 by local farmers and conservation organization leaders who decided to find common ground to address water supply and quality issues. The group was initiated through interest in the soil health initiative.

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

    The Colorado River Water Conservation District as fiscal agent does have Tabor capacity concerns. According to River District Staff, the organization can manage the funds without Tabor impacts. If the status of the limitations changes NoChicoBrush is currently in discussion with the Montrose Community Foundation as that entity.

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

1. Purpose of the Program/Project

Background:

The No-ChicoBrush group evolved in 2013 out of the Soil Health Initiative (http://soilhealth.net/), which is an ongoing project directed at assisting farmers with implementing practices that improve soil health. Through this initiative, farmers and conservation organizations realized the important tie to water availability and the link to on farm and on system improvements that can improve water use efficiency and lead to increased profitability and sustainability of farming. The impetus for forming the group was to address the growing water availability and water quality concerns in the Gunnison and Colorado River Basins. This group understands the severity of the issues related to water in Colorado and downstream on the Colorado River and realizes that without change, farming in the lower Gunnison Basin will be increasingly difficult and will lead to an increasing strain on water resources. Projections from SWSI 2008 reveal that there will be increase in M&I demands in the area as well as agricultural lands retired for development. For these reasons, local farmer leaders along with interested parties including Uncompahgre Valley Water Users Association managers, Colorado River District representatives, Delta Montrose Electric Association, local business leaders, local lending institutions, Montrose and Delta County Commissioners, Trout Unlimited, The Nature Conservancy, and others have formed a farmer led group focused on creating and implementing innovative water management strategies to address water availability and water quality issues in the basin.

To address the issues associated with increasing demand, limited supply, agricultural water shortages and water quality, this group has envisioned a "Grand Design" for agricultural water use and deliveries in the Lower Gunnison Basin, including the Uncompahgre and North Fork Valleys that is driven by the simple idea of making the best use of water as possible**.** The group aims to expand implementation of improvements to irrigation water systems that include common sense solutions such as soil moisture monitoring, on farm efficiency projects, canal lining and piping as well as more multipart improvements such as system optimizations, system storage, and increased hydroelectric production. The No-ChicoBrush group realizes that improved water use efficiency may lead to increased consumptive use of water in some cases, but that by fine tuning applications and delivery systems to more closely match crop demands, water may be made available to fill existing and future demands.

The Problem:

Based on population projections from SWSI 2010, the population of the Gunnison Basin alone will likely double by 2050 creating additional demand. Furthermore, the Gunnison Basin already has an identified agricultural gap of 90000 AF/year, as well as significant non-consumptive needs including species of special concern and threatened and endangered fish in the Gunnison River. In addition to current and future local demands, shortages on the Colorado River as a whole are at the forefront of every water supply discussion. The overarching goal of NoChicoBrush is to focus on making the best use of water possible for the local community to help meet these shortages while keeping productive agricultural lands in production. The NoChicoBrush

applied research project along with the outreach, demonstration, and education efforts described in this application will address how improved water use efficiency can help fill the current agricultural gap while providing an additional environmental benefit for rivers and streams.

Additionally, the group includes municipal water suppliers and civic leaders who have concerns about long term water supply for M&I use. These groups and individuals realize that under current water use regimes, future M&I demands will need to be met through construction of storage facilities, which have a host of challenges, or through the very unfavorable "buy and dry" mechanism. For these reasons, they see the benefit of looking toward system improvements and increased efficiencies that make better use of currently available water as an alternative that can lead to security for all water users.

Our Proposal:

The *Alternative Agricultural Water Transfer Methods Grant Program Summary and Status Update*, November 2012 recommends addressing future municipal water supply demands by examining the institutional, sociological and structural hurdles associated with water banking and transferring water to other uses without impacting agricultural production. Through the process of on farm research and demonstration, we will begin to develop the tools necessary to address future municipal water shortages as well as current agricultural and non-consumptive gaps

To accomplish this, NoChicoBrush will implement a 3-year on farm research and demonstration project that will compare and analyze water use, field inputs, crop yield, and runoff between four different irrigation systems. The field work will include a side-by-side comparison of flood irrigation with three more efficient irrigation technologies: subsurface drip, overhead sprinkler, and big gun sprinkler. Study sites have been selected to compare identical crops on similar pieces of ground to reduce variability in soil type or effective precipitation. The project will expand this work to also include the use of soil moisture monitoring and automated delivery systems for optimal irrigation water management. The on farm research is being organized and directed by Dr. Perry Cabot of Colorado State University, Colorado Water Institute.

The findings of the on the ground work will be shared through demonstration and outreach efforts with local producers and interested parties. By sharing the results of the research, No-ChicoBrush will demonstrate how producers can maintain and even improve agricultural production through the implementation of precision irrigation techniques. Furthermore, these farmer led outreach projects will facilitate the discussion about how on-farm and near farm efficiency projects can reduce conflict over water scarcity, improve water quality, maintain sufficient streamflows during periods of drought, and provide multi-stakeholder benefits in the Lower Gunnison.

The intended outcome of this work is to create information that is easily used and accessible to local producers in order to increase their understanding and adoption of improved irrigation infrastructure and water management. Additionally, information from this research will inform how efficiency projects can be successfully built into transfer programs that provide a long-term reliable water supply while sustaining meaningful production agriculture.

Project Description:

The proposed activities will establish up to six long-term demonstration farms where water applications will

be compared and technological improvements will be implemented.

Technical description: Irrigation efficiency (IE) is an important factor into improving water management but so is economic return. Therefore, because the monitored fields are different in terms of area, the dependent variables in each case will be normalized values, based on monetary returns and applied water. Therefore, the objectives of the project are to determine the irrigation efficiency[1], irrigation water use efficiency (IWUE)[2] and water use efficiency (WUE)[3], under sprinkler, furrow, and drip irrigated crops for different yield potential levels and to determine the IE associated with the amount of water application for a sprinkler and drip irrigation systems that had the highest economic return. Since a major component of farmer-led studies includes an evaluation of the economics, enterprise budgets, and return on investment, data will be gathered to understand these variables, comparing irrigation systems side-by-side.

Although scientific and engineering literature is replete with research comparing irrigation methods, it is true that producers often want to see applications of this research in the context of their own regional conditions. This is because agricultural producers face highly site-specific conditions with regards, for instance, to crop type, soils, water availability, weather and climate, and management conditions.

Taking an applied research approach to the application of irrigation technology within the context of region-specific conditions is necessary to alleviate the risk that concerns many farmers when making major changes on their operations. Applied research is less focused on pure hypothesis-deduction than theoretical or developmental research, but must still minimize variability within the study system, more so than basic demonstration projects.

A report summarizing the findings from each irrigation year, including water budgets, yield analysis, photos and additional relevant data for participating farms and research will be provide. 2015 and 2016 reports will include trends and comparisons to previous results. We will also produce a final summary report with all data and recommendations from participants and NCB executive committee.

NCB will duplicate the on farm research that was completed in 2014 making necessary adjustments and improvements while installing the same suite of water measurement and crop monitors on 1-2 additional farms each year.

Applied Research Design. The project will adopt a water-balance approach to the assessment of irrigation water usage. This approach is commonly used in irrigation research, and is analogous to monitoring a checkbook balance. Daily withdrawals from the water are subtracted from the checkbook balance and deposits are added. Management of the balance depends on the water demand during the project. Due to evapotranspiration (ET) or consumptive use (CU), the water balance periodically approaches, or - less desirably, drops below - a prescribed minimum level of soil moisture or water content. By carefully monitoring the soil system and crop conditions, special applications of irrigation are initiated to supplement any natural precipitation.

[1] Irrigation efficiency (IE), as defined by the American Society of Civil Engineers (ASCE) on-farm irrigation committee (ASCE, 1978), is the ratio of the volume of water that is taken up by the crop to the volume of irrigation water applied.
[2] Irrigation water use efficiency (IWUE) is defined as the ratio of the crop yield to seasonal irrigation water applied, including rain.
[3] Water use efficiency (WUE) can been defined as the ratio of dry matter produced per unit area per unit of ET, the ratio of total dry matter per unit of ET, or as the harvested yield per unit of ET.

This project will utilize an applied research design based on cross-system or "side-by-side" comparison of irrigation approaches. The intent is to deduce, to the greatest possible extent, the impact that changing on-farm approaches to irrigation will have on important parameters concerning farmers and watershed stakeholders. For example, farmers are concerned with yield, profitability, water management and water quality, and other watershed stakeholders may be interested in these same parameters, some in greater degree than others.

Site Selection. Initially, the project team will initiate a site selection process, with the intent of locating operations that represent regional conditions that an executive group of farmers deem most important among their neighbors and peers. Because the project design will focus on changes due to different irrigation approaches, it will be imperative to conduct this research at operations where a farmer has: 1) deployed a new irrigation technology of interest, and; 2) maintained a "control" system of irrigation that represents historic approaches.

Site Description. Comparisons between the different irrigation systems will be conducted at locations that reflect the important soil and crop types that are dominant in the Lower Gunnison Basin. Additional comparisons between a flood-furrow and drip systems, planted to onions will be conducted, also within vicinity of an existing COAGMET station. Selection of these compared fields will be made to maintain similar soil types One site, at which an initial deployment of research equipment has already been undertaken, includes a location approximately 6 mi. from Olathe, CO and 2.2 mi. from an existing CSU COAGMET station (*see figure below, for an example showing side-by-side comparisons of a furrow and pivot system, with associated equipment layout*). Soil types on the flood-furrow irrigated field (17 ac.) and the sprinkler-irrigated field is very similar, recorded using SSURGO as Mesa series – gravelly loam.

In order to minimize system variability due to other factors, it will be critical to collaborate with producers that understand the nature of experimental control. In particular, the irrigation system management will be overseen carefully to maintain the goal of a uniform comparison between dependent variables such as yields, irrigation water productivity (i.e., crop per drop), and efficiency on the different systems.
Because the water-balance assessment approach is rooted in monitoring inputs and outputs, the irrigated field or "management unit" must be monitored for inputs and outputs. Monitoring equipment must therefore be deployed in the field to measure surface inflow, ET, soil moisture or wetness, and outflow. By measuring these variables and establish their comparison in common units (e.g., acre-in), the cycle and usage of water within the management unit. Essentially, the process utilizes an assessment approach akin to managing an irrigated field as a non-weighing lysimeter.

Scaling Up. The process of scaling up will be drive in part by pertinent areas of interest. For example locations that may have an issue with water deliveries, important or dominant soil types, and locations within basins that are critical to water management concerns. NCB intends to expand the technical scope of the project to include telemetry and other precision irrigation technologies that will be linked to the demonstration and outreach component. For the sake of pure observation and true control NCB will be monitoring and observing irrigation practices through instrumentation on farms sites that are not subject to research structure.

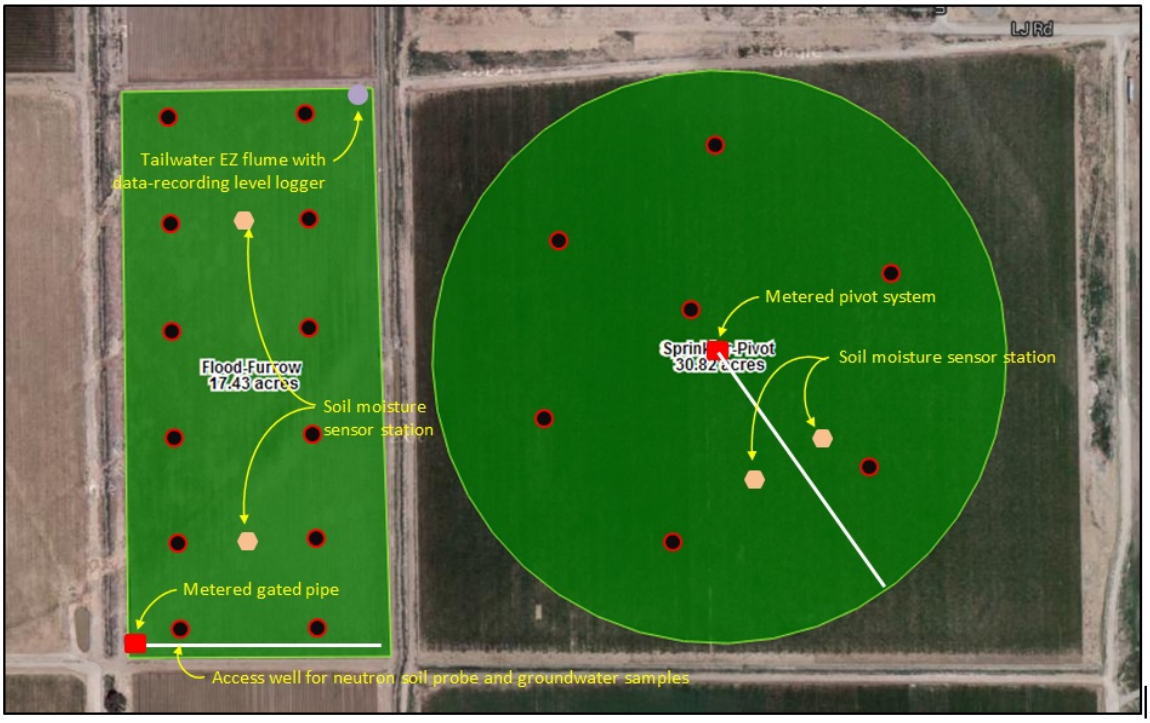
Site Management. The site will be planted to corn in Spring 2014, maintaining identical planting densities on both fields. Effort has been made to support the farmers in planting the same crop type at each site (5654 Dekalb seed corn). Irrigation practices will adhere to a scheduling regime intended to supply a full ET

requirement for the crops. Irrigation scheduling will utilize the nearby COAGMET station, in coordination with a management regime developed using CSU eRAMS platform (https://www.erams.com/) for irrigation scheduling. The COAGMET station will record regional rainfall and local rainfall will be measured using a direct-read raingage.

A water-balance approach will be used to understand the management of water on the sites. Applied water on each field will be metered (http://www.greatplainsmeter.com/products/product_mcpropeller.asp) and recorded by NCB project assistants. Field visits will be required to document the applied irrigation water on the basis of the totalizing meter, but as funding materializes, these systems will be retrofitted with digitally recording data loggers. For the flood-furrow system, the water leaving the field surface (return flows) will also be isolated, measured and recorded using a "stub-lateral" approach that allows a single contiguous area to be monitored independently of the ditch lateral. Water lost from the system via evapotranspiration (ET) will be estimated using the Penman-Kimberly method, as per the COAGMET site (www.coagmet.com). Evapotranspiration can also be "measured" using atmometers (http://www.etgage.com/), which will be purchased as funding materializes. Irrigation water management on the sites will be conducted to maintain proper soil moisture levels in order to satisfy the full ET consumptive use (CU) requirement for the crops, and maintain a field-capacity soil condition to the best extent possible.

Soil moisture sensors (http://www.irrometer.com/sensors.html#wm) will be installed with data-logging equipment to measure soil water content at various depths within the root zone. Moisture sensors will be useful as a trigger under management allowed depletion (MAD) so that common management rules for irrigation are used. Additionally, these tools are imminently useful for understanding the nature of the irrigation system efficiency. These sensors also allow for the measurement of ΔS (change in soil moisture) over time. Estimates of deep percolation are then possible using an approach such as the Water-Table Fluctuation Method (http://water.usgs.gov/ogw/gwrp/methods/wtf/).

Illustration of existing comparison site



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.

This project is complimentary to The Nature Conservancy's ATM study in the Yampa-White Basin that evaluated potential voluntary alternative transfer methods that would allow agricultural water to be used to meet both irrigation shortages and environmental needs without permanently drying up currently irrigated land.

One of the findings from the Yampa study was that it would be very difficult to address agricultural water shortages with temporary transfers because of the timing of available water. To address this, the recommendation was to just transfer the water in stream, thereby improving water availability for downstream users.

We are proposing something very similar for the Lower Gunnison Basin whereby improved efficiencies would result in improved water availability for other consumptive and nonconsumptive needs without actually having to make a legal transfer. NoChicoBrush believes this is an effective approach for the local situation where most water is controlled by UVWUA and not available for transfer under Bureau of Reclamation oversight.

As shown in numerous studies, farmers using and correctly managing improved irrigation systems can see significant benefits to the irrigation efficiency (IE) of their systems. These studies are being used to inform the correct research design for the proposed project, to maximize the possibilities for accurate comparisons with the current state of knowledge on this subject. As defined by the American Society of Civil Engineers (ASCE) on-farm irrigation committee (ASCE, 1978), IE is the ratio of the volume of water that is taken up by the crop to the

volume of irrigation water applied. Drip irrigation has long been known to increase IE, because the farmer can methodically adjust the frequency of water applications to optimize soil moisture levels for crops evapotranspiration (ET), without generating tailwater or runoff conditions. Reported IEs range from 54 to 80% (Chimonides, 1995[4]; Zalidis et al., 1997[5]) with a sprinkler irrigation system, in direct comparisions with IEs under furrow irrigation, which exhibited IEs from 50 and 73% (Oster et al., 1986[6]; Battikhi and Abu-hammad, 1994[7]; Chimonides, 1995[1]; Zalidis et al., 1997[2]. Reported IEs ranged from 80 to 91% for various crops grown in fields using surface drip systems (Battikhi and Abu-hammad, 1994[4]; Chimonides, 1995[1]; Al-Jamal et al., 2001[8]). These improvements can be more significant for subsurface drip systems (Ayars et al., 1999[9])

As defined by Howell (1994)[10], irrigation water use efficiency, IWUE is defined as the ratio of the crop yield to seasonal irrigation water applied including rainfall. Previous research shows a higher IWUE for subsurface drip, surface drip and sprinkler systems compared with furrow irrigation (Sammis, 1980[11]; Bogle et al., 1989[12]; Lamm et al., 1995[13]). When growing onions, a crop that this project takes a specific interest, research has generally also shown higher IWUE values using surface drip , and sprinkler irrigation, in direct comparison with furrow irrigation (Ells et al., 1993[14]).

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.

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4 Chimonides, S.J., 1995. Irrigation management under water shortage conditions. In: Tsiourtis, N.X. (Ed.), Water Resources Management Under Drought or Water Shortage Conditions. Balkema, Rotterdam, pp. 73-78.

5 Zalidis, G., Dimitriads, X., Antonopoulos, A., Geraki, A., 1997. Estimation of a network irrigation efficiency to cope with reduced water supply. Irrig. Drain. Syst. 11: 337-345.

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7 Battikhi, A.M., Abu-hammad, A.H., 1994. Comparison between the ef®ciencies of surface and pressurized irrigation systems in Jordan. Irrig. Drain. Syst. 8, 109-121.

8 Al-Jamal, M.S., S. Ball, and T. W. Sammis. 2001. Comparison of sprinkler, trickle and furrow irrigation efficiencies for onion production. Agricultural Water Management, 46(3): 253–266.

9 J.E. Ayars, C.J. Phene, R.B. Hutmacher, K.R. Davis, 1, 1, R.A. Schoneman, S.S. Vail, R.M. Mead. 1999. Subsurface drip irrigation of row crops: a review of 15 years of research at the Water Management Research Laboratory. Agricultural Water Management 42(1): 1–27.

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11 Sammis, T.W., 1980. Comparison of sprinkler, trickle, subsurface and furrow irrigation methods for row crops. Agron. J. 72, 701-704.

12 Bogle, C.R., Hartz, T.K., Nunez, C., 1989. Comparison of subsurface trickle and furrow irrigation on plasticmulched and bare soil for tomato production. J. Am. Soc. Hort. Sci. 114 (1): 40-43.

13 Lamm, F.R., Manges, H.L., Ston, L.R., Khan, A.H., Rogers, D.H., 1995. Water requirement of subsurface drip-irrigated corn in northwest Kansas. Trans. ASAE 38 (2): 441-448.

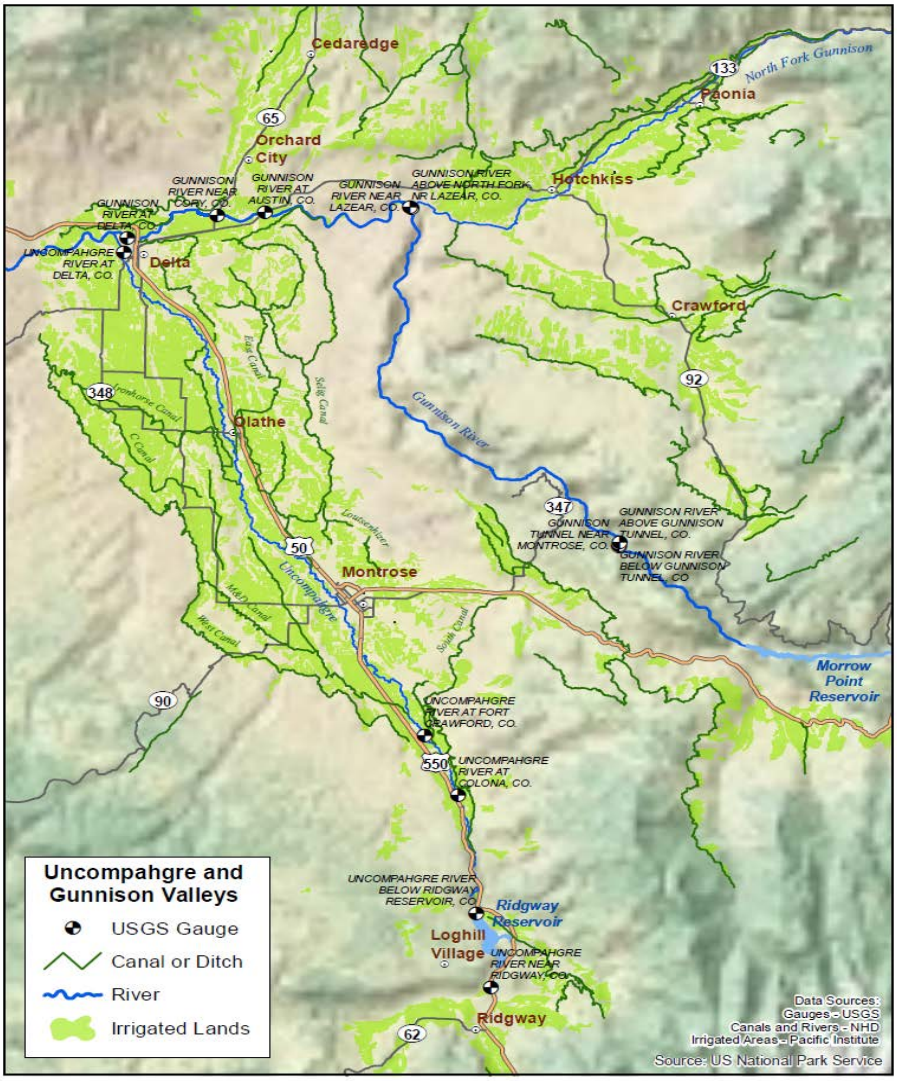
14 Ells, J.E., McSay, A.E., Soltanpour, P.N., Schweissing, F.C., Bartolo, M.E., Kruse, E.G., 1993. Onion irrigation and nitrogen leaching in the Arkansas valley of Colorado. Hort. Technol. 3 (2): 184-187.

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:

The area of interest for the purpose of this project includes the irrigated lands downstream of the Aspinall Unit on the Gunnison River, irrigated lands downstream of Ridgway Reservoir and all irrigated land in the North Fork and Smith Fork of the Gunnison drainages. The 'hub' of this project will be the irrigated lands within the Uncompahgre Valley Water Users Association area near the town of Olathe where No-ChicoBrush is currently conducting the on farm research project. Within Montrose and Delta County 3 more working farms will be studied and accessed for demonstration.

Project Area Map:



Irrigated lands and production within project area:

Based on NRCS data, there are approximately 171,000 irrigated acres within the area of interest which produce corn, alfalfa, onions, beans, grain crops, orchard crops, and grass hay. Because the lands in this area are spread across a vast basin and are serviced by numerous water rights and diversions it is difficult to provide an accurate total of average annual water diversions. A large portion of the lands, approximately 70,000 acres, are within the Uncompahgre Valley Water Users Association (UVWUA) project area, which is served by approximately 600,000 acre feet of annual diversions.

Of the 171,000 acres, 108,694 are irrigated with flood practices, 53,900 with improved flood, 7,121 with sprinkler and 1,285 with drip according to NRCS data.

Ongoing farm research sites for this project are located on a 40-acre parcel a 30-acre parcel within the UVUWA area on lands California Mesa west of the Uncompahgre River which are rated for 5 acre feet per year and a 20 acre parcel located on the East side of the Uncompahgre system which is rated for 4 acre feet per year.

Crop yield statistics for Delta and Montrose County per the department of agriculture census revealed total agricultural sales for both companies $113,960,000.

a) 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.

Currently No-ChicoBrush has not identified a new or existing water user that will receive water that will be served by transferred waters from this project. Part of this is due to the complex nature of the UVWUA and other local delivery systems, where irrigation runoff is captured and reused throughout the system. No-ChicoBrush and partners are working on complimentary projects to better understand UVWUA operations, the impact of improved efficiencies, and the potential to save water.

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

Area:	**2010 Population:**	**2009 Per capita income:**
Delta County	30,885	$29,665
Montrose County	41,183	$30,264

The Montrose and Delta County areas are primarily supported economically by coal mining, small industry, agriculture, recreation and tourism. Populated areas of the lower Gunnison basin are surrounded by agricultural lands and bordered by public lands including the Black Canyon of the Gunnison National Park and the Gunnison Gorge National Conservation Area.

Delta County alone has lost nearly 400 primary industry jobs in the past year; including 300 jobs from the Coal mining industry, 50 jobs from the timber industry and 50 jobs from the milk processing area.
The loss of these primary industry jobs has a negative economic impact regionally. This economic security issue is another factor in the importance of maintaining and improving our agriculture industry.

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.

The on-farm water and crop analysis from the NoChicoBrush applied research project will provide important data on consumptive crop use and cropping practices in this area that can be used to inform multiple types of alternative transfer methods such as water banking, interruptible water supply agreements and others. While this project does not have a direct intent of transferring consumptive use out of agriculture it does intend to addresses how efficiency improvements, combined with new management strategies, can address local water supply challenges and avoid the need for costly new storage projects or "buy and dry" on agricultural lands. Additionally this work will provide useful framework for implementing creative solutions to water shortages in the future.

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.

This project is primarily focused on the on-farm research and outreach to water users, therefore we do not feel it places project partner's water rights at risk. No reductions to diversions that could impact or threaten a water right are being considered at this time by the project proponents.

   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.

For this applied research project, NCB is currently working with three agricultural producers and has identified water users willing to participate in the on-farm research and demonstration over the next 3 irrigation seasons.

As a project partner, UVWUA is also participating in the Water Bank Feasibility Study, led by the Colorado River Water Conservation District under another ATM grant. UVWUA has agreed to look at potential participation in a water bank to address issues associated with the Colorado River Compact. While UVWUA has not agreed to any transfer of water, information we gather in this applied research project on crop demands, crop consumptive use, and field runoff will help inform multiple aspects of the water bank project.

   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.

This project will address how implementation of agricultural efficiencies can be used to reduce water shortages. Across the lower Gunnison there are agricultural water shortages that exist for a variety of reasons, many of which are due to the inefficiency of the delivery system where farmers don't get the water in the right time or amount to satisfy their needs. Other shortages are the product of location in relation to senior water user. Regardless of the reason efficiency and conservation practices can be applied to decrease the likelihood and causes of many of these shortages. Through this on-farm research and demonstration project we intend to assess how efficiency improvements can be used to address agricultural and other water shortages in the basin.

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.

No funds will be used for legal assistance.

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).

NCB has cash match of $30,000 or 15% of total request. These funds are provided by Trout Unlimited, The Nature Conservancy and Miller Coors Corporation.

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.

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.
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.
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.
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).
f. The proposed project/program addresses key water needs identified in SWSI 2010 or as identified in a basin's needs assessment.
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.
h. The proposed project/program addresses water quality, or provides other environmental benefits to rivers, streams and wetlands.
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.
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.
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.
l. The quantity of water produced by the proposed project/program. Preference will be given to programs that can address larger water supply needs.
m. Applicants are encouraged to develop projects demonstrating participation and/or support from a diverse set of stakeholders and interests.

Statement of Work

WATER ACTIVITY NAME – No-ChicoBrush Water Budget and Efficiency Pilot and Demonstration Project

GRANT RECIPIENT – Colorado River District

FUNDING SOURCE – Colorado Water Conservation Board

INTRODUCTION AND BACKGROUND

The No-ChicoBrush group is focused on researching and highlighting the benefits of agricultural water system and irrigation system improvements to drive wide scale modernization to assist in alleviating pressures from water shortages on agricultural water producers and other water users while addressing water quality concerns. NCB has teamed with the Colorado Water Institute of Colorado State University to implement on-farm research and to assist with compiling the data in a useable and understandable format that can be shared with other water users.

NCB has a vision that water shortages, both current and future, can be alleviated through large scale efficiency projects. The on farm research is the first phase of forwarding those projects and examining the hurdles that may exist in implementing projects that make the best use of water possible.

Currently NCB is developing the early phases of on-farm research on 3 farms where we are comparing drip to furrow, sprinkler to furrow and assessing flood prior to installation of a big gun sprinkler system. This work will be scaled up to 5 more farms in the Uncompahgre and North Fork drainages where water budget, consumptive use, water quality, and crop yields will be compared over a period of 3 years. Within this process we will highlight how the use of precision irrigation technology such as soil moisture sensors, remote monitoring, telemetry and other improvements can be used on-farm to improve yields and reduce impacts of shortages. The outreach portion of the project will be used to draw in producers and other water users in the Lower Gunnison to inform them of the benefits of efficiency and advanced irrigation water management.

OBJECTIVES

- Accurate comparison of pressurized irrigation practices to traditional flood/furrow irrigation
- Outreach to water users and water managers in the area about the study, including on farm demonstrations
- Yearly and final reports synthesizing the findings of the research, attendance at outreach events, and feedback from participants

TASK 1 –Outreach 2014-2016

Description of Task

Outreach and education to producers, water managers, Conservation Districts, NRCS, River District, Basin Roundtables and other interested partners.

Method/Procedure

2014: Conduct one on farm demonstration day and one outreach meeting to provide the findings from the research to water users and mangers. NCB will partner with local water provider groups, soil conservation districts, and Colorado River District on this task.

2015: Conduct two on farm demonstration days and two outreach meetings to provide the findings from the research to water users and mangers

2016: Conduct two on farm demonstration day and two outreach meetings to provide the findings from the research to water users and mangers and one final project summary conference.

Deliverables

Event/meeting summaries including list of attendees, feedback from attendees, lessons learned, and next steps.

TASK 2 – On farm research implementation: 2015-2016

Description of Task

NCB will duplicate the on farm research that was completed in 2014 making necessary adjustments and improvements while installing the same suite of water measurement and crop monitors on 1-2 additional farms each year.

Method/Procedure

Work with CSU water institute, farmers and other participants to evaluate the previous year's work to guide on farm research design.
Purchase necessary water measuring and monitoring equipment.
Establish monitoring and operations protocols with participants and project management.
Install on farm equipment prior to beginning of irrigation year.

Deliverable

Map and summary of research plan and individual project sites, including description of marked changes in equipment or analysis techniques for each year.

TASK 3 –Data collection: 2015-2016

Description of Task
Throughout both the 2015 and 2016 irrigation year, data from the on farm research will be gathered weekly.

Method/Procedure
NCB staff and/or interns will collect data from on farm sensors and measurement devices and provide the data to CSU.

Deliverable
Results will be compiled, analyzed, and included in Research Reporting described in Task 2.

TASK 4 –Research Reporting 2014-2016

Description of Task
Data analysis and research synthesis following each irrigation year

Method/Procedure
Data collected from each irrigation season will be analyzed and compiled with the assistance from Dr. Perry Cabot from CSU.

Deliverable
A report summarizing the findings from each irrigation year, including water budgets, yield analysis, photos and additional relevant data for participating farms and research will be provide. 2015 and 2016 reports will include trends and comparisons to previous results. We will also produce a final summary report with all data and recommendations from participants and NCB executive committee.

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BUDGET

Provide a detailed budget by task including number of hours and rates for labor and unit costs for other direct costs (i.e. mileage, $/unit of material for construction, etc.). A detailed and perfectly balanced budget that shows all costs is required for the State's contracting and purchase order processes. Sample budget tables are provided below. Please note that these budget tables are examples and will need to be adapted to fit each individual application. Tasks should correspond to the tasks described above.

NoChicoBrush Project Budget

Project Item	Project Manager @ $25 per hour	Project Intern $16 per hour	Mileage	Equipment and Supplies	Contractor @ $75 per hour	Fiscal Agent: Colorado River District 3%	Total Costs: $168,039
Outreach	$30,240	$2,903	$560	$750		$1015.59	$33,853
On Farm Implementation	$10,080	$4,354		$60,000	$6,600	$2,431.02	$81,034
Data collection	$10,080	$18,869	$3,850	$500		$998.97	$33,299
Reporting	$16,800	$2,903		$150		$595.59	$19,853
Total Hours:	2688	1814					
Cost:	$67200	$29030	$4410	$61400	$6600	$5,041.17	**$173,080.17**

In-Kind Contributions				
Personnel Hourly Rate:	Trout Unlimited Cary Denison:	The Nature Conservancy: Aaron Derwingson	Colorado State University: Perry Cabot	Total
Task 1 - 4	$7200.00	$7200.00	$13,098	$27,498

Budget Narrative

Budget Item	Cost	Identity/Relationship /Responsibilities to project
Project Manager	$67,200	Steve Schrock, provides project oversight including planning meetings, reporting, organizing etc.
Project Intern	$29,030	Likely CMU student necessary for collecting data and monitoring equipment
Mileage	$4,410	For hired intern and manager for driving to and from farms
Equipment and Supplies	$61,400	Water measurement and crop monitoring equipment such as flumes, recorders, level loggers, sensors etc. (see below farm example)
Contractor	$6,600	Necessary for installation of on Farm research equipment (included in attached budget example)
Fiscal Agent	$5,041.07	CRWCD will provide fiscal agent assistance and support

The project manager position as well as the project intern position is critical to the success of this project.

Farm Instrumentation Budget:

Water-Balance Approach Site Budget (Sprinker Pivot-Furrow) - Hines/Ryan

Compiled by: *Dr. Perry E. Cabot* Date: *March 26, 2014*

NOTE: *These are quoted costs associated with a single-site budget to monitor water balance at a site comparing a single irrigated flood-furrow and sprinkler-pivot "management units."*

Measurement Parameter	Device	Cost per unit	Qty	Cost	Vendor
Rainfall	tipping-bucket	$ 420.00	0	$ -	Onset
	event logger	$ 105.00	0	$ -	Onset
	direct-read	$ 29.95	2	$ 59.90	COCORAHS[1]
Evapotrans.	atmometer (Mod A)	$ 202.00	1	$ 202.00	ET Gage
	atmometer (Mod E)	$ 630.00	0	$ -	ET Gage
	event logger	$ 105.00	0	$ -	Onset
Soil moisture	IRROmesh Base Node	$ 450.00	1	$ 450.00	Irrometer[2]
	IRROmesh Logger	$ 450.00	1	$ 450.00	Irrometer
	IRROmesh End Node	$ 265.00	4	$ 1,060.00	Irrometer
	soil moisture sensor	$ 39.00	12	$ 468.00	Irrometer
	temperature sensor	$ 39.00	4	$ 156.00	Irrometer
	tower	$ 250.00	1	$ 250.00	Rohn
	software	free	0	---	Irrometer
	IRROmesh Cell Gateway	$ 1,165.00	0	$ -	Irrometer
	solar battery pack	$ 340.00	0	$ -	Irrometer
	monitoring wells	$ 100.00	16	$ 1,600.00	various
Volumetric Flow (flood furrow)	level logger (U20L)	$ 299.00	1	$ 299.00	Onset
	data shuttle (U-DTW-1)	$ 289.00	1	$ 289.00	Onset
	carrying case (U20-CASE-1)	$ 33.00	1	$ 33.00	Onset
	HOBOware Pro (BHW-Pro-CD	$ 99.00	1	$ 99.00	Onset
	EZ flume/stilling well	$ 700.00	1	$ 700.00	Welfelt Fab
	wingwalls	$ 100.00	2	$ 200.00	Local
	8" meter system	$ 1,089.00	1	$ 1,089.00	Great Plains[3]
	shipping	$ 30.00	1	$ 30.00	Great Plains
	3-year warranty	$ 100.00	1	$ 100.00	Great Plains
	gated pipe, elbows, etc	$ 3.20	40	$ 128.00	Grand Junc. Pipe
	data logger (for meter)	$ 725.00	0	$ -	Great Plains
	install (hourly rate)	$ 75.00	8	$ 600.00	Arlie Clark
Volumetric Flow (pivot sprinkler)	10" meter system	$ 1,166.00	1	$ 1,166.00	Great Plains
	shipping	$ 30.00	1	$ 30.00	Great Plains
	3-year warranty	$ 100.00	1	$ 100.00	Great Plains
	addtl. Supplies (15%)	$ 174.90	1	$ 174.90	Local
	install (hourly rate)	$ 75.00	8	$ 600.00	Arlie Clark
Water Quality	autosampler	$ 4,535.82	0	$ -	ISCO/Teledyne
	bottle rack	$ 302.94	0	$ -	ISCO/Teledyne
	suction tube	$ 88.61	0	$ -	ISCO/Teledyne
	deep-cycle marine	$ 200.00	0	$ -	Batteries Plus
TOTAL				**$ 10,333.80**	

[1] http://www.weatheryourway.com/

[2] http://www.irrometer.com/

[3] http://www.greatplainsmeter.com/

SCHEDULE

Tasks	2014			
	Spring	Summer	Fall	Winter
1. Outreach				
2. Research Reporting				
3. On Farm Research Implementation				
4. Data Collection				
5. Progress Update Reports to CWCB				
Tasks	**2015**			
	Spring	Summer	Fall	Winter
1. Outreach				
2. Research Reporting				
3. On Farm Research Implementation				
4. Data Collection				
5. Progress Update Reports to CWCB				
Tasks	**2016**			
	Spring	Summer	Fall	Winter
1. Outreach				
2. Research Reporting				
3. On Farm Research Implementation				
4. Data Collection				
5. Progress Update Reports to CWCB				

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

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: Stephen D Schrock

Project Title: NO CHICO BRUSH GROUP

Return this application to:

Mr. Craig Godbout
Colorado Water Conservation Board
Water Supply Planning Section
1580 Logan Street, Suite 200
Denver, CO 80203
Todd.Doherty@state.co.us