RADAR MONITORING & HYDROLOGIC MODELING IN THE UPPER RIO GRANDE BASIN TO DEVELOP ACCURATE STREAMFLOW FORECASTING

RIO GRANDE BASIN ROUNDTABLE

Water Supply Reserve Account

Grant Application

JULY 9, 2013

COLORADO WATER CONSERVATION BOARD

WATER SUPPLY RESERVE ACCOUNT APPLICATION EFORM

Radar Monitoring & Hydrologic Modeling in the Upper Rio Grande Basin to Develop Accurate Streamflow Forecasting

Name of Water Activity/Project

Conejos Water Conservancy District

Name of Applicant

Rio Grande Basin

Approving Basin Roundtable(s)
(If multiple basins specify amounts in parentheses.)

Amount from Statewide Account:	$200,000
Amount from Basin Account(s):	$ 37,000
Total WSRA Funds Requested:	$237,000

Application Content

Required Exhibits

A. Statement of Work, Budget, and Schedule
B. Project Map
C. As Needed (i.e. letters of support, photos, maps, etc.)

Appendices – Reference Material

1. Program Information
2. Insurance Requirements
3. WSRA Standard Contract Information (Required for Projects Over $100,000)
4. W-9 Form (Required for All Projects Prior to Contracting)

Instructions

To receive funding from the Water Supply Reserve Account (WSRA), a proposed water activity must be approved by the local Basin Roundtable **AND** the Colorado Water Conservation Board (CWCB). The process for Basin Roundtable consideration and approval is outlined in materials in Appendix 1.

Once approved by the local Basin Roundtable, the applicant should submit this application **with a detailed statement of work including budget and schedule as Exhibit A** to CWCB staff by the application deadline.

WSRA applications are due with the roundtable letter of support 60 calendar days prior to the bi-monthly Board meeting at which it will be considered. Board meetings are held in January, March, May, July, September, and November. Meeting details, including scheduled dates, agendas, etc. are posted on the CWCB website at: http://cwcb.state.co.us Applications to the WSRA Basin Account are considered at every board meeting, while applications to the WSRA Statewide Account are only considered at the March and September board meetings.

When completing this application, the applicant should refer to the WSRA Criteria and Guidelines available at: http://cwcb.state.co.us/LoansGrants/water-supply-reserve-account-grants/Documents/WSRACriteriaGuidelines.pdf

The application, statement of work, budget, and schedule **must be submitted in electronic format** (Microsoft Word or text-enabled PDF are preferred) and can be emailed or mailed on a disk to:

Greg Johnson – WSRA Application
Colorado Water Conservation Board
1580 Logan Street, Suite 200
Denver, CO 80203
gregory.johnson@state.co.us

If you have questions or need additional assistance, please contact Greg Johnson at: 303-866-3441 x3249 or gregory.johnson@state.co.us.

Water Supply Reserve Account – Application Form
Revised December 2011

Part I. - Description of the Applicant (Project Sponsor or Owner);

1.	Applicant Name(s):	Conejos Water Conservancy District		
	Mailing address:	Nathan Coombs, Manager P. O. Box 550 Manassa, CO 81141		
	Taxpayer ID#:	XH-84-0776076		
	Primary Contact:	Nathan Coombs	Position/Title:	Manager
	Email:	cwc548@centurytel.net		
	Phone Numbers:	Cell:	Office:	719-843-5261
	Alternate Contact:	Joe Busto	Position/Title:	Project Director
	Email:			
	Phone Numbers:	Cell:	Office:	303 587-5585

2. Eligible entities for WSRA funds include the following. What type of entity is the Applicant?

	Public (Government) – municipalities, enterprises, counties, and State of Colorado agencies. Federal agencies are encouraged to work with local entities and the local entity should be the grant recipient. Federal agencies are eligible, but only if they can make a compelling case for why a local partner cannot be the grant recipient.
x	Public (Districts) – authorities, Title 32/special districts, (conservancy, conservation, and irrigation districts), and water activity enterprises.
	Private Incorporated – mutual ditch companies, homeowners associations, corporations.
	Private individuals, partnerships, and sole proprietors are eligible for funding from the Basin Accounts but not for funding from the Statewide Account.
	Non-governmental organizations – broadly defined as any organization that is not part of the government.

3. Provide a brief description of your organization

The Conejos Water Conservancy District (CWCD or the District) is a public, quasi-governmental entity, eligible under SB 06-179 to apply for funds for this structural water project to improve the water management capabilities of District on the area of the Conejos River (the Conejos) commonly known as "The Confluence." The District's boundaries include about 100,000 acres, of which 86,000 acres are capable of being irrigated. An additional 8,000 acres that are not within the boundaries of the District are also irrigated by the Conejos and its tributaries. CWCD is that portion of the *San Luis Valley Project Colorado* designated by the Bureau of Reclamation in 1928 and formed in September 1940 under the *Water Conservancy Act of 1938* codified at 37-45-101. The CWCD formed an Enterprise when Platoro Reservoir, a U.S. Bureau of Reclamation project, became available for the CWCD's operation and control, after Colorado's Rio Grande Compact debt was satisfied in 1985. Total operating budget for the Conejos Water Conservancy District is about $200,000, which includes one full time salary.

The District plays a critical role in the management of flows on the Conejos River and its tributaries, ensuring that sufficient quantities of water are available to meet agricultural needs within the District and to satisfy Colorado's obligation to the Rio Grande Compact. The Compact requires deliveries of water from the Rio Grande to the New Mexico State line based on an annual volumetric delivery, with the volume of water obligated downstream in a given year depending on the volume of flow measured at four index stream gages within the Rio Grande basin. In any given year Colorado is required to deliver between 25 and 70 percent of the water generated in the two river systems -- the Rio Grande and the Conejos.

Erroneous seasonal water supply forecasts in the Upper Rio Grande (URG) basin have a profound impact on water management, agricultural production and economic vitality. A recent analysis by the Colorado Water Conservation Board (CWCB) and Colorado Division of Water Resources (CDWR) illustrated that seasonal water supply forecasts based primarily on Natural Resources Conservation Service (NRCS) 'SNOw TELemetry' (SNOTEL) data have struggled with inaccuracy, particularly in wet and dry years. The high error rate in the annual April 1 forecasts translates into millions of dollars lost annually due to reduced agricultural productivity on irrigated lands. Working with the DWR Division Engineer, the CWCB helped determine that the economic impact of those water supply forecast errors was $15.1M in Water Year 2005 and $19.03M in Water Year 2007. This project aims to develop systems for the accurate measurement and prediction of snowfall and snowpack, and, through advanced radar systems and 21st Century hydrologic modeling, for error-free forecasts of streamflow.

4. If the Contracting Entity is different than the Applicant (Project Sponsor or Owner) please describe the Contracting Entity here.

NA

5. Successful applicants will have to execute a contract with the CWCB prior to beginning work on the portion of the project funded by the WSRA grant. In order to expedite the contracting process the CWCB has established a standard contract with provisions the applicant must adhere to. A link to this standard contract is included in Appendix 3. Please review this contract and check the appropriate box.

   [x] The Applicant will be able to contract with the CWCB using the Standard Contract

   [ ] The Applicant has reviewed the standard contract and has some questions/issues/concerns. Please be aware that any deviation from the standard contract could result in a significant delay between grant approval and the funds being available.

6. The Tax Payer Bill of Rights (TABOR) may limit the amount of grant money an entity can receive. Please describe any relevant TABOR issues that may affect the applicant.

The Conejos Water Conservancy District is exempt from Tabor regulations per the passing of Referendum B in a Conejos County election held November 6, 2007 in which voters granted the District its exemption.

Part II. - Description of the Water Activity/Project

1. What is the primary purpose of this grant application? (Please check only one)

   [ ] Nonconsumptive (Environmental or Recreational)

   [ ] Agricultural

   [ ] Municipal/Industrial

   [ ] Needs Assessment

   [ ] Education

   [X] Other Explain: Use RADAR for accurate Streamflow Forecasts

2. If you feel this project addresses multiple purposes please explain.

   a. **Improved water management efficiency:** Gather enhanced precipitation and snowpack data to improve weather forecasting, thereby reducing uncertainty in current estimates of water resources.
   b. **Support CWCB Flood Decision Support System:** Use radar, satellite, and ground-based observations to upgrade forecasting capabilities and previous CWCB Flood Decision Support System studies, providing accurate streamflow forecasts, even after headwaters have experienced extensive beetlekill and wildfires.
   c. **Safety and flood plain function:** Deploy radar sites and gather data to more accurately anticipate annual water supplies, including run-off prediction, monitoring of monsoon precipitation, and flash flood events.
   d. **Improve administration of Rio Grande Compact deliveries:** Reducing streamflow forecast errors will reduce or eliminate premature and unnecessary curtailments, delivering the correct amount of water to downstream Compact partners.

3. Is this project primarily a study or implementation of a water activity/project? (Please check only one)

X	Study		Implementation

4. To catalog measurable results achieved with WSRA funds can you provide any of the following numbers?

	New Storage Created (acre-feet)
	New Annual Water Supplies Developed, Consumptive or Nonconsumptive (acre-feet)
	Existing Storage Preserved or Enhanced (acre-feet)
	Length of Stream Restored or Protected (linear feet)
	Length of Pipe/Canal Built or Improved (linear feet)
	Efficiency Savings (acre-feet/year OR dollars/year – **circle one**)
	Area of Restored or Preserved Habitat (acres)
X	Other -- Explain: Use radar to improve stream flow forecasts

4. To help us map WSRA projects please include a map (Exhibit B) and provide the general coordinates below:

   Latitude: TBD Longitude: TBD

5. Please provide an overview/summary of the proposed water activity (no more than one page). Include a description of the overall water activity and specifically what the WSRA funding will be used for. A full **Statement of Work** with a detailed budget and schedule is required as **Exhibit A** of this application.

(next page please)

Knowing where the Basin's water comes from: Streamflow in the Rio Grande and the Conejos River comes mostly from snowfall in the San Juan and the Sangre de Cristo ranges of the Rocky Mountains. In the Upper Rio Grande (URG) Basin, water managers must rely on the accuracy of precipitation forecasts by the Division of Water Resources (DWR) as the basis for their decisions on the storage, release, and beneficial use of water. Ideally, these forecasts should be based on accurate estimates of snowfall, careful monitoring of the water content and behavior of snowpack, and a good understanding of snowmelt, run-off, and streamflow. But that is not the case. Inaccurate streamflow forecasts are causing unnecessary curtailment of ditches, over- or under-delivery of Colorado's compact obligations, and a disruption of the priority system. This Project will evaluate and implement new data collection, data integration and modeling methods in order to reduce/eliminate errors in water supply forecasts.

This project has three major components: (1) Develop a Rio Grande Compact Decision Support Tool for DWR; (2) generate historical forecasts using the Weather Service hydrologic models to better understand forecast errors; and (3) use snow-covered area data to improve snow modeling and water supply forecasts. The District requests $237,000 in WSRA funds: $60,000 for the NCAR instrumentation required to ground-truth the radar readings; $150,000 for contracting the hydrologic modeling and the interpretation of the radar data; and $27,000 to cover the District's direct costs and administration.

Need for more data: These funds will complement, leverage, and expand upon CWCB's ongoing studies in the Rio Grande Basin, for which matching funds of $215,000 were recently allocated under SB 13-181. Since 2007 the CWCB has worked with federal and private partners to improve the description of spring snowpack conditions, using hydrologic models, and providing SNODAS data to the Rio Grande Division Engineer. SNODAS is thirty years newer than some of the currently operational forecasting models, so it will provide another means of "assessing" our watersheds more comprehensively during the snowmelt part of the hydrologic cycle. One of the recommendations after the final phase of the SNODAS project was to seek more inputs and forcing data for the SNODAS model, beyond SNOTELs and numerical weather prediction model forecasts.

Need for better data: Although the CWCB has invested in additional SNOTEL stations, the URG Basin has only 7 stations in its entire 7,000 square mile region. The team of scientists in this study anticipates that well-calibrated radars have the potential to simulate the precipitation observations of hundreds of SNOTEL sites – far more than could possibly be deployed in a lifetime. The goal of this pilot project is to develop an accurate April 1 annual streamflow forecast and to improve forecast updates during the melt season. Instead of basing forecasts on data from only seven SNOTEL sites, this project will deploy modern radars, creating thousands of data points to feed into prediction models. Dr. Nolan Doesken, Colorado State Climatologist, will advise the project, representing the interests of Rio Grande Basin water users, and CWCB's Joe Busto is Project Director.

Need to verify or "ground-truth" the data: The work proposed here is the deployment of a network of surface instrumentation which will be used to calibrate radar precipitation estimates and to monitor local snowpack and meteorological conditions in the URG Basin. These instruments will be left in the Basin as a legacy of this Project, providing water managers nearly twice the in-situ observing capacity in monitoring snowpack, snowmelt, and streamflow conditions as they presently have.

Need for 21st Century modeling: The Basin is seeing radical changes in watershed conditions due to widespread forest fires and insect-induced forest mortality, causing ash and mud flows, flash floods, and streambank instability like we've never seen before. This Project will advance streamflow forecasting into the 21st Century, developing dynamic and evolving streamflow prediction models and state-of-the-art modeling approaches.

Part III. – Threshold and Evaluation Criteria

1. Describe how the water activity meets these **Threshold Criteria.** (Detailed in Part 3 of the Water Supply Reserve Account Criteria and Guidelines.)

   a) The water activity is consistent with Section 37-75-102 Colorado Revised Statutes.[1]

   This is a pilot project to more accurately estimate Rio Grande Basin snowfall and snowpack, providing new models and predictive systems to improve forecasts of streamflow. Nothing in this project has any effect with the issues raised in Section 37-75-102 Colorado Revised Statutes.

   b) The water activity underwent an evaluation and approval process and was approved by the Basin Roundtable (BRT) and the application includes a description of the results of the BRTs evaluation and approval of the activity. At a minimum, the description must include the level of agreement reached by the roundtable, including any minority opinion(s) if there was not general agreement for the activity. The description must also include reasons why general agreement was not reached (if it was not), including who opposed the activity and why they opposed it. Note- If this information is included in the letter from the roundtable chair simply reference that letter.

   This information is provided in the cover letter by the Chairman of the Rio Grande Basin Roundtable.

[1] 37-75-102. Water rights - protections. (1) It is the policy of the General Assembly that the current system of allocating water within Colorado shall not be superseded, abrogated, or otherwise impaired by this article. Nothing in this article shall be interpreted to repeal or in any manner amend the existing water rights adjudication system. The General Assembly affirms the state constitution's recognition of water rights as a private usufructuary property right, and this article is not intended to restrict the ability of the holder of a water right to use or to dispose of that water right in any manner permitted under Colorado law. (2) The General Assembly affirms the protections for contractual and property rights recognized by the contract and takings protections under the state constitution and related statutes. This article shall not be implemented in any way that would diminish, impair, or cause injury to any property or contractual right created by intergovernmental agreements, contracts, stipulations among parties to water cases, terms and conditions in water decrees, or any other similar document related to the allocation or use of water. This article shall not be construed to supersede, abrogate, or cause injury to vested water rights or decreed conditional water rights. The General Assembly affirms that this article does not impair, limit, or otherwise affect the rights of persons or entities to enter into agreements, contracts, or memoranda of understanding with other persons or entities relating to the appropriation, movement, or use of water under other provisions of law.

c) The water activity meets the provisions of Section 37-75-104(2), Colorado Revised Statutes.[2] The Basin Roundtable Chairs shall include in their approval letters for particular WSRA grant applications a description of how the water activity will assist in meeting the water supply needs identified in the basin roundtable's consumptive and/or non-consumptive needs assessments.

This information is provided in the cover letter by the Chairman of the Rio Grande Basin Roundtable.

d) Matching Requirement: For requests from the **Statewide Fund**, the applicants is required to demonstrate a **20 percent** (or greater) match of the request from the Statewide Account. Statewide requests must also include a minimum match of **5 percent** of the total grant amount from Basin Funds. Sources of matching funds include but are not limited to Basin Funds, in-kind services, funding from other sources, and/or direct cash match. Past expenditures directly related to the project may be considered as matching funds if the expenditures occurred within 9 months of the date the application was submitted to the CWCB. Please describe the source(s) of matching funds. (NOTE: These matching funds should also be reflected in your Detailed Budget in **Exhibit A** of this application)

Total Project Cost	$561,000
CWCB	$215,000 as matching funds for this project
Local stakeholders	$ 20,000 toward administrative costs
USBR & NCAR	$ 89,000 in-kind and estimated matching funds*
TOTAL MATCH	$324,000 = more than the total WSRA request
Statewide Fund Request	$200,000
Basin Fund Request	$ 37,000
Total Grant Request	$237,000

* Even if the $89,000 from USBR is not approved, the match is 99% of the grant request!

2. For Applications that include a request for funds from the **Statewide Account**, describe how the water activity/project meets all applicable **Evaluation Criteria.** (Detailed in Part 3 of the Water Supply Reserve Account Criteria and Guidelines and repeated below.) Projects will be assessed on how well they meet the Evaluation Criteria. **Please attach additional pages as necessary.**

[2] 37-75-104 (2)(c). Using data and information from the Statewide Water Supply Initiative and other appropriate sources and in cooperation with the on-going Statewide Water Supply Initiative, develop a basin-wide consumptive and nonconsumptive water supply needs assessment, conduct an analysis of available unappropriated waters within the basin, and propose projects or methods, both structural and nonstructural, for meeting those needs and utilizing those unappropriated waters where appropriate. Basin Roundtables shall actively seek the input and advice of affected local governments, water providers, and other interested stakeholders and persons in establishing its needs assessment, and shall propose projects or methods for meeting those needs. Recommendations from this assessment shall be forwarded to the Interbasin Compact Committee and other basin roundtables for analysis and consideration after the General Assembly has approved the Interbasin Compact Charter.

Evaluation Criteria – the following criteria will be utilized to further evaluate the merits of the water activity proposed for funding from the Statewide Account. In evaluation of proposed water activities, preference will be given to projects that meet one or more criteria from each of the three "tiers" or categories. Each "tier" is grouped in level of importance. For instance, projects that meet Tier 1 criteria will outweigh projects that only meet Tier 3 criteria. WSRA grant requests for projects that may qualify for loans through the CWCB loan program will receive preference in the Statewide Evaluation Criteria if the grant request is part of a CWCB loan/WSRA grant package. For these CWCB loan/WSRA grant packages, the applicant must have a CWCB loan/WSRA grant ratio of 1:1 or higher. Preference will be given to those with a higher loan/grant ratio.

Tier 1: Promoting Collaboration/Cooperation and Meeting Water Management Goals and Identified Water Needs

a. The water activity addresses multiple needs or issues, including consumptive and/or non-consumptive needs, or the needs and issues of multiple interests or multiple basins. This can be demonstrated by obtaining letters of support from other basin roundtables (in addition to an approval letter from the sponsoring basin).

Multiple needs and issues:

Effective water administration requires accurate streamflow forecasts and decision tools that enable water users to obtain maximum beneficial use from existing water supplies. This project will develop those tools, resulting in accurate streamflow forecasts.

This project directly addresses National Center for Atmospheric Research (NCAR) priorities related to improving the understanding and prediction of precipitation, snowpack and streamflow processes in the western U.S.

The CWCB's mission is to conserve, develop, protect and manage Colorado's water. Better methods to account for snow as part of the hydrologic cycle may lead to better management of water within its boundaries and to meeting Colorado's obligation to accurately deliver flows to downstream states under terms of the RIo Grande Compact.

This project advances radar methodologies to predict floods, severe weather, rain, and rain on snow events. It thus helps DWR and CWCB to prepare for, respond to, and mitigate the effects of these events, supporting flood plain and flood protection missions in the watershed.

This project will develop the Rio Grande Compact Decision Support Tool, thus supporting DWR in its use of Ensemble Streamflow Prediction (ESP) forecasts to evaluate curtailment scenarios and to correctly estimate the probability of Compact compliance.

This project addresses the Colorado Water Conservation Board (CWCB) mandate to utilize the maximum amount of water in the state. In these times of severe extended drought and with rising temperatures, general drying, and the increasing occurrence of forest fires and severe floods, we need to increase the accuracy of streamflow forecasts. This collaborative project provides the data and the models which will significantly increase the accuracy of precipitation observations and improve hydrologic forecasts in the Rio Grande Basin.

This project, spearheaded by the District, complements the CWCB Flood Decision Support System. Its accurate streamflow and radar-derived quantitative precipitation estimates will assist the Basin's water managers and decision makers to identify areas of concern, and will help to more adequately prepare Colorado to meet its future water needs.

b. The number and types of entities represented in the application and the degree to which the activity will promote cooperation and collaboration among traditional consumptive water interests and/or non-consumptive interests, and if applicable, the degree to which the water activity is effective in addressing intrabasin or interbasin needs or issues.

THE PARTNERSHIPS to be developed in this project bring together a diverse group of stakeholders and decision makers who have vested interests in improving water supply prediction capabilities. At its core, this project is a user-motivated project that is driven by the imperative to create improved methods for measuring and predicting snowpack, snowmelt and streamflow in a critically-stressed river basin, the Upper Rio Grande. Providing improved tools to meet those objectives are critically important to the Basin, CWCB, DWR, and NCAR.

THE DISTRICT was selected by the team to take the lead in this study, providing administrative and fiscal management of the Project. The District therefore seeks funding to deploy specific data-gathering devices and to expand on previous studies and modeling done by Riverside Technologies, Inc. and continuing currently thanks to the investment of CWCB.

CWCB has allocated $215,000 towards this project/concept and will contract Riverside Technologies, Inc., with administrative support from the District. The role of CWCB is detailed under Task 2 of the Scope of Work.

NSSL – National Severe Storms Laboratory's Steve Vasiloff, will be the Basin's go-to radar site expert, running and interpreting initial radar information. Dr. Vasiloff conducted the Southwest Colorado Radar Project, completed at the end of February, 2011, with deployment of the NOAA X-Pol mobile radar unit as part of the study to collect data on snowfall in the area. Dr. Vasiloff was awarded the 2001 NOAA Distinguished Career Award for Scientific Achievement for the design and implementation of a seamless gridded system for multi-sensor-derived precipitation estimation over the continental U.S..

Riverside Technology Inc., headquartered in Fort Collins, will continue & expand previous contracts for development of the modeling. Riverside is an internationally recognized engineering, science, and information technology company with more than 25 years of experience providing innovative information technology solutions for environmental decision support systems using a variety of different environmental data sources, from satellite sensors and imagery to stream gages in local rivers. Riverside has projects in more than 30 countries and maintains a strong worldwide customer base, including U.S. government agencies such as USAID and USTDA, and international donor organizations such as the World Bank, Asian Development Bank, and FAO.

NOAA – National Oceanic and Atmospheric Administration will provide direction and expertise for the implementation of the information that comes from the radar experiments.

NWS – The National Weather Service will provide in-kind technical support, time, and personnel, with potential further involvement, depending on the findings and outcome of this project.

As further evidence of collaboration, the following personnel from the various entities will be directly involved in running this project:

State of Colorado Sponsors

Joe Busto, CWCB Watershed Protection & Flood Mitigation Program
Joe.busto@state.co.us;(Ph) (Ph) 303 866 3441, ext. 3209, Fax (303) 861-4272

Kevin Houck, Section Chief, CWCB Watershed Protection & Flood Mitigation Program
kevin.houck@state.co.us;(Ph) 303-866- 3441 ext. 3219, (Fax) 303-861-4272

Steve Shull, CWCB Contract Specialist
steve.shull@state.co.us, (Ph) 303-866-3441 ext. 3235, (Fax) 303-866-4474

Maggie Van Cleef, Department of Natural Resources Purchasing
maggie.vancleef@state.co.us, (Ph) 303-866-3292 ext.8641, (Fax) 303-866-5575

NCAR Project Contractor & Scientific Team

David Gochis, Scientist III, Research Applications Laboratory, National Center for Atmospheric Research. gochis@ucar.edu, (Ph) 303-497-2809

Martyn Clark, Scientist III, Research Applications Laboratory, National Center for Atmospheric Research. mclark@ucar.edu, (Ph) 303-497-2732

NCAR Contract Specialists

Gina Taberski, National Center for Atmospheric Research
taberski@ucar.edu, (Ph) 303-497-2132

c. The water activity helps implement projects and processes identified as helping meet Colorado's future water needs, and/or addresses the gap areas between available water supply and future need as identified in SWSI or a roundtable's basin-wide water needs assessment.

In 1981, the Natural Resources Conservation Service (then known as the Soil Conservation Service) Colorado Snow Survey Supervisor teamed up with a water engineer from the Colorado Division of Water Resources, also called the Office of the State Engineer, to devise a relatively simple Surface Water Supply Index (SWSI) that would take Colorado's precipitation, mountain snowpack, stream

flow, and stored water in reservoirs into account in a way that was specific to each major Colorado watershed.

The Surface Water Supply Index has been produced every month for 30 years by either the NRCS Snow Survey during winter and spring, or the Colorado State Engineer's Office in summer and fall. While imperfect and often criticized, the index prevailed because it incorporated complex data into a simple number so that anyone could quickly judge conditions.

In the past few years SWSI has been undergoing modernization to take advantage of considerable advances in streamflow forecasting that have occurred during the past several decades. A new SWSI is now being generated for each river forecast point in the Colorado River Basin in western Colorado, with other basins to follow. (From *Monitoring Drought: Using Indices to Simplify Complex Climate Data* by Nolan Doesken and Wendy Ryan, Colorado Climate Center, Colorado Water Magazine, August/September 2011.)

The results of this project will enable critical advances in the evolution and expansion of SWSI, contributing to the improvement of streamflow forecasts throughout Colorado. With CWCB's strong commitment to this ongoing study in the Rio Grande Basin, the District appreciates the opportunity to administer this important project.

Tier 2: Facilitating Water Activity Implementation

d. Funding from this Account will reduce the uncertainty that the water activity will be implemented. For this criterion the applicant should discuss how receiving funding from the Account will make a significant difference in the implementation of the water activity (i.e., how will receiving funding enable the water activity to move forward or the inability obtaining funding elsewhere).

   Without the funds requested in this proposal, the scientists and agencies involved in this project could not proceed, as they do not have the cash or the budgets to conduct such a large field experiment and modeling program. The project has requested $89,000 from the US Bureau of Reclamation in order to increase the number of data points, but if this does not materialize, the District will still be able to carry the project forward with the WSRA funds requested here. If the USBR funds are forthcoming, it will improve, but not materially change the project. The entire team is counting on the District obtaining these funds.

e. The amount of matching funds provided by the applicant via direct contributions, demonstrable in-kind contributions, and/or other sources demonstrates a significant & appropriate commitment to the project.

   The applicant and participating partners are providing more than 100% match of funds.

Tier 3: The Water Activity Addresses Other Issues of Statewide Value and Maximizes Benefits

f. The water activity helps sustain agriculture & open space, or meets environmental or recreational needs.

This project provides the means to improve forecasts of snowfall and streamflow, thereby helping water managers to more accurately manage irrigation.

g. The water activity assists in the administration of compact-entitled waters or addresses problems related to compact entitled waters and compact compliance and the degree to which the activity promotes maximum utilization of state waters.

This project will develop a Rio Grande Compact Decision Support Tool for DWR, materially assisting in the administration of compact-entitled waters, reducing errors in the forecasting of streamflow, and reducing the occurrence of premature or unnecessary curtailments.

h. The water activity assists in the recovery of threatened and endangered wildlife species or Colorado State species of concern.

NA

i. The water activity provides a high level of benefit to Colorado in relationship to the amount of funds requested.

This is a top priority initiative of multiple state and federal agencies, and is being closely watched by other basins, which also have problems related to uncertainties in today's streamflow forecasting methods.

j. The water activity is complimentary to or assists in the implementation of other CWCB programs.

The District is participating as a partner with CWCB in this project.

Continued: Explanation of how the water activity/project meets all applicable **Evaluation Criteria**.
Please attach additional pages as necessary.

Part IV. – Required Supporting Material

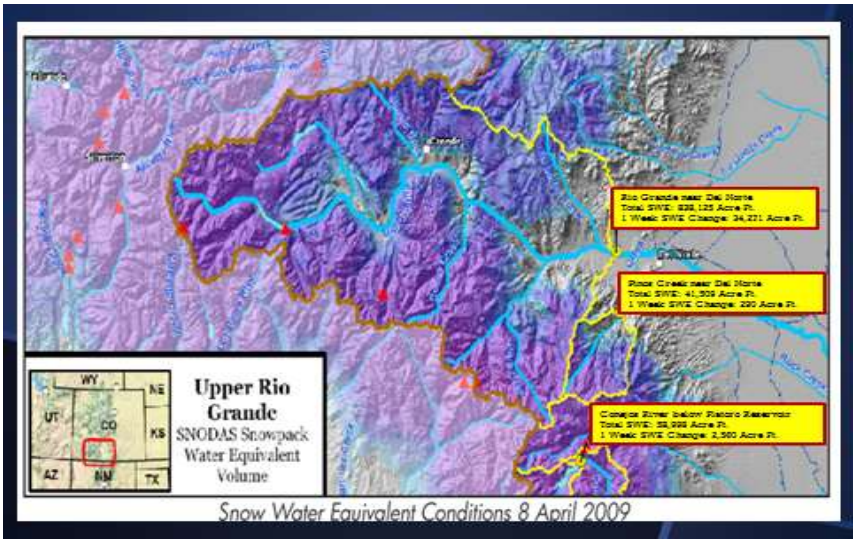
1. **Water Rights, Availability, and Sustainability** – This information is needed to assess the viability of the water project or activity. Please provide a description of the water supply source to be utilized, or the water body to be affected by, the water activity. This should include a description of applicable water rights, and water rights issues, and the name/location of water bodies affected by the water activity.

   No water bodies will be affected by this water activity. No water rights will be involved; no issues of availability and sustainability will be raised; and no water supplies will be utilized.

2. **Please provide a brief narrative of any related studies or permitting issues.**

   In his article, *Advancing Snow Science in Changing Climate and Complex Terrain*, Joe Busto, Scientist and researcher with CWCB, reviews prior science and studies directly related to this project. Most of the following is quoted from that article:

   Since 2004, the CWCB has partnered with the NRCS and water users to establish 20 new SNOTEL sites for an 18 percent increase and a total of 110 SNOTEL sites in Colorado. However, SNOTEL sites represent a fraction of a basin's area and are limited in developing spatial assessments of snow water equivalent (SWE). Many sub-basins do not have SNOTEL sites. This lack of representation directly translates to water supply forecast difficulties. In search of spatially-continuous data, the CWCB contracted with Riverside Technologies, Inc. (RTi) to utilize data from the NWS/NOHRSC—Snow Data Assimilation System…. The Division Engineer uses SNODAS SWE maps to track melt-out in three key basins in the Rio Grande, delineated in yellow in Figure 1.



SNOTEL sites are shown as red triangles. This represents use of spatial modeled snowpack data to complement the point measurement snowpack data. For more information about the CWCB SNODAS Project, visit: http://www.riverside.com/projects/uscanada/tabid/121/ItemId/45/Default.aspx .

3. Statement of Work, Detailed Budget, and Project Schedule

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**. All WSRA funds are disbursed on a reimbursement basis after review invoices and appropriate backup material.

Please provide a detailed statement of work using the template in Exhibit A. Additional sections or modifications may be included as necessary. Please define all acronyms and include page numbers.

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

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

Signature of Applicant:

Print Applicant's Name:

Project Title:

Return an electronic version (hardcopy may also be submitted) of this application to:

Greg Johnson – WSRA Application
Colorado Water Conservation Board
1580 Logan Street, Suite 200
Denver, CO 80203
gregory.johnson@state.co.us